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JANUARY
1948

Featuring:

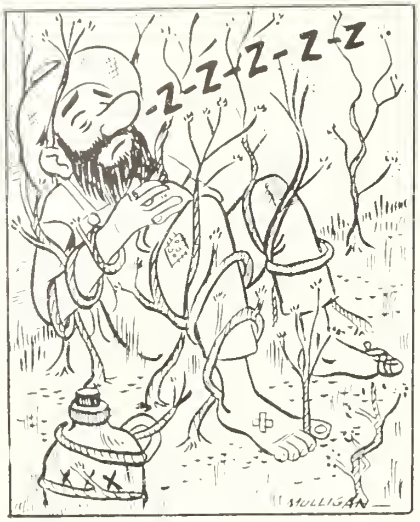
The Gully Problem
by H. V. Peterson

Irrigation in Australia

Date Festival—
Below Sea Level

THE *Reclamation* ERA

Weed Resolutions—1948



"Out of sight out of mind . . ."

Some New Year's resolutions may be made to be broken—but not those that actually affect our welfare. Resolutions which will save an irrigation farmer money are those he vows he will be sure to keep this year regarding weed control.

Such resolutions are easy to make while fighting weeds during the summer months.

But sometimes the old "out of sight—out of mind" psychology creeps in and during the winter, when the weeds are not seen, it is easy to forget the extra work that had to be done, the extra irrigation water used, the extra wear and tear on equipment and the extra costs in harvesting and marketing the crop.

Also, by spring, some of the edges of shock and disappointment caused by the actual loss of income due to reduced crop yields and dockages for lower crop quality due to weed competition, are worn off.

Spring is an optimistic time of year when a true tiller of the soil's fancy lightly turns to fields of waving alfalfa and sturdy sugar beets.

But just do not forget all those ornery little wriggling roots and those millions of seeds just waiting until the back of your mind is turned to send out shoots and strangle your pocketbook.

That sounds like the worst kind of pessimism but it need not happen if you make and keep your set of weed control resolutions.

Make them now while all the trials and tribulations of weed fighting last summer are still fresh in your mind—and then do not forget to review them in the spring.

Keep them where you will be sure to see them, where they will remind you that instead of being just a bed of roses, farming may become a bed of morning glory or

(Continued on next page)

Reclamation ERA

Vol. 34 **January 1948** **No. 1**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Publication approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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Contents

Ruth F. Sadler, *Editor*

Our Front Cover

The Golden Experiment

Art Willis, the determined looking chap on the cover, is a homesteader on the Bureau of Reclamation's Yakima-Roza project in the State of Washington, having won an irrigated farm in last summer's drawing. However, it took will power and an estimate of irrigation values to enable him to leave a 320-acre dry-land farm in Kansas for the smaller irrigated farm he calls "The Golden Experiment." This portrait was taken by Chief Photographer Stanley Rasmussen of Region 1.

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Bindery will disregard this column

"The W[illegible] [illegible]"

A great deal has been [illegible] the loyalty and devotio[illegible] certain occupations. In [illegible] the motto is "The show [illegible] Post Office uses the mot[illegible] go through." The Bur[illegible] "The water must be del[illegible] ployees display the sam[illegible] tion to duty, and experie[illegible] parable to those encoun[illegible] in the more publicized [illegible] [illegible]mployed [illegible]ove of a [illegible] the most [illegible] operate [illegible] during [illegible]ar. Too [illegible]en these [illegible] duty—[illegible] to the [illegible]age and [illegible]nen that [illegible] success[illegible] the first [illegible]925. •

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With temperatures run[illegible] below zero at times, and [illegible] for weeks at a stretch, a [illegible] various kinds is formed. [illegible] kept open if water is to f[illegible] channels open, men [illegible] throughout each 24-hour [illegible] with ice saws, guiding [illegible] through spillway channe[illegible] jobs calling for skill an[illegible] stand extreme cold and physical discomfort.

At times the task seems hopeless, but the fight still goes on. In spite of the hardships, the men stick to their work and the power plant operates. The men performing

[illegible] the [illegible]is de[illegible]ation [illegible] can [illegible]fit to [illegible]tives [illegible]price [illegible]are a [illegible]asso[illegible]nts a [illegible]ding [illegible] your neighbors. Help build the circulation of the RECLAMATION ERA and add to the number of informed proponents of western water resource development.

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J. A. Krug, Secretary

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Weed Resolutions

(Continued from preceding page)

Canada thistle. How about hanging them on the barn door? (The resolutions—not the weeds.)

Here is a set you may want to consider. You will probably want to add a few of your own.

RESOLVED:

1. To start weed control operations early so I can keep ahead of the weeds.
2. To learn to identify noxious weeds so I can control them before they become a large patch or spread to other parts of the farm.
3. To buy clean crop seed so I won't actually be planting weeds.
4. To encourage my irrigation district to appropriate sufficient funds for proper weed control on ditchbanks so this source of infestation to my farm is eliminated.
5. To encourage seeding of ditchbanks with weed-competing grasses.
6. To encourage pasturing of ditchbanks to help control weeds which, if left to mature, may send seeds to my farm by the water route.
7. To see that threshing and other equipment is thoroughly cleaned before it enters my farm.
8. To use every other means possible to prevent weeds starting on my farm.
9. To investigate new methods of control such as the use of 2, 4-D to see how I might be benefited.
10. To help in the formation of a weed district or to cooperate with weed districts.
11. To plan a real weed control campaign on my farm.
12. To carry the plan out, and *last but not least*
13. To keep these resolutions. •

Resolution No. 2

121866

The GULLY Problem

By H. V. PETERSON, Geologist, United States Geological Survey

Gullies form one of the most destructive and certainly one of the most spectacular types of erosion to be found in many western areas, particularly in the Southwest.

These deep incisions, bounded by ragged, caving, and almost vertical walls have, for many years, been eating insidiously mile after mile through the heart of numerous broad flat valleys that once formed some of our most productive range lands. Headcuts that ordinarily appear to be nothing more than harmless drops in a dry or nearly dry stream channel are converted to veritable raging waterfalls during flood periods and with the enormous cutting impetus imparted by a 5- to 30-foot drop, extend the gully upstream with surprising rapidity. Examples of gullies eating headward several hundred feet during a single storm lasting no more than a few hours are not uncommon.

Once the main stream becomes entrenched in such a channel, the tributaries are temporarily left at their former elevations. The waterfalls formed by the drop rapidly undercut the bed of the tributary which then is progressively entrenched upstream. Myriads of side headcuts are thus developed, each progressing outward whenever run-off from side drainage occurs.

Secondary headcuts along the tributaries in turn develop, the final result being such a maze of gullies that level terrain is converted to typical badlands. In some localities badland belts several hundred feet wide are conspicuous features of once smooth valley floors.

To the physiographer and the student of the earth's weathering cycle, the presence of a gully is evidence of an unbalanced condition between the processes of sedimentation and erosion.

To the cattleman, the farmer, or the administrator concerned in obtaining the greatest measure of productivity from the land, it represents a destructive force that has already taken a heavy toll from the land's potential forage or agricultural yield and one that, if allowed to continue at an accelerated or even the present rate, will eventually destroy much of the productivity of our western range.

Every gully of appreciable depth forms an effective drain causing a drop in the ground-water level, which thus deprives plants of their life-sustaining moisture. Thus a familiar accompaniment of gullies in many localities is the belt of barren land extending back from the headcut area where the plants have withered and died, leaving bare soil exposed to the elements. Some of these belts are but a few feet wide, others are several hundred, but each is expanding.

But the loss of range forage resulting from gullying represents only a part—possibly a minor part—of the total harm which can be attributed to erosion of this type.

More critical than depletion of the range is the actual and potential contribution of silt from these denuded areas—silt which, unless control measures are instituted, will move in constantly mounting quantities into the major streams to fill reservoirs, to clog natural stream channels and irrigation canals, and eventually to blanket rich farm lands with a sterile impervious coating.

Only a casual examination is needed to show that the principal sources of silt in many large stream basins are these gullied tributary valleys, and already in some localities farmers prefer to bypass the run-off from these tributaries on the grounds that an irrigation with such silt-laden waters is not only valueless but harmful to the land. The problem thus involves more than destruction of range forage, it affects the entire land economy of the arid and semiarid west.

What Causes Gulleys?

What caused the unbalancing of nature's forces and instituted the cutting cycle is a controversial subject.

It has been suggested in some quarters that parts of the western area may have

LIKE AN OCTOP

been subjected to regional uplift, thereby increasing the stream gradients and greatly augmenting the stream's ability to erode. There is little, if any, direct evidence to support this theory and considerable to disprove it.

Another theory advanced is that of a changing climate. Advocates of this idea contend that even a slight reduction in the amount of annual precipitation or minor shifting in its distribution would be sufficient to upset the delicate balance between erosion and deposition. They point to the protracted droughts and the severe floods experienced in recent years as conditions that foster and stimulate rapid and destructive channel cutting. The paucity of long-term weather records in the West makes it impossible to prove or disprove this theory or to show that climate during the past 50-70 years differed from or was more

Photo by Dale A. Hovey, former Region I photographer

ullies ravage New Mexico terrain as shown in the foreground of this aerial photo.

severe than during that prevailing previously. Nonetheless climatic changes cannot be ignored as a possible cause of the cutting, particularly in view of the findings resulting from close examination of some alluvial valley fills which show evidence of previous cycles of erosion, difficult to explain other than by changes in the amount and distribution of precipitation.

Probably the most widely accepted reason for the channel cutting, and certainly the most publicized one, attributes the cause to man's abusive practices.

Overgrazing is consistently pointed out as the most serious of these abuses, although several other practices are listed as important contributory features in starting the cutting cycle.

Early settlers are accused of locating roads and ditches without consideration of their effect on the drainage aspect of the areas. Their herds were allowed to concentrate along the valley floors where the feed was lush and range water was easily provided, while more remote areas, where water was difficult to obtain, were left untouched. Thus overgrazing was particularly aggravated in these vulnerable spots.

Stock trails likewise followed the more accessible valley bottoms and trailing herds tramped out vegetation and left the soil scarred with deep rutty trails, thus affording an ideal condition for concentration of flood flows and initiation of erosion. In a few cases it is known that settlers, in order to overcome the nuisance of shallow flood water passing over their land, build channels and dikes to drain off the flow. This was often sufficient to start the gullying.

Unfortunately there is little that can be said in defense of many of our early land-use practices.

In spite of repeated warnings from competent and conscientious observers and students of land utilization, the early West was developed mainly on the theory that our land resources were unlimited. What matter if gullies threatened to cut the heart from a few hundred square miles of grassy valley lands when there were millions of acres and scores of other valleys beyond the horizon? Not until the erosion problem became critical in many sections of the country did we come to the realization that our limitless frontiers had vanished and that henceforth it would be sound business to conserve what was left.

In a few instances the beginning date of the gullying is known. According to testimony of living witnesses, trenching in the San Pedro River, a tributary of the Gila River in southern Arizona, began with the tremendous floods that occurred during the summer of 1881. (The few rainfall records available indicate that this was by far the wettest summer season ever recorded in that part of the State.) Ten or twelve years later the headcut had eaten headward 125 miles and created one of the worst erosion problems in the Southwest.

The San Simone Wash, another tributary of the Gila, draining parts of southeastern Arizona and southwestern New Mexico, started in 1881 or 1882 but never became serious until the flood year of 1904–5. By 1920 it had trenched 60 miles headward, laying waste a range many square miles in extent that is reported to have once been one of the best in southern Arizona. Fifty thousand head of cattle are said to have grazed in the San Simone Valley in the eighties, whereas today it supports less than one-tenth of that number.

Valleys in northern Arizona and southern Utah are believed to have been incised slightly earlier, possibly in the late seventies and early eighties.

There is evidence that the Rio Puerco, a south-flowing tributary of the Rio Grande in central New Mexico, was gullied to some extent as early as 1846 but by the late eighties settlers were having difficulty maintaining dams of sufficient height to divert flood waters from the deep channel onto their adjoining farms. Today the channel is from 20 to 50 feet in depth and the farms have been abandoned.

The beginning of trenching in Kanab Creek, Utah, is definitely placed as July 1883. Other streams in this general vicinity probably began cutting somewhere near this date, although it is rather definitely established that they were not all influenced by the same series of storms and did not begin cutting at identical times.

It would appear to be no coincidence that gullying started in most valleys within a few years after the white settlers arrived and with this array of evidence it is difficult to absolve them of blame for starting it. But even so the case is not conclusive. That erosion occurred before this arrival is shown by the outlines of buried channels.

exposed in existing gully walls, evidence that former cycles of erosion not unlike those of the present day have occurred. These channels were cut long before domesticated livestock were present in sufficient numbers to deplete or destroy the natural vegetative covering of the range.

In numerous valleys older river terraces parallel present stream channels, sometimes occurring as steps one above the other. They represent final stages of former channel cutting, each of which probably started as a gully. The remains of former mud flows, many of them now solidified into rock, are found in many localities, mute testimony of the erosive power of violent floods of the past. Even modern observers have described gullies in areas where cattle have never grazed.

With so much controversial evidence involved it is doubtful if any one item or set of circumstances can be assigned as being directly responsible for the development of gullies.

The most plausible and consistent theory of initiation would appear to involve both climatic changes and land misuse, the latter acting as a trip to upset a delicate balance just able to maintain itself in a climate possibly growing slightly drier with drought periods appearing more frequently and with greater severity.

But, one may argue, of what concern is the cause when the damage is already done? With valley after valley being cut out by these networks of gullies, are we not literally in the proverbial position of trying to lock the barn door after the horse has been stolen? In some measure this is correct.

The problem has been neglected too long but there is still opportunity for correction.

In this respect diagnosis for prescribing a remedy is necessary and to this end typical gullies in various locations throughout the West are being studied with a view of obtaining every shred of evidence which relates to their genesis and which might be turned to advantage in designing corrective measures.

Geologists—for erosion is a geologic process as old as the earth—direct their search to the gully banks and other outcrops in an effort to unravel the history not only of present and past periods of erosion but of the intervening periods of alluviation when nature's processes were reversed.

- How often have these reversals occurred?
- Were they of local or widespread extent?
- Can the periods be correlated from one area to another, indicating widespread and significant changes in climate or perhaps other conditions?
- Where did the sediments come from?
- How did they arrive, by wind or water?
- What changes occurred in transit?

These are some of the questions for which answers will be sought.

Geologists look for these answers in such features as the size, shape and positions of buried stream channels, evidences of a past temporary reversal from erosion to deposition, variations in character of the sediments, etc., just as historians search ancient documents for an accounting of man's past activities.

To supplement geologic data, information from other sources is being gathered. For example, mixed with the sediments in many localities are artifacts, potsherds, and other relics of human habitation showing that former populations also had their erosion troubles.

Archaeologists can identify and date many of these items and furnish information on the culture and living habits of these people. It is entirely possible that even our enlightened generation can learn much from the experience of these crude prehistoric inhabitants.

Studies of buried soil layers likewise offer a fruitful field of research for the soil scientist in unraveling the complex history of these areas. Some horizons represent swampy conditions associated with high precipitation, others arid or semiarid conditions perhaps similar to those existing at present. If a relationship between erosion and these soil types can be established, an important step in approaching the cause of erosion will have been taken.

In the meantime other aspects of the problem are receiving their complement of attention.

Overgrazing is being eliminated through regulation and by better distribution of livestock accomplished largely by providing additional range water facilities. Stockmen generally accept this regulation with enthusiasm for they see in it the prospect of better ranges, better beef, and better profits for their operations.

But, unfortunately, once the gullies are established, regulation or, in some localities, even the elimination of grazing is inadequate to stop the headcutting. Nature under these circumstances must be given assistance in the way of structural treatment. Thus engineering plays an essential part in the investigation.

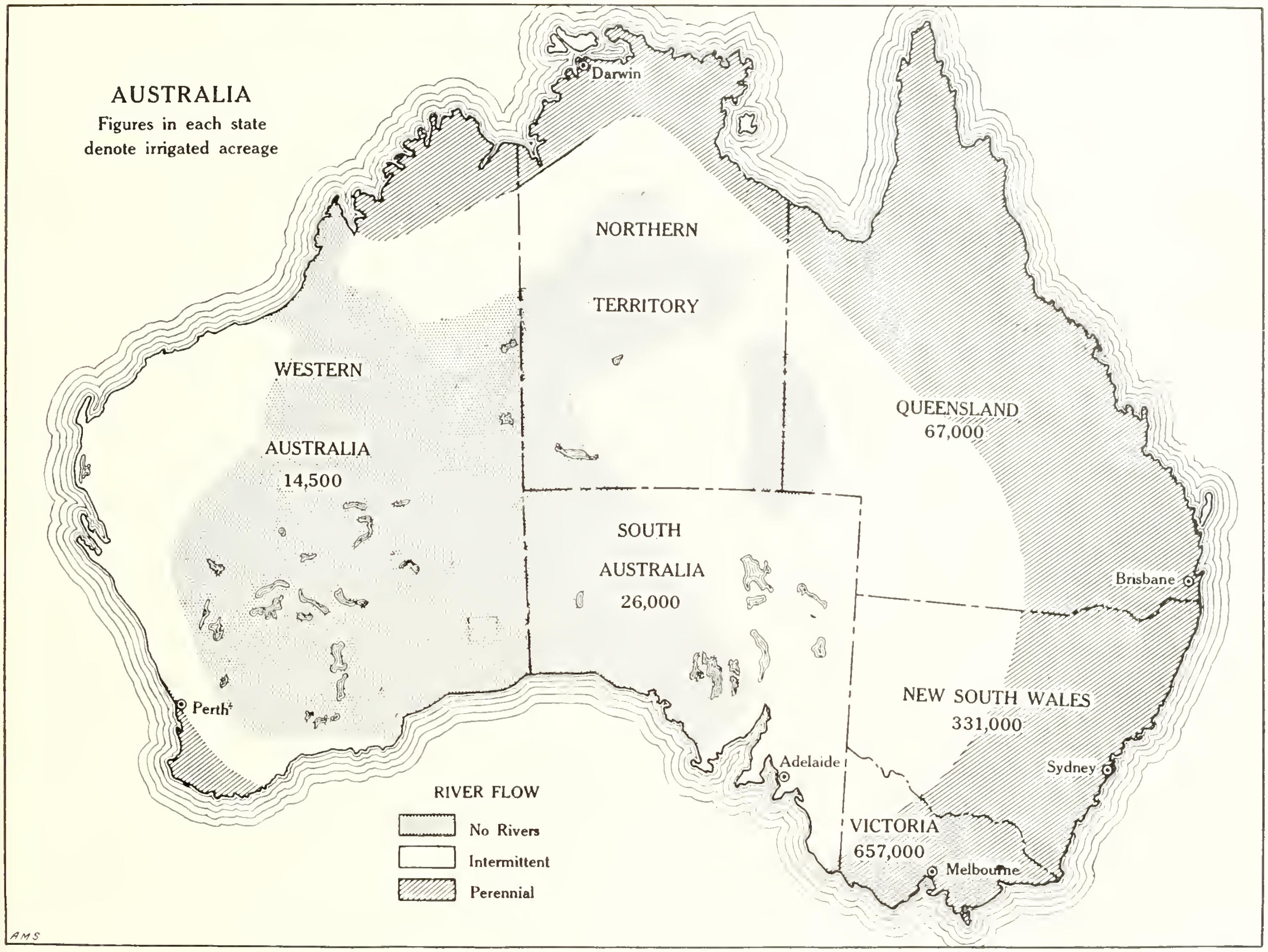
Engineering phases of the problem include studies on hydrology as it relates to flood run-off and to the dynamics of silt movement, the effectiveness of structures of various sizes and design located at various positions within the drainage basin in controlling headcutting and in causing deposition within existing gullies.

Closely associated with these investigations, archaeologists and plant technicians are studying the role of vegetation not only as a weapon in combatting erosion and gully cutting but also as a means of improving the range.

Thus efforts are being directed toward an integrated program of investigation with no phase being overlooked. Technicians from many Government agencies enthusiastically aided in many cases by local land owners, stockmen, private engineers, and others interested in conservation are participating. So complex and so widespread is the problem of gully control that it is going to require their best efforts to formulate a solution. •

NATURE'S UNBRIDLED EXCAVATOR *goes to work: on the left, "badlands" along the fringe of the San Simon Gully, Ariz., at center, headcut at Henry's Lake, Idaho, and on the right, the Malpais Arroya in New Mexico that resembles a miniature Grand Canyon. Two outside photos by Geological Survey, center photo by S. R. Marean, Region I.*

Irrigation in AUSTRALIA



Map by Drafting and Graphics Section

by Lester A. Robb
Engineer, Office of the Engineering Assistant

(The following article is based on information made available by Mr. G. M. Gray, Agricultural Attaché, Australian Embassy, Washington, D. C.)

The importance of irrigation in relation to the wealth and prosperity of a nation has long been recognized in Australia.

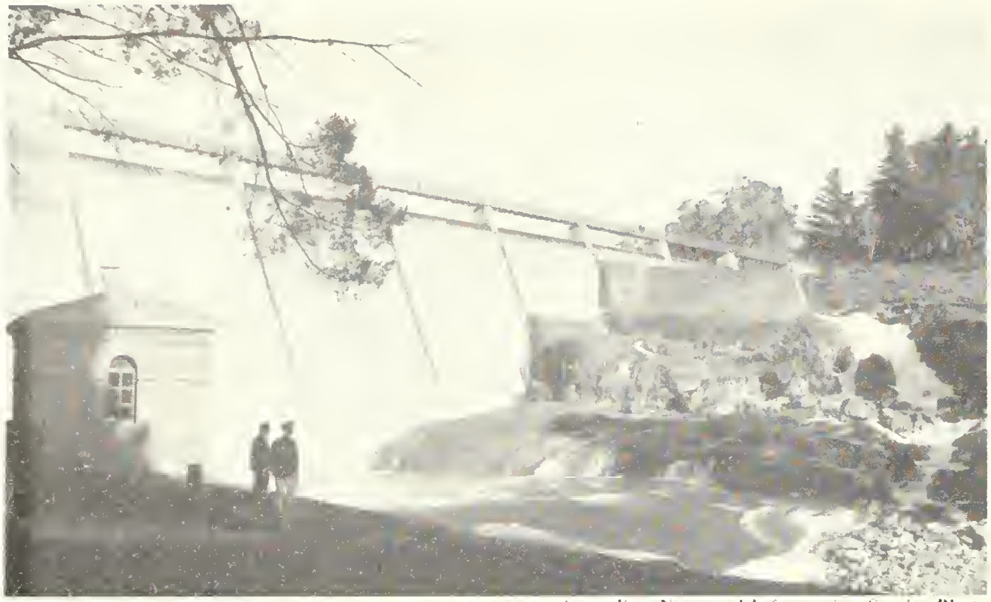
Though this country "down under" is well known to every school child as the home of the kangaroo and the bushman with his boomerang, more important things than these contribute to the fame of Australia today, and among them is the ever-growing practice of irrigation.

Australia has an area of approximately 3 million square miles, slightly less than that of the United States. It is, however, more comparable, both as to geography and climate, with northern Africa. Australia, the most arid of all the continents, has an average yearly rainfall of only 17 inches. This, however, is not evenly distributed—38 percent of the country receiving less than 10 inches per year. In contrast, only 7 percent of the area of the United States has less than 10 inches of annual rainfall. Australia's population is concentrated in the coastal regions of greatest rainfall and in vast areas of arid and semiarid lands which continue to wait the coming of water which will only be made available if means can be found of conserving the precious flood waters which infrequently fall.

When the first agriculturists settled in Australia, they began to find that their pastoral and agricultural occupations were handicapped by uncertain rainfall and recurrent droughts. It was only natural for them to begin to think of reinforcing the natural rainfall by supplies of water obtained by other means. The State of Victoria has the distinction of being the State where irrigation was first practiced in Australia. It has since continued to lead the other States in amount of land irrigated (see map) and all of the States have followed quite closely the plan of irrigation development adopted by Victoria.

From its early beginning in the 1870's, irrigation has spread from valley to valley wherever water may be stored and diverted, so that now more than a million acres of Australian land are under irrigation. Although this figure is small compared with irrigated acreages in the United States, and while it represents only a minor portion of all cultivated lands in Australia, more and more water is being made available each year so that Australia is rapidly becoming one of the great irrigated nations of the world.

Australia has long been recognized as the largest wool-producing nation in the world and, as such, has encountered some resistance on the part of sheep raisers against the development of irrigated lands in certain areas. This resistance has not perceptibly affected the growth of irrigation, however. The chief irrigated crops at present are lucerne (alfalfa), grasses, and green fodder



Australian News and Information Service Photo

Western Australian Goldfields Reservoir at Mundaring on the Helena River is world renowned. Water is pumped 375 miles through 32-inch steel mains to Kalgoorlie.

which account for about 35 percent of the total; cereals account for another 25 percent, and the remainder is represented by orchards, vineyards, and truck produce. Considerable areas of pasture land are also irrigated each year. Irrigated pastures may amount to as much as 500,000 acres, but this acreage is not included in the figures shown on the accompanying map nor is it included in the total of irrigated acreages mentioned above.

The first irrigation schemes were private affairs developed on individual holdings. Later, larger scale district schemes were developed, particularly along the River Murray, Australia's largest river, whose basin embraces practically all of the State of New South Wales and large portions of Victoria, Queensland, and South Australia.

While many of the early irrigation attempts were remarkably successful, fully as many failed completely. Most of the early failures were due to several contributing factors. Often the land irrigated was not particularly suitable, methods employed were sometimes extremely crude and many farmers did not recognize that an irrigation district scheme involves its members in a liability to pay their share of charges even in seasons when they do not want the water, as well as in the drier years—a condition which often exists in the more humid coastal regions of Australia.

In Victoria the unsatisfactory financial position of these schemes led to the Government taking most of them over and setting up a State body to deal with irrigation matters in 1905. Previous legislation in this State had provided for the advancing of Government funds for certain water supply purposes.

The Water Act of 1905 abolished all the irrigation trusts in Victoria, excepting one, and created the State Rivers and Water Supply Commission to take over complete control of rural water supplies generally in that State. Another feature of this act was the declaration that the bed and banks of all streams should become and remain the property of the Crown. This completed the nationalization of streams and other natural resources of water supply in Victoria commenced by earlier legislation in 1886.

In Victoria, at the present time, no one has a legal right to water except where authorized under the various water acts.

Further legislation was provided through the years, and in 1909, "compulsory" water rights were introduced to compel payment for water in irrigation districts whether it was used or not. This law was designed to provide a permanent financial return to the State and to insure full utilization of the land to which the water right applies. Provision for flood protection works and drainage was made in later legislation so that these two items have played an important part in recent developments.

The next big step forward in water supply policy was taken in the adoption of an act in 1937. Under this act, the entire cost of flood protection and drainage works was nationalized and a substantial part of the cost of rural water supply and irrigation works, including headworks and main supply works, was transferred to the State. This step was taken when it was realized that the ideal of the water users bearing the full cost of constructing and operating works could seldom be attained.

In Victoria the State has had to accept responsibility for four-fifths of the capital costs of all irrigation works constructed.

Generally speaking, the rates and charges which the water users are required to pay are such that the surplus revenue over operation and maintenance costs is sufficient to meet interest and redemption charges on only one-fifth of the capital cost of the works. Including operating and capital charges, it can be said that for every dollar the water user is required to pay, the State contributes $2, which, of course, is met from general funds of the State.

It is generally felt, not only in Victoria, but in the other States as well, that the financing of irrigation by the State is the logical mehod. It is felt that the whole State and Nation benefit from irrigation developments in such forms as increased productivity and the general improvement in employment which the resultant trade provides. As roads and communications benefit the Nation as a whole, so do the irrigation, flood control, and power developments. Recognizing that the future economy of Australia depends greatly upon the conservation and utilization of its water resources, it is natural that they should be treated as a public works. Certainly the increased agricultural productivity has fully justified the expenditures of State monies made to date.

On the other hand, such a system is not entirely without its faults. There are those who do not feel that the general taxpayer should bear a portion of the expenditures that more directly benefit certain relatively small groups.

It is also at times difficult to select a "yardstick," so to speak, to determine the justification for carrying out a new project in which the water users would be expected to pay only operating costs.

It has also been observed that heavy capital expenditures on dams, pipelines, and concrete-lined canals can reduce water distribution and maintenance costs to a minimum. This means that the revenue from water rates which are based on maintenance and operation only are very low, while the interest and redemption costs to be met by the State are very high. There is thus no real relationship between cost and benefit as far as the water users are concerned.

However, plans similar to those of Victoria are now in effect in all of the States and they have proven to be the most satisfactory all-around systems devised to date. No doubt these systems of financing will be changed from time to time in minor details, but it is doubtful if the water users will again be required to pay for the major portion of capital costs. Their share may possibly be increased slightly but considering the present concept of irrigation in Australia and the important part it is expected to play in the future, undoubtedly irrigation development will continue to be a function of the State and Nation as a whole. •

READ *Impressions of China* in next month's RECLAMATION ERA by Constantin P. Christopoulos Professor of Hydraulic Engineering and UNRRA Conservancy Advisor for North China.

DATE FESTIVAL
Below Sea Level

Ride 'em, Sheriff! Novel camel race adds to color of Riverside festival. Photo courtesy Hartman Photos, Indio, Calif.

by Hubert M. Williams

Engineer, Coachella Division, All-American Canal System, Region III

One of the first and most unique fairs of this year will be the Riverside County Fair and Date Festival, being held at Indio, Calif., February 11–15.

Staged in the heart of the Nation's date country—the Coachella Valley—the event has not only the unique distinction of being the only known date festival in the world but it is also held below sea level. Some ranches at the lower end of the Coachella Valley, near Salton Sea, are located about 220 feet below sea level while a few ranches in the northwestern portion of the valley are in an area which is 220 feet above sea level. The site of the Riverside County Fair and Date Festival is located approximately 10 feet below sea level, just outside the city limits of Indio, Calif.

The theme of this year's date festival, like that of last year, will be built around the Arabian Nights motif. Visitors from near and far will enter through mosque-like gates, designed in authentic Arabic architecture and decorated with Arabic and English greetings, and will go past Arab sentries into grounds where a carnival-like atmosphere will prevail. Near-eastern costuming, decorations and music will lend color and atmosphere to the occasion.

Cities throughout Riverside County have entered contestants in a queen contest in which the winning contestant will be crowned "Queen Scheherezade" the opening night of the fair on the large new outdoor stage. Queen Scheherezade, with the remaining contestants as her attendants, will then rule throughout the festival. Each night the queen with her attendants will present a pageant depicting a different Arabian Night's tale.

One of the most colorful and spectacular features of the entire festival will be an Arabian parade staged in downtown Indio on February 12. This year's parade, like last year's, will be led by the California Highway Patrol and a color guard from the R. O. T. C. unit of the Riverside (Calif.) High School Band. There will, besides the queen's float, be more than 200 entrants. Equestrian groups, colorful floats, and Arabian costumes will be featured in the parade which will be over four miles long.

During the 5-day period of the fair, there will be a Desert Citrus Institute which will be held at the Coachella Valley High School in connection with the fair. Daily lectures on desert agriculture will be conducted in cooperation with the University of California Agriculture Extension Service. Mr. H. L. McFarlane, county farm advisor, will have a "questions and answers" exhibit where he and members of his staff will give useful advice and answers to questions on farm matters.

As the Coachella Valley produces ninety percent of all dates grown commercially in the United States, the story of date culture will be featured for the benefit of the visitors. Drawing unusual interest will be the many date and citrus exhibits entered by local growers, packers and shippers, wholesalers and retailers. The growth of the date from blossom stage to one of many packs for shipping, will be shown. Samples of male and female blossoms, with examples of various pollination methods, will also be shown. Different varieties of date trees are planted throughout the fair grounds with samples of different offshoots that have been removed from parent trees to start new gardens. There will be exhibits showing different varieties of dates, some that must be hydrated before using and others that have to be dehydrated before they can be used.

In preparation for this year's fair festival, close to $125,000 has been spent on capital investments. This amount was allotted to the fair committee by the State of California from funds received from the 4 percent levy on thoroughbred race track wagering in the State of California. This amount has been spent on a new exhibit building, grandstands for the outdoor arena, and for facilities to handle 250 head each of horses, cattle, swine, and sheep.

Each afternoon during the 5 days of the fair, there will be a horse show and circus acts in the outdoor arena. The response to last year's camel races was so enthusiastic that again this year they will be featured every afternoon. Members of the Riverside Sheriff's Posse help to make this event one of the feature attractions of the entertainment portion of the festival.

This year's fair and date festival is the second to be held since 1941. Last year's event broke all previous records for attendance with 29,351 paid admissions, the previous high being 8,700 in 1941. The festival has been lengthened 1 day this year and it is expected again to break all attendance records.

Photo courtesy M. D. Bradshaw, Thermal, Calif.

Atmosphere of Middle East prevails at Riverside as fair and festival get under way.

Photo courtesy Hartman Photos, Indio, Calif.

A FAIR attraction surrounded by some of the luscious products of the Coachella Valley.

The first of many date festivals was held October 23, 1921. This and succeeding festivals were held in a large tent near Indio, sponsored by a number of date growers of the Valley. In 1938 a county fair was held in conjunction with the date festival, and the Indio Civic Club arranged with the county board of supervisors to hold county fairs during the years 1938–41. The county supervisors handled last year's event and will be in charge of the festival this year. The county of Riverside has set up a revolving fund of $22,000 for operating expenses. However, last year's event showed a slight profit.

Future plans of the fair committee call for the construction of additional exhibit buildings, a larger arena and grandstand.

At present there are approximately 20,000 acres of cultivated lands in the Coachella Valley, irrigated by wells alone, with about one-fifth of this acreage planted to dates. Upon the completion of the Coachella Canal and distribution system by the Bureau of Reclamation there will be a total of 77,000 acres of arable lands subject to irrigation. With this expected large increase in date plantings, the date industry will play an even more important part in the economic future of the Coachella Valley.

In the years to come the Riverside County fair and date festival, keeping pace with the rapid growth of the desert area, should be a great asset to both the county and to Coachella Valley and prove to be an event which will be one of the outstanding affairs of its kind.

Report on Bureau Conservation Conference

Last November, Reclamation's operation and maintenance supervisors discussed problems of soil and moisture conservation with representatives of project planning and other Bureau and Interior Department staff members.

Every Reclamation project may eventually lose its usefulness—perhaps hundreds of years hence—unless conservation methods and new engineering techniques gives it permanence. No matter how well a dam is constructed, sedimentation eventually will fill the reservoir it creates, unless we reduce the silt inflow. The useful life of reservoirs can be greatly extended by suitable preventive measures that are taken in time.

The people using watershed lands and the various local, State, and Federal agencies which are concerned with conservation and land management already are doing much of the needed work. However, increased attention must be given to the special problems of protecting the enormous public investment in Reclamation works and in protecting the millions of acres of irrigated land that are dependent for their water supply on Bureau reservoirs.

Reforestation of mountainsides, revegetation of grazing lands, and the use of farming practices which prevent the soil on millions of good acres from wasting into the rivers are some of the practices which are used.

A broad-gage program, focusing these practices on the needs of Reclamation projects, was mapped out in November at a conference in Washington, D. C., of the Operation and Maintenance supervisors. The session on conservation policy and program was held jointly with representatives of the Branch of Project Planning. The proposed program is now being reviewed in the field by the Regional Directors prior to its adoption by Commissioner Michael W. Straus. The plan which the conference worked out will be tied into the Interior Department program through the Office of Land Management.

The call to action was stated by Acting Commissioner Kenneth Markwell. He pointed out enormous demands which have been made upon this country for food and raw materials of almost every variety by the recuperating nations of Europe. Secretary J. A. Krug has set in motion in nearly every bureau and office of the Interior Department an intensive study of means to increase and conserve our national resources to meet the demands of peace—and, if need be, the requirements of national defense. Edward N. Kavanagh in the Office of Land Management is coordinating the conservation programs of the various Interior Department agencies. The Bureau of Reclamation is cooperating fully with this program.

Assistant Commissioner Wesley N. Nelson opened the session on conservation by reading excerpts from a speech made by Robert S. Kerr, former Governor of Oklahoma. He read:

"Most of history's wars have been fought to keep or obtain natural resources, including the chemical elements that give fertility to the soil. Yet, in whatever direction we look we see the results of waste, erosion, and useless destruction.

"On the face of our denuded forests, our scarred and eroded acres, our polluted and silted streams, many of our oil and gas fields from which only the cream of production was skimmed and which were too soon abandoned, the hand of destiny has written the condemnation of the extravagance of this and past generations: 'Thou hast been weighed in the balances and found wanting.'

"Shall we maintain a fierce and stubborn pride in the face of this condemnation, or shall we acknowledge our responsibility and obligation and honor them?"

The conference report is a direct answer to that challenge. The group recommended to the Commissioner that a program be adopted effectively to apply all of the funds that are made available for conservation purposes. A program of $50,000

(Continued on page 16)

Above, spraying to outlaw mysterious disfiguring thrip disease. Below, thrip-infected grapefruit. Top photo by Harry W. Myers, by Ed Handly, Region III, Boulder City, Nev.

The *BITTER* and SWEET of Citrus Farming

by Harry W. Myers, *Regional Photographer, Region III, Boulder City, Nev.*

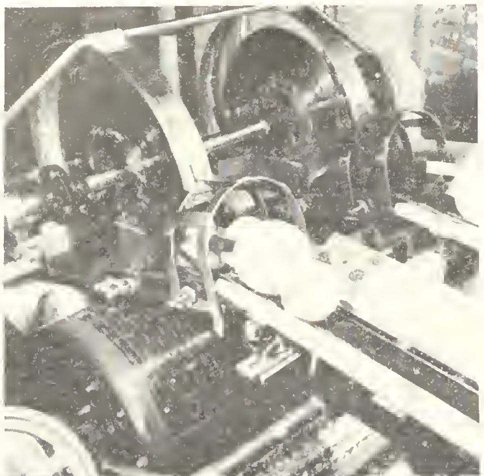
Would you like to make a fortune? Here is your opportunity. The citrus growers are looking for someone to solve a problem they have been battling for years. It means millions to the growers and better living for everyone. It means stabilization for the industry. And it means money in your pockets, if you are the bright person with the right ideas.

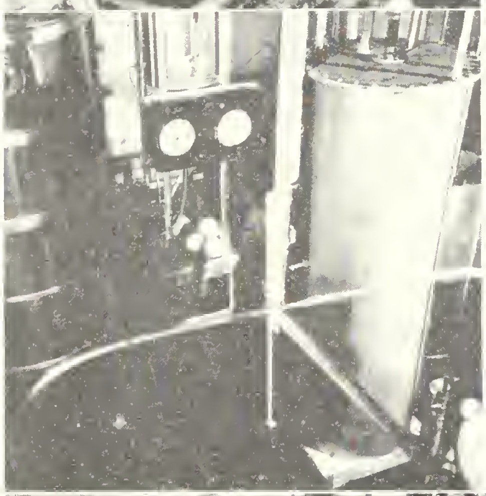
The problem may be stated simply—how can fruit, which can't be marketed fresh, be disposed of profitably? There has always been a surplus of usable fruit which cannot be sold. For years this fruit was dumped to rot, while the growers tried many ideas to turn this waste into a profit. Unsuccessful attempts were made to develop salable wines and brandies and to produce other byproducts. Early efforts to can citrus juice failed. The juice spoiled in the can. This problem was eventually solved by pasteurizing the juice prior to canning. And although pasteurization kept the juices from spoiling and did not alter the food value, it did, unfortunately, change the taste. That "fresh fruit" taste just wasn't there.

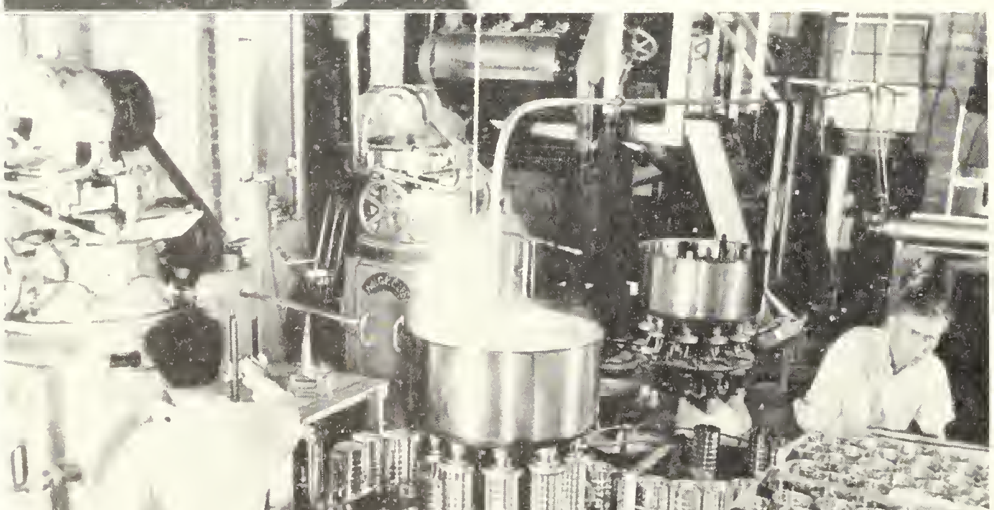
Despite this, the industry plunged into canning and the juices sold readily for a few years, but now warehouses are filling with cases of juice. The industry is finding it harder and harder to dispose of its yearly pack.

If only they could can that "fresh fruit" taste, the growers believe the market for juice would increase tremendously. Quick-

Perfect the following operations to enable the grapefruit to retain its fresh fruit flavor and sweeten your bank account. Step 1, cutting and slicing fruit; Step 2, pasteurizing juice; Step 3, canning and sealing. Somewhere along the line the fruit loses its original flavor—but where? Photos by Harry W. Myers and Samuel B. Watkins, Region III.







freezing may provide a solution. It is being tried, but not on a large scale as yet. Possibly the answer lies in a new method of packing and distribution that will cut consumer costs and provide a bigger market. Or, perhaps citrus fruit is the base for some valuable byproduct.

At any rate, citrus farmers are keeping their eyes peeled for a solution to the canning problem as well as other perplexities connected with their industry. They are busily engaged in a never-ending search for the best ways to plant, care for, and market their fruit.

Take for example the Yuma Auxiliary project near Yuma, Ariz. This is a comparatively small citrus-producing area but the farmers who till its soil have lots of "know-how." Last year on 1,727 acres they produced a crop worth almost $605,000. This figures about $350 to the acre.

The first citrus trees were planted on the auxiliary project in 1909. The area then was known as "Yuma Heights" since it is located on the mesa overlooking the city of Yuma. About this same time the Bureau of Reclamation was developing the Yuma project. The mesa grove, a private development, pumped its water supply from wells and continued in production until the 1930's when rock-bottom prices and rising operation costs forced its abandonment.

In 1914, three men—Mr. Hill, Mr. Wood and Mr. Vincent—started an extensive citrus development further south on the Mesa. Using pumped water, groves were planted and brought to maturity. The project slowly bogged down under high development and operation costs, and never attracted sufficient growers to be a paying proposition. Today, of all these groves, only the Hill Orchard is still in existence.

The present flourishing citrus industry on the Yuma Mesa had its beginning in the Bureau's studies made in 1917, 1918,

The barren waste above, now being staked ou laborers planting Valencia oranges, and at Right, giving the trees a sunburn treatm to stimulate growth of trees. Photos by Har

and 1919. From these studies, it was determined that an area further south and slightly west of the original private developments was ideally suited for large-scale citrus growing. There was little rainfall, the relative humidity was low, the area was free of injurious plant pests and damaging frosts—an extremely rare set of circumstances.

In 1919, 6,300 acres were offered for sale at public auction. Funds derived from this sale were sufficient to enable the Secretary of the Interior to authorize the construction of works to irrigate 3,800 acres with the water to be pumped from the Yuma project's East Main Canal. The first water was delivered to the system in 1922; and by 1923 there were 300 acres planted to citrus.

From this small beginning, despite low prices and depressions, the project has grown and prospered. At the end of 1946 there were 1,727 acres planted and 400 additional acres readied for planting. Of this acreage, 1,033 acres are in grapefruit, 390 acres in oranges, 282 acres in lemons, 20 acres in limes and 2 acres in tangerines.

In spite of lower prices and the threat of surplus production, new acreage is still being planted—although no longer to grapefruit. Some grapefruit growers are even considering cutting back and budding their trees to oranges—a process which takes the trees out of production for 3 years. There has been very little budding-over in the Yuma Mesa groves to date. It is being done much more extensively in the Salt River Valley where operating costs are higher.

Thick skin and rough skin texture of fruit have plagued Yuma Mesa grapefruit growers but careful attention to exacting nitrogen requirements has done much to overcome this difficulty. The same March Seedless grapefruit grown in the Salt River

e day be a beautiful orange grove. Center checking to make certain trees are alined. leaves on ground which have been stripped **Region III**

Valley and in the Coachella Valley, especially in the case of the latter, have much smoother and thinner skins.

Yuma Mesa growers insist that their grapefruit is far superior in flavor regardless of skin texture. As to flavor, that seems to be a very controversial question, judging from the claims of the various areas. But it can be safely said that skin texture does not impair fruit quality. However, because the public has come to accept skin characteristics as criteria of quality, Yuma Mesa grapefruit has often brought as much as a dollar less per box in the competitive market.

The planting of a new grove begins with the leveling of the land on a grade that will permit proper irrigation. Following the leveling, a cover crop (usually alfalfa) is planted to prepare the soil and to hold it in place during the wind storms. The cover crop is left in usually until the trees come into bearing. During the past years of high alfalfa prices, growers with new orchards have defrayed part of the cost of bringing a grove into production by cutting and selling their alfalfa.

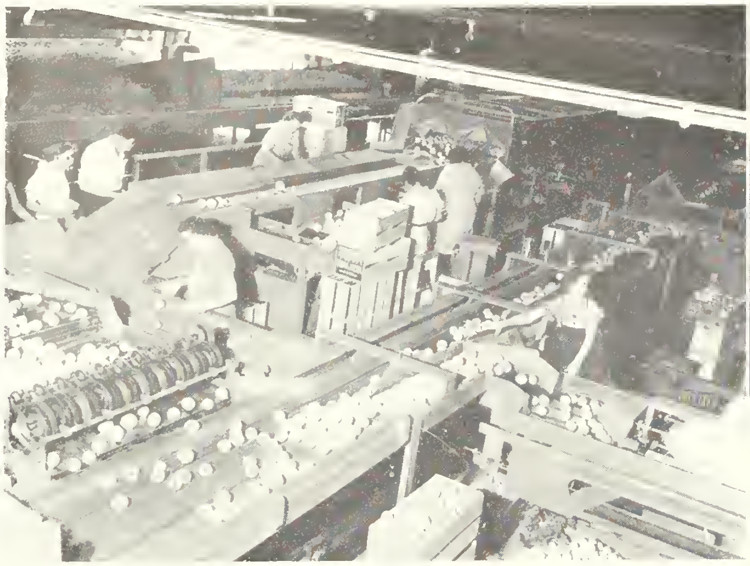
Two-year-old rough lemon stock, budded over to the variety of citrus desired, commonly has been used for new groves on the Mesa. Extensive tests are underway to determine the possibilities of other stocks. At the time of planting, the bottom of each hole is lined with a shovel full of barnyard manure. As soon as new trees are in the ground they are usually stripped of all leaves. Thus treated they recover from the shock of transplanting and regrowth starts more quickly. Following the leaf stripping, each tree is white-washed to protect it from sunburn.

The first year after planting is the critical period. Young trees require a great deal of water and are irrigated every seven to ten days, depending on climatic conditions.

Above, mechanical loader, brain-child of Harry Ellis, Yuma Fruit Growers Association, which saves precious time in getting fruit on its way. Right, petite packer Dorothy Tschilar of Phoenix, one of the fastest in the business. Photos by Harry W. Myers, Region III.

Old groves require water every 14 days. Five years will pass before a new grove produces sufficient fruit to pay maintenance costs.

Citrus thrip is the only plant insect pest with which the growers on the Yuma Mesa have had to contend. Thrip cause damage by feeding on the skin of the tiny new fruit as it forms from the blossom. To combat the thrip, a mixture of 1 pound of tartar emetic and 6 pounds of sugar to 100 gallons of water is sprayed on the trees during the blossom season. The sugar attracts the



Left, interior of new packing plant at Yuma. In center foreground is sorting table and left, roller stamping machine which trade-marks fruit. Above photo shows exterior of packing shed with conveyor belt handy to trucks, left bodyside of which is unhinged, creating shoot direct to belt. Photos by Harry W. Myers and Samuel B. Watkins, Region III.

thrip and the tartar emetic kills them. While this spray does not kill off all the thrip, it does reduce their number to a point where the damage is not serious.

A few of the growers have used DDT as a spray, but to date it has not come into general use. Other methods of control are being investigated. The damaging "scale" that has played havoc with California fruit, has not invaded the groves on the Mesa.

Killing frosts on the Mesa occur so seldom that none of the growers equip their groves with smudge pots.

The trees blossom in the spring, usually in March. Often, especially if prices are low, some fruit from the last crop is left hanging on the trees amid the blossoms, and fruit harvest continues until early summer. Throughout the hot summer months, the new fruit grows and matures.

Picking begins in October and continues until the trees are stripped of fruit. Fruit that cannot be sold is either juiced or dumped on the desert to rot. Yuma Mesa growers use crews of 12 to 15 men, each with a foreman, to do the picking. Each crew works as a unit rather than as individuals. A crew will pick from 24 to 40 tons of grapefruit a day. Pay is on a tonnage basis. The total tonnage picked per day is less when picking oranges. Pay per ton last year was $2.90 for grapefruit and $4 for oranges. Average pay for a picker is $50 to $60 per week.

Each crew works with two trucks and while the first loaded truck is driven to the packing shed (a round trip of 25 miles), the crews load the second truck. The Yuma Mesa Fruit Growers Association has abandoned the use of field boxes for bulk handling of fruit. In the orchard the fruit is loaded into high-sided trucks with a mechanical loader. These trucks are dumped at the packing shed onto a slatted conveyor which carries the fruit into the plant. This method has eliminated a great deal of hard hand labor, speeded up the processing of the fruit and reduced handling costs.

This continuous conveyor takes the fruit over the presizer, where all over-size and under-size fruit is removed. In the case of oranges, this fruit is sold in bulk as culls—usually to juice plants. The conveyor system carries the fruit rapidly over rotating transverse dry brushes which thoroughly clean each one.

From the cleaner they pass into the waxing machine to be waxed and polished, then over the grading table, where the graders remove scarred and misshapen fruit.

Leaving the grading table, the fruit is channeled over inked rollers where the brand name is "rolled" onto each orange or grapefruit. A roller system distributes the fruit, deftly sorting it into standard sizes, to the long packing tables.

Girl packers, with a dexterity that is fascinating to watch, wrap and hand pack the fruit in boxes. As the left hand reaches for a paper, the right hand picks up the fruit, there is the flash of a quick twist, and the wrapped fruit is in the box. The packers are paid on a piecework basis, depending on the size of fruit and type of pack. The scale per box varies from $3\frac{1}{2}$ to 18 cents.

Top packers, depending upon the fruit and type of pack, will pack from 100 boxes of wrapped oranges to 390 boxes of unwrapped grapefruit a day. Originally most of the fruit was wrapped before packing. The necessity for cutting costs and wartime shortage of paper, forced the development of other packs, such as the "place pack" (all fruit unwrapped) and the "blind pack" (two rows in the bottom and top layer, wrapped).

The various size packs are sorted out and trucked into refrigerator cars for shipment. These cars are iced only during the warm fall or spring months. Most of the grapefruit packed in Yuma is shipped to western markets.

The whole industry—from grower through packer—is working to cut costs, to find new, cheaper methods of delivering the fruit to the consumer.

A large part of the final cost of citrus to the consumer is the packing cost. There have been some attempts to sell bulk fruit, but so far no convenient, cheap method has been evolved to transport large quantities of bulk fruit over long distances. Some of the growers, particularly those in southern California who have higher operation costs, are experimenting with fruit sacked in various size string sacks, in an attempt to cut costs. It is possible that, except for the luxury trade, the familiar case of wrapped fruit we see today with its high packing costs, may be on the way out.

The Yuma Mesa Grower's packing shed is a modern concrete building, equipped with the latest in citrus fruit processing machinery. Its old shed burned in 1944, and while this was definitely a blow at the time, it did enable the association to build its present, airy, efficient plant. While the plant is geared primarily to the packing of grapefruit, it can be converted over in 30 to 40 minutes to packing oranges.

Yes, the citrus industry has its problems, but despite all these, most of the Yuma Mesa growers are satisfied with their investment as evidenced by the constant inquiry for land suitable for citrus production. •

Survey Forecasts Cropland Crisis

The findings of a recent Associated Press survey disclosed the following:

Crossing of the rising population line and declining cropland line about 1950 with gradual deterioration of the American standard of living as an inevitable corollary is forecast in a recent Associated Press survey of statistics of the Bureau of the Census, Soil Conservation Service, and Bureau of Agricultural Economics.

Total good cropland left in the United States is set at 460 million acres, comprising 390 million acres of lands immediately available, and 70 million acres requiring reclamation by irrigation, drainage, or other improvement work.

The population estimates indicate 147,-500,000 persons by 1950, rising to 165 million by 1990. After 1950 there will be fewer than the traditional 3 acres per person for the first time in history.

How to Conserve Irrigation Water Supplies (Part One)

By L. R. Fiock

Superintendent, Rio Grande Project. N. Mex.-Texas, Region V

Editor's Note:

When extreme droughts in the Rio Grande watershed threatened the Bureau's 155,000-acre Rio Grande project in New Mexico and Texas, the superintendent and officials of the El Paso and Elephant Butte irrigation districts initiated a comprehensive educational campaign on water use and enlisted the support of all farmers to conserve the dwindling irrigation supply. Water users rallied to meet the challenge. They participated as a group in a program to utilize the natural resource for peak per-acre production, and the project-wide enterprise was eminently successful. In the following article, Superintendent L. R. Fiock, discusses conservative use of an irrigation water supply.

Although his statements apply particularly to the Southwest and specifically to the Rio Grande project, many irrigation farmers in other sections of the West may find helpful suggestions for conserving water in their area.

Photo by Ben D. Glaha, Region II

ROW-CROP IRRIGATION. ***The little wooden tubes through which the water is led from the farm header ditch into the furrows are called spiles. The mouth of the tube extends into the header ditch several inches and the flow is regulated by driving a lath vertically against it, and moving the lath sideways to open or close.***

When is an irrigation project feasible? How large an area should be included in the project? The answer to these questions depends upon the available water supply—not the amount of land that is irrigable, nor topographic obstacles that present construction difficulties—but available water supply, first, last, and always. This is true in the semiarid West, particularly in the arid Southwest.

Major steps required to achieve maximum use of the water supply for ultimate crop production are outlined briefly as follows:

- Storage and release to meet irrigation requirements.
- Diversion of storage release or natural stream flow.
- Operation of the distribution system.
- Delivery of water to farms.
- Preparation of land for irrigation.
- Use of water on land to produce crops.

True conservation in the use of the water supply should result in production of the greatest quantity and quality of crops attainable by the most efficient use of the amount of available water. Beginning with control and regulation, the end objective—water on the land to produce crops—must be kept in mind at all times.

Storage and Release To Meet Irrigation Requirements

It is reasonable to expect that the most conservative use can be made of the water supply where it is controlled by storage located within a reasonable distance of the point of use. Releases can then be regulated to meet requirements with minimum waste or deficiency. However, deliveries must be based on orders received sufficiently far in advance to allow the releases to arrive at each point of use when needed.

This requires constant vigilance and alertness and cooperation between the farmers and the operating organization.

Farmers must know their soil, moisture, and crop conditions in order to anticipate advance water requirements.

Ditchriders must get their orders in advance of actual need and turn in their requests to the watermasters.

The Watermaster must inform the project water dispatcher of the total amount of water requested by ditchriders in his division.

The Project Water Dispatcher then must total the requests of all divisions. He must also allow for river losses and gains in transportation, drain return flows and probable operating waste available for rediversion. He then determines the amount to be released from storage and directs the gatetender to regulate the outlet gates accordingly.

The most beneficial and economic use of a water supply generally contemplates occasional years of shortage as well as some years of overabundance. This is especially important where irrigation is limited by an available water supply rather than by land susceptible of irrigation. In the arid Southwest the supply is limited and the watershed run-off, which is the source of supply, is extremely erratic from year to year, varying annually between 10 to 15 times the minimum. Under such conditions, it is necessary to have reservoirs with large carry-over capacities.

The basis for development and operation of the Rio Grande project in New Mexico and Texas is the control by storage of the very erratic run-off of the Rio Grande, which varies from 200,000 to 2,800,000 acre-feet annually.

The capacity of project storage reservoirs is sufficient to control almost the entire run-off of the Rio Grande entering the reservoirs and the carry-over of water from years of abundant run-off for use in years of deficient run-off.

The capacity of Elephant Butte Reservoir is 2,200,000 acre-feet at spillway elevation; Caballo Reservoir has 346,000 acre-feet capacity; a total of 2,546,000 acre-feet. In 33 seasons of operation, overflow spill has occurred in only 1 year, 1942, or 27 years after the commencement of storage operation in 1915—1 year before completion of Elephant Butte Dam.

Although there has never been an actual shortage, the project has been threatened at the beginning of 4 years, 1919, 1935, 1941, and perhaps 1948.

This record might be taken to demonstrate a fine balance between the water supply and irrigation use, but it must be recalled that at the time storage water was first available in 1915 there were only about 70,000 acres in cultivation.

The area in cultivation has gradually increased until the project development now approximates 100 percent with 155,000 acres irrigated—the area for which there has been considered to be a safe and reliable water supply. As the irrigated area increased, the more necessary it became to control and conserve the water.

There now is apparently no way to increase the water supply. A change in crop system, that will result in a material decrease in acreage planted to cotton, with a corresponding increase in the acreage of other crops, is inevitable on the Rio Grande project. This change may require the delivery of water on an allotment basis as a normal practice each year.

It has been determined that the average amount of water available for release from storage is 790,000 acre-feet annually. Although this amount is mentioned in the Rio Grande Compact, it is not an arbitrary amount fixed by the Compact. It was fixed by the Compact Engineers in their study of past records and substantially agrees with findings stated in the reports on several previous studies of the project water supply. With 790,000 acre-feet the average annual amount of water available for release from project storage, farmers must expect that each year water is released in excess of 790,000 acre-feet there must be that much less water released in other years to compensate for the amount taken from storage.

Aside from any disadvantages or penalties devolving upon the project through the operation of the Compact for having exceeded an average annual release of 790,000 acre-feet (and the Compact does inflict such penalties) if excess releases are not compensated for by under releases, the inevitable result will be to intensify shortages when they do occur, both as to frequency of occurrences and acuteness.

Such would be the consequences during low reservoir stages, which are sure to occur, if wasteful water practices are followed during periods of high reservoir stages. Conservation is the watchword.

Diversion of Storage Release or Natural Stream Flow

Whether diversions are from storage release or natural stream flow, available water should be allotted to the various divisions or districts in accordance with requirements, previous orders, or priority of water right. Deficiencies should be prorated accordingly. Diversions should be measured and reported daily.

When increased demand develops, waste ceases, and if a lower division has been depending on waste water, that division suddenly finds itself doubly short of water, for it also probably has increased its demand.

Each district, division, unit, and farm on an irrigation project must be held responsible for its proportionate share of waste reaching the lower end of the project. Lower units cannot and should not be expected to depend on or have to absorb the waste from other units.

Operation of the Distribution System

The distribution system can be operated most efficiently in the Southwest where there is little precipitation during the growing season by grouping deliveries to farms. This may be referred to as the "rotation plan" but, when combined with an order system, it becomes a modified rotation-order system.

This provides for deliveries to be made in accordance with orders received but varying sufficiently from the sequence in which they were received to insure that deliveries move up the canal or lateral in the same general area.

It gives the ditchrider better control over the water and makes it possible for him to give better service by eliminating the need for him to travel continuously back and forth over his unit. This plan also reduces waste because it is not necessary to handle small heads in laterals over the entire unit.

Each ditchrider should request the amount of water required for his particular unit on the basis of orders received. Then he should account for the total in the delivery charges, less a reasonable allowance for system losses and possibly, where permissible, a minimum of unavoidable operating waste. However, this waste should also be reported. When deficiencies occur, the immediately available supply should be prorated over the various units in proportion to the requirements of each.

Ditchriders should report daily by telephone to their division watermaster, giving the amount of water being received, the total number of acres for which there are outstanding orders, and general conditions of each unit. Watermasters should then make a summarized daily report to the project water dispatcher.

Running extra water through one unit and counting on the unit below to make use of the waste cannot be tolerated in a good operation. The lower unit cannot operate on waste from above. The only reason for running extra water through a unit should be to have it available on demand or in case of an unexpected increasing demand.

Delivery of Water to Farms

The manner of making deliveries to farms may vary considerably in accordance with established practices and customs, but it is influenced largely by the character of the water supply.

There may be variations and modifications by partial combinations of methods but all are subject to restriction by allotment or rationing in times of deficiency. Here is a description of some of the methods in use.

Continuous Flow usually involves the use of small heads continuously rotated over the farm. This is not generally the most efficient as it results in great loss and may also cause the farmer to use water when not necessary.

Strict Rotation means the delivery of a fixed head of water for a set period at regular or established intervals. This too, may result in the use of water when not really needed and, to that extent, is a wasteful practice.

Delivery on Advance Orders is made to meet anticipated actual requirements, modified by sufficient rotation to keep deliveries bunched. This appears to be the most conservative and efficient practice, especially where the water supply is controlled by storage and releases can be regulated when and as needed to meet requirements.

Delivery on Demand, at least in the Southwest, is the most wasteful practice of all and cannot be utilized when the demand exceeds the capacity of the irrigation system or where there is a deficiency in the supply.

Equitable distribution of the available water supply; uniformity of service to all users; efficient and conservative control in distribution; and necessary records as a basis for the accomplishment of the above can only be achieved by the application and use of reliable methods for measuring individual deliveries to farms, diversions and distribution to lateral canals. This becomes increasingly important when the supply is limited and rationing or delivery by allotment is necessary.

On an irrigation project, as in any utility service, flat rates breed wasteful practices. Flat rate charges usually should not be tolerated. Possible exceptions are limited to communities of small home sites, where a relatively small percent of the area not covered by improvements is irrigated, and the amount of water used cannot justify the extra cost of making accurate measurements, charges and billings for each irrigation.

In some cases a graduated rate schedule, with increasing rather than decreasing rates in proportion to the amount of water used, encourages conservative use.

(To Be Concluded In Next Issue)

FM RADIO Works for RECLAMATION

Photo by Harold Foss, Region I

Photo by Frank B. Pomeroy, Region I

Above, central unit of the short wave radio set is operated at Columbia Basin project headquarters by E. B. Comstock. Right, Project Superintendent Phil C. Royer on his tour of the Potholes Dam job calls for emergency aid to start idle dragline, in background.

by Gene Nicolai

Columbia Basin Project, Region I

Moving as silently as the shimmering heat waves of eastern Washington's summers, radio signals flash along the 3½-mile Potholes Dam of the Bureau of Reclamation's Columbia Basin irrigation project to coordinate the countless activities that go into building the Nation's fourth longest earth-fill barrier.

Patterned after communications systems that function so effectively for police and highway departments and other organizations, the Potholes Dam radio network is writing a new page in the use of static-free frequency-modulated equipment. With it, the contractors have eliminated all guesswork in sending and receiving messages along a far-flung construction site. Today each part of the job is in immediate touch with the other and with headquarters.

As one engineer described it: "F-M radio is the answer to a contractor's prayer for efficient communication."

Builders of the Potholes Dam (Lytle, Amis, and Green) have six combination sending and receiving sets in the field and one at headquarters, which is atop a hill overlooking part of the great dam. The headquarters station also is connected with a companion unit at the main repair shop. Five of the six field sets are installed permanently in cars and trucks. A sixth set is portable and can be used in any vehicle or location when needed.

Because it covers a limited area, the network has only one licensed operator. He is responsible for Station KWDH, the headquarters unit, and for the field units. The field sets, using the call letters KWDI, followed by identifying numbers, can be operated by any authorized employee.

Transmission of vital messages is instantaneous. If a workman is injured on the job, headquarters is notified at once by a field radio, and an ambulance is dispatched immediately to the scene of the accident. If a power shovel or other equipment needs service, the shovel mechanic's truck or the field mechanic's truck is notified by radio, regardless of where the repair equipment may be.

On an average day, the high-frequency network may carry 40 or 50 messages. On a particularly busy day, the number has reached 70.

KWDH, being in the headquarters building, is the busiest unit and is handled by E. B. Comstock. Standing beside his desk, you can take in a series of typical messages to the KWDI units in the field.

Here's one:

"KWDH calling KWDI–One."

"KWDI–One. Royer."

"We have an important message for the survey crew. Have you seen them lately?"

"Yes. I just now passed them up near Station 29."

"Can you drop back to them?"

"Sure. What do you want?"

"Have the chief of the party call me on your radio."

"Will do."

"OK. KWDH out to KWDI One."

Whereupon Royer (Project Superintendent Phil C. Royer) who has KWDI–One radio set in his car, is cutting through the sagebrush to reach the surveyors. In a few minutes, KWDI–One, with a member of the survey crew speaking, contacts headquarters and receives new orders.

As Royer travels along the job, his radio is picking up other messages being sent from headquarters or being received there from other radio units.

Telegrams from all parts of the United States are relayed immediately to the field. Requests for parts are transmitted in a matter of seconds. Orders are passed along to key men on the entire job in less time than it takes a man to walk across a room.

"You might describe it as being like a seven-party telephone line, with each telephone owner listening in and talking when occasion demands," says Comstock. "Is it worth it? Just ask anyone on the job. There's no fumbling of the ball when you have two-way radio; no delay." ●

COMING NEXT MONTH

River Control by Radio by Rolland F. Kaser, of the Office of River Control, Region III.

Organization for Progress

by ALFRED R. GOLZE, *Acting Director, Office of Programs and Finance*

The Office of Programs and Finance was recently created in the Bureau of Reclamation to streamline its administrative structure by putting together under one head the fiscal, budgetary, and programming work previously divided between three separate offices.

The coordination and integration of these various functions is one of the two main objectives of the reorganization. Control of expenditures and allotment of funds as directed by the Conference Report on the 1948 Appropriation Act, is the other. The combined aim of the new organization is the fullest, most economical use of all available funds for the maximum construction effort.

You, as a water user, get the benefits of reclamation, and as one of the underwriters of the repayment obligation you also help foot the bill. You want to know what you are paying for. You want to know that the work has been done—or will be done—rapidly and economically without costly delays or needlessly added expenses of other kinds arising from poor coordination and unrealistic planning.

Budgeting and programming go hand-in-hand, each meshed with the other. For each authorized project and potential project in each river basin still under investigation, a long-range program is developed. A consolidation of these long-range programs, projecting the work into the future and providing an integrated plan for periods of many years, serves as a base for the preparation of annual budget estimates submitted to Congress by the President. To insure a higher degree of correlation and interlocking year-around functioning, the programming and budgeting have been combined in the new office. In the preparation of the 1949 estimates of appropriations the budget has been geared exactly to a predetermined program.

When the budget process has been completed and the Congress has determined the amount of appropriations for a fiscal year, the program group supervises and coordinates the translation of these appropriations into definite work schedules designed to utilize the available funds with maximum effectiveness.

The need for adequate controls and detailed reporting of work progress and fund expenditures in a program of such vastly increased scope, places a heavy responsibility on the new office. With Reclamation activities spread widely over 17 States and under the direction of 7 regions, numerous districts, and projects, the Commissioner and his immediate assistants cannot maintain close personal supervision of individual operations. In the main he and his regional directors must rely on carefully evaluated, selective, and comprehensive reports and digests to maintain close control of this far-flung organization.

The rate of progress of the whole program in all of its complex aspects is anticipated by the "flag dates" (dates set for the completion of specific jobs) in the work schedules formulated at the beginning of the fiscal year. Subsequent reports recurrently count the pulse of the program, enabling the administrators of the Reclamation program to spot places where the work is lagging and take steps promptly to get it back on schedule.

Your Bureau of Reclamation—operating very much in a fishbowl under a policy of full disclosure—must make many varied and special reports to your elected representatives in the Congress and to agencies of the executive and administrative branches of the Federal Government. To make these reports promptly and accurately requires an up-to-date reservoir of extensive data additional to the information required for administration of the program.

The Bureau of Reclamation regularly reports to the Congress, the General Accounting Office, the Bureau of the Budget, the Treasury, the Federal Power Commission, and the Secretary of the Interior—all of whom have regulations or rules which must be observed.

A newly instituted quarterly report to the House and Senate Appropriations Committees for example, details the status of funds, costs and allocations to project features. These various reports, unfolding every phase of the Reclamation program and exposing every recess to public scrutiny, insure that it is administered strictly in accordance with the will of the Congress.

Accurate cost accounting—the third major function of the Office of Programs and Finance—has been of primary importance in Reclamation since work began in 1902, because of the repayment provision of the basic law. Every water user has to pay a share of the recoverable construction cost, making it vitally important to you that the costs are fairly determined and equitably allocated.

The accounting system reflects the widening experience of Reclamation under changing conditions for nearly half a century. Now, responsive to the demands of the rapidly accelerating construction tempo of the program, the time-tested system is being further reshaped to provide the highest possible degree of flexibility consistent with sound accounting practice. ●

Report on Conservation Conference

(*Continued fron page 8*)

to $100,000 for the purpose is proposed for conservation activities in each Reclamation region for the fiscal year 1949.

With these funds, action programs would be started in each region designed primarily to prevent erosion in the drainage basins from which Reclamation projects derive their water. These will be started on lands under Interior Department jurisdiction wherever the initial expenditure of limited amounts of money can be expected to produce results. At the same time examinations will be started to find the most fruitful fields for larger scale activity. A preliminary inventory of such undertakings will soon be available largely through utilization of surveys and reports already made by the various conservation agencies.

Specifically, the conference suggested that the rseponsibilities of the Bureau of Reclamation in the conservation program be defined as follows:

- To determine the waste, loss and damage that has occurred or may be anticipated to occur on Bureau projects.
- To inventory the general areas of watershed lands which are the source of harmful silt or flood flows, or from which soil and water is being wasted.
- Where such source areas are on Bureau-controlled lands, to plan and carry to completion programs for the control of soil and water losses.

It was particularly recommended that where private, local, State, or other Federal agencies are carrying on adequate programs designed to meet the Bureau's objectives, the Bureau coordinates its activities with such programs. Other agencies which are concerned with the broad program are the Office of Land Utilization, Bureau of Land Management, Geological Survey, Bureau of Indian Affairs, and Park Service in the Department of the Interior; the Forest Service, Bureau of Plant Industry, Soils and Agricultural Engineering, Soil Conservation Service, the Office of the Secretary charged with flood control program of the Department of Agriculture; the Army's Corps of Engineers, State Highway Departments, and State Departments of Agriculture.

(*Continued on page 18*)

Growing Up With the Country

"He is growing up with a country that grows with the vision and effort of men like himself." Jay Carman, new homesteader on the Roza Division of the Yakima project.

Written for the ERA by Elma Hill Neal

Photographs by Stanley Rasmussen

Everywhere out here in the West we hear the phrase, "growing up with the country."

Over in the Magic Valley, a rugged old Twin Falls pioneer will tell you that he has been there more than 40 years and "grew up with the country." Young veterans and their wives are taking up homesteads on the Minidoka project or in the Yakima-Roza area, primarily of course to make a better living, but they will explain, with a wistful look in their eyes, that one of their long-cherished ideals is to get out on some new land and "grow up with the country." It's a fine phrase and it has more meaning than at first meets the eye or the ear.

When one thinks back, he knows that for many geologic centuries the country has grown up. Vast glaciers have swept down from the North and took aeons to melt and vanish, leaving only their great swooping marks along the terrain. Enormous lakes were gouged out and for ages they supported a marine life that died and enriched the soil when the waters finally seeped away. For generations the rivers have run down to the seas, scooping out their courses, tearing at the soil, building up their deltas. For centuries the wind has blasted along the plateaus and shrilled down the valleys. For eternities the rain has beat down and the sun has beamed broadly, the forests have grown great and the plains have tossed their grasses like the waves of the summer sea. And yet, in this twentieth century, man makes the remark that he is "growing up with the country." The country was old when man came to it.

Still, there is an element of rightness in the use of the saying, if for no other reason that, in this calendar year, the balmy charm of an April morning will be as sweet and fresh as when man first tilled the land and the colors in autumn this year will gleam like rubbed gold, and the first snowflake will be as pure and white as those that fell on the Grand Teton a thousand years ago. Each spangled dawn is new and inspiring, each reddening sunset burns with an undimmed glow. Only a wise God could have made a world so old and yet so perpetually new. Lucky man can still grow up with the country.

But "growing up with the country" involves old-time virtues often hidden away in this scientific age, like that peculiar brand of courage that hangs on in the face of monotony, or that sort of good humor that laughs at mistakes, or that type of resourcefulness that gets around a lot of obstacles that cannot be imagined but can only be met up with on a piece of raw ground.

Most of the problems of farmers are discussed in agricultural journals or thrashed out in farm meetings, but the distaff side of the modern pioneering set-up on newly irrigated lands is one to be considered seriously before undertaken, because too little has been said about it that really helps.

On most of the projects, it has been the earnest attempt of the settlers to get habitable places in which to live before bringing their families. Sometimes this is impossible, for getting the crops in the ground is first and foremost in a homesteader's thoughts. Early financial return is a saving grace, yet every woman who is willing to live with her husband on an undeveloped project is anxious to share in the pioneering and usually moves into a house of a sort before it has much more than shingles on the roof. She too, feels the challenge and delights in her own paint job on the woodwork. She glories in the rose-bedecked paper that she pasted on the walls of the bedroom herself, and in the smell of clean kalsomine in the kitchen. She helps her husband put up the cupboards at night while her city sister is taking in the premiere of a new show. There are no baby sitters on new projects unless the hired man can be occasionally coaxed to take the part.

But there **are** babies, and they play their part in the pioneering. Young Junior sleeps placidly in an apple box in the spring sun while his mother hills up long rows for lettuce and string beans, or sets out strawberry plants. He gurgles contentedly while his parents plant pencil-size Chinese Elms and Early Transparent Apple trees. His older brother delights in the vastness of space in which to roam and to dig, the joy of little chickens and young calves and of a dog at his heels. Nowhere else does a child more quickly learn the privilege of early responsibilities.

It is very true that the woman pioneer

Home is what you make it. Left, Junior Hall on the Roza project gets a "once over lightly." Center, the Burns of Roza, with their electric stove, are almost "luxury liner pioneers." Right, Byron Myers "supervises" the missus' artwork.

today can take with her a radio and a washing machine. She can listen to the morning news, **provided** the battery hasn't run down or if the electric line has reached their acres. Otherwise the silence is as great as that which surrounded Rebecca Boone in her wilderness home in Kentucky, and the washboard is just as backbreaking as that of Grandma's, who did her washing under a walnut tree on the sandy shores of a Missouri creek. **Provided,** of course, that she has the water. And she does have, **if** the well works all right. Otherwise she dips it out of the ditch, **provided** the ditches have been dug and the water is in them.

Usually during the first year, with the clothes all gleaming white on the lines which her busy husband found time to put up (or perchance she put them up herself) there is another obstacle to a perfect washday—the dust, oh, my friend, the dust! How it comes rolling in across the fresh-plowed acres of the Jones brothers to the southwest. It starts up like the Biblical cloud, the size of a man's hand. It raises behind the tractor busy preparing the potato field. It puffs and spreads and seemingly gathers all of the loose ground on the tract. It towers up, brown and menacing toward the zenith and then descends with a rolling fury that leaves the poor clothes wrenched and streaked with ropes of dirt, the window ledges soft with the fine silt and the dishes in the cupboard gritty. No window has ever yet been invented that will keep out the dust from that sort of a storm. She has to laugh that one off, too.

Pioneer women of the West fight the battle of bleakness and bareness and ofttimes loneliness. A great naked plain may stretch around them for miles, with mountains seen dimly in the hazy distance. No friendly tree hovers near to beat off the summer sun or lend a feeling of protection or give rest and nest to a singing bird.

But there is always compensation in the soil. Vegetables grow with a Jack-and-the Beanstalk speed. One doesn't exactly have to step back when seeds are dropped into the ground, but with a tiny stream of water to slake their thirst, asters and zinnias and petunias and a world of other flowers soon brighten the doorsteps and the garden edges with their color and perfume. During the long purple twilights and the quiet early mornings, the little gardens are beautiful and green, and appreciation grows for the simple things of nature.

Far to the north and west, the big dam is pouring millions of gallons of water into the huge canals, that in turn pour into smaller. The big generators are turning out millions of kilowatt-hours of energy which are converted into power and light for the individual farms. From project manager through ditchrider to farmer, the flow of water is maintained, but not without help too, from the farmer's wife, who keeps her faithful vigil over lesser channels. She helps her husband make spiles in the shade of the house. These are tubes made from laths cut in short lengths, which when inserted in heads of irrigation rows, control the flow of water and prevent the fine dusty soil from washing away. (*See photo on page 13.*) She uses some in her garden, too.

Once around the calendar on a new farm and the worst part is over. The toehold has been clinched. The modern pioneer and his wife have gained a victory over at least a part of the land. The alfalfa fields hold back the dust storms. Even the patch of lawn planted the first year makes a soft place to lay the baby and to shell peas. One has learned what to expect in growth. One has learned to measure many things, like men and miles and a trifle of money. School districts are laid out. A PTA is organized. A Sunday School is started. Dances are held and community life is begun in earnest.

Pioneers are growing up with the country and the old, old country is growing up with the pioneers. •

DON'T MISS the story of the British War Bride at Bumping Lake—February RECLAMATION ERA.

Report on Conservation Conference

(Continued from page 16)

Solutions for a number of other problems also were sought by the Operation and Maintenance Supervisors. One of particular interest to water users related to the problem of drainage. On this subject the report of the conference committee on irrigation operations declared:

"In planning new projects, ample estimates of cost for foreseeable drainage work should be included in the over-all project cost estimates. This does not infer that such drainage facilities should always be constructed at the same time as the irrigation works." Actually, this proposal is now being put into practice in planning a number of the new projects.

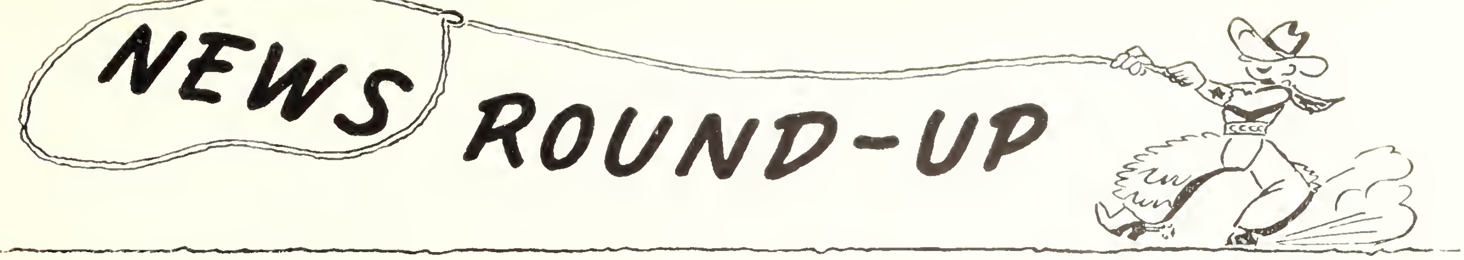
"In project operation," the report continues, "more careful attention should be paid to maintenance of, and results being obtained from, existing drains. Discharge readings of flow from major drains should be made semiannually to check on their continuing efficiency. In order to anticipate the need for additional drainage, project operations personnel should also make observations annually or more often if necessary, of ground water levels at various places over the project area. This can often be done by the use of domestic wells until an area becomes threatened with immediate trouble. When trouble is imminent, consultation should be requested with specialists in the office of the Chief Engineer."

The irrigation operations committee also recommended:

"In general, projects should be turned over to the water users for operation and maintenance as soon after the completion of the project development period as the system has become thoroughly stabilized, the repayment contract in final form has been executed, a reserve fund has been accumulated, and State laws have been complied with."

It was recommended also that an aggressive program should be adopted to train

(Concluded on inside back cover)



Lake Mead Sedimentation Survey

Assistant Secretary of the Interior William E. Warne recently approved a cooperative Bureau of Reclamation-Geological Survey sedimentation survey and investigation of Lake Mead. The Geological Survey will be responsible for over-all supervision of the work and the preparation of reports.

In earlier discussions, the Geological Survey obtained favorable expressions of interest from specialists in the Navy Department. Their special skills and facilities are to be enlisted in the project.

The agreements call for reexamination of existing horizontal control; rerun, as necessary, of first order level network; hydrographic and river channel surveys; salinity and core sampling; laboratory work; preparation of maps, charts, and reports.

Additional reports to be prepared include underwater photography, echo-sounding, base data on salinity and density currents, and characteristics of sediment deposits.

Field Level Cooperation Lauded

Field level cooperation in such programs as the Gila and Columbia Basin projects' development farms has produced excellent results, O. & M. Director Goodrich Lineweaver declared recently in an appearance before the Bureau of the Budget to support Agriculture's request for an increased appropriation for the cooperative work.

The cooperative arrangement was initiated by the House Appropriations Subcommittee on Agriculture in 1945, leading to development of a comprehensive Columbia Basin program. The State College of Washington, the Bureau of Plant Industry, and the Soil Conservation Service are cooperating with the Bureau of Reclamation in the operation of Columbia Basin development farms although the memorandum of understanding had not been approved by the Agricultural Research Administration of the Department of Agriculture as this issue goes to press.

The University of Arizona, the Bureau of Plant Industry, and the Bureau of Reclamation are cooperating under the fully approved Gila agreement.

Director Lineweaver told Budget examiners that this type of cooperation paves the way to provision of information to future irrigation farmers on Reclamation projects and gives added protection to the Federal investment in irrigation facilities. Under this procedure, he pointed out, there is no duplication by the Bureau of Reclamation of State college or Department of Agriculture functions. It is hoped, he said, that similar arrangements can be made in each Western State.

Gila Land Opening Scheduled

Assistant Secretary of the Interior William E. Warne recently announced the opening to homestead entry of 4,940 acres of public land on the Yuma Mesa Division of the Gila project in southwestern Arizona. The acreage will provide for settlement opportunities on 54 farm units.

Filing Instructions

All applications received prior to 2 p. m., March 29, 1948, will be considered as simultaneously filed. Applications should be filed with the Superintendent, Gila project, Bureau of Reclamation, Yuma, Ariz., either by mail or in person. All unsuccessful applicants for public land farms on the Yuma project may apply for a farm on the Gila project. Commissioner of Reclamation Straus announced that the general regulations under the homestead and reclamation laws which have applied in previous openings would prevail in the Gila opening.

Veterans' Preference

First opportunity for homesteading will be given to veterans of World War II, the War with Germany, the War with Spain, or in the suppression of the insurrection in the Philippines, who make application for land on the Gila project.

A public drawing from the applications of those qualified, which were filed simultaneously, will be held to determine eligibles to enter the farm lands. It is not necessary for an applicant to be present at the drawing in order to obtain a farm. Successful applicants will be notified by the Bureau of the results as soon as possible after the drawing.

Farm units of two types are available on the Gila project. The units of 80 acres or more are suited to general crop production, while those ranging from 40 to 70 acres are considered more suitable for raising specialized crops such as citrus fruits and vegetables. If either type farm is preferred it should be so noted in the proper place on the application blank.

For additional details write to the Superintendent, Gila project, Bureau of Reclamation, Yuma, Ariz.; Regional Director, Bureau of Reclamation, Boulder City, Nev.; or Bureau of Reclamation, Department of the Interior, Washington, D. C.

Middle Rio Grande Report Approved

Secretary of the Interior J. A. Krug recently announced approval of a departmental report sponsored by the Bureau of Reclamation which outlines a proposed program of irrigation and drainage development in the Middle Rio Grande Valley of New Mexico. Also coordinated in the plan are flood and sediment control development measures proposed by the Army Engineers. The report has been sent to the Governors of New Mexico, Colorado, Texas, and their official designees under the Flood Control Act of 1944, and to the Secretary of the Army, for review and comment prior to submitting it to the President and the Congress.

Because of the urgency for submittal of reports to achieve authorization of the critically needed works for irrigation, sedimentation, and flood control, the coordinated plan does not now include hydroelectric power development other than provision for penstocks at the dams to permit future power installations if later investigations indicate that they are practical and economically feasible.

However, Commissioner of Reclamation Michael W. Straus said that study of the hydro-power potentialities will be continued, and a report on this phase will be submitted as soon as the feasibility of power development has been ascertained.

The report recognizes the need for a watershed control program, and the report recommends that programs to accomplish this be enlarged and that a comprehensive watershed program be undertaken by the appropriate Federal agencies at the earliest practicable date.

Major features of the recommended Reclamation plan are as follows:

- Rehabilitate and extend the irrigation and drainage systems of the Middle Rio Grande Conservancy District, including the El Vado Dam and Reservoir.
- Construct Chamita, Chiflo, and Jamez Dams and Reservoirs for flood and sedimentation control.
- Provide levees for local flood protection.
- Channel rectification of the Middle Rio Grande. This includes Hot Springs and Espanola Valley channel improvements and dredging from near the southern boundary of the Middle Rio Grande Conservancy District into the backwater of Elephant Butte Reservoir, and
- The Blue water floodway project.

Congressional Investigation of the West

by Ralph L. Williams
Administrative Assistant to the Regional Director Region VII, Denver, Colo.

When you were reading in your home-town newspaper or hearing over the radio about members of the House Subcommittee on Appropriations for the Department of the Interior who were inspecting projects in the West, you probably little suspected the hard work involved in that 2 months' inspection by the three members who made the trip.

Photo by Ralph L. Williams, Region VII

Construction Engineer H. F. Bahmeier, in charge of the Davis Dam job, gives members of the Congressional Subcommittee on Appropriations a first-hand account of activities. Left to right: Bahmeier, Chairman of the committee; Ben F. Jensen of Iowa, Hon. George Schwabe, Oklahoma, and Hon. Ivor D. Fenton of Pennsylvania.

Congressman Ben F. Jensen of Iowa, chairman of the committee; Congressman Ivor D. Fenton of Pennsylvania; and Congressman George B. Schwabe of Oklahoma worked hard, and I mean hard. I know. I accompanied them throughout the trip. Just keeping up with them is work, staying even with them is rough, and you can never get ahead of them!

Last spring when the committee was in session, some of them (particularly Dr. Fenton of Pennsylvania) decided that never again would they sit upon a committee, hearing requests for appropriations, without first having visited the projects for which the requests were being made. As a consequence, it was agreed that in the fall they would make an inspection tour of the West.

And what a schedule! Every morning at 7:30 a. m., they were in the hotel lobby waiting to go. They wanted to see the projects first-hand, wanted to talk to the people in the project areas, to the engineers on the job, to the truck drivers, the surveyors, and to those who were planning the various jobs. And that's exactly what they did.

We took off from Sioux City, Iowa. Chairman of the committee Ben Jensen and his secretary, Bill DeyErmand, arrived from Exira, Iowa (Bill with his notebook and all). Congressman Fenton came from Chicago (the first time he'd been that far west), and Congressman Schwabe arrived from Tulsa, Okla. Assistant Secretary of the Interior William E. Warne was on hand to accompany the members as far as Billings, Mont.

The first day gave just an inkling of what was scheduled for more than 7 weeks. We were on the road at 8 a. m., had luncheon at noon at Fort Randall; inspected the dam in the afternoon; then drove to the Niobrara River Basin for an inspection as far as Ainsworth, Nebr. There, about 300 citizens of that valley gave the committee members a huge banquet, told of the benefits they thought a fully developed irrigation project would bring, and asked the Congressmen to tell them their thoughts on the subject. It was a grand meeting—and was followed by a 60-mile drive to Valentine, Nebr., where welcome hotel rooms were awaiting us. Next morning, we were up at 6:30, and went through more of the same thing, visitations during the day, another meeting with a local citizens group that evening, then to bed.

I was right in the middle of this procedure from September 15 until the first of November. And those days shown on our itinerary as "no activities planned, left to the discretion of the committee members"—those were the busiest of the lot. It seemed that everyone who saw a schedule and noted "no activities planned" did his best to see that a full day's work was arranged. In fact, before the end of the trip, we wondered what else could happen on a "no activity day."

What did they inspect? Everything. Proposed dam sites, authorized projects, projects in the first stage of construction, projects nearly finished, and completed jobs. Yellowstone, Glacier, Yosemite, and Grand Canyon National Parks. Some committee members visited the Government docks in Seattle; others inspected the fisheries in Astoria, Oreg. Grand Coulee, Shasta, Friant, Hoover Dams, and dozens of Reclamation projects were visited. The committee spent 2 days driving through the Navajo Indian Reservation and hearing of the problems that confront the Indians and the Indian Service. They listened to the Taos Indian tribal council, with its great wisdom, declare that appropriations to them were similar to waters of an irrigation ditch—"Lots of water up there but only a trickle when it reaches here."

They heard the merits of many proposed projects explained, such as the Missouri-Souris, the Middle Rio Grande, the Gunnison-Arkansas, the Blue-South Platte. And the final 2 days of their trip were spent high in the Rocky Mountains in Colorado—2 days of driving in the snow, inspecting the Colorado-Big Thompson project. Yes, on this trip they saw everything: Beautiful farmlands, splendid crops, and the winter snows.

But "seeing" wasn't all the Congressmen did. They listened generously and often. Literally dozens of meetings were held, with many different groups. Chambers of commerce, Lions, Kiwanis, Rotary, reclamation organizations, joint meetings of all varieties; with Governors of the several States; with organized labor; with farmers; with representatives of private and public utilities; Government officials; dozens of newspaper and radio conferences. They were talking with people everywhere, finding out what they were thinking, and seeing what would be needed next year to make America great insofar as the activities of the Department of the Interior were concerned.

"We're the All-American Committee," Congressman Schwabe told the audiences. "We like our job of inspecting this great West because this is truly the only way to find out about America!"

When the Needles, Calif., Chamber of Commerce told the members about the damage done by siltation in the Colorado River and how part of their town was now just a swamp, the Congressman determined that the best way to really know was to get into an amphibian boat (or "duck") and see. When the Park Service mentioned that additional funds might be needed for work on the donkey trail to the floor of the Grand Canyon, a trip to the bottom was taken. (And that's work, riding a mule 11 miles up and down the canyon in less than 8 hours.)

What commitments did the visitors make? "To give each and every project full and complete consideration" when the committee meets in formal session in Washington. Equipped with a better knowledge of the details through the intense investigation of practically every Reclamation project and Interior Department activity in the West, the committee is now fully informed about the West. Nothing short of sympathetic understanding and assistance can result. •

U. S. GOVERNMENT PRINTING OFFICE: 1948

NOTES FOR CONTRACTORS

Contracts Awarded During November 1947

Spec. No.	Project	Award date	Description of work or material	Contractors' name and address	Contract amount
1916	Fort Peck, Mont.	Nov. 26	Circuit breakers and disconnect switches	General Electric Co., Denver, Colo	$37,446
1916	do	do	Transformers and lightning arresters	Westinghouse Electric Corp., Denver, Colo.	167,930
1916	do	do	Transformers and circuit breakers	Allis-Chalmers Manufacturing Co., Denver, Colo.	117,642
1924	Colorado-Big Thompson, Colorado.	Nov. 20	Electrical equipment for Marys Lake and Estes switchyards, schedules 5 and 6.	General Electric Co., Denver, Colo	63,285
1931	do	Nov. 10	Transformers and lightning arresters	Westinghouse Electric Corp., Denver, Colo	77,150
1931	do	Nov. 7	Voltage regulator and circuit breaker	General Electric Co., Denver, Colo	19,017
1931	do	do	Disconnect switches	A. B. Chance Co., San Francisco, Calif	5,297
1936	Boise, Idaho	Nov. 19	30-ton traveling crane for Anderson Ranch Dam	Marias Crane & Hoist Co., Philadelphia, Pa	18,710
1943	Central Valley, Calif.	Nov. 18	Radial gates for Delta-Mendota Canal	Pacific Coast Engineering Co., Alameda, Calif	16,020
1944	do	Nov. 20	Construction of switchyards for Keswick power plant	Hams Brothers, Sacramento, Calif	361,151
1949	do	Nov. 12	Doors and windows for Keswick power plant	George T. Gerhardt Co., Inc., San Francisco	30,688
1953	Davis Dam, Ariz.-Nev	Nov. 25	Bulkhead gates for Davis power plant	Independent Iron Works, Inc., Oakland, Calif	35,878
1956	Boulder Canyon, Ariz.-Calif.-Nev	Nov. 14	Electrical equipment for Boulder City water supply pumping plants	Westinghouse Electric Corp., Denver, Colo	13,321
1958	Tucumcari, N. Mex	Nov. 17	Construction of bridges and inlets, Conchas Canal	J. A. Terteling & Sons, Boise, Idaho	95,220
1959	Missouri Basin, Colo.-Nebr	Nov. 25	Construction of Sterling-Sidney transmission line	Utilities Construction Co., Nashville, Tenn	318,280
1961	Davis Dam, Ariz.-Nev	Nov. 14	Erecting 20 prefabricated residences	John Bohannan, Pacific Palisades, Calif	72,900
1962	Missouri Basin, Mont	Nov. 19	Construction of streets and utilities for Canyon Ferry Government Camp	Kiely Construction Co., Butte, Mont	153,131
1980	Tucumcari, N. Mex	Nov. 21	Construction of Saxon lateral	J. A. Terteling & Sons, Boise, Idaho	28,642
6 R4	Minidoka, Idaho	Nov. 25	Construction of laterals, Gooding Division	The Shoshone Co., Twin Falls, Idaho	19,225

Construction for Which Bids Will Be Invited During January 1948

Project	Description of work
Central Valley, Calif	Construction of earthwork, lining, and structures for 13.6 miles of Delta-Mendota Canal.
Do	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado.	Erection of a 162-by 70-foot steel warehouse at Wilds Spur.
Do	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on Big Thompson River, a 1-mile tunnel, 12 concrete siphons, 1 steel siphon, and other structures.
Columbia Basin, Wash	Construction of various features in the vicinity of Grand Coulee Dam as follows: Production of concrete aggregates for all remaining construction, completion of right power plant control building, completion of right power plant control tunnel, construction of right power plant switchyard, construction of transformer circuits R-1, R-2, and R-3, construction of tie circuits T-1 and T-3, completion of right power plant parking area.
Hungry Horse, Mont	Construction of Hungry Horse Dam (arch-gravity, concrete) and power plant.
Klamath, Oreg.-Calif	Enlargement of concrete pumping plant D.
Missouri Basin, Frenchman-Cambridge unit, Nebraska	Construction of earthwork and structures for 12.5 miles of Cambridge Canal.
Riverton, Wyo	Construction of lateral system on Wyoming Canal extension from beginning to station 1606.
Yakima-Roza, Wash	Construction of one 18 cubic-feet-per-second, and one 33 cubic-feet-per-second concrete pumping plant for pump areas 13 and 14 on Yakima Ridge Canal.
Do	Construction of earthwork and structures for approximately 14 miles of laterals for pump areas 13 and 14.

Bureau Conservation Conference

(*Continued from page 18*)

younger employees, both in the subject of irrigation operations on a regional level and on actual project operation.

The committee on land use and settlement considered the question of development work, prior to settlement of new Bureau of Reclamation projects on public lands. In the committee's opinion, it would be possible to construct more economical projects than generally have been built in the past, by clearing, levelling and roughing-in the water distribution systems. This would mean quicker returns for the farmer and enable him to conduct his operations with smaller amounts of credit. Where private contractors can make such a service available to entrymen at reasonable costs, the entrymen should be encouraged to use the private contractors, although the Bureau should usually offer such services on public lands, the report stated. When the cost of land development equipment is high in relation to the area to be developed, it was suggested that such equipment might be shared by several projects so that the cost could be prorated.

The committee on allocation and repayments advocated, among other things, that every repayment or water use contract, both new and amendatory, contain adequate provisions covering land use and conservation of water, with the understanding that such provisions will be carried out by the water users under the auspices of the district. It also recommended a simplification of contract language. ●

Hydrologic Conference Series Planned

The first of a series of hydrologic conferences of Federal agencies for the purpose of correlating their needs in the extension of the hydrologic network will meet in New York January 14–16, 1948. Similar meetings will be held subsequently in each watershed. In view of the importance of coordinated hydrology in the Missouri Basin and the reflection in later watershed meetings of the policies and decisions reached at the first conference, V. A. Koelzer and W. U. Gartska will represent the Bureau at the New York sessions.

Cooperative Seismological Studies Okayed

Cooperative seismological studies through fiscal year 1948 at Hoover, Grand Coulee, and Shasta Dams and initiation of such studies at Hungry Horse dam site are provided for in a memorandum of agreement among the Bureau of Reclamation, the Coast and Geodetic Survey, and the National Park Service recently approved by Assistant Secretary of the Interior William E. Warne.

Such studies furnish scientific earthquake information of value to designing engineers, determine whether earth movements are endangering dams or appurtenant structures, where the movements originate, and furnish data for considering stress conditions.

From Swamp to Settlement—On the upper half of the page, J. E. Fluharty's photo of the drained lands of Tulelake, Oregon. Below, G. V. Gideon's copy of a picture taken on June 9, 1905, from the same spot. Bloody Point in the background remains the same, but the foreground shows the results of development through the years.

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Featuring:

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hy Our Conservation
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y Oscar L. Chapman
nder Secretary of Interior

OLDEN HARVEST
at
KLAMATH

THE *Reclamation* ERA

United States Department of the Interior

J. A. Krug, Secretary

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Washington Office: United States Department of the Interior, Bureau of Reclamation, Washington 25, D. C.

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Reclamation ERA

Vol. 34 **February 1948** **No. 2**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Publication approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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Contents

Ruth F. Sadler, *Editor*

Our Front Cover

Klamath Combine

Little man begins a busy day as he willingly gives "advice" to his dad, homesteader George A. Douglass, Jr. Little man is Eddie Douglass—See "Golden Harvest at Klamath," page 30. This photo was taken by photographer J. E. Fluharty of Region II in September 1947.

Letters to the Editor

Comments From Canada

3 Glenholme Avenue, Toronto,
November 28, 1947.

GENTLEMEN: The writer had the joy of attending the Convention of the National Reclamation Association held recently at Phoenix. On my journey to Phoenix, I examined Bureau projects in Utah, Nevada, and southern California, and on my journey after the Omaha Convention of 1946 I examined Nebraska, Colorado, and Wyoming projects. I cannot praise too highly the marvelous "works" and achievements of the Bureau of Reclamation. I am convinced that the crop returns on the reclaimed acres in all those low-moisture Western States, thanks to the magnificent achievements of the Bureau of Reclamation, do more than any other single agency to enable the United States to play the major part she is playing in European rehabilitation in food.

The Bureau has plainly demonstrated that reclamation is not a cost but is a strikingly profitable national investment.

At Phoenix one of the pamphlets issued the delegates was entitled, "Altus, the Irrigation Pioneer of Oklahoma."

About this project, may I ask for a little information:

1. What was the acreage of the project under water in 1947?
2. What was the value of the farm production, grain, stock, etc., in 1947?
3. What horsepower of electric energy was produced on the project in 1947 by the water; what was its value, or rather what was the money return from the electric energy?
4. What is the population on the project?

Personally I was thrilled with what I saw of results of the Bureau's projects. To mention only two, the Platte basin and the Salt River basin are both living examples of the remarkable benefits to the Nation that accrue from water conservation and its use for irrigation and power.

Yours faithfully,

JOHN R. MACNICOL.

Mr. MacNicol was thanked for his remarks concerning the important role that Reclamation projects have achieved in American agriculture and their probable influence on the program for European rehabilitation. He was also told that the Bureau is putting forth every effort to see that more irrigation water is made available in the next few years so that additional food may be produced when it is so badly needed.

His questions as to the W. C. Austin project (formerly the Altus project) in Oklahoma were answered, to some extent, from preliminary information for 1947. Crops had not been completely harvested, but a complete report was expected by January as to the results of irrigation during 1947, and as the ERA goes to press these data were being sent to him. Replies to his questions were as follows:

1. There were 3,686 acres in cultivation during 1947 which received an irrigation water supply. Of this area, 2,209 acres were planted in cotton.

2. The total gross value of the crops raised on the above acreage in 1947 is now estimated as $410,695, or an average of $111.42 per acre. This contrasts with a return of $27.46 per acre for crops grown on the project lands which were not irrigated. Of the total irrigated crop value, $312,362 was the value of the cotton; $67,206 for alfalfa hay; $30,166 for grains; and the remainder in miscellaneous crops.

3. No power development is contemplated on this project because of the low head available and lack of water regulation below the reservoir to coordinate the erratic irrigation demand of the project with power requirements.

4. There are 505 farms on the project and the population on these farms is approximately 650. The 5 towns on the project have a combined population of 12,950.

We are glad that Mr. McNicol had the opportunity to visit so many of the Western States and hope that he will return to see the rest of them.—Ed.

Greetings From Greece

4 Churchill Street, Athens, Greece.

DEAR EDITOR: Well, I've been on the job 3 months and haven't got a story for you yet, but so help me I will yet.

Thanks for the ERA; it is arriving every month, is dutifully read and passed on. Congratulations on it. It is getting better all the time.

At present, I am in the Corps of Engineers as a consultant on loan from the State Department.

The work is very interesting and I have never regretted for a moment that I came. The training in the United States Bureau of Reclamation was far more than I needed for the job, so I'm really enjoying the assignment.

Regards to all the gang and to all a Merry Christmas and Happy New Year.

ED CORFITZEN.

Eulogy From Egypt

EGYPTIAN ROYAL SOCIETY OF ENGINEERS,
Cairo, Egypt, October 22, 1947.

DEAR EDITOR: This acknowledges with thanks receipt of the September number of ERA. The features embodied in the number make very interesting reading and in particular Sawyer's article on Sprinkler Irrigation in the Willamette Valley. You might be interested to know that I am an irrigation engineer who had considerable experience in Egyptian irrigation, and naturally the article attracted my attention and interest.

Thanking you once more for your kindness, I remain,

MICHEL BALADI,
Associate Member,
Egyptian Royal Society of Engineers.

Errata note on Gila opening

The closing date for simultaneous filing of homestead applications specified as March 29, 1948, in the January issue of the ERA has been changed to March 30, 1948.

Chapman Addresses Kansas Engineering Society

Oscar L. Chapman, Under Secretary of the Interior, was the principal speaker at the annual meeting of the Kansas Engineering Society held in Topeka, Kans., on January 23. The theme of Secretary Chapman's talk was the Missouri Basin development program and its effect and benefits on those living in the basin area.

____
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Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

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Why Our Conservation Program Must Work

by Oscar L. Chapman, *Under Secretary of the Interior*

WITH THE HUMAN RACE facing its greatest period of trial in modern history, the part which wise use of natural resources probably will play in national survival is coming into the spotlight. Manpower, food, minerals, fuel and electrical energy, every form of raw material, have become of enormous importance for the rebuilding of a damaged European civilization, and for our own survival.

Today this Nation is engaged in trying to bring about the survival of Democracy in the fatherlands from which the people who comprise this Nation came. But we shall be of little aid to the world unless we maintain an economy approaching full production. If we allow ourselves to slip into another depression, if we allow the purchasing power of the lower and middle income groups to be any more seriously impaired by inflation than it is today, if we allow our ideas of political freedom to be paralyzed by a fear that our own democracy is not strong and healthy enough to withstand without special props the impact of foreign ideologies, we may find ourselves slipping into a way of life that could be extremely unpleasant.

Of one thing we can be certain—the world's need for all forms of energy-producing materials, both foods and fuels, and almost every kind of industrial raw material will continue to be very great for a number of years. Only if we save ourselves by preserving our economic health can we hope to save others.

There are three outstanding reasons why the world requires so much more food and raw materials than ever before.

Despite the decimation of war, modern medical and engineering science have made a greater population possible than ever before, and the number of people in the world continues to increase rapidly. Even our own population, which seemed a few years ago to have been approaching an upper limit, has taken a new spurt, and will continue to expand for more years than we at first anticipated.

Secondly, the rapidly advancing technological command which man is attaining over the material universe makes it possible to use a much greater variety of materials in processing and manufacturing, so that we use more types of material, and in larger quantities. A spectacular example is the processing of fissionable material which produces atomic energy. Also, a rapidly changing technology means a more rapid replacement of productive equipment than formerly.

And most important of all, during the war we increased the material standards of living of the lower income groups so that they eat food that is more nourishing and more of it, wear better clothing than ever before and hope some day to live in better houses.

For all of these reasons we require more food—more iron, copper, zinc, tin and other metals—more fuel and electrical energy, than at any time in our history. And yet our supplies of some of these materials are becoming exhausted or extremely tenuous.

Let us consider one resource alone—agricultural land. The Secretary of Agriculture recently testified before the House Committee on Agriculture that, even allowing for a continuation in the march of technology with intensified fertilization, adoption of improved varieties, and other improvements, this country would require more than 415 million acres of crop land. This compares with 408 million acres under cultivation last year and an average of 406 million before the war.

This also envisages checking the loss of soil through erosion and depletion by the adoption of modern soil conservation methods—a situation which some agricultural economists tell us will require 50 years on eastern farms alone, before annual soil gains begin to equal annual soil losses.

A recent study made by the Bureau of Agricultural Economics showed that the West more and more will absorb the food it grows; and that the East must depend more and more upon the regions east of the Rocky Mountains for its supply of beef and lamb.

Other studies indicate in only a few years this country will be consuming more food than it produces, and must depend upon imports.

Thus, it is tremendously important to our national future that every foot of good agricultural soil be preserved, and improved with use if possible.

We could go on to explain the problems which the country faces in conservation of oil, gas, and coal—in the conservation of iron ores, copper, zinc, lead, many other metals, phosphates, and other nonmetallic minerals. Most of you already are familiar with the need for conservation of grazing lands and the preservation of fish in our western rivers.

But we cannot stress too much the necessity for preserving and prolonging the life of Reclamation projects, so that they will serve posterity for as long as possible. This is an enormously vital task. That is the Bureau of Reclamation's share of the Department's program. (See page 8, January 1947 Reclamation Era.)

The Department of the Interior is not the only agency concerned with conservation of national resources. Anything which tends to make men, women, families, communities healthier, happier and more effective is conservation—conservation of human resources. Health and housing programs, in a way, are conservation programs. And in an important way the development of recreational areas in the West is a program for physical and mental health.

The soil conservation program of the Department of Agriculture is enormously important. But the Bureau of Reclamation's program for the prepetuation of the projects it builds is important also.

In 45 years we have spent about a billion dollars on Reclamation projects. Projects now under construction will cost at least that much again. And the long-range program envisages the expenditure of many more billions.

In planning these projects we would be neglectful of our duties and short-sighted in the highest degree if we were to plan only for the span of our lives—or even for another generation ahead. The duration of these projects probably can be extended two and three times what appears to be their present life expectancy, if we attack the problem of erosion by reforestation of our watershed hillsides, revegetation of the cover of our vast grazing lands, and preservation everywhere of the good soil that washes into our streams.

If we are to do this job as we should, however, we cannot afford to accept any short-term viewpoint. We may feel justified in destroying communities with bombs in time of war, but to build communities up in times of peace only to permit them to decay within a generation or two is neither good sense nor humane. We should make the resources which have been entrusted to us last as long as we possibly can.

Minus animal power, and with manpower depleted, the women of China must work the rice paddies to survive. *Photo courtesy of UNRRA.*

IMPRESSIONS OF CHINA

by Constantin P. Christopoulos

Conservancy Advisor for North China and Manchuria, United Nations' Relief and Rehabilitation Administration

When I was asked to write for the Reclamation Era and its farmer-readers something about my recent experiences with China and her farmers, I might say the anxiety of the editors for having the American farmers well informed and possibly entertained, impressed, or better say moved, me much.

Having myself farmed and having been in close touch with farmers in several countries all my life, I have not even the least doubt that farmers everywhere form the best and the most stable foundation of the human community. From the farmer all other social classes originate and soon degenerate. The farmer, away from the turmoil and the corruption of the big city, keeps healthy physically, mentally, and morally. He emanates his eternal health to all society.

The editors of the Reclamation Era are right. The farmer becomes a much more influential factor in the human community as he is kept well informed and decently entertained.

In these few lines I would like to be more entertaining to my farmer friends of the West and less of a lecturer or even an engineer.

People everywhere upon our earth are basically the same. Everywhere they have fundamentally the same human nature and the same good and bad motives in life. However, above this common basis people branch off and develop in a different way in each country. The people of each country develop their own common characteristics, different from those of other nations, according to their origin, to the nature of their country, its geographic position, its history. All these four factors have an overwhelming bearing upon the physical, the mental and the moral attitude of their inhabitants. Obvious as these things may be, they are often ignored, or more often misunderstood, and this ignorance and misunderstanding has had some of the most lamentable effects on the peace and prosperity of the world.

China is a country essentially different in nature from the United States and has a history entirely different from that of all America and much different from other countries. Consequently, the Chinese people—probably not worse nor better qualified naturally than the people of the average nation—have developed a way of living and an outlook of life differing essentially and in many respects from those of other nations.

Over 450,000,000 people live upon an area almost equal to that of the United States, with its population of 140,000,000. Obviously there is not enough land in China to go around. The average farm area cultivated by one farmer does not exceed 5 acres, sometimes in several unfortunately located parcels, but usually of an excellent quality. The moisture in China is abundant for crops—except in North China, where features of desert are prevailing. In the southern two-thirds of China, where rains are frequent, rice is the prevailing crop and main food. In the northern one-third, where rains are scarce all the year around except July and August, the prevailing crops and main foods are wheat, kaoliang, millet, and soybeans.

Animals in China are rare. People cannot afford to feed them, and they themselves eat the grains, use the hay as housing material and fuel, and do almost all the work which is done by animals in other countries.

The scarcity of land has pushed the Chinese farmers to cultivate their lands with their own hands and with the utmost care. I understand that Americans like to believe that they excel in everything. But I have enough respect for my readers to be able to tell them that from my impressions the Chinese farmers, most skillful and laborious, are probably the best in the world as far as cultivation and productivity of land are concerned, regardless of cost and profit. They do not consider the cost of human labor. They have an over-excess of it.

They have developed elaborate and interesting technics and tools for cultivating in mathematical straight-lines the strips of their land, and for draining or irrigating them, all by hand.

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THE AUTHOR, Mr. Christopoulos, is well-known to the readers the RECLAMATION ERA for his article "Old and New World" wh appeared in the December 1936 issue. At that time he had c cluded a year's residence in the U. S. A., had made a study the Bureau of Reclamation and toured the reclamation proje in this country. Professor of the University of Thessaloniki, Sal iki, Greece, civil engineer, and former Chief Engineer for reclar tion works in southern Greece, he was also a Rockefeller Fell for the Study of Engineering in the United States in 1936. Hav recently returned from North China, Mr. Christopoulos is in enviable position of being well-acquainted with irrigation in th countries—Greece, a nation of revered antiquity, the United Sta a relative newcomer in the world scene, and China, one of the m ancient of civilizations.

Here, he is shown holding the plaque presented to him by North China Conservancy Bureau. It bears the inscription " Professor Constantin P. Christopoulos IN APPRECIATION HIS INVALUABLE SERVICE, October 1, 1947."

The scarcity of land has pushed them to other extremes, too. They take the utmost care to utilize for their crops every possible type of fertilizer including human (called "night soil") and animal. This is why shallow ground waters have been polluted; no one dares drink unboiled water, and few dare eat raw salad in China.

Regarding irrigation, it is extensively practiced for raising rice mainly in "wet" China, where extensive canal systems provide water, which is then elevated to the land surface mostly by manual power with some very crude and some very ingenious devices. In "dry" China, north of 34° north parallel, little irrigation is practiced owing to the lack of provision for it, according to my observations.

The United Nation's Relief and Rehabilitation Administration (UNRRA) under the inspirational leadership of a brilliant American, Harlan Cleveland, besides assisting in the flood control and reclamation of millions of acres, has even more essentially caused the vital question of irrigation to be squarely faced in North China. It has helped conduct research work, and established principles of economics and engineering, for an over-all water plan in the northern one-third of China Proper, covering an area of about 650,000 square miles and populated by nearly 100,000,000 people, almost entirely farm families. By irrigation, flood control, and drainage, ultimately an increase of land production is contemplated up to two or three times the present yearly average.

Furthermore, UNRRA contributed substantially toward the construction of the first high dam to be started in that area. This project, the Kuan-Ting Dam, of concrete, gravity type, nearly 150 feet high, on the Yung-Ting Ho (Ever-Stable) River near and to the northwest of the former imperial capital, Peiping, was originally planned for flood control, but at the advice of UNRRA it will be eventually turned into a multiple-purpose project on the basis of the aforementioned principles aimed chiefly at utilizing the flood waters for irrigation.

Irrigation is the primary means available for promoting the well-being of the farmer especially in North China, where the climate, besides being dry, is too cold for more than one crop yearly. In Central China (the Yangtze River Basin) two crops a year are the rule and more southwardly three crops are not unusual.

China is known as the country where famine often occurs. Lack of communications and isolation of villages are secondary causes of this inhuman circumstance, which is mainly due to floods and droughts in both the "wet" (rice) and the "dry" (wheat) regions.

Irrigation works, flood control, and drainage systems are of paramount importance for all of China. Without them the Chinese farmer will continue to be the victim of nature's adversities and live a life at the bare subsistence level.

Whether we like it or not, we are all human beings and live in the same one and physically indivisible world. The fate of our fellow men and cohabitants of this globe sooner or later, in some way or another, will affect our own life in our own homes. Care for the well-being of all men on earth is the moral duty and to the material interests of everyone. It is most regrettable that this plain truth escapes the attention of many people even in our age of the flying boat and atomic energy.

Helping China and other overpopulated and under-developed countries to take full advantage of their own natural resources and stand on their own feet is the duty of and to the interest of all. China at least has a tremendous amount of latent natural resources: abundant waters, enormous coal deposits, rich and widespread mineral ores. All that she needs badly is peace, the spark for improving social conditions, and a plan for the development of her economy.

The cultural side of the Chinese farmer's life is not less interesting to the farmers of other countries and especially of America. China is the cradle of all Eastern civilization. What Greece is for the West, China is for the Orient.

It is well known that our weste zation is distinguished first for tha rational thinking and reasoning called Science; second for that wa erning the community that has bee from the Roman law; and third moral attitude that is known as religion. All these three influen our everyday life originate chiefly idealistic and none-the-less ration mind and philosophy. Most pro of the leading thinkers of our da cently written that all so-called w are Children of Greece.

Similarly one might say that all orientals are "children of Chi course the oriental civilization is e different from that of the wester In fact, the Orient has not devel science by itself; but it has devel arts of its own, entirely different fr of the West, and a number of and practical philosophies of l more or less materialistic and supe

But this is neither the proper the right time to discuss such What should be said here is that b ern and eastern civilizations and must inevitably develop one wor losophy of life common to all or—and the answer to that you know.

Unlike the goddess Athene wh from the head of Zeus, neither th nor the eastern civilization an sprang up spontaneously and sudde certain privileged minds. On the any civilization and culture has g grown up from seeds deep-seate souls and minds of people living touch with nature, that is to say, ers. From such seeds grew grad epics of Homer, the Greek Mytho ligion, Art, and Philosophy. F seeds in the souls and minds of th farmers grew the Chinese pract losophy of life that was later exp Confucius in his Classics, where. fying the social classes, this eas losopher put first the scholars and rs, and then the other professions, the last ne being the military.

What is still more interesting is that the eeper a civilization and culture has its oots in the souls of the farmers, the longer survives. The students of ancient birth-laces of the western and the eastern cul-ures will find roots of them alive in the olklore and everyday life of the Greek and he Chinese farmers respectively. Genuine nd noble civilizations and cultures are robably expressed in big cities, but they re certainly created and preserved by the armers who stick to their lands and pros-er. No one has more right to raise his oice and govern this earth than the farmers f the world.

Regarding the Chinese folklore, it is nore superstitious and artistic than philo-ophical and idealistic. But what mainly listinguishes the spiritual life of the Chinese armer is his profound attachment to his wn farm, where generations after genera-ions have been buried in graves which are acred and immutable and sometimes cover ver 5 percent of the arable land.

Equally cardinal features of the spiritual ife of the Chinese farmer are his respect or his elders, the scholars, and the criticism of the community; but more than anything else characteristic of the Chinese is his unlimited devotion to his family and his ancestor worship. His family is his only world for the Chinese farmer who has very little, if any, social life.

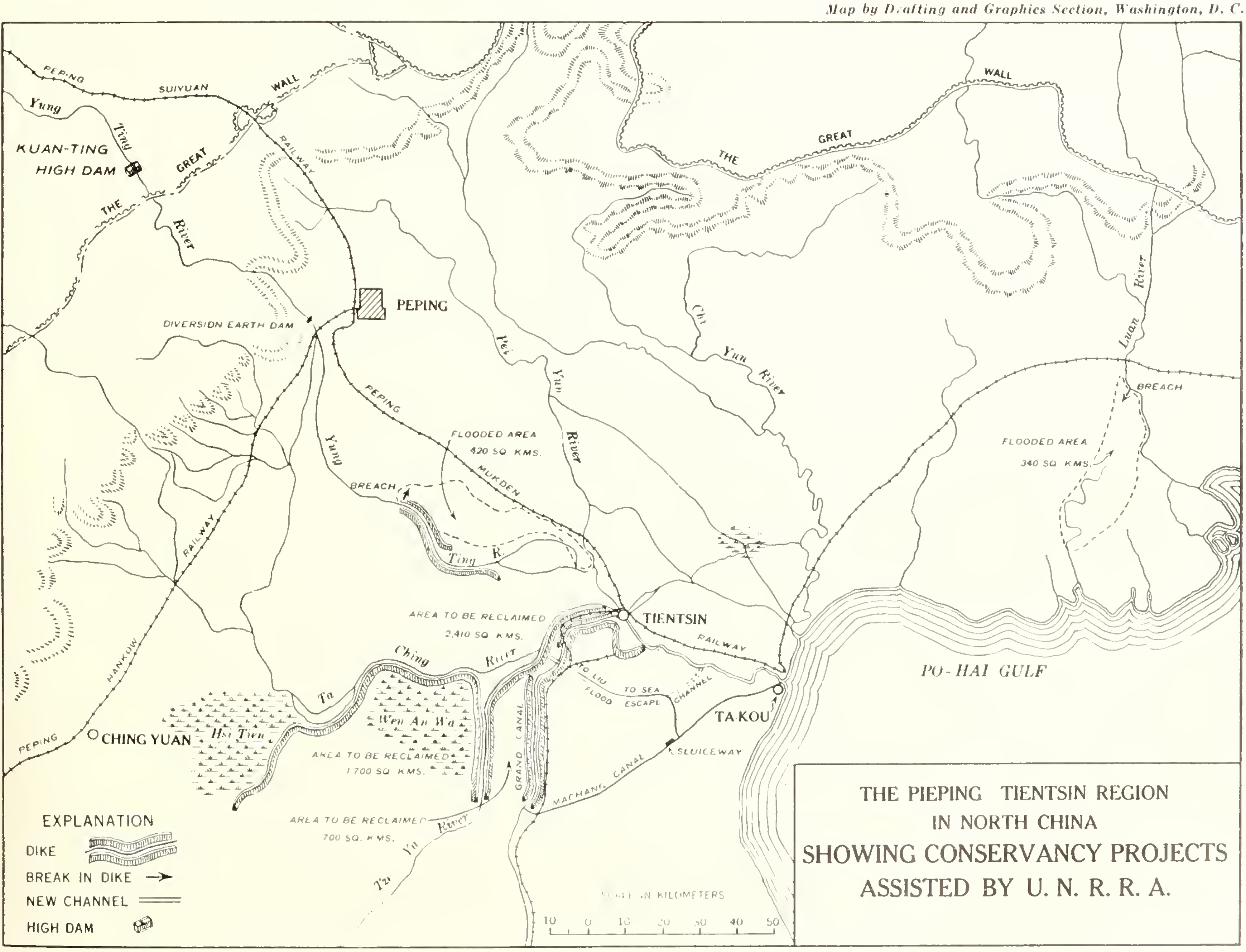
The best of these cultural traditions of the Chinese farmer through innumerable generations upon the same piece of land account for the preservation of this people through milleniums and innumerable adversities of history, and for the growth of the country to the largest nation of the world.

With such a nature and economy, so long a history and such deep-seated traditions, it is quite natural for the western visitor to China to find there things he likes and things he dislikes, some that should be changed and some that should be preserved. However, the unprejudiced visitor will soon become aware of the genuine democratic spirit and the sense of dignity and self-respect of the Chinese, even in the lower class, the "coolies."

When in such a country and nation, a westerner approaches the people with the preconception that he himself is by nature superior, that all that he sees there is bad, merely because it is different from what he is used to seeing in his own country; that all the real evil in that country is due to the defects of the people, and that all the real good in his own country is to be attributed to his own superior nature, this man, sooner or later, will become antipathetic, even if he goes there with the best intentions and with relief gifts. In the long run he may become hated by the beneficiaries of his relief gifts; especially in China where westerners have repeatedly mistreated the Chinese and approached them mostly with selfish intentions.

To this mental attitude, generally speaking, many of the evils in this world of ours are basically due. As long as we imitate the Nazis of the "Superior race," we shall continue to be unable to understand the reasons underlying the differences in the outlooks between the various nations, the reasons for the evil in other countries and the good in our own country. We shall continue to be unable to understand and help each other, unable to live in peace with each other and enjoy the beauties and blessings with which God has covered this mother earth of ours, and, first of all, mother earth of all farmers in the world. ●

Map by Drafting and Graphics Section, Washington, D. C.



THE PIEPING TIENTSIN REGION
IN NORTH CHINA
SHOWING CONSERVANCY PROJECTS
ASSISTED BY U. N. R. R. A.

How to Conserve Irrigation Water Supplies (Part Two)

By L. R. Fiock

Supt. Rio Grande Project
N. Mex.-Texas, Reg. V

Editor's Note: In last month's issue, Mr. Fiock outlined four major steps required to achieve maximum use of the water supply for ultimate crop production: (1) storage and release to meet irrigation requirements, (2) diversion of storage release or natural stream flow, (3) operation of the distribution system, and (4) delivery of water to farms. He completes his discussion in the following article.

Preparation of Land for Irrigation

Proper land preparation for irrigation depends upon topography, type of soil, kind of crop to be grown and method of irrigation. Whether the irrigation method be surface flooding, bordered tables, beds, furrows or corrugations, the most conservative and efficient use of water requires a fine balance between type of soil, slope of land, length of runs, and head of water applied.

If the soil is sandy or light and the slope too flat, the runs too long, or the head of water too small, the upper end of the field will be over-irrigated before the lower end has received sufficient water. Excess water absorbed at the upper end constitutes waste and may result in a rising water table.

Where the soil is adobe or heavy and the slope too steep, the runs too short or the head too large, the lower end of the field will be flooded before the upper end has absorbed enough moisture. This again constitutes water waste and may result in drowned crops at the lower end and a rising water table.

Each farmer must, by trial and test, gain knowledge about his soil, slope of land, length of runs, and head of water to achieve the right combination of land preparation for successful operation. Little, if anything, can be done about soil types. Desired slope can be achieved by land levelling if the cost is not too great. Length of runs usually can be established to match conditions, but the irrigation heads or size of streams turned into each table or furrow should always be regulated, adjusted, and fitted to other conditions, thus effecting a proper balance.

Land should be levelled to a uniformly smooth plane surface. The proper slope of irrigation furrows depends on the type of soil and length of run. Depressions which impound water become over-irrigated and may injure the crop as well as raise the water table. High spots will receive insufficient water. Water run on surrounding land, long enough to reach high spots, over-irrigates the lower parts of the soil. Such conditions result in waste.

Use of Water on Land To Produce Crops

The basis for ownership and retention of a water right is beneficial use of the water. Consequently, it is to the interest of the property owner, whether he is a resident farmer or conducts his farming operations through a manager, foreman or tenant, to apply every known principle for maximum conservation and beneficial use of the water supply.

The most conservative use of the available water supply is that which results in maximum crop yields. However, this does not imply excessive use of water to produce the highest possible yield per acre. In the application of irrigation water, a point is reached where the increase in yield is not in proportion to the additional water applied.

Each farmer must observe and study conditions and requirements and crops to be produced on his own place and then regulate his operations according to his knowledge and understanding of his peculiar problems. He may obtain help and advice from technical and agricultural agencies, but withal, he must adapt the general theories and principles to his own particular conditions.

Experiments on test plots, with complete records of irrigations and yields, will aid in determining methods that create optimum results.

There are no set rules that can be applied universally without judicious adaptation and variation, if necessary, to fit the immediate conditions and requirements.

Soil moisture and crop needs should be studied carefully at all times and irrigations regulated accordingly. This is essential to effect the proper combination of soil type, slope of land, length of run and head of water and also to give the crop just enough water to meet its requirements without a deficiency or excess and waste. This rule is especially important during and immediately following light showers, when assumed soil moisture conditions are often misleading. Project personnel must guard against crop damage from this cause, which in turn may bring forth an accumulation of orders that result in a peak demand on the system, often beyond its capacity to serve in a resonable time. Depth of soil saturation by irrigation or rain should be determined by using a probe rod or shovel to the depth of the root zone. Although a limited portion of the applied water must percolate through the soil to prevent accumulation of alkali salts on the surface, farmers must resist over-irrigation.

A rising water table, high water delivery charges, and water waste are companion evils of excess irrigation.

Where sufficient water is available, its application should be limited to an amount necessary to keep the crop in continuous healthy growth. Irrigators, especially those in the Rio Grande Valley, should not wait until the crop is suffering and then demand or expect immediate relief by delivery of water on short notice. Such a practice disrupts normal irrigation schedules and, if commonly practiced, leads to peak demands which cannot be relieved. There is then no alternative except to deliver regular irrigation heads on a rotation schedule or by deliveries, as near as possible, in the sequence in which orders are received. Careful observation of soil moisture conditions permits anticipation of water needs sufficiently in advance to allow storage releases on the basis of consolidated orders.

Delayed orders, whether due to a lack of accurate information on soil moisture conditions and crop requirements or postponement or cancellation of orders during periods of light rain showers, when soil conditions may be misleading, result in the loss of water released from storage to meet anticipated requirements. Water cannot be made available when needed and then used only as desired without waste, intermittent service, and disrupted operations.

Proper cultivation of plants during the early stages of their growth not only controls weeds but conserves moisture.

Plants should be forced to develop a deep root system during the early part of the growing season. This can be accomplished by avoiding over-irrigation. Too much water on young plants tends to develop a shallow root system which in turn requires frequent irrigation throughout the growing season. Properly developed root systems require less water, produce superior plants of better quality and give greater yields.

Ditches, gates, and boxes should be sufficiently large to handle maximum flows, and they should be kept clean. As a general rule, irrigations should begin at the far end of the field to avoid waste of a full ditch of water after the application has been completed. If the headgate is distant from the field, it should be closed soon enough to finish the irrigation without wasting a full ditch of water.

Irrigation abuses are often the fault of employed irrigators, especially if they are inexperienced. Farmers cannot expect best results unless their employees are properly supervised and required to use approved irrigation practices.

Crop and irrigation programs of individual operators, particularly for specialized and minor uses, should be adjusted to schedules established to meet major requirements. Adherence to such schedules is particularly important for fall and winter irrigations, when water runs are intermit-

(Continued on page 29)

British War Bride in the Wilderness

A boyhood ambition was realized, and a wartime dream came true, when Pat Ford became the caretaker at Bumping Lake and gave his wife, Doris, the "quiet home in the country" he had promised.

by Stanley Rasmussen,
Chief Photographer, Region I, Boise, Idaho

Photographs by the author

Doris Ford proudly raises Old Glory and anxiously looks forward to the day when it will be her flag, too.→

FOR the second time since coming to America from her home in Surrey, England, British war bride Doris Ford has gone into seclusion at Bumping Lake Reservoir of the Yakima Reclamation project, situated high in the Cascade Mountains of central Washington. Until spring she will see no one except her husband, Pat, and their 6-month-old son, Billy. Since the first heavy snow in November, Doris has been forced to restrict her activities to her home and the immediate area surrounding it. Until she learns more about the art of skiing she will probably stray no farther from her home than the distance she can throw a snowball at the man who took her to this wholesome outdoor life.

It was probably the most natural thing in the world that husband Pat was chosen for the position as caretaker of the isolated reservoir, replacing colorful Jack Nelson, who retired after 30 years' service. (See RECLAMATION ERA, December 1946.) Pat was born and raised at Goose Prairie, 5 miles from Bumping Lake and the post office for the rugged area. As a tow-headed boy he spent many happy hours romping around the reservoir and in the surrounding mountains. He recalls that he had some of his most exciting times throwing pieces of wood into the spillway waters and watching them drift off down the mountain stream. As he grew older he hunted and fished the area.

All of this time he was subconsciously storing up information about the duties of a caretaker as he followed white-haired Jack Nelson around during his frequent visits to the lake. Even though he had a hidden ambition to live the free and open life that was Nelson's, it wasn't until he had gone overseas that he realized that it might materialize. His mother wrote him about the position which was to be vacated at Bumping, and Pat immediately submitted his application.

That application was also the concern of another person, for Pat had married Doris White, a flight sergeant in the Women's Auxiliary Air Force. His promise of a quiet home in the country was to be taken more literally than she suspected at the time. It has certainly proved to be a lot different than anything that she had known in England.

Doris had become accustomed to being away from home while in the army but yet she adhered to a pattern of living wholly English. In Surrey, a suburb of London, where she grew up, she was constantly surrounded by a lively environment. She has six brothers and sisters—always a source of great fun. In direct contrast to the quiet life that Pat had known in the mountains. Doris spent hers enjoying the ways of the big city.

When the time came for her to depart for America she claims to have experienced no qualms at the discouraging prospect of not seeing her English home and friends again for a long time. It wasn't until they were on the last lap of a pleasant trip—when the Fords alighted from the bus at Bumping Lake Junction en route to Goose Prairie—that Doris was abruptly initiated into the new life which was to confront her on a Federal Reclamation project. The 6 miles from the highway to Pat's home had to be traversed on foot, as the young couple had forgotten to inform Pat's folks of the time of their arrival, and thus no one met them at the bus. But Doris remembers that she was so intrigued by the contrast of the tall pine and fir trees to the sturdy oak and elms which were familiar to her in England, that she hardly noticed the long walk. This was the start of a rugged existence in the mountains of Washington for the attractive 24-year-old bride from the British Isles.

Pat is 23 years old—probably the youngest employee of the Bureau of Reclamation holding a position as caretaker of a reservoir. Each morning in the spring, summer, and early fall he receives word via short wave radio from the Bureau's Yakima office as to how much water is needed. He goes to the gate house and turns the wheel which governs the flow of the precious irrigation supply to the farms of the Yakima Valley. Just as vital to the efficient operation of this reservoir—one of six on the project—are the readings which he takes the year around at the weather station situated in his front yard. From these figures Weather Bureau officials predetermine how much water can be expected for Yakima's irrigated farms due to summer rains and how much storage can be expected through the winter's snowfall.

The maintenance of equipment and features of the dam keeps Pat busy for long hours during the late spring and summer months. The spillway must be tarred to prevent rotting. There are many logs and floating obstacles to be disposed of. When all of this has been done, there is a general clean-up of the reservoir to be made. Then too, he must be constantly alert against forest fires in the area. On several occasions he has notified the ranger station about fires he has spotted and then has joined them in fighting the blaze. Visitors are welcome but they bring with them the danger of fire.

When the Fords first took up their duties at Bumping Lake Reservoir they found themselves handicapped by an acute lack of transportation. What was needed was a conveyance which could serve many purposes. They wanted a vehicle which could be subjected to heavy duty and yet be used for an occasional run into town or for getting around on the rough mountain roads.

A surplus army truck seemed to be the answer but an extended search of car lots of the Yakima Valley disclosed only one on sale and it was priced at $2,100. That was definitely out of the Ford's budget range.

When it seemed that all hope for an answer to the problem had ebbed away, Pat's brother ran into their home one day with the solution. He had seen an army "duck" at a surplus sale in Yakima with a price tag of $750. One look at the massive piece of equipment was enough. They drove it home.

The "duck" serves a double purpose. It is used in the lake to pull stumps and tow obstacles. Formerly Ford had to use a small and inadequate motorboat. His present vehicle also fills the bill for transportation when the Fords find it necessary to run down to Goose Prairie for groceries and the mail. Doris derives a lot of pleasure from the strange craft, having learned to operate it when Pat took her on an occasional jaunt around the reservoir.

The 6-month isolation during the first winter made a change in Doris, unbeknown to her. Friends noted she had lost most of her English accent. She had also adopted some slang expressions from Pat, such as "once in a blue moon." While Pat may have succeeded in changing Doris' diction considerably, there are some English habits with which she refused to part. The most prominent of these is her inherent desire to sip tea at 10 in the morning and in the middle of the afternoon. And she must have toast and marmalade to go with it. Pat, like the rest of the boys who served in the armed forces, has developed an aversion to marmalade, but Doris still has it as regularly

At left, Doris "doubling in brass" as she takes message from Yakima project office, even if it does inconvenience Master Billy a little. Below, she and Pat check the anemometer to determine the wind velocity, just another of the many tasks connected with the caretaker's job.

as "Big Ben." She did try iced tea but says "I wouldn't give you a 'thank you' for it." She still wants hers hot, with milk, not cream, and with sugar.

The long winter provides Doris with a chance to try a recreation entirely new to her—skiing. She made several attempts at it during the snow season of 1946 but admits they were not successful. Taking short walks around the area on snow shoes had more appeal for her because she "found it not so difficult to stand up on them."

But outdoor sports are just one form of diversion which the Fords resort to in their search for amusement during the long winter days. Playing "monopoly" is another. Neither of them will claim the Bumping Lake championship but Pat was challenging no beginner when he played Doris. Monopoly is played extensively in England. Besides this unending game, the Fords can turn to a library of several hundred books in their living room. Woodworking is a pastime for Pat. Last winter he turned eight table lamps on his wood lathe from pieces of fir which he had seasoned. He sold the lamps to a nearby riding lodge in the spring when he could once again drive out to civilization.

Being cooped up for 6 months and finding an interesting diversion for all those idle moments is a test for anyone's ingenuity, but Doris claims, "I didn't mind it at all." Of course, since the arrival of Master Billy, the problem of what to do with leisure time has been much less acute! She does confess that during the long winter nights when she is sitting in front of a hot blazing fire in the huge fireplace, which resembles those found in English homes, she thinks too frequently of her folks back in England and the hardships which they are facing. Doris periodically sends a box of foodstuffs and clothing to her people.

Last summer much of Doris' time was spent in stocking the pantry shelves with a variety of foodstuffs to last them through the winter. The Fords made several trips to Yakima and loaded up on canned goods. This was something which Mrs. Ford really enjoyed, for she had spent many a fatiguing hour standing in queues in her home town. But the variety of the items which she was able to purchase posed a problem for her. There were a lot of cans about which she had never heard. This meant she had to learn all about American cooking and eating habits. She was lucky in this respect, however, for she had Pat in a spot where he had to take it or leave it.

Home canning was something else of which she knew nothing. Pat brought her some of the famous Yakima peaches and apricots and helped her preserve them. This venture was apparently successful for she said, "I was afraid that we wouldn't have any fruits left for winter the way that Pat devoured them."

When spring comes again to the Bumping Lake area and the Fords both can once more travel the now impassable road from the lake to Goose Prairie they will climb into their "duck" and take a week end to look up the friends whom they will not have seen for 6 months.

Most important of all, Doris will go to Yakima and make application for naturalization papers. She is now spending endless hours studying the history and constitution of the United States, so she can become a full-fledged citizen.

And when that happens she and Pat each morning will, more proudly than ever, raise the American flag to the tall pole in the front yard of their wilderness home in the West. ●

How to Conserve Irrigation Water

(Continued from page 26)

tent. Operation of the system for special deliveries to limited and scattered acreage is extremely expensive and wasteful. It also interferes with necessary maintenance work because there are certain nonirrigation periods when water must be out of the canals to accomplish necessary repairs.

Irrigation farmers should not gamble with irrigation water, especially when the supply is limited. The gain, if any, is not worth the risk. Preseason planting to attempt to force the growing season results too often in replanting and stunted growth. This, in turn, adds extra seed and farm operation costs, in addition to consequent loss of the stored irrigation supply. Crops planted in season, when germination and continued growth are assured, will usually outproduce those planted prematurely. ●

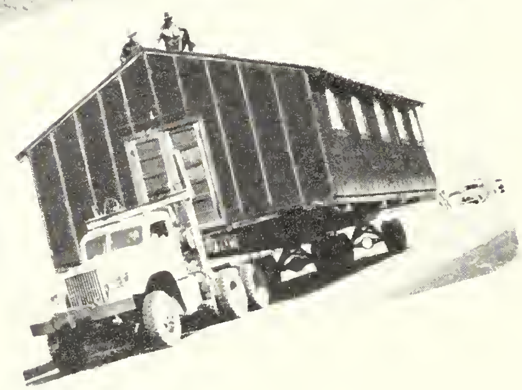
Army "duck" provides Pat and Doris with ideal transportation for this rugged country—being serviceable on both land and sea.

Golden Harve

**Tule Lake homesteaders, tak
lifetime opportunity, plus a ha
fect timing, ideal locality, and
dented and perhaps never-to-l
eff**

by A. D. Harvey a

Region II, Sac



Above, left corner—Harry H. Hundley home; extreme left, Mrs. Hundley helps Harry with lighting fixture; directly above, "house on wheels" barracks en route to new homesite; below left, Mrs. Hulse in her new kitchen; directly below, Frank Sullivan enjoying a repast.

If you were, like most of us who had to take American Literature in the late 1920's, fed an exclusive diet of Sinclair Lewis, Knut Hamsun, and Hamlin Garland until you almost cultivated a taste for their leaden epics of Life. Thwarted by the Rigors and Disappointments of Wrestling with Farm Problems on the Dour Midwestern Prairie, you are apt to regard this chronicle of the first crop-year among the 1946 Tule Lake homesteaders with faint disdain.

It definitely lacks "class"—that monumental quality evoked by the lurking presence of Fate near the family hearth, quiet, unobtrusive, but forever watchfully waiting, ready to flop her wet blanket and douse the tiniest glow from the embers of youth and hope.

For one thing, nature was particularly kind. A June frost looked bad, but the crops came through all right. The market was unusually favorable—even better than 1946. It was up to the levels of 1945, in fact, with barley bringing $5 a hundredweight. Credit was easy and ample and cheap. The long shadow of the banker, coming to grab the crop and tools, never darkened a single doorstep.

Fate was, thanks be, indifferent. And Fortune, which gave farms to the 86 homesteaders last Christmas, beamed down on them rather steadily all year.

There's little of the epic about the story of the year 1947 in the Klamath country. But if you're a normal, optimistic American who likes to see people happy and sucessful rather than bloody but unbowed; if you believe that money to spend is good stuff; if you quip naturally, "Well, Columbus took a chance"; then the adventures of the lucky 86 who got farms for Christmas presents last year will interest you. *You may even see it as a story of pioneering: for if half the pioneering spirit is willingness to endure hardships, the other and bigger half is willingness to gamble on a long shot.*

For that's the way it turned out at Tule Lake this year. Everybody was fairly happy, but those of the veterans who took the biggest chances were happiest.

Because of an inevitably late start, most of the veterans felt that the best way to assure the success of the first year on their farms was to lease their land to experienced operators at relatively high prices, and then by working with them, learn how the land ought to be farmed. Meanwhile, they could work on the two barracks each from the old WRA center which were allotted for hous-

at Klamath

vantage of a once-in-a-
peat combination of per-
rices, reap an unprece-
icated reward for their

n Cassmore

, Calif.

ear them down for lumber to build ment houses, or reconvert them into looking shelter via siding and picture ows. Early in the year you heard so about this type of planning that you ht the whole area might be leased out. sudden wave of optimism seemed to over the newcomers at planting time. inal result was that only 10 home- rs leased out all of their land. Only ised out any of it. Sixty farmed it all elves.

imism was justified. Last Novem- omesteader James Stearns said, "I fig- the best thing to do was to play it lease my land, work out: get the ngs torn down and ready to build a next year. To my sorrow, I won't again." Here are the crop returns the 7,500 homesteaded acres that d his chagrin.

ose who leased out averaged a gross 5, and after deducting $500 for water other charges, netted approximately 5.

rest of the homesteaders—those who ted all their land or operated most and leased some out—averaged a income of about $10,150. As nearly sts and production figures can be ad- , their net return—over and above ction and maintenance costs—was a over $6,000.

ese were incomes from the homesteads In addition, most of the settlers to have paid for groceries between ime and harvest by using the GI bill hts' provision which allows veterans siness or on farms to draw the differ- between their incomes and $100 a n. Also, many worked off their at some time—on other farms, in otato sheds, as carpenters, or at other

ew incomes soared far above the gen- verage. Some homesteaders success- oid on project lease lands—lands not fficiently reclaimed and developed to for homesteading which are leased r grain farming until they are ready. ncome from the lessees goes into t funds and the leveling and draining lo reduces construction costs. Seven s who won out on the bidding for lands last spring added a gross of) and a net of perhaps $4,000 apiece ir year's earnings.

cking individual homesteaders, we that the above estimates from in-

John S. Wynn, above. At right—Klamath homes: (1) George A. Douglass, Jr.; (2) Shirley A. Congdon; (3) Paul E. Christie; (4) Walter M. Hulse; (5) Robert G. Stoerbeck's machinery shed (6) Walter E. Johnson's barn and machinery shed, and (7) James G. Stearns' home.

complete crop returns, couldn't be too far wrong.

We found long, lean Jack Mace, once a gunnery officer aboard a destroyer in the Pacific, scrambling with a sailor's nimbleness up and down the sides of a pile of baled alfalfa hay that looked a city block long and five stories high. He shouted down to us that this was part of 500 tons he had taken off some 110 acres (he has one of the larger farms on the sod lands near the edge of the homestead area) and that most of it had brought about $25 a ton. Next year and the year after he "intends to do some better" by putting the land into barley and then leveling it completely enough to handle anything.

Mace reported that neighbor Bill Crawford, Signal Corps ETO veteran, had already taken 18 tons of seed off 93 acres of clover that were growing when he got the place. The price was reported as 40 cents a pound (that amounts to a total return of $14,400) and the crop had not yet been completely harvested. Crawford also had 16 acres of barley.

It was some satisfaction to an old GI to find the ex-Colonel Irvings living in a barracks just like anyone else. John Irving was not at home. But his wife, as we took her picture reading a copy of *The Reserve Officer* by the picture window that looked out on the lovely view of the peninsula you see at the bottom of page 32, told us the story of their year's operations. Being mellow enough by now not to wish even the brass any hard luck, we were glad to note that they had taken better than 1,700 sacks of barley off 74 acres. They're going into clover next year.

We approached the Bolesta farmstead with some trepidation. The Bolestas had to succeed. *To begin with, it was ex-Wave*

1

2

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4

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Eleanor Jane Bolesta (see November 1947 ERA cover) *who won the farm. She is undoubtedly the only woman veteran homesteader in history* (unless George Washington gave Molly Pitcher a land grant). *Husband Charles Bolesta is a fine looking ex-Marine, invalided out of the service after being badly shot up about the legs on Guam. He was born and raised in a big city and never saw a farm until he met and fell in love with farmer's daughter Eleanor while he was doing guard duty on Whidby Island, Wash., before he went overseas.*

Well, we were more than satisfied. Charles Bolesta was looking fine, although the strain of farm work on his legs had laid him up for 6 weeks during the summer. He was feeling fine, too. "Got about 2,000 sacks of barley off 104 dry-farmed acres," he bragged. "Seven acres of clover seed to come in yet. Got 28 sacks off land that I plowed, 18–22 sacks off that I just tilled. I think I'll make a farmer yet." He probably will. While we were there a couple of

Top left, Jack C. Mace on the "house of hay;" immediately under is a field of barley and to the right the sacked product; above at left, Lee S. McMullen; at right, Big Jim Bell, the happy homesteader; immediate right is George A. Douglass, Jr., and little Edie; below, The Peninsula.

farm-bred neighbors, who had been generous with advice earlier in the year, were asking him questions: Lee McMullen, local Production Credit chief, talks about the Bolestas:

LEE: "I am very proud of them."

US: "Yes, they did real well—and he isn't even a farmer."

LEE: "I beg your pardon—he IS a farmer."

The John Wynns were in the upper brackets. He fought through Europe as a field artillery lieutenant, and was discharged just in time to put in an application blank for last year's opening. He leased his 74-acre place for $4,300 and went in with ex-County Agent Ernest Lindsay and Vernon McVey on a lease-land deal that had grossed the three of them $25,000 with 90 percent of the crop in. We didn't see Lindsay and McVey, but they probably did even better than Wynn. Lindsay had 83 acres of his own place in 28-sack-an-acre barley, which should have grossed him $11,000, 14 acres of potatoes for another $5,000–$8,000, depending on the type, and 2 acres of oats. McVey had 45 acres of barley and 29 of clover.

Obviously, nobody starved. Even Jim Stearns, who had gloomed to us about his fatal conservatism, analyzed his income for the year from the place as "56 acres rented at $60—$3,360; 8 in 28-sack barley—$1,120; 8 in seed rye—$945; total $5,425." He made some more running a few cattle up at his dad's place near La-Pine, Oreg.; worked out some; but drew only 2 months' checks under the GI bill.

For a first year, there has never been a homestead tract as successful as this one.

But, on the other hand, there has never been an inflation like this one, either. So when you ask wistfully, "What did the homesteaders do with all that money?" we come right back at you with "What did you do with all your dough during calendar year 1947?"

Like *you*, the homesteaders spent it, of course:

- on food, averaging better than $100 per month per family. For grub is never cheap in a new country with no competition among corner groceries and supermarkets and no time yet to put in a garden.
- on moving their barracks to the farm and making them weathertight—perhaps $1,000–$1,500 per farm.
- on gasoline, getting around the wide country.
- on home furnishings.
- on tractors and tools.

Most families ended up with not much left, needing production credit loans for their second year.

But probably the difference between them and you and me is that when they had spent their money they had something to show for it.

Everybody had a roomy, weather-tight house, many nicely finished on the outside with shingles or siding or ¾-inch plywood (see houses in the outside column on p. 31) often finished on the inside, too. Every house that we looked at, no matter what the condition of the outside or inside, had a shining new kitchen, crammed with a washing machine, mixer and all that multiplicity of bright new labor-saving devices available to the modern woman.

The sole exception to this culinary convenience and general shipshapeness was the windy, dust-ridden, unchanged barracks of Frank Sullivan, 23-year-old veteran of countless years in the back end of a B-17 over the ETO. One corner of "chez Sullivan," is shown on page 30. As we gazed around at the masculine surroundings and the new Oldsmobile in the front yard, we sneered enviously, "Why don't you marry you a wife?"

He chortled, "Sorry fellows, don't think I'm mature enough to take on such a responsibility until at least 1955."

A wife might help him settle down. He ***only*** *got 2,072 sacks of barley off 74 acres and when we saw him he was doing* ***nothing*** *but picking up potatoes on his dad's farm all day and* ***then*** *coming home to disk his own acreage to keep it from blowing away. Lee McMullen claims he's the best credit risk in the area: "We've been lending that kid money since he was leading whitefaces three times his height into 4-H shows."*

A few homesteaders have already put up permanent homes. George Douglass, Jr., built the house at the top of the opposite column. It is simply the frame of the barracks with good redwood siding; shingles over the tar paper roof and hardwood flooring over the planks; cut up a bit and rearranged. A contractor estimated $13,000 for one like it, "but not as good because the 2 by 4's in the barrack frame are better seasoned and you can't buy that kind of tar paper any more, so build it yourself." His expenditure for the home has been $1,000 for three carpenters for three weeks plus $4,000 for materials.

On page 30 you see the Harry Hundleys cleaning up the front yard of their concrete-block home and putting up an indirect light. Harry Hundley did a lot of the work himself and figures the total cost around $7,000. John Wynn is shown in the photo on page 31 laying the first courses of pumice blocks for a similar house, which will cost him about the same and which would sell for $18,000.

Were the homesteaders reckless in building right now? Farm-raised, most have acquired some skill with tools. This year was a year when you could plant a field crop and figure on having a good income and time to work on your house.

How about high prices for the other things they bought? Several had purchased $2,500 worth of new furniture and household equipment. They commented, "Sure, this is the wrong time to buy. But when the right time comes to buy, who knows whether we'll have the money to buy anything? And maybe inflation will be worse and taxes higher next year."

One said, "Farming is a way of life. Well, it ought to be a pleasant way. I figure we'll be happier and more secure-feeling and feel we have a bigger stake here if we fix things up just as nice as we can. The home is the important thing out here. It's nearly 10 miles to the bright lights of Tule Lake and 30 into Klamath Falls. Lord knows if we'll even be able to get there on these roads this winter. The sooner we make it as pleasant as possible to live on the place the better."

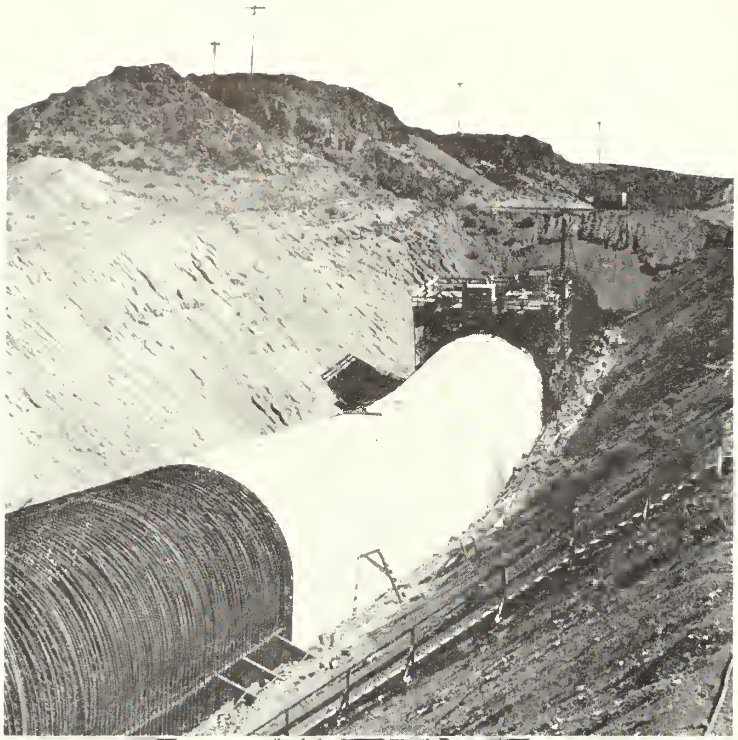
From this kind of talk; after looking at those shining kitchens and seeing how the houses are planned so their picture windows will frame the wonderful views of Mount Shasta, the Peninsula and the lower ranges which are a "no-extra-cost" feature of the project, it is clear that the new settlers realize the sober truth of the fact—brought out in every study of why people leave homesteads—that the attitude of the homesteader's wife is the one most important factor in making a go of pioneering, other things being equal.

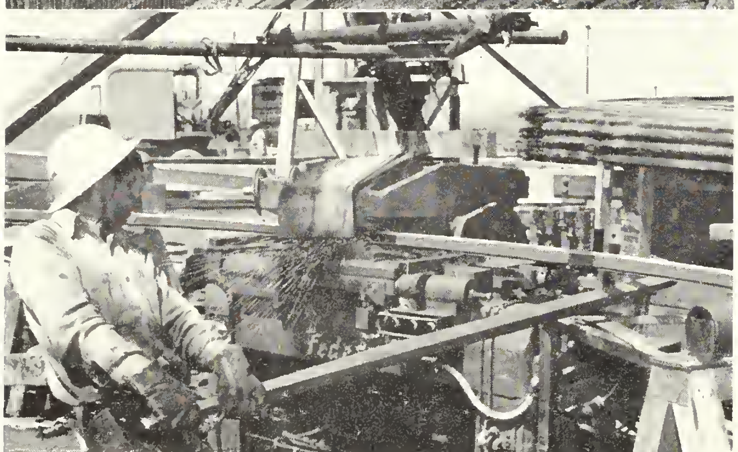
Almost undoubtedly, the "other things" that lead to homesteading success will be equal among this group. The land is good, and the people are already showing the qualities that make successful farmers. We talked about their capacities with Lee McMullen, manager of the Klamath branch of the Production Credit Association, that incredible lending agency, run by the borrowers, which extends credit at infinitesimal interest and still comes out with only a tiny fraction of 1 percent of losses. The PCA has a larger number of homesteader accounts than any other credit agency in the area. McMullen ran over $100,000 worth of loans for them, all paid, cash on the barrelhead, as soon as the crops were sold, against his own figuring that there would be a carryover on 60 percent of the loans for the first 3 years. "The PCA here is in fine shape, and these veterans aren't hurting it at all. We are very happy. Bankers are happy to lend money. But they are even happier to get it back. So the homesteaders make us very happy indeed."

While he admits that this year was kind of a freak, he says, "Even though this was an awfully good year, prices of the things the homesteaders had to buy were very high, and there were lots of things they wanted to buy. Yet the first thing they did with their money was pay their bills. They understand the value of operating on low-cost credit, but they hate debt. That is a very important indication of an attitude that will go a long way toward guaranteeing them success even in normal times, which aren't too bad up here."

Have they bought wisely? Are they overbought on shiny new equipment, which most farmers seem to like to buy for the same reason so many people like to buy shiny new cars? No, he says.

(*Continued on page 40*)





CONQUERING the COULEES

Today in the Columbia Basin project of eastern Washington, obstacles to construction are being surmounted by ingenious methods, particularly on the West Canal, where contractors have adopted unusual techniques to build the Northwest's biggest siphons.

Midway between Long Lake Dam and Soap Lake, the West Canal leaves elevation 1,320, and drops 100 feet to cross the Dry Coulees in two of the largest siphons constructed for irrigation. Designed to carry 5,100 cubic feet of water (40,000 gallons) per second, sufficient for 300,000 acres, the combined length of the Dry Coulee Siphons is 5,700 feet—more than 1 mile.

The siphons, as designed by the Bureau of Reclamation, are 25 feet in diameter, reinforced with steel. The Bureau specified that the steel must be welded firmly into rings. It also decreed that the concrete of the siphons be at least 2 feet thick.

When Winston Brothers of Los Angeles and the Utah Construction Co. of San Francisco were awarded the West Canal contract, construction engineers decided that only unusual equipment and unusual methods would solve the problem of building the Dry Coulee siphons. So they ordered special welding equipment and had reusable forms designed to carry out the job of building two gigantic concrete tubes.

The time allowed for construction dictated that the normal construction rate be one 25-foot section of siphon each 24 hours. This meant that during each working day 25 tons of steel, including 54 hoops over 80 feet in circumference and weighing 900 pounds each, had to be cut, bent, welded, and erected; the reusable steel forms had to be moved, set to exact position, and filled with 185 cubic yards of concrete. This speedy routine required special welding equipment and unique form design.

These siphons will be subjected to a maximum head of 100 feet of moving water and therefore must be unusually strong. The reinforced concrete shell has a minimum thickness of 2 feet and it requires 1 ton of reinforcing steel and $7\frac{1}{2}$ cubic yards (two truck loads) of high-quality concrete for every linear foot of siphon. Heavy reinforcement is required, and the steel bars are spaced so closely there is not room for the conventional lap splice where bar lengths are joined. Consequently, specifications called for welding without overlapping.

Steel for the hoops was available in maximum lengths of 50 feet, so each hoop required two pieces. The bars were cut to exact length by a diamond saw and then rolled into half circles in a special bending machine. The half circles were placed on a welding table with one pair of opposing ends in the welding machine. After the first weld was made, the hoop was rotated and the remaining ends welded to form the completed ring. When the crews got the "feel" of the job, they turned out from 75 to 100 of these hoops every 8 hours.

A flash welder was used to fuse the steel. In welding, the ends of the bars were clamped in jaws, leaving a gap of approximately three-eighths inch. The operator moved the jaws closer together until the electricity arced across the gap. The full force of 150 kilovolt-amperes (200 horsepower) flashed away tiny pieces of metal in a shower of hot sparks, while the energy of the arc heated the ends of the bars a dull red. The operator then closed the gap and the temperature increased until the bars were bright red for about one-half inch. The operator forced the bar

Top left, steel-ringed carcass of the Dry Coulee Siphon No. 1 awaiting eighth placement of concrete: Center, shaping reinforcing rings for siphon. Crews can turn out 75–100 hoops daily. Lower left, engineer's "House of Magic," an arch of triumph over construction problems. Nearest camera is U-shaped form. Background shows collapsible inside forms. Top and center photos by A. W. Bauman, bottom photo by H. Wayne Fuller, Region I.

by Floyd S. Arnold,

Resident Engineer, Columbia Basin Project, Region I, Boise, Idaho

ends together under a pressure of 8,000 pounds per square inch. The current flowing through the closed circuit brought the weld area to a white heat, and the pressure on the jaws forced the metal together with a slight bulge at the weld line. Flashing and welding consumed 1½ inches of bar for each weld.

The cage of reinforcing steel for the siphon, consisting of hoops, segmental bars, and longitudinal bars, was supported on steel rails placed on concrete pedestals in the subgrade. Precast concrete blocks were placed along the outer edges to insure that all steel was above the subgrade. All steel was supported by the hoops without internal bracing, thus permitting free movement of an inner form. When the siphon form was in final position, precast concrete blocks were placed between the reinforcement and the form where necessary to insure full coverage over the reinforcement.

To assure a smooth, tight inner surface in the siphon, the Bureau specified that the concrete in each 25-foot section be placed as a monolith—one piece without construction joints. This eliminated the conventional method of placing an invert, or floor section, first, and completing the barrel by placing concrete in forms supported on this invert.

Contractors solved these problems by designing a movable cantilever beam, locally called a "jumbo," to support the inner form for the concrete. Although the individual sections of the siphon are only 25 feet long, the jumbo is 75 feet long, and extends through three sections of the siphon. Cross beams support a track about 4 feet above the subgrade.

The jumbo is supported in the *middle third only*, by two sets of wheels, which travel on this track. The jumbo in turn supports the two sections of inner forms which hold the concrete in place until it hardens. This mechanism is entirely of steel, and is operated by hydraulic jacks.

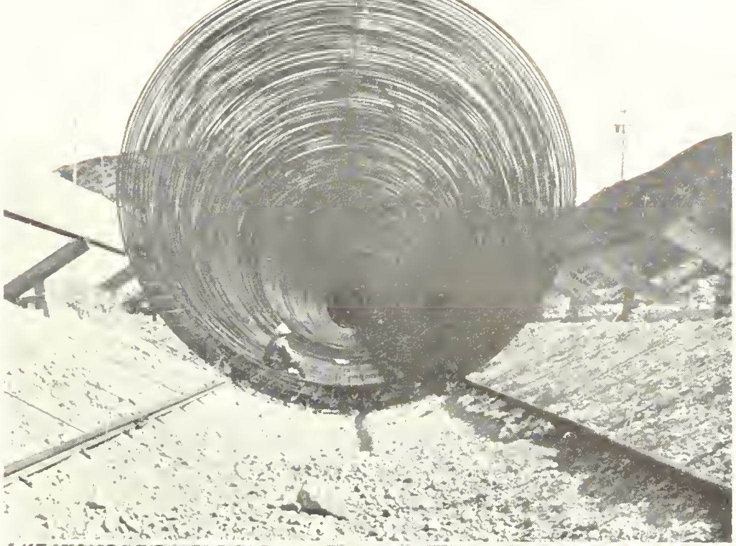
Each 25-foot section of forms weighs approximately 25 tons, and the jumbo alone weighs 20 tons. The total weight of the concrete supported by the inner forms during the hardening exceeds an additional 100 tons.

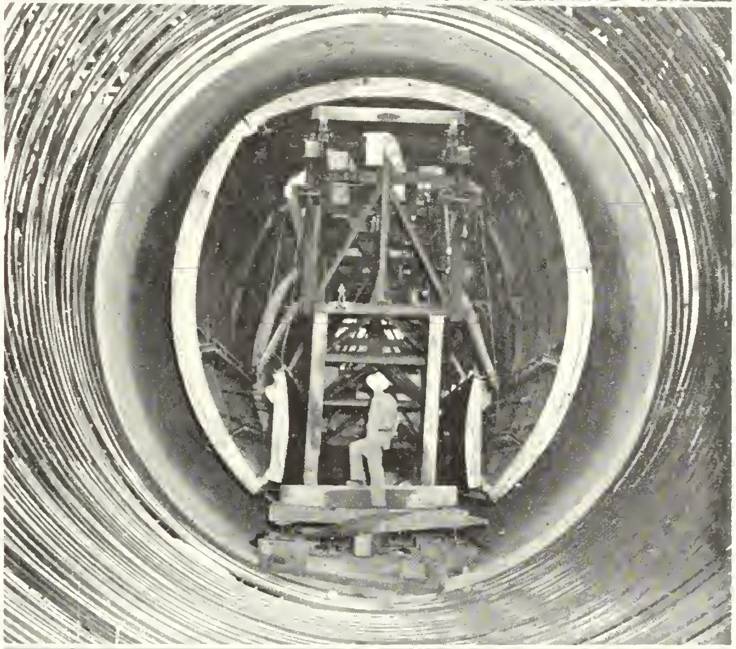
In operation, the center of the jumbo is placed in a completed section of the siphon. With one inner form wall still in position, the jumbo is supported by concrete previously placed, and extends a full section on each end. A second, or inner form, is collapsed and moved along the jumbo on a carriage through the leading form and into the next section. This inner form is then expanded into position, and concrete is placed between it and the outer form. Again the jumbo is moved forward, and an inner form collapsed, moved ahead, and expanded in position.

The jumbo always rests in a completed section of the siphon, and supports an inner form by cantilever action during concrete placing. The counterforce is supplied by the weight of concrete previously placed around the trailing form. This cantilever action has the distinct advantage of eliminating the use of temporary supports for the inner form.

The outer form is much simpler in design and operation. It appears as a giant, inverted U and travels on rails constructed on each side of the siphon. The walls of the outer form are moved into position opposite an inner form section, and the space between them is filled with concrete. Concrete hardens in 12 hours or more. The outer wall is then loosened by expanding its sides, and it is moved ahead to the next position. A deck over the gantry which

(Continued on Inside Back Cover)





Top right, steel web of enormous hoops shows siphon in formative stage. Center, trailing inner form of siphon in collapsed position, ready to be moved ahead for placing additional concrete. Lower, reusable forms moved into position for placing of concrete. One form inside remains to hold freshly poured concrete. Top and center photos by Harold E. Foss, and lower photo by F. B. Pomeroy, Region I.

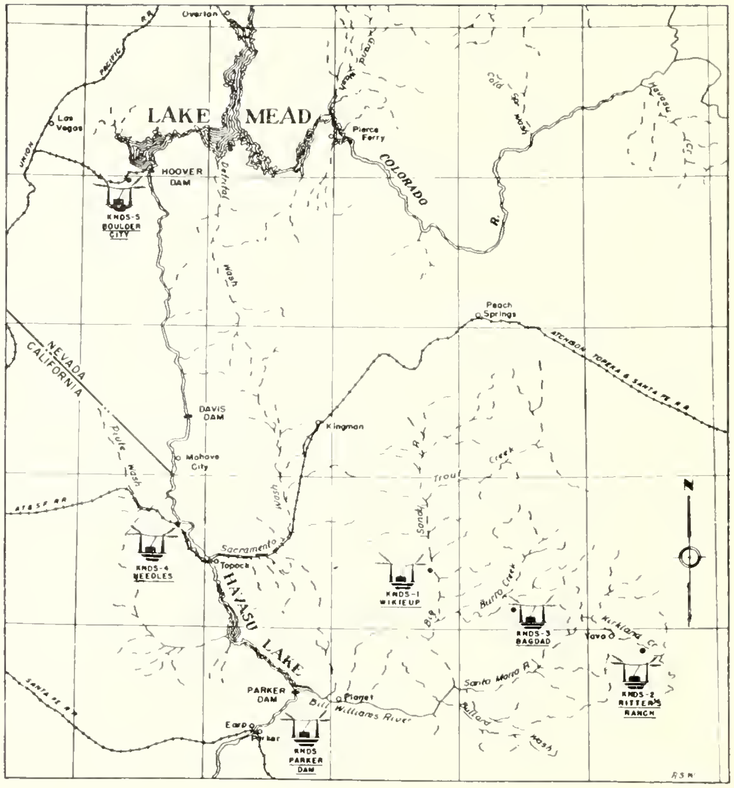
River Control by *RADIO*

by Rolland F. Kaser

Rolland F. Kaser, the author, is Acting Chief of the Division of Operational Control, Office of River Control, Region III, Boulder City, Nev. In this capacity he has charge of dispatching the water of the lower Colorado River as required to satisfy—

(1) diversion requirements for irrigation and domestic uses;
(2) requirements for power production at the several power plants, and
(3) flood-control requirements.

●



Close control of the lower Colorado River is simplified by communication through the radio network shown. Region III photo. ➔

Let us go back to Labor Day, September 4, 1939, and imagine that you are the reservoir superintendent at Parker Dam. You and your assistant are the only occupants of the Government camp built for operating personnel. All other residents of the camp have taken advantage of the long weekend caused by the Monday holiday and have journeyed to Phoenix and other distant populated places. Such a complete exodus can be understood when it is explained that the camp is at the end of the road, 16 miles from the nearest railroad station and motion-picture theater and 77 miles from the nearest bank.

Monday

Rain has been falling since Sunday night and at noon there is no indication of the end of the storm. Although Havasu Lake is low enough and can store an additional 200,000 acre-feet of water, you decide to begin taking hourly readings of the reservoir gage, so you will know when flood waters begin to reach the lake.

Tuesday

At 2 a. m. Tuesday morning you note that the lake has begun to rise and by 4 a. m., you figure that inflow is 15,000 second-feet. The heavy rain is continuing and you decide to call Lee Dana, water master at Hoover Dam, and ask him to reduce his rate of water release to the minimum for power requirements. Mr. Dana agrees to make the reduction at once and before you have finished your conversation with him the telephone line goes dead, cutting you off completely from the outside world.

Throughout Tuesday, September 5, the rain continues and between 10 and 11 p. m. it reaches cloudburst proportions, so severe that the reservoir gage cannot be read 60 feet away with the aid of a 1,000-candle-power floodlight. The roar of the water racing down the canyons into the lake and river immediately above and below the dam can plainly be heard above the noise of the 11,300 second-feet passing under the spillway gates.

What should you do! You know for sure that a bad flood, possibly larger than the one of February 1937 which is still fresh in your memory, is at hand. Your orders are that all instructions for changing the rate of release from Parker Dam will come from the chief engineer, over 1,000 miles away in Denver, Colo., and you have no way of contacting him or of receiving any message he might be trying to send to you.

Any action you might take yourself could well be disastrous to the safety of the dam and to life and property along the river downstream.

If you continue the present rate of release the dam could very easily be overtopped, with possible catastrophic results.

If you increase the rate of release you might be adding to flood flows which, for all you know, are occurring along the lower river from heavy rains on the lower tributaries, thus causing or increasing heavy flood damage.

The preceding account relates the actual experience of Boyd E. Coffey, reservoir superintendent at Parker Dam. In such a predicament, Mr. Coffey recalled his experience during World War I as a radio technician in the Army Signal Corps. If only he had a radio set to use to contact the outside world!

Wednesday

Suddenly, on Wednesday morning Mr. Coffey remembered that one of the employees of the Metropolitan Water District, who lived in the Gene Camp about 2 miles from Parker Dam, had told him a month or so earlier that he had ordered a shortwave radio transmitter and receiver.

Rushing to the Gene Camp, he found the man and was told that the set was all ready to go but no antenna had been built. Working in the rain, they strung an antenna between two houses and turned on the set. Glory be, it worked! At 11:40 a. m. Wednesday, they contacted a "ham" in San Francisco who managed to contact an acquaintance (also by radio) in Denver.

Using the San Francisco operator as a relay, Mr. Coffey gave the Denver operator a message to the chief engineer, which he delivered by telephone. In this message the chief engineer was informed of the urgency of the situation and the necessity of arranging for expert assistance in deciding upon operation of Parker Dam.

You can well imagine Mr. Coffey's relief in knowing that his message had been delivered and that, by some means, advice and instructions would be on the way.

Thursday

At 1:30 a. m. before dawn on Thursday, September 7, Mr. Coffey determined that inflow to Havasu Lake had reached a peak of about 146,000 second-feet and if inflow continued at that rate the lake would be filled in about 6 hours.

(Continued on page 40)

Converted Rice

by Garford Wilkinson

Amarillo, Tex.

Region V

Photo courtesy Albert Gommi, Rio Reamy Studios, N. Y.

Fit for a King. ***One of many eye and taste appealing dishes prepared with a rice base. This one features sweet and pungent chicken livers.***

Now you can enjoy white, fluffy rice containing the natural vitamins, minerals, and proteins supplied by nature.

This cereal, known as converted rice, is processed from the raw state, still packed with nutritive requirements. The milling operation does not harm its appearance or food value. Delectable as a cookbook picture, it is certain to be popular with America's vitamin-conscious home makers.

Developed in the early years of the recent war, the high food value product was manufactured exclusively for the armed forces until demobilization. Only recently has it become available to the Nation's retail trade.

Events leading to the discovery of the manufacturing process have all the elements of a drama: conflict, human ingenuity, disappointment, perseverance, success!

Houston, Tex., geographical center of the State's rice-growing section, and a chemical food laboratory in far-away England, are the two locales for this drama. Beriberi, the disease resulting from an unbalanced diet, especially common among those who subsist largely on old-fashioned polished rice, is the villain. Two men, a half-world apart and unknown to each other, are the principal characters. Meet the stars—Gordon Harwell, a Texas food broker, and Eric Huzenlaug, an English food chemist.

The time—the late 1930's.

Young, handsome, personable Harwell became interested in rice. He was alarmed by what he learned. Polished rice was good to look at, good to eat, but the outer layers, where nature stores so much of the food value, were being stripped. The product was being robbed of its maximum usefulness.

Harwell became imbued with the idea that in some way nature's store of vitamin's, minerals, and proteins could be preserved by a process of manufacture that would not harm the eye and taste appeal of the rice. The Texan invested \$10 in a pressure cooker, a quantity of field-ripened rice, and went to work.

Day after day, night after night, Harwell boiled rice. He soon became one of the best customers the area's rice dealers had encountered up to that time. If placed end to end the grains of rice that he boiled and threw away would reach from here to there. He made some progress. The goal was less distant.

But now, just as they do it in novels and in the cinema, we'll "cut" to Huzenlaub in his laboratory in England, where the food chemist and his coworkers have been laboring for more than 10 years on an identical problem—a manufacturing process that would result in an edible rice, and still retain the essential nutritive elements.

Back to Harwell in Houston. The Lone Star State entrepreneur gets a whiff of news about the successful experiments of the English food chemist. Harwell dashes off a letter to England. According to custom, the letter arrives. Huzenlaub, the British researcher, opens the letter, reads it and—

Huzenlaub isn't interested—his dream, his work, his successful tests have been undertaken for the salvation of millions of persons who eat rice—the populations of India, China, Japan, South America. Americans are not rice eaters: not to any appreciable extent. Fact is, Americans consume less than 6 pounds per capita annually as compared to a pound and a half daily in other parts of the world. What help could be given by this stranger in Houston, Texas?

The Britisher threw the American's letter on a pile of wasted rice and proceeded with his plans to impress the world's largest millers with his new discovery.

But this Texan was a persistent character. He continued writing to Huzenlaub, even though the letters remained unanswered. Eventually, the letters were augmented by cables and telephone calls. The men discussed their experiments, but Huzenlaub definitely was not inclined to enter into any business transaction with Harwell.

Then one day Huzenlaub sailed for this country. He hoped to interest some of the larger American rice millers in his process. When Harwell learned that Huzenlaub had left England for the United States, the Texan went East and met the British scientist when his boat docked. Huzenlaub was courteous. He and Harwell became good friends but the Britisher remained unyielding to the American's proposition of a partnership for the manufacture of the fortified cereal.

The world was at war. "Food for Freedom" was the slogan. American millers were engaged in a world struggle for production. They had no time for experiments or innovations. Food and more food. That was the important thing, Huzenlaub was told.

This was the culmination of more than a decade of life devoted to a successful enterprise that would have meant so much to so many. Disillusioned, dejected, his spirit broken, Huzenlaub prepared to return to war-stricken England.

Through all the weeks that Huzenlaub remained in this country, traveling from city to city, discussing his new food product with manufacturers, receiving negative replies to every plea, Harwell, the friendly, percipient Texan, remained close to the Englishman's side.

Time came for Huzenlaub to board an England-bound plane. Harwell would accompany him to the airport. There he would say good-bye to the Englishman—sever the last thread of hope that the two of them might join forces to improve the basic diet for millions of the world's inhabitants.

Then it happened! Cast aside the story

Left, checking converted rice in the "lab." Above, home of Converted Rice, Inc., Houston, Tex. Photos by Dale Hovey, former Region V photographer.

books with their fictionalized plots and climaxes. Here's the genuine article!

The departing Britisher was injured by a fall. His American friend took him to a hospital and there, during the period of Huzenlaub's recovery, the two men struck a deal.

Men and machines, food, fiber, and metals were scarce items in those days. Harwell and Huzenlaub, striving desperately to begin the manufacture of their new food product, were enmeshed in the struggle for War Production Board priorities, the prerequisite for tools, machinery, plant space.

Armed with reports by noted American chemists showing that this process for rice manufacture retained most of the natural food values, Harwell eventually clinched a few precious priorities. He was spurred on as never before when the research director of the Quartermaster Corps called the Huzenlaub discovery "one of the most significant scientific developments" of the Second World War.

Harwell and Huzenlaub became familiar figures around southwestern junk yards. They picked up boilers, pressure tanks, odds and ends of various machine parts. These were rushed to Houston and assembled in an old, dilapidated warehouse. In this ludicrous setting a marketable supply of polished rice—polished but still a complete food—was manufactured for the first time.

For ages rice has been the staple food for many millions of the earth's inhabitants. It may not be mentioned in the Bible, but its culture is alluded to in the Talmud and there is proof of its culture in the Euphrates Valley and in Syria hundreds of years before the birth of Christ. It is estimated that half of the people in the world now subsist chiefly on rice. As originally prepared by a great majority of persons in those countries where rice is the staple diet, most of the essential dietary elements were retained, but when the millers, in response to demand, removed the outer layers of the grain and polished it to make it more attractive and tasteful, the health of the consumers was affected. They starved, though their stomachs were full.

The process discovered by Huzenlaub, and brought into the trade with the help of Harwell, eliminated the need to rob the grain of its essentials while making it savory and pleasing to the eye.

This secret process involves cleaning the natural grain, placing it in vacuum tanks that suck the air from the kernels and then permeating the required food elements originally contained in the outer husk and bran into the kernels.

The finished product has a sunny color. Strangely, however, the easy-to-cook cereal is fluffy white, after cooking, delicious to the taste and it lacks a gooey substance common with some ordinary rice.

Another important feature of this processed rice is its defense against weevils, one of the costliest enemies known to the trade.

After the initial milling in 1942, increased demands for the new kind of rice by the armed forces and the allied food program made it necessary for Harwell and Huzenlaub to move from the warehouse to a modern plant in Houston's expanding industrial section. The plant was equipped with every facility to speed the food to far ends of the earth. A laboratory, staffed with skilled technicians, tested every batch of the important product to be sure that it met the rigid standards established by the processors and their customers. The product then was packed in waterproof containers which could be, if necessary, floated to shore in distant, embattled areas.

Today, this same company that processes and markets the food product for retail in this and foreign countries under its own trade name is continuing to expand in a new home—one of America's finest and cleanest food plants. Harwell, now president of the concern, and Huzenlaub, who lives in Chicago, where he is continuing laboratory experiments, say that the same method used to process rice from its raw state to an edible, vitamin-packaged product, can be applied to most all other cereals, and even grits, a vitamin-deficient food common to the southern United States.

This relatively new processing method for rice is benefiting growers as well as consumers. Heretofore, farmers often lost a great deal of money by rains at harvest time, which necessitated field shocking. The converted rice company is generally able to purchase the grain just as it comes from the combine in the field, eliminating drying and storage.

Moreover, this new technique for a very old food is certain to increase its consumption in the United States and other parts of the world where it never gained more than a country-cousin welcome.

Another gigantic development that can augment the production of rice and the earnings for growers in the Texas Gulf Coastal Plains region is being investigated by the Bureau of Reclamation. Texas rice growers, along with other farmers and livestock producers, are plagued by the lack of a comprehensive, efficient, economical drainage system for the several million acres of potentially high production land.

The Bureau's investigations, which now are being compiled in report form, will help to design a basic pattern that may be used to reclaim vast areas in the region of which Houston is the principal city.

Although requiring great quantities of irrigation water for the seeding and growing seasons, rice lands must be drained as quickly as possible just before harvest. Where drainage is inadequate, much of the ripened grain shatters and is lost in the soil while farmers remain unable to use their heavy combines. A properly constructed drainage system would solve this problem.

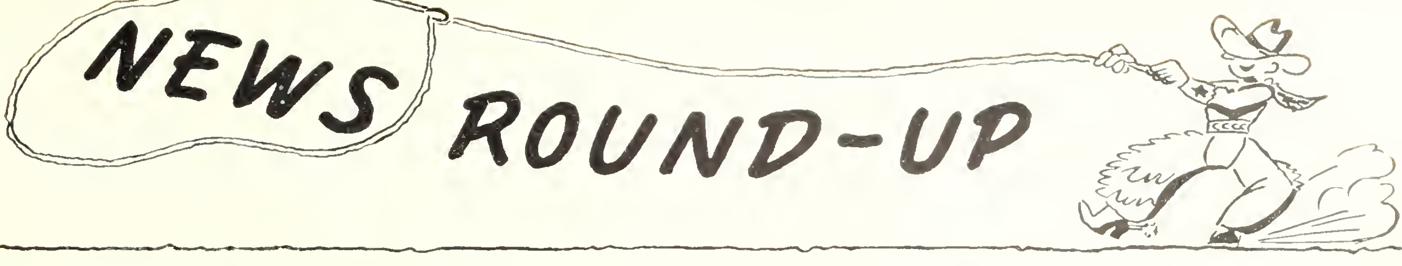
Thus, at a time when a new process for milling rice increases a demand for crop production, when the whole world remains at bayonet point for the lack of food, the Federal Government, through the Bureau of Reclamation and other agencies cooperating with the growers, may soon help to increase and keep production abreast of demand. •

Next Month's FEATURES

SILT — Despoiler of the Soil — by Assistant Commissioner Wesley R. Nelson.

LING FISHING on Ocean Lake by H. P. Vogt, Safety Inspector, Riverton project, Wyoming.

GRAPE Production by Frank D. Maupin, Kennewick, Wash.



Attention: Would-Be Homesteaders!

The table below lists proposed public land openings to be held by the Bureau of Reclamation during 1948. All dates are tentative and dependent upon the availability of funds and personnel. For information on the Shoshone, Heart Mountain, and Riverton openings write to the Regional Director, Bureau of Reclamation, Billings, Mont.; for Klamath, write to the Regional Director, Bureau of Reclamation, Sacramento, Calif.; for Boise, Minidoka, and Yakima write to the Regional Director, Bureau of Reclamation, Boise, Idaho.

Project	Date of opening	Acres	Farm units
Shoshone Project, Heart Mountain Division, Wyoming.	Summer of 1948.	21,700	217
Riverton Project, Wyoming	Fall of 1948	9,000	90
Klamath Project, Tule Lake Division, California—Oregon.	Fall of 1948	6,000	60
Minidoka Project, Gooding Division, Idaho.	Spring of 1948.	4,500	45
Boise Project, Payette Division, Idaho.	Spring of 1948.	7,000	70
Yakima Project, Roza Division, Washington.	Fall of 1948.	700	15
Total	.....	48,900	497

Work Speeded on Missouri Basin

December 22, 1947, marked the third anniversary of the Missouri River Basin project, and found the Bureau of Reclamation planning to place the sixth major dam and reservoir under construction. Preconstruction engineering had advanced on nine other dams to the point where all should be under construction this spring. In addition, preconstruction work on four other dams advanced to the point where actual construction probably can begin early in the 1949 fiscal year if funds are provided.

By July 1947 when Congress issued a mandate ordering construction to be stepped up on the Missouri Basin project, contracts had already been awarded for the construction of three dams: Kortes, Wyo., April 1946; Angostura, S. Dak., July 1946, and Enders, Nebr., November 1946. Subsequent to the mandate, contracts were awarded for the construction of Boysen Dam, Wyo., in August 1947, and Heart Butte, N. Dak., in December 1947, and bids were opened at Indianola, Nebr. in late December for the construction of Medicine Creek Dam in Nebraska.

Preconstruction work is underway at Canyon Ferry Dam in Montana. At the same time, investigational and other preliminary work is proceeding on both gravity and pumping irrigation systems, and hydroelectric power developments so that reclamation can help fortify America's "bread basket" for the critical years ahead in the world food situation. Work on several Yellowstone River pumping units has advanced toward start of construction.

The rate of progress attained in the Missouri River Basin since last July 1947 is expected to bring irrigation water to the first acres as fast as construction, financial and economic condition will permit. The project as a whole will bring water to 5,560,000 acres of farm lands having rainfall that is inadequate or unreliable for sustained, profitable crop production.

The Missouri Basin program was approved as a coordinated development by the Bureau of Reclamation and the Corps of Engineers, with the latter agency responsible for extensive flood control and navigation improvements on the main stem, and the construction of certain hydroelectric power plants in connection with these improvements. The Bureau of Reclamation is charged with the irrigation and hydroelectric power developments on tributary areas where for the most part rainfall is insufficient for sustained agriculture, and to bring the corollary benefits of reclamation development, such as municipal water supplies, fish and wildlife, recreation, and flood and silt control.

The hydroelectric power output in the Basin, including that of installations at Army-built dams whose power will be marketed by the Bureau, will be increased by 23 plants having a total 2,000,000-kilowatt capacity in the ultimate development to provide urgently needed power for agricultural uses and to develop mineral, metal, and manufacturing industrial resources. The Missouri Basin project has now obligated approximately 62 percent of the funds available for the 1948 fiscal year.

Bureau's 1948 Appropriations Highest Ever

On December 23, 1947, when President Truman signed the third Supplemental Appropriation Act for the fiscal year of 1948, carrying an item of $32,011,000 for advancing construction on five Bureau of Reclamation projects, the total appropriations for Reclamation were brought to the highest point in any one fiscal year.

The total funds granted the Bureau of Reclamation for the fiscal year of 1948 now total $136,644,738 including authorizations from power revenues, or 13 percent greater than in 1946 the previous high year. Included in the 1948 total are $98,133,738 in the regular appropriation, $6,500,000 in the second supplemental, $6,400,000 of which was for work on the Missouri Basin project, and $100,000 for Yuma, and the third supplemental of $32,011,000.

The last named amount was granted for the continuation of construction on the following projects:

- Columbia Basin project, Wash., $13,584,000.
- Central Valley project, Calif., $11,405,000.
- Colorado Big-Thompson project, Colo., $4,150,000.
- Davis Dam project, Ariz.-Nev., $2,800,000.
- Deschutes project, Oreg., Arnold Irrigation District (rehabilitation), $72,000.

Bureau Publication "Control of Weeds on Irrigation Systems" to be Revised.

The publication "Control of Weeds on Irrigation Systems" distributed in preliminary form in July 1946 by the Bureau of Reclamation is being revised and is scheduled to be printed early this year. It was the first book of its kind ever to be published.

The mimeographed edition was designed to serve two purposes. The first was to compile and publish as soon as possible such information as was then available so that if desired it could be put into practice by irrigation districts at an early date. Second, it was to serve as a preliminary copy for review by all interested in the subject so that they might give their comments and suggestions for additions and revisions.

According to the responses received it has served both of the purposes well. Many comments have been received regarding the aid it has given irrigation projects.

Numerous suggestions for the revision of the book have been received from Federal agencies, State agricultural colleges, irrigation districts, and many other sources. These suggestions together with new developments which have been made as a result of the weed control research program being conducted cooperatively by the Bureau of Reclamation of the United States Department of the Interior and the Bureau of Plant Industry, Soils and Agricultural Engineering of the United States Depart-

(Continued on next page)

WEEDS

(Continued from page 39)

ment of Agriculture will be included in the new edition.

The Bureau of Reclamation is very desirous of making the publication as complete as possible. The information which has been assembled has come from observations made by Bureau officials, through research and from contributions. However, there is no doubt but that many irrigation districts have developed other methods of weed control on their distribution and drainage systems which have proven more economical than methods which are generally known. If possible such information should also be included in the revised edition of the publication. If you know of some labor, time and money saving device or method for controlling weeds on irrigation systems, please forward your suggestion to the Commissioner, Bureau of Reclamation, Washington 25, D. C. Full credit will be given to any such contributions that are used. ●

KLAMATH

(Continued from page 33)

They probably haven't bought quite enough yet. They seem to be doing it right—one man buying one thing, another man another and using the equipment cooperatively on a rational basis for the area, balancing the size of the homesteads against the short seasons, and having about one complete set of equipment for each three farms. The general settler financial status now, he thinks, is that most people have paid all their expenses, have most of the necessary equipment, a good deal of the furnishings for their houses, and are squared away, ready for a smaller amount of loans next year, with the prospect of farm prices just about what they were this year. "Give them one more good year and the whole bunch will be fixed for life!"

The veterans themselves were sure that they would live happily ever after with another good year or two; but they were confident they could make a long time go of the project in any case. They didn't even seem to be too much concerned whether they made a fortune out of their places or not. It was the home that counted.

One couple in their thirties had adopted a fine-looking blonde kid just under two because, as they said, "We felt a home like this needs a little boy running around."

Jim Bell, the big laughing man close on 50 whose picture you see inset on page 32, was buoyant about the whole deal after selling a 2,500-sack crop of premium barley. *He even approved of the Bureau, stating "Everybody says for a Government outfit it's the best outfit we ever dealt with."*

But George Douglass, Jr., the smiling fellow featured on the front cover and page 32, was the man who summed it up best for all the homesteaders. George sailed in a navy gun crew "on every ocean in the world for over 3 years and now I'm in my home port for the first time and home for good. I wouldn't take a million dollars for it. I feel like all the rest of the homesteaders: *this is my home!*"

River Control by Radio

(Continued from page 36)

Still no word had come from the chief engineer, so he tried the telephone again and managed to get a call through to John K. Rohrer, assistant construction engineer, at Yuma, Ariz. He then found that the chief engineer, realizing that he had insufficient information in Denver to give detailed instruction for operation of the gates of Parker Dam, had authorized Mr. Rohrer, by an exchange of telegrams, to issue such instructions and to send an assistant by airplane to Parker Dam.

A telegram had been sent by Mr. Rohrer the previous afternoon but it had not yet been delivered to Mr. Coffey. Accordingly, Mr. Rohrer instructed Mr. Coffey to begin increasing Parker Dam releases at the rate of 6,000 second-feet per hour.

By 7:30 a. m. the total release was about 19,000 second-feet, and was held constant at that rate. T. A. Clark, office engineer, All-American Canal project, arrived at Parker Dam by airplane at 10:30 a. m., Thursday, in time to observe the reservoir peak and to give assistance and advice during the remainder of the flood. His presence was greatly appreciated by Mr. Coffey and his assistant as they had been on constant duty since Sunday night and were practically at the point of exhaustion.

This dramatically illustrates the difficulties encountered by local operating personnel when they are dependent entirely upon telephonic or telegraphic instructions from distant higher authority. Break-downs of such systems invariably occur just when ability to secure a good connection is of utmost importance. In the case cited, Mr. Coffey's telephone connection with Hoover Dam and other outside points was interrupted for almost 3 days during the worst part of the flood. Telegraph communication was also worthless as shown by the fact that the assistant construction engineer at Yuma sent a telegram to Parker Dam on Wednesday, September 6, and it was received 24 hours later, after the flood peak had passed.

Availability of the private short-wave radio set was the factor which saved the day for life and property along the river below Parker Dam.

In 1946 a radio network became essential in order to justify holding the operating level of Havasu Lake higher than had been originally planned, thereby increasing power production at Parker power plant from the limited water supply, in order to partially alleviate the severe power shortage in central Arizona.

The Office of River Control, the recently organized regional office charged with the responsibility of dispatching the water of the lower Colorado River, made studies which showed that some increase, over the levels used during the war, could be allowed if an efficient flood-warning system was installed.

The radio stations, located at strategic points in the Bill Williams River basin in Arizona, would provide the basic data needed for such a warning system. This information (including precipitation, stream stage, and other hydrologic data) would be analyzed by hydrologists and meteorologists of the Office of River Control, together with all available meteorological data (raobs, pibals, etc.) and forecasts received from the Weather Bureau, who would then be able to make plans for scheduling releases from Hoover and Parker Dams to control possible flood run-off.

Two-way radio stations were installed during the fall of 1946 at Wikieup, Bagdad, and Ritter's Ranch near Yava, Ariz. Since their installation these stations, using surplus Navy equipment modified by Parker Dam forces, have been in daily contact with each other and with a private station installed at Parker Dam by Boyd Coffey. A frequency of 2,822 kilocycles has been used exclusively thus far; however, authorization to use a frequency of 5,287.5 kilocycles during daylight hours has been obtained and tests indicate that this latter frequency may prove better during the summer months.

Operation of these "pioneer" stations has amply demonstrated the practicability of using radio communication and the desirability of completing the network.

A 100-watt station was placed in operation early in November of this year in the quarters of the Office of River Control in Boulder City and another went into operation in the River Control office at Needles, Calif., shortly thereafter.

An additional station will be added by the Parker Dam power project at Parker Dam in the near future. This last station will be used for water and power dispatching and for contact with line maintenance crews in addition to transmission of flood warning information, while the Boulder City and Needles station will also be used for communications in connection with river channel construction activities.

As a result of installation of the radio network, we can now be sure that Mr. Coffey's experiences during the September 1939 flood will not be repeated during future floods.

In addition, officials responsible for dispatching the water of the river will have complete up-to-the-minute information on storm and run-off conditions as they occur and will be able to modify their plans to accommodate changing conditions, since they will be able to predict future inflow within reasonable limits about 12 hours before the inflow reaches Havasu Lake. ●

NOTES FOR CONTRACTORS

Contracts Awarded During December 1947

Specification No.	Project and State	Award date	Description of work or material	Contractor's name and address	Contract amount
1903	Missouri Basin, Wyo	Dec. 12	2 vertical-shaft, 10,500 horsepower hydraulic turbines	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	$258,000.00
1903	do	do	2 governors for 10,500 horsepower turbines	Woodward Governor Co., Rockford, Ill	11,396.00
1903	do	do	2 8,333-kilovolt-ampere generators	Westinghouse Electric Corporation, Denver, Colo.	305,105.00
1910	Davis Dam, Ariz.-Nev.	Dec. 26	Construction of Parker-Pilot Knob 161-kilovolt transmission line.	J. & J. Construction Co., Oklahoma City, Okla	1,213,197.62
1918	Boise, Idaho	Dec. 15	7 5,500 kilovolt-ampere transformers	Pennsylvania Transformer Co., Pittsburgh, Pa	162,106.00
1918	do	Dec. 5	2 115,000-volt, outdoor circuit breakers	General Electric Co., Denver	16,047.00
1918	do	Dec. 10	1 115,000 volt, outdoor disconnecting switch	Schwager-Wood Corp., Portland, Oreg	7,661.87
1924	Colorado-Big Thompson, Colorado.	Dec. 17	10 115,000 volt, outdoor circuit breakers	Westinghouse Electric Corp., Denver, Colo.	193,256.00
1924	do	Dec. 19	10 6,000-kilovolt-ampere and 1 3,333-kilovolt-ampere transformers for Estes switchyard.	Pennsylvania Transformer Co., Pittsburgh, Pa	319,006.00
1924	do	Dec. 17	18 disconnect switches for Estes switchyard	Electric Power Equipment Corp., Philadelphia, Pa	70,196.61
1932	Davis Dam, Ariz.-Nev.	Dec. 29	Steel structures for Phoenix switchyard	Allison Steel Mfg. Co., Phoenix, Ariz	19,251.00
1939	Central Valley, Calif	Dec. 23	6 108-inch butterfly valves	Newport News Shipbuilding & Dry Dock Co. Newport News, Va.	177,000.00
1940	Boise, Idaho	Dec. 9	Control and station service equipment	Westinghouse Electric Corp., Denver, Colo	26,898.00
1940	do	do	Station service unit substation	ITE Circuit Breaker Co., Philadelphia, Pa	27,751.00
1954	Boulder Canyon, Calif	Dec. 4	Construction of dyke No. 1, All-American Canal	Marshall, Haas, and Royce, San Mateo, Calif	879,245.00
1954	do	Dec. 3	Construction of dyke No. 2, All-American Canal	Claude Fisher Co., Ltd., L. S. & R. S. Crow, Los Angeles, Calif.	916,930.00
1970	Missouri Basin, S. Dak	Dec. 5	Embedded anchorages for radial gates	Willamette Iron & Steel Co., Portland, Oreg	27,995.00
1971	Davis Dam, Ariz.-Nev	Dec. 24	Circuit breakers and disconnecting switches	Westinghouse Electric Corp., Denver, Colo	21,102.80
1978	Columbia Basin	do	Resistors	do	11,365.20
1978	do	do	Transformers	Allis-Chalmers Mfg. Co., Denver, Colo	16,832.00
1982	Davis Dam, Ariz.-Nev.	Dec. 12	1 24-ton traveling gantry crane	Judson Pacific-Murphy Corp., Emeryville, Calif	33,045.00
1983	Missouri Basin, S. Dak	do	5 50-foot by 50-foot radial gates	Virginia Bridge Co., Denver, Colo	150,000.00
1987	W. C. Austin, Okla	Dec. 15	Construction of Ozark laterals 4.6 and 15.2	Pannell Construction Co., Helena, Mont	288,730.00
1988	Colorado Big Thompson, Colorado.	Dec. 21	Traveling cranes	Judson Pacific-Murphy Corp., Emeryville, Calif	80,409.00
1988	Missouri Basin, Wyo	do	do	do	41,600.00
1992	Missouri Basin, N. Dak	Dec. 3	Construction of Heart Butte Dam and dike and relocation of State Highway No. 49.	C. F. Lytle Co. & Greene Const. Co., Des Moines, Iowa	2,360,713.00
1994	Deschutes, Oreg	Dec. 23	Construction of laterals M 58 and M 64 and sublaterals	Adler Construction Co., Madras, Oreg	414,736.00
2002	Missouri Basin, S. Dak	Dec. 30	Structural steel for Angostura Dam spillway bridge	Virginia Bridge Co., Denver, Colo	20,600.00
2009	Boulder Canyon, Nev.	Dec. 23	Construction of pumping plant No. 2 A, Boulder City	Griffith, Gornall and Carman, Inc., Salt Lake City, Utah	31,195.50
2013	Columbia Basin, Wash	Dec. 31	Steel workbarge and revolving crane	American Bridge Co., Denver, Colo.	78,000.00
2020	Boulder Canyon, Nev	do	Steel structures for Boulder City substation	do	15,165.00

Construction and supplies for which bids will be invited during February 1948

Project and State	Description of work or material
Boise, Idaho	Hydraulic turbine driven pumping unit for Willow Creek pumping plant.
Boulder Canyon—All-American Canal, Calif	Construction of about $6\frac{1}{2}$ miles of high-pressure concrete pipe laterals for Coachella division.
Central Valley, Calif	15-kilovolt oil circuit breakers and disconnecting switches for Tracy switchyard.
Colorado-Big Thompson, Colo	11-foot discharge pipes for Granby pumping plant.
Columbia Basin, Wash	230-kilovolt, 10,000 kilovolt-amperes oil circuit breakers, 230-kilovolt disconnecting switches for Grand Coulee switchyard
Do	Unit substations for tail tower, caisson drydock, and caisson puller machines, Grand Coulee power plant.
Do	Extension to 6,900-volt station service switchgear for Grand Coulee power plant.
Davis Dam, Ariz.-Nev.	22 by 19-foot radial gates for Davis Dam power plant.
Fort Peck Power, N. Dak	Main control board for Williston substation.
Hungry Horse, Mont	Hydraulic turbines and governors for Hungry Horse power plant.
Do	Generators for Hungry Horse power plant.
Kendrick, Wyo	Construction of approximately 16.5 miles of 34.5-kilovolt transmission line from Medicine Bow to Hanna, Wyo. Wood poles.
Klamath, Calif.-Oreg.	Pumping units 4 and 5 for Modoc pumping plant D.
Missouri Basin, Colo	Erection of 12 2-bedroom and 4 3-bedroom prefabricated residences at Narrows Dam Government Camp, near Fort Morgan, Colo.
Missouri Basin, Kans	Construction of Cedar Bluff Dam and earthfill structure on the Smoky Hill River, near Hays, Kans.
Missouri Basin, Wyo.-Neb.	Construction of 45 miles of Gering-Alliance, Nebr. and 38 miles of Cheyenne-Pine Bluffs, Wyo., 115 kilovolt transmission lines. Wood poles.
Ogden River, Utah	Construction of equalizing reservoirs No. 13 and No. 17 and pipe-line structures for laterals No. 13-1 and No. 17-1 in South Ogden distribution system.
Provo River, Utah	Construction of steel pipe line and structures for Big Cottonwood section.

CONQUERING THE COULEES (Continued from Page 35)

holds the outer form provides a working platform from which concrete can be placed between the inner and outer forms.

High-quality concrete to protect the reinforcement and contain the irrigation water is necessary for successful operation of the high-head Dry Coulee siphons. Aggregate for the concrete was obtained from a nearby gravel deposit, washed clean, and separated into four sizes—three of rock and one of sand. All were carefully graded as to size and recombined by weight to form dense concrete mixtures: 1 part cement, 2.2 parts sand, and 4.1 parts rock of the maximum size of $1\frac{1}{2}$ inches.

A special cement was used to increase the resistance of the concrete to alkalis, and an air-entraining agent was added to the concrete to increase resistance to weathering and to improve the workability of the mixture, thus insuring both a durable surface and sound concrete consolidated tightly about the reinforcement.

A system of vertical pipes, known as "elephant trunks," was used to carry concrete to proper places in the form. Once in place, the concrete was thoroughly consolidated by air-actuated internal vibrators.

The placing operation required an average of 8 hours for a section—185 cubic yards. After the concrete hardened 12 to 36 hours, the forms were moved, and the surfaces covered with a white pigmented sealing compound. This compound seals all moisture in the concrete and assures proper strength development because the chemical action of hardening continues indefinitely in the presence of water. The sealing compound also reflects the sunlight which, if absorbed, may cause damage to the concrete by creating high surface temperatures. ●

KLAMATH BARLEY—A Study in Perspective

by Ben Glaha, Chief Photographer, Region II

MARCH 34/3
1948

Featuring:

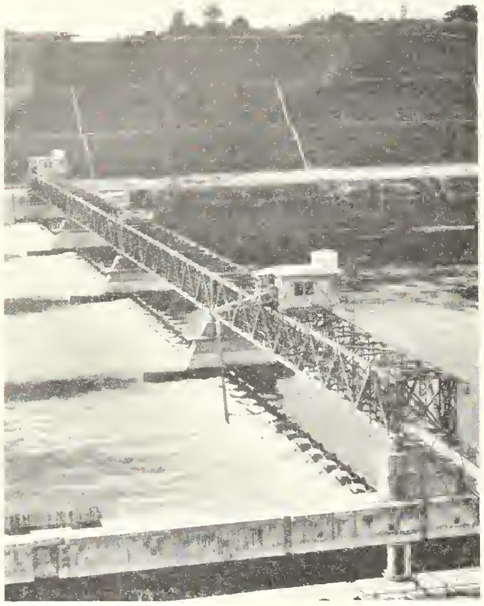
ILT—*Despoiler* of the Soil
by
Asst. Commissioner
VESLEY R. NELSON

ultiple-Purpose PLOW

RECLAMATION* in *AFGHANISTAN

THE *Reclamation* ERA

Letters to the Editor



SESTO CALENDE—regulates Lake Maggiore

Milano via Privata Mangili, 2,
16 December 1947.

Dear Editor: I have received your communication informing me that from May 1946 you have again begun to publish your beautiful magazine Reclamation Era. I was a regular subscriber up to December 1940.

Will you kindly send me all the numbers issued from 1941 and regularly subscribe me for 1948?

During the war I constructed the plan of a great barrage for the regulation of the Lake Maggiore. I was also the director of the works.

I here include a photo of the barrage.

I am now the director of this State corporation. The barrage is actually managed by a State corporation called "Consorzio del Ticino" in Milan, Corso Porta Nuova 18, and I am the general director.

Today by post I have sent you two books of studies we have published during these years and I hope you will accept them.

The next new publication will soon be ready and I will send it to you.

I have also sent you a map scale 1:500,000 of Lake Maggiore regulation and I hope it will interest you.

With kind regards, yours sincerely.

Dr. Ing. Riccardo Gramigna.

Land Speculation

Assistant Secretary of the Interior William E. Warne kindly turned over to the Reclamation Era the following letter from John Haw, believing it to be of interest to our readers.

I read with unusual interest your article in the August issue of the Reclamation Era entitled "Land Speculation." I meant to write complimenting you on presentation of this subject and the manner in which it was done.

Emphasis on the speculation in desert land ahead of construction on Federal projects needs to be called to the attention of water users who are now screaming about construction costs on projects

(Continued on next page)

Reclamation ERA

Vol. 34 **March 1948** **No. 3**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Publication approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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Contents

Ruth F. Sadler, *Editor*

NEXT MONTH—How natural boundaries are utilized in laying out Columbia Basin farms—a story on topography and irrigation farming by W. W. Johnston, project development supervisor, Columbia Basin project.

***ALSO*—Dr. Schildknecht's report on Switzerland's wartime reclamation program for food production, and an account of underground pipe irrigation in the Yakima Valley.**

Our Front Cover

Sweet Grape Picker

Ellen Honeycutt, Benton City, Oreg., seems to be enjoying her hard work in the grape arbors of the Kennewick Division of the Yakima project in Washington. The box she is holding is known as a "lug." This is carried by the picker until filled, when it is collected by a truck. Ellen picks an average of 35 lugs daily. See "Grapes," page 49. This photo was taken by Stanley Rasmussen, photographer, Boise, Idaho, Region 1.

recently completed or now in work. I hear so often the statement that early project water users had difficulty in meeting construction costs of only $75 or $100 per acre thereby leaping to the assumption that costs of $200 or $250 per acre is certain to ruin those who assume the burden on new expensive projects. Entirely overlooked is the fact that the raw desert land cost these early project water users all the way from $200 to $500 per acre, that unpaid balances on this land purchase price carried at from 6 to 8 percent interest and had to be repaid over a period of 5 to 10 years. This is to say nothing of the larger interest-free repayment period.

Furthermore, and in addition, present debts will undoubtedly be paid with diluted dollars as compared to 20 or 30 years ago. . . . Your article was very well done and well-timed.

Yours sincerely,

JOHN W. HAW,
Director, Agricultural Development Dept., Northern Pacific Railway Co., St. Paul, Minnesota.

From Ohio

MANSFIELD, OHIO,
238 RENNY AVENUE,
December 13, 1947.

DEAR EDITOR: I am more than interested in your good Bureau, and the good work you are doing and intend to do in the future. I enjoy studying your magazine, and would be more than pleased to receive a few of your back numbers. And oblige,

J. C. BOYER.

Un-Busy Beavers

With the kind permission of the United Press we are reprinting the following article datelined St. Helens, Oreg., August 28, 1947:

Two males and a female beaver, recruited to do a dam-building job for this city of 4,000 persons, disappeared today and nobody seemed to know whether they were easing the assignment or solving the eternal triangle.

The beavers were obtained last week from the Oregon State Game Commission and freed alongside Milton Creek, a dwindling source of city water. The city council decided it needed more retaining dams on the creek.

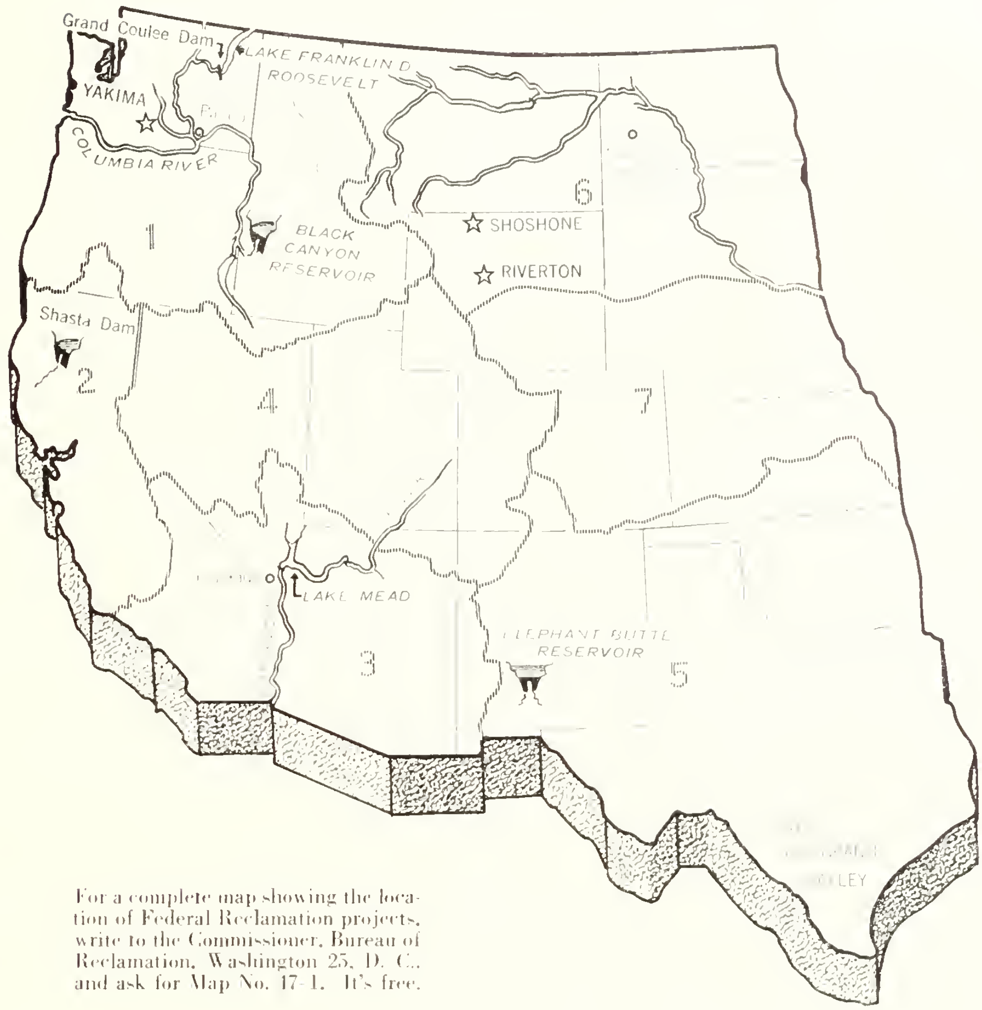
"We just put them in and told them to do what comes naturally," Councilman Ben Coleman explained.

But yesterday the council sent a man out for a progress report. His report indicated something was wrong: "No dams, no beavers."

There was no immediate explanation. Mr. Coleman put it this way:

"We thought that when you put out two he-beavers and one she-beaver, you got a dam. But now I don't know. Maybe you get trouble."

Reclamation Place Names in this Issue



For a complete map showing the location of Federal Reclamation projects, write to the Commissioner, Bureau of Reclamation, Washington 25, D. C., and ask for Map No. 17-1. It's free.

Credit

Photographs which illustrated the "Golden Harvest at Klamath" article in last month's issue were all taken by J. E. Fluharty of Region II.

Name	Address

"Get Acquainted" Copies

If you have friends or associates who would be interested in the *Reclamation Era*, please list their names and addresses in the box to the left, clip and send it to the Commissioner, Bureau of Reclamation, Washington 25, D. C. We shall be glad to send them copies of back issues so that they can get acquainted with your magazine.

A Plan for Expanded Food Production

Secretary of Agriculture Anderson in his annual report to the President of the United States for the fiscal year ending June 30, 1947, called for a fivefold increase in range and pasture seeding, in drainage and preparation of land for more efficient irrigation. He said that if we permit our land to deteriorate we cannot maintain our present standard of living, as American agriculture "now finds it has reached the limits, practically speaking, of its land resources," and that "from now on we must live with the resources at hand." He stated that the American people would like to be able to buy one-third more food than they had during the last half of the 1930's.

This statement confirms the findings of the Bureau of Reclamation which last November was requested by Representative Walt Horan of Washington to submit a report on the extent to which Reclamation construction could be speeded up to expand Reclamation farmlands in the West and produce more food to meet domestic and foreign needs.

Subsequently, Assistant Secretary of the Interior William E. Warne and Commissioner of Reclamation Michael W. Straus testified before the Western Subcommittee of the Congressional Joint Committee on the Economic Report on December 17, 1947, and at the request of the chairman of the subcommittee, Senator Watkins of Utah, submitted into the report of the hearings a plan for speeding up construction on certain Reclamation projects in order to accelerate a special-purpose food production program.

In this report, Commissioner Straus stressed the following facts:

- If we are to meet the demands of Europe in addition to those of our own country, extraordinary efforts must be made within a period of time which is comparatively short in relation to the long-range objectives of Reclamation.

- The span of the proposed European recovery program (or Marshall plan) is approximately 4½ years from now, or until June 30, 1952, therefore, Reclamation's participation would be limited to—

(*a*) Projects now under construction, or those which can be placed under construction relatively soon;

(*b*) Projects that can be producing food within the period of the European recovery plan; and

(*c*) Projects which are part of Reclamation's long-term program and whose construction at this time will not throw the entire program out of balance.

Keeping these points in mind, Commissioner Straus stated that an accelerated program on specific irrigation projects would bring some 5,600,000 acres of new lands into production and additional crops totaling over 28,000,000 tons.

On the basis of 1947 prices, this program would cost a little over $1,300,000,000. Although resort to speed-up methods would undoubtedly force up the total cost, much of the addition would be offset by savings in overhead and investment charges so that the increased cost would probably not exceed 25 percent of the normal expected cost of the program.

Following are excerpts from the report submitted to the subcommittee based upon the Bureau's analysis of the subject as requested by Representative Horan.

Acres of Additional Land

The total acreages of land that can be placed in production each year on the selected projects in the Western States (exclusive of Reclamation by drainage in the Gulf States), together with the estimated annual crop yield, and the estimated additional funds required, are as follows:

Fiscal year	Land	Annual crops [1]	Additional funds required
	Acres	*Tons*	
1948	331, 801	792, 000	$53, 707, 054
1949	562, 305	2, 193, 950	384, 344, 586
1950	1, 351, 258	4, 810, 595	401, 095, 706
1951	2, 480, 850	9, 572, 689	339, 781, 239
1952	880, 790	10, 793, 963	187, 854, 136
Total	5, 607, 004	28, 163, 197	1, 366, 782, 721

[1] Estimated production each calendar year corresponding to the fiscal year in which the land is made available.

Each of the projects listed below has been found to be justified on the basis of benefit-cost studies and each is a part of the long-range program of the Bureau. The list is flexible and indicates only those projects on which there is a reasonable certainty the necessary schedule can be met without unusual or extraordinary cost. It does not represent the maximum upper limit of the program.

Additional Food Required

The present food situation, both here and abroad, calls attention to the urgent need for bread grains, consisting of wheat and rye. Other grains, fats and oils, meat, dairy products, and fruits and vegetables will also be required for shipment abroad.

Irrigated land can be depended on to produce large quantities toward meeting the goals for these groups of food products.

In addition to the foodstuffs which will be needed for the foreign aid program, we must maintain the American standard of living for an increasing population. In some sections irrigated land can best be utilized by growing specialty crops for home consumption. This would permit acreages in other sections of the country to be placed in wheat, which is not considered a good irrigated crop, as well as corn, which cannot be grown in large quantities on irrigated land in northern areas where the growing season is short. Total crops, as estimated, include alfalfa and other food and forage crops that are converted into meat, eggs, and dairy products.

Western irrigated areas are important segments of the livestock industry, providing pasture and alfalfa for winter feeding. Development of additional feeding areas means more pounds of meat and butter and more eggs and milk on tables at home and abroad.

The total amount of crops resulting from this accelerated program would be substantial, resulting in a maximum annual figure of over 10 million tons in 1952, a part

(*Continued on page 48*)

TENTATIVE LIST OF PROJECTS INCLUDED IN FOOD PRODUCTION PLAN

Region I

Boise-Anderson Ranch, Idaho.
Boise-Payette, Idaho.
Columbia Basin, Wash.
Deschutes, Oreg.
Lewiston Orchards, Idaho.
Minidoka-Gooding-North Side, Idaho.
Yakima-Roza, Wash.
Council, Idaho.[1]
Vale-Bully Creek, Oreg.[1]
Crooked River, Oreg.[1]
Yakima-Kennewick, Wash.[1]
Upper Star Valley, Wyo.[1]
Rathdrum Prairie-Hayden Lake, Idaho.
The Dalles-West Unit, Oreg.[1]
Baker Upper Unit, Oreg.[1]

Region II

Central Valley, Calif.
Klamath-Tule Lake, Calif.-Oreg.
Kings River, Calif.[2]
Solano County, Calif.[1]

Region III

All-American Canal-Coachella, Calif.
Gila (incl. Wellton-Mohawk), Ariz.
Holbrook-Joseph City, Ariz.[1]

Region IV

Mancos, Colo.
Paonia, Colo.
Provo, Utah.
Newton, Utah.
Preston Bench, Idaho.[1]
Vernal Project, Utah.[1]
Sublette (La Barge), Wyo.[1]
Minnesota, Colo.[1]
La Plata, Colo.[1]
Gooseberry, Utah.[1]

Region V

W. C. Austin, Okla.
Tucumcari, N. Mex.
San Luis Valley, Colo.
Valley Gravity, Tex.
Fort Sumner, N. Mex.[1]
Fort Supply Pumping, Okla.[1]

Region V.—Continued

Canton, Okla.[2]
Vermejo, N. Mex.[2]
Fort Gibson, Okla.[2]
Balmorhea, Tex.[1]
Dry Creek, Tex.[1]
Middle Rio Grande, N. Mex.[2]
Zapata, Tex.[1]
Englewood, Okla.[1]
Miami, N. Mex.[1]
Cotulla, Tex.[1]
Big Creek, Tex.[1]
Blue Water, N. Mex.[1]
Fort Cobb, Okla.[1]
Mountain View, Okla.[1]

Region VI

Riverton, Wyo.

Region VII

Colorado-Big Thompson, Colo.
Kendrick, Wyo.

Missouri River Basin

Angostura, S. Dak.
Belle Fourche, S. Dak.

Missouri River Basin—Continued

Big Horn Pumping, Wyo.
Bostwick, Kans.
Boysen, Wyo.
Cannonball, N. Dak.
Cedar Bluff, Nebr.
Clarkston Pumping, Mont.
Edgemont, Wyo.-S. Dak.
Frenchman-Cambridge, Nebr.
Grand River, S. Dak.
Heart River, N. Dak.
Kirwin, Kans.
Lower Marias, Mont.
Montana Pumping, Mont.
North Dakota Pumping, N. Dak.
Owl Creek, Wyo.
Paintrock, Wyo.
Rapid Valley-Pactola, S. Dak.
St. Francis, Colo.-Kans.
Shoshone Extension, Wyo.
South Bench, Mont.
Sun River, Mont.
Tongue River, Wyo.
Wilson, Kans.
Yellowstone Pumping, Mont.-N. Dak.

[1] Unauthorized.
[2] Contingent upon expedition of construction by Army.

View of Jemez dam site, N. Mex. Note cows in background of reservoir area. Photo by Dale A. Hovey, formerly of Region V.

SILT

Despoiler of the Soil

By Wesley R. Nelson

Assistant Commissioner, Bureau of Reclamation

The subject of reservoir sedimentation and its relation to upstream conservation and engineering may be a dry topic but it is a subject which is of vital importance not only because of the direct effects of sedimentation, but by its implications—the destruction of the soil which provides the bread on which we live.

The process of water, picking up the soil, transporting it and redepositing it has been underway since water first appeared on the earth. Without this natural process there would have been no rich deltas, no fruitful valleys, in fact very little soil on which man might live. Man has accelerated the process in many places—in too many places—but in others he has slowed the process to a marked extent.

Far up in a valley of the Rockies a spring bubbles forth from beneath a sandstone ledge. Its waters form a brook which tumbles over the rocks, at the beginning of a journey which may lead perhaps to the sea from which it came. Soon the brook is joined by others, a creek is formed, other creeks join and a river is formed.

The waters leaving the spring are clear, cold, and usually pure. They remain so until disturbed by some untoward event, but that these events do occur is made evident by the appearance of most of our western rivers.

Sediment Rides Again

These waters are spirited extroverts. They are great joiners and they love company. They enjoy taking anything movable along for the bus ride and as long as there is room and a passenger is available, the bus continues to fill. But unlike our modern transportation, the water bus, operated by gravity, must be going somewhere before it will take on a sediment passenger, and the faster the bus travels, the more sediment passengers can climb aboard. In turn, when the sediment-laden bus slows down, some of the passengers must get off.

Unfortunately, the sediment passengers who are going for a ride are carrying off our valuables of prosperity and even life itself; so we had better get a cop out on the bus line and keep the passengers at home.

With this in mind let us follow this allegory a little further and find out why the sediment passenger leaves home. In the first place, he has been a great traveler. Usually, that is how he got where he is today. And although he is willing to stay at home and be a "do-gooder," he loves his old pal water who made him what he is today, and is easily carried away by overenthusiasm. Where practicable, the best way to keep him at home is to give him a job to do—supporting a family of grass, of shrubbery, of trees. In this way he gets tied down and if he still has roving tendencies, his family will sit on him.

With this homely introduction, let's get down to cases. Flowing water has a tendency to pick up sediment whenever the two come in contact. The amount taken into suspension depends on the volume, velocity, and turbulence of the water, the type of soil and the soil covering. Whenever the velocity of a sediment-laden stream is reduced, sediment is deposited, the amount of deposition depending on the amount of silt in suspension, the amount of reduction in velocity, and the quality of the sediment.

Rapidly melting snows and torrential

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storms are the greatest producers of sediment-laden streams. If not halted by barriers, either natural or man-made, the soil is carried into the sea and forever lost to man. Even if deposited in or along the stream the soils usually have been torn apart and are not immediately available for plant production. If the sediments are deposited in a reservoir, the life of this man-made lake is definitely limited and the fish, wildlife, and recreation values are impaired. Practically all of our reservoirs are of a multiple-purpose type. Thus, the loss of reservoir capacity to sedimentation may be felt by irrigation, power, municipal water supply, flood control, recreation, and wildlife. And don't forget that loss of soil from our watersheds means bigger floods. It also means loss of plant life for the support of game and fish.

Tremendous Soil Losses

The loss of soils in the United States from erosion, of which uncontrolled water is a major offender, is estimated to be 500,000 acres per year. The amount of sediment carried by our western rivers is tremendous. The Colorado River at the upper end of Lake Mead carries an average of more than 100,000 acre-feet of sediment annually which is deposited in Lake Mead. Elephant Butte Reservoir in New Mexico lost 17 percent in 31 years; Black Canyon Reservoir in Idaho lost 11 percent in 12 years. These are a few of the more critical examples. Sedimentation has affected all reservoirs in some degree.

Closely associated with reservoir sedimentation is the deposition of sediment in the backwater area immediately above a reservoir pool. In addition to causing possible damage to existing valley improvements by restricting flood channel capacities, a problem of reduced water supply of another nature than actual reduction of storage capacity is caused. This results from a high increase in nonbeneficial consumptive use of water from heavy growths of salt cedars or similar vegetation which generally occur in the delta deposits. At the head of Elephant Butte Reservoir this nonbeneficial consumptive use has been estimated to be in the neighborhood of 150,000 acre-feet per year, which is approximately 13 percent of the average annual flow.

The vegetation in delta areas is not entirely nonbeneficial, however. This vegetation acts as a screen to trap sediment before it enters the reservoir. At Elephant Butte Reservoir, for example, the annual rate of depletion of storage capacity in the reservoir proper has fallen from about 18,000 acre-feet to about 6,000 acre-feet because of vegetation. In addition wildlife interests have found this vegetative area to be an excellent home for various types of wildlife. The fact remains, however, that these advantages have been gained at terrific cost of water, in an area that can ill afford such losses.

The loss of storage through sedimentation deals a blow to the economy of a project area far greater than the initial cost of the reservoir. In the first place it can reasonably be assumed that the dam was constructed at the most favorable location, either in point of initial cost or in operating charges. A new damsite, if available, will have to be a point where either construction costs are higher, or where water conveyance costs are higher. Secondly, continuous loss of reservoirs through sedimentation will mean that all available sites will eventually be used up, since there is generally a definite physical limitation on the number of feasible sites available. Dam sites can therefore be considered a natural resource and must not be used up carelessly, in the same sense that timber resources must not be wantonly depleted, without regard to restoration.

In many reservoirs constructed by the Bureau of Reclamation and by other Federal agencies, provision is made for reservation of a minimum pool to preserve fish and wildlife habitats or for minimum releases from the reservoir to protect downstream fish or wildlife. For these purposes, the problem of siltation is vitally important also, since deposition of sediment in reservoirs immediately begins to encroach upon the minimum pool, and the wildlife habitats along the shores are soon made unusable by the layers of muck deposited. On the other hand, the removal of sediment by the reservoir may have a beneficial effect upon the stream below since the water released is cleansed of all but the finest particles.

The Seventy-ninth Congress recognized the value of reservoirs to fish and wildlife conservation, and passed Public Law 732 which authorizes the Secretary of the Interior, upon finding of the part of the project cost which can properly be allocated to these purposes, to make such an allocation on a nonreimbursable basis. This law, and its provisions for mandatory inter-agency cooperation on investigations, will go far toward insuring adequate consideration of these matters in future project planning. A still more far-reaching piece of legislation is now on the calendars of Congress, however. This bill (H. R. 2873) if passed in its present form, would provide for nonreimbursable allocations of cost not only to fish and wildlife, but also to general salinity control, recreation, and silt control.

"Life Extension" for Reservoirs

It behooves us, therefore, to give careful consideration to all possible means of conserving this natural resource of damsites, through extension to the maximum possible of the life of our reservoirs.

How then can we take the steps to assure maximum life of our reservoirs? Many suggestions have been advanced by engineers, geologists, and conservationists. Their proposals may be generally grouped in two classes; first, proper planning, design, and operation; and second, upstream sediment-control measures.

Through proper planning and design the loss of a reservoir may be delayed. Reservoir sites should be selected at locations where, with due regard to other considerations, the rate of sediment accumulation will be at a minimum. After a site has been selected, the very least we can do is assure ourselves that sufficient space has been allowed for accumulation of sediment which will not be exceeded within the period of amortization of the project.

In many reservoirs it has been observed that finer sediments entering a reservoir will, in some cases, remain in suspension and are transported to the lower end of the reservoir, at the dam. The use of these so-called "density currents" to discharge a portion of the sediment load has appealed to many engineers. Through proper location of outlet gates and through properly planned water releases, a certain measure of the sediment load can undoubtedly be discharged. All agree, however, that this possibility offers only a partial solution. They do not agree on the amount of reduction in sediment accumulation that can be obtained.

"Stalling Off" Sedimentation

In special cases, engineers have suggested bypassing the reservoir during periods of heavy sediment flow, sluicing of deposits, or removal by other methods. Even the most optimistic agree, however, that these measures are feasible only in isolated cases where special local conditions are extremely favorable.

It can be seen, therefore, that even with the most efficient planning, design, and operation of a reservoir, the best that can be expected is to "stall off" the eventual loss of a reservoir. These measures, while highly essential, can only mitigate the evil and cannot be considered a real cure.

Engineers are conscious of the obvious fact that if sediment were controlled at its source, if it were kept in place on the land and in the stream channels, the problem of reservoir sedimentation would cease to exist. There has been almost unanimous disagreement, however, as to the effectiveness of the various methods of watershed sediment control that have been proposed.

Without attempting in any sense, to evaluate their respective merits, here is an outline of the general methods of upstream sediment control which have been proposed.

Afforestation and Forest Management—including reestablishment of forests in areas which have been cut over or burned. This also includes proper management of existing forests, including scientific timber cutting, fire control and exclusion of grazing in order to protect sprouts of new trees. It is maintained by proponents of this method that forests lower the rate of erosion, conserve precipitation and equalize runoff.

Regrassing and Grassland Management—including revegetation of denuded areas with grasses, shrubs, vines, etc., and the maintenance of existing grassland through reseeding, fertilizing and grazing control. The purpose of maintaining grassland is to prevent sheet erosion, and the formulation and propogation of gullies.

Cultivation Practices—including crop rotation, increasing organic matter, mulching and seasonal cover crops for the purposes of maintaining better and more continuous vegetative cover. In the same general category the practices of strip cropping, contour cultivation and terracing are intended to reduce concentration of runoff and hence soil losses.

Protected Channelways and Gully Control—on the basis that one of the major sources of sediment is the channelways themselves, vegetative or other types of lining are intended to prevent gully formation. Where gullies have already been formed, vegetative control, diversion of runoff from gullies through terraces or water spreading devices, and the construction of check dams have been proposed as means of eliminating further gully development and the "healing" of existing gullies.

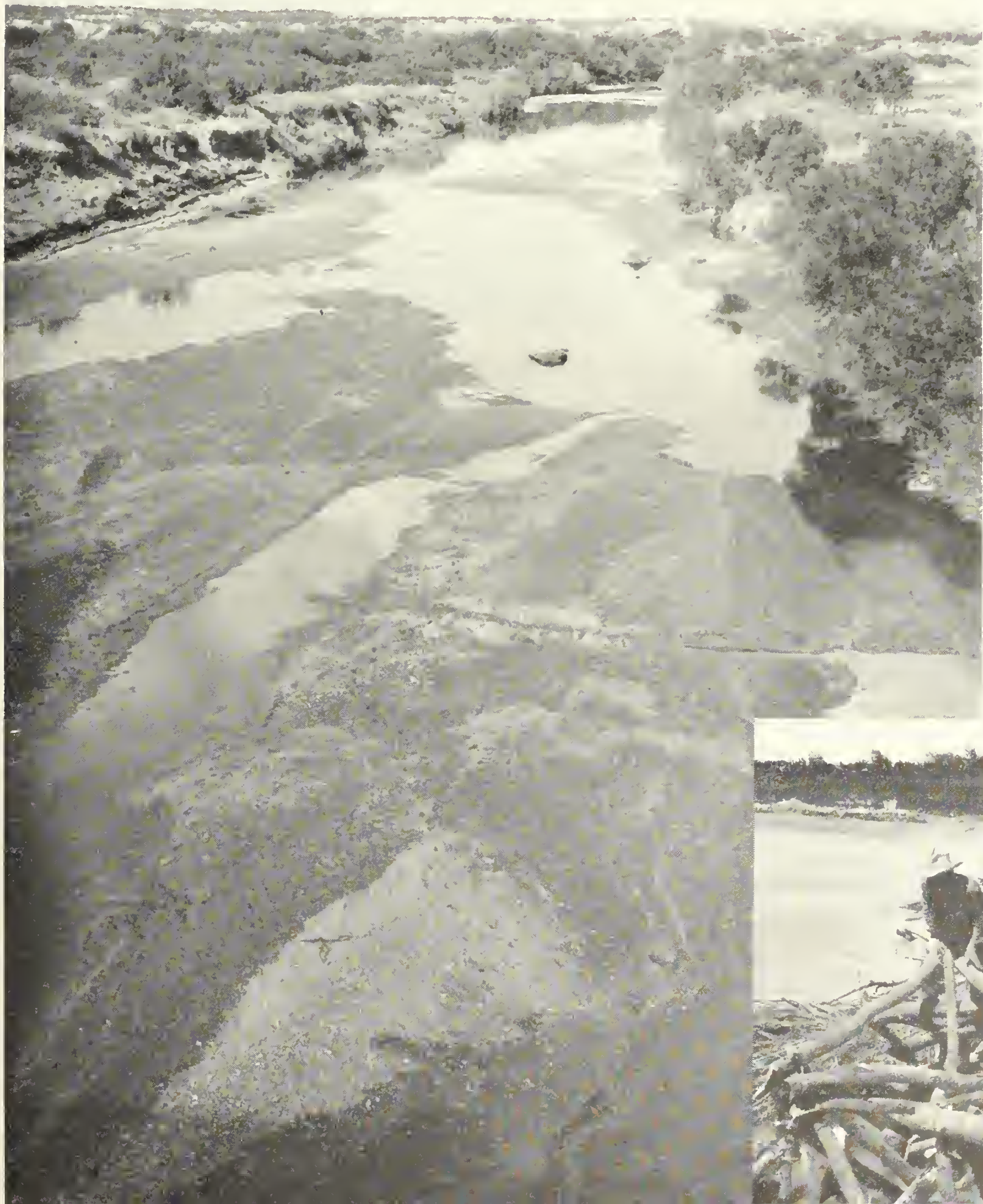
Sediment Detention Structures—including construction of dams on tributary or main streams for the sole purpose of keeping sediment out of downstream areas. Such dams may vary from small ponds to major river structures.

Water Spreading—by means of various types of barriers on streams, the purposes of which are to spread the water discharging from the pool behind the barrier over a great surface. Such spreading is intended to prevent erosion by reducing concentrations of water flow, to induce revegetation of areas on which the water is spread, and, as an incidental benefit, to store sediment behind the dam.

Stream Bank Protection—to eliminate erosion of major stream banks. Two methods have been proposed. The first is to blanket the eroding area by establishment of vegetative cover, such as grass sod or a stand of willows, or by brush and wire matting. The second method is to divert the high-velocity stream flow away from the banks by jetties constructed of timber piles, trees, stones, or other material.

Other methods proposed for controlling sediment at its source include protection of flood plains by hedgerows or similar vegetation, protection of reservoir shore lines, wildlife plantings in fence rows and other wasted areas of land, and propagation of beavers for the purpose of beaver-dam construction, suggested by biologists.

The problems of reservoir sedimentation are serious and vital, and deserving of serious consideration by all associated with development and conservation of water and land resources. These problems, together with various proposed methods of control, should offer food for thought to everyone. •



At left: Silt scars (note left bank) are prominent in this photo of the Gulf Coastal Basin, Robert Lee Project, Tex. Below: Mexican laborers installing river bank protection at Mission First Lift Pump, Valley Gravity Canal and Storage Project, Tex. Top photo by D. B. Parker, Region V. Bottom photo by Dale A. Hovey, formerly of Region V.

Multiple-Purpose Plow

by *Garford L. Wilkinson, Region V, Amarillo, Tex.*

All photos by Fred Finch, Region V

A revolutionary plow developed in the Nation's Dust Bowl a decade ago, and put to the test by producers in the Lower Rio Grande Valley in Texas may provide western irrigation farmers with the answer to their soil conservation and utilization problems.

The beneficial use of this plow to combat wind and water erosion, conserve moisture and increase production has been recognized since 1937, when drought and wind erosion combined to damage seriously 34,000,000 acres of farm land in a half dozen States. These plows have been used successfully for the last 10 years in the Great Plains States, Canada, Old Mexico, the Carolinas, and Georgia.

Widespread use of the plow in irrigated lands, however, was not initiated until 1946 when several of the largest operators in the citrus, vegetable and cotton growing areas of the Lower Rio Grande Valley made comparative tests between this "all-purpose plow" and the types of tillage machinery customarily used in the million-acre area.

The result of these tests, according to a large number of Lower Rio Grande Valley farmers, is phenomenal. For example, Jim Wade, of Edcouch, Tex., who owns and farms 2,600 acres of cotton, corn, and vegetable land, says, "this plow is the greatest plow that has ever been used in the Rio Grande Valley."

V. V. Winsett, Mission, Tex., said that the land prepared with this plow produced three-quarters of a bale per acre more of cotton than did the land prepared with the kind of machinery generally used by farmers in the region. Winsett said his test was made in the same field and that both plots received an equal amount of irrigation water.

R. H. Guinn, Edcouch, Tex., grows endive, escarole, dandelion, collards, mustard, turnips, carrots, cabbage, root parsley, and cotton. He declares that the use of this plow has cut his land preparation cost 75 percent and increased his production more than one-third per acre.

"Last year we got a fine increase in our cotton production on land prepared with this plow," Mr. Guinn said. "We grew 49 bales on 30 acres in 1947. Previously we had averaged about one-bale per acre. We also learned that less water was required on the land where we had used this new type plow."

H. G. Bannwarth, a young, good-looking farmer who lives near Mission, Tex., said he produced three-quarters of a bale of cotton per acre in 1947 on land prepared with this plow, whereas the same former lake-bed land, prepared in the usual manner, failed to return his investment in the crop.

D. J. McAlexander, farm manager for F. H. Vahlsing, Inc., Elsa, Tex., is using several of these plows on a 5,000-acre vegetable farm. "Our land preparation costs are reduced very materially by the use of this plow," said Mr. McAlexander, "and we consider it to be a valuable adjunct to our line of equipment."

Those are the statements of a few of the several hundred irrigation farmers in the Lower Rio Grande Valley who are using this plow. This is their story. The Bureau of Reclamation has undertaken no studies of the equipment or the results claimed for it. The statements by the farmers in the Lower Rio Grande Valley who are using the plow were obtained directly from them by a representative of the Reclamation Era, and are being reported in the belief that the experiences of these farmers will be of interest to farmers in other irrigated sections of the West. However, no reports have been received regarding the use of the plow on irrigated lands made up of sandy soils, where deep penetration of water is a deterring rather than an advantageous factor.

THE PLOW—*R. H. Guinn, first user of the all-purpose plow in the Texas Lower Rio Grande Valley is one of its staunchest supporters because it has saved him 75 percent of land preparation costs.*

The first model of this "all-purpose plow" was fashioned in a farm blacksmith shop in the Oklahoma Panhandle during the dark days of the middle 1930's when thousands of farmers in the Great Plains area were packing up their small possessions, loading their families in dilapidated cars and fading away in the pall of smothering dust, some to become leading characters in The Grapes of Wrath.

In 1929, Bill Graham, still under 30 years of age, owned one of the prettiest farms to be found on the South Plains, near Silverton, Tex. His fields were smooth and clean. The mortgage had been reduced after each succeeding harvest. The soil, the crops and the prices for his produce foretold a life of security for the family's agricultural kingdom. Then came the crash! Wheat sold for 18 to 25 cents a bushel. It was of such small value that many Plains farmers used it for fuel. And then the rains failed!

The Great Plains area, from Canada down through the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, took on the appearance of another world—some strange planet—unbelievably barren. Former fields of waving golden grain were seared. A tour through the area was like moving up to the front line on a battlefield. Skeletons of horses and cows, broken windmills, rusted cultivators, abandoned houses and farm buildings half buried in the incessant, shifting sand, dotted the landscape.

Bill Graham remembers well that first dust storm. Men prayed for rain in those years. That Sunday afternoon, Bill Graham thought the cloud in the northern sky was a rain boiling across the horizon. He ran bareheaded from the house into the yard with arms outstretched to embrace it. A moment later, half-blinded by sand, he stumbled back into the house to help his wife dampen bed sheets, and spread them over the little baby girl to keep her from suffocating. But neither Bill Graham nor any of the thousands of Great Plains farmers could spread wet sheets over their burning fields. The land lay bare and smooth and powdered at the mercy of the winds.

For three tortuous years Bill Graham used every means available to halt erosion and stop the destruction. Nothing he did was successful. One June day in 1937, the combine crew arrived to cut Graham's wheat. He calculated that if he helped out as a hand he might get enough for his year's work to pay for his harvesting and keep his credit at the grocery store alive. Even so, he was more fortunate than many of his neighbors.

Graham had his tractor hooked to his disk plow by the time the wheat had been harvested. "If you disk that field again, you'll ruin it," the combine man told him.

"What else can a man do?" Graham asked.

"There's a farmer up in the Oklahoma Panhandle," the combine man replied, "who has saved most of his soil and is producing fair crops right through the dust storms by using a cultivator he made himself. His name is Fred Hoeme."

Before the sun set that day, Graham was knocking on the door of Fred Hoeme in Oklahoma's "No Man's Land." But when he saw the farm implement that had been described to him by the combine man he shook his head.

"What's the matter?" Hoeme asked.

"What I need is right plowing. That doesn't look like any plow I've ever seen." Hoeme didn't argue. He took Graham out to a healthy field of wheat in which there were no signs of blowing. Across the fence on similar land lay sand dunes and barren subsoil. Hoeme then explained how he had developed the new farm tool.

THAT SAVED—***The plow is used on former waste land that has been graded and leveled, breaking up the hard plow-sole, leaving a roughed-up surface which permits maximum moisture penetration.***

During the height of the dust bowl tragedy in 1935, a highway worker had dragged a scarifier—an implement with long spikes for tearing up the surface of the roads—across Hoeme's field, digging a number of deep furrows. The next year the wheat growing where those furrows had been dug was healthy, vigorous, and over a foot higher than the wheat in the rest of the fields.

It was evident to Hoeme that the scarifier had caused the difference in the soil and the yield. He decided to build one for use on all of his farm land. He welded curved shanks three feet apart, with two-inch chisels on them, to a railroad iron. This was mounted on wheels and used to dig furrows in his wheat before the winds began to blow in the spring. He produced a fairly successful crop that first year. By planting time he rebuilt his first crude instrument into a full-scale cultivator by adding more beams and staggering the shanks so that they dug furrows 1 foot, instead of 3 feet, apart.

When Bill Graham returned to his South Plains home he took one of Fred Hoeme's new-fangled implements with him. He used it to plow deep. Graham's neighbors laughed when they saw what he was doing to his land. He didn't blame them a bit, for the fields no longer were smooth and clean, the way good farmers tilled their soil. Instead, there were little 6-inch terraces a foot apart, most of them covered with stalks, straw, grass and weeds. It was a sorry looking mess. Graham dug into the ground to see what had happened. He learned that the resilient, pumping shanks with their chisel points had penetrated the hard subsoil and opened cracks and fissures in all directions. He learned also that the powdered dirt began sifting down beneath the clods and vegetation. The wind couldn't get to it.

But Bill Graham didn't know what he had discovered until a week later when a 5-inch rain fell on the parched, hardened soil. He went into the fields to make an investigation. The water had disappeared almost as if by magic. On a smooth disked field next to his, the powdered dirt had caked and sealed over, causing heavy erosion and loss of most of the rainfall. On another field, plowed with a lister, the water had raced down the steep furrows taking part of the topsoil with it.

When it was dry enough, Graham dug holes in his fields. He found that the moisture had penetrated two to four times deeper where he had used Hoeme's implement. Later, United States Department of Agriculture employees (Soil Conservation Service) inspected the fields. Their reports showed that there was "moisture penetration to a depth of 52 inches on land which had been cultivated with the Hoeme plow."

The Soil Conservation report continued: "Moisture penetration checks were also made on adjoining land of the same slope and same type of soil at the same time and we found moisture penetration to a depth of 24 inches on land which had been cultivated with a one-way plow."

This new implement had put the moisture down deep in the subsoil to be stored and used as required by plant life.

Graham's wheat, grown on land prepared with this new type plow, produced more stalk. It sent down more feeders into the ground, and it improved in color and yield. His land required less seed than before.

This experience changed Bill Graham's life. He reasoned that if this plow would save his soil from wind and water erosion and at the same time produce larger crops, why wouldn't it help farmers throughout the world? He became a salvationist of soil. He and Fred Hoeme began making plows for other farmers in the Great Plains area. Since they made the first ones for sale, the plows have been used widely in Canada, the Great Plains States and Mexico. In North and South Carolina and in Georgia they are used for the revitalization and rebuilding of worn-out, eroded land.

Bill Graham's hopes to provide a plow for every farmer who needed one, and the idea of gearing production to an automobile-

THE PLAINS—***V. V. Winsett, Mission, Tex., farmer, is another booster for the plow. He claims greatly reduced land preparation costs and doubled cotton production.***

assembly line didn't appeal to Fred Hoeme. So in 1939 Graham bought Hoeme's patents and began manufacturing the plows in an old garage in Amarillo, Tex. There, in what has grown to be a huge factory, with a branch in Pueblo, Colo., and a business association with a steel mill, the orders for the plows pour in faster than they can be supplied.

In the years since he used the first home-made implement, Graham has added features to the plow which he had developed on his own farm and by the experiences of users all over the country. Today the plow bears but little resemblance to Hoeme's first crude device. Now it is made in widths from 8 to 34 feet, the largest model being hinged 8 feet from each end so that it will plow on three contours at the same time.

The plow is described as "revolutionary" because it goes back to the first principles in plowing—that of the aborigine with his pointed stick. The plow stirs the soil deeply but does not turn it over. Graham says this is the way God intended land to be cultivated.

Two years ago Graham produced a set of knives, a pair of them attached at an angle behind each chisel. These knives run flat just under the surface of the ground, as deep as 4 inches, and cut weeds and leave them to decay. Also they break up the continuity of the soil and thus cut off the capillary action which funnels up water to be wasted in air and lost to evaporation.

One variation added just before the war, and soon to be reintroduced as more material becomes available, is a combined plow and drill. This simply mounts drills behind each chisel or spike and you plant your grain as you plow. This, it is said, is the long-sought, single-treatment tool for grain farmers. Another variation from the regular plow is the use of strong springs on each chisel. This feature is designed for use in ground where there are large boulders. The use of the springs permits the chisels to relax when they strike an immovable object.

Lower Rio Grande Valley farmers, however, use only the regular all-purpose plows which it is claimed are built to last a lifetime, with nothing to grease or wear out.

Jim Wade, who has been an irrigation farmer in the Valley since 1917, and his two sons, J. H. and J. R. Wade, Jr., graduates of Texas A. & M., own several of these all-purpose plows, all of different sizes. They use the smaller ones on land that has been in cultivation for a number of years. The large ones are used on former waste land that is first levelled and then plowed. Large track-type tractors are required to pull the plows on land that is tight and packed as hard as concrete. However, the plow, according to Mr. Wade, never jumps out of the ground and will plow as much as 18 inches deep or as long as there is sufficient power to keep it moving.

"I've learned that by using these plows on my new and old land I can penetrate the soil to greater depths and yet leave trash and humus on top," Mr. Wade said. "It is the best and most economical plow I've ever used. It conserves moisture, the land requires less frequent irrigation, because there is less baking, and my crops produce more than I ever dreamed possible."

Lee Prater uses the all-purpose plow on his 50-acre farm at Monte Alto, Tex. "I estimate that I have cut my land preparation and cultivation cost 50 percent since I began using Mr. Graham's plow," Mr. Prater declared. "I seriously believe that Mr. Graham has done the small and big farmer of America a big favor in developing this plow."

Mr. Prater utilizes the 8-foot plow for various types of work, using a small tractor for power. "I pull my plow as deep as it will go into the ground and I use it to prepare my land for planting, to chisel my corn and cotton middles before irrigating, and to plow out my carrots. I would like for all other farmers, especially the small operators, to discover the value of this implement."

Walter Rabe and his son, Bill, farm 800 acres of irrigated land in the Valley. They have two of these new-type plows. "We have found the answers to every wish in these plows," the elder Rabe volunteered. "This includes the matter of economy, sturdiness and simple operation. They have definitely left our land in better condition than it ever was before under various methods of cultivation."

Mr. Guinn, previously mentioned, was the first irrigation farmer to use the all-purpose plow in the Lower Rio Grande Valley. He claims his one plow is doing work formerly requiring three plows. "I have made the statement repeatedly that if I could not get another Graham plow I would not take $5,000 for the one I have. This one has more than saved its cost in what I would have spent on grease alone with other types of plows," he declared.

Space does not permit more statements from the many irrigation farmers in the Valley who now use this plow, nor did time allow an interview with but more than a score of them, for each one contacted said, in effect, "let me put you up for the night so I'll have time to tell you about this plow."

Bill Graham has thousands of written testimonials from farmers in many sections of the country and reports from experiment stations which have tested the results of his plow. He appreciates the letters, but doesn't care to discuss them. At heart he remains a Texas farmer, so much so that he often keeps important business callers waiting while he chews the fat with a group of men who have had the same farming problems that he has experienced. He says that most of his improvements for the plow have been suggested by actual dirt farmers. He makes no personal attempt to sell his plows. He prefers that potential buyers talk to the men who are using them. ●

Food Production Plan

(*Continued from page 42*)

of which would result from the normal construction program of the Bureau. However, it would be a mistake to consider this amount the total of the food contribution, or to assume that the need for such production would disappear in 1952. If it is true that Americans are consuming 25 percent more food now than before the war, and that trends from agricultural to urban pursuits are continuing, the need for greater production is apparent.

Many of the projects of the Bureau take a long time to build, even at the most accelerated rate, and many are excluded from this program because the time for construction is too short, or because nature will not fill the required reservoirs in time to be effective by 1952.

During the year 1946, all irrigated farms in the United States produced 40 million tons of crops. This figure can be doubled several times before our water supply is fully used.

It is doubtful if the dry farms will be able to maintain the bumper crop production of recent years. For several years, the great farm lands of our country have enjoyed better than normal precipitation. Any drought period in our Western States would increase the value of irrigation beyond its already important contribution to our food supply.

The type of food to be produced is very important, in an analysis of the contribution of irrigation to the world food shortage. Many of the crops cannot be produced in greater quantity economically except by irrigation, and moreover, they already occupy an important place in our needs. These foods will become increasingly critical as available supplies of grain are reduced by exports.

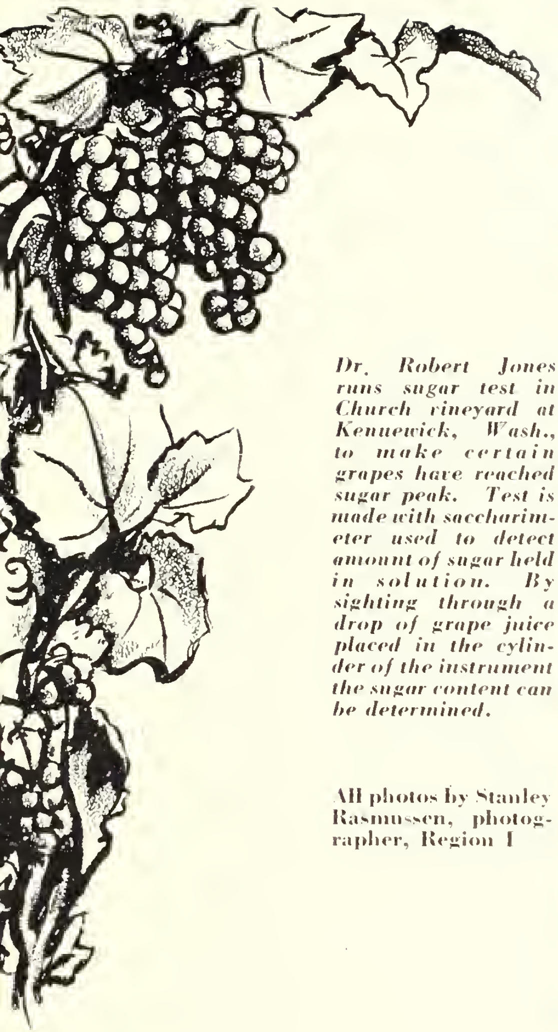
Other Benefits

It is probable that irrigation investment is one of the few ways, if not the only way, in which aid to Europe *and to ourselves* can be met without nonrecoverable grant from the Federal Government. The repayment nature of Reclamation is well known. Not so well known is the indirect manner in which the Government is repaid many times through broadening the base for taxation.

The secondary benefits of power, industrialization, and supporting communities, may far exceed direct repayments in returns through taxation.

Flood control, soil conservation, recreation, and fish and wildlife benefits are likewise important. *In short, the benefits that*

(*Continued on page 60*)



Dr. Robert Jones runs sugar test in Church vineyard at Kennewick, Wash., to make certain grapes have reached sugar peak. Test is made with saccharimeter used to detect amount of sugar held in solution. By sighting through a drop of grape juice placed in the cylinder of the instrument the sugar content can be determined.

All photos by Stanley Rasmussen, photographer, Region 1

Grapes

Producers on the Kennewick Division of the Yakima project in the State of Washington claim their Concord grapes are sweetest

By FRANK D. MAUPIN, ***Secretary, Kennewick Project Committee, Kennewick, Wash.***

Washington State, and particularly the ver Yakima River Valley, was introduced the Concord grape industry via the chen stove.

M. H. Church, a native of the Michigan ape belt, migrated to Kennewick, Wash., 1907, when irrigation was initiated in e lower Yakima River Valley. Mr. urch brought with him a few Concord ape plants from his native State and inted them in his yard. He and Mrs. urch picked their grapes the first year d pressed them into juice in their kitchen. e little mail-order hand press they used still in possession of the company he unded. In 1913, Mr. Church, whose business was ice and cold storage, installed a press in his ice plant and produced his first commercial grape juice.

In tribute to his farsightedness, the grape juice company retains the name of its founder, Mr. Church, who passed away 20 years ago. The company is now under the direction of F. M. Ludlow, of Kennewick, general manager; J. G. Kelly, Walla Walla, Wash., publisher, president; and Donald Sherwood, of Walla Walla, vice president.

There is a part of Washington State where Concord grapes take on a maximum amount of natural sugar, and that is around Kennewick and Pasco, where the Yakima and Snake Rivers flow into the Columbia. The altitude at Kennewick is only 365 feet above sea level, and the rainfall about 7 inches annually. The soil is reasonably light and the growing season about 2 to 3 weeks longer than other irrigated areas of the Northwest. This combination seems to account for the high sugar content and the low acidity that makes naturally sweet grape juice so palatable and desirable. The area centering at Kennewick is the only known location in the Nation where this condition exists.

Pioneering of Concords was slow, and it was not until 1937 that Mr. Church's company and others began development of this crop in earnest. That year the company planted 500 acres of its own grapes and began contracting with private growers to do likewise. Since 1943 individual growers have planted grapes on a large scale for the reason that all processors in the area are contracting for the crops 10 years in advance, and guaranteeing a floor price of $25 per ton for the entire contract term. As a result, Concord acreage now is into the thousands of acres. In 1946 the growers were paid $80 per ton for their Concords, and even with high farm labor costs, most growers were realizing a substantial profit from their vineyards.

Yields of Concords in lower Yakima Valley is unusually high, averaging 6 tons to the acre or more. Frequently the yield is as high as 10 and 12 tons per acre. In 1945, two vineyards, one 70 acres and one 30 acres, averaged 10 tons per acre. The life of a Concord vineyard is known to be up to 60 years, and many of them 10 to 20 years old are at their peak production. Medium sandy-loam soils are among the best producers, although excellent yields are obtained in most soils from heavy to light-sandy, where good husbandry is practiced.

Over 700 growers service the Church plant at Kennewick, and probably an equivalent number for 2 other plants situated in Grandview, 40 miles to the northwest. These two plants are operated by a garden products company with headquarters in San Francisco, and a juice-producing company, subsidiary to a Chicago company, which uses juice for jams, jellies, and flavors.

The average individual planting of Concords is usually small, ranging from single-acre vineyards to 35 or 40 acres. Newer vineyards are planted in 9- or 10-foot rows spaced 8 feet in the row. This plan allows the use of ordinary farm trucks for transporting the field lugs direct to the processor with one handling. This spacing also allows for ease in cultivation, and the use of green manure for fertilization. Fertilizing programs usually include barnyard, Austrian Winter peas for green manure, and commercial 16–20.

Since the last 4 years have shown tremendous growth in Concord plantings, the county agents, State College of Washington, and the irrigation experiment station have taken an active part in the study of practical irrigation, cultivation, fertilization, and pest-control programs. Well-attended grape-grower schools are held in Kennewick, Pasco, and Grandview, where various problems are studied and discussed. Included in the agenda is field demonstrations of pruning, so important to good yields. Dr. John Snyder, of Washington State College, has conducted these schools for many years.

The Church Grape Juice Co. has recently established a research department under the leadership of Dr. R. E. Jones, plant specialist from the University of Maryland. This research work will cover all phases of grape culture, in cooperation with other agencies interested in this educational phase of grape culture.

Sugar Tells the Time

Harvest time is determined by sugar test, and when the required sugar is present the vineyards are cleaned with one picking. This usually starts about September 15 at Kennewick, and continues until October 25 in the Sunnyside area to the west.

Picking is done into 30-pound lug boxes placed in alternate rows in the vineyards. The truck drives down the clear row and the filled lug boxes are handed over the 5-foot trellis onto the flatbed truck. The truck goes direct to the processor for unloading, its weight being checked en route. The lugs are wheeled from the truck bed with standard hand trucks. The trucker then loads empty lugs and returns to the vineyards, scattering them directly ahead of the picking crew. Some pickers will pick 100 lugs a day. The 1946 wage was 14 cents per lug.

Pressing the juice is comparatively simple compared to other food processing. In the Church plant, the lugs are wheeled from the farm truck to an automatic dumper, which drops the grapes into a wash pit, and sends the empty lugs away on a conveyor. The grapes are then crushed, stemmed, and the resulting pulp pumped to the press filling stations. Here mats, or "cheeses" of pulp are made and inserted into the press, where, under 2,000- to 3,000-pound pressure, the juice is removed to the last drop. The juice is then pasteurized and placed in 5-gallon glass demijohns for storage, being rebottled later from these containers into the retail pint and quart bottles for shipment to 27 of the 48 States.

While comparatively new, the Concord grape sector of Washington farming is due for much further expansion. New York, Michigan, and Arkansas have previously supplied most markets, but all of these areas require the addition of sugar for a palatable drink. Production is declining in the Eastern grape belts, and the total for the Nation has declined from 270,700 tons in 1929 to 165,300 tons in 1946. The Washington production has shown a steady increase from 7,600 tons in 1929 to 21,700 tons in 1946, and the increase during that period has been constant.

The southern portion of the million-acre Columbia Basin project is adjacent to this area and crops similar to those produced in the Kennewick section, including Concords, will, no doubt, be grown. The initial 5,400-acre unit of this project, which is to be irrigated for the first time next spring by direct pumping from the Columbia River, will get its share of Concord plantings.

The Kennewick Division of the Yakima project, which local people are urging the Bureau of Reclamation to construct, will make an additional 16,000 acres of land available in the Yakima River area. Much of it will probably go into Concord grapes.

Grape mash is poured into blanket-lined tray and placed under hydraulic presses.

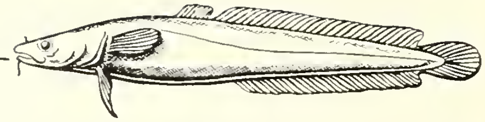
Closeup of six huge presses which squeeze the grape juice from the mash.

Irrigation supply for Kennewick grape area is provided by Bureau of Reclamation.

These eleven grape juice pasteurizers are in constant around-the-clock service during harvest season at the Church Grape Juice Co., Kennewick, Wash.

Just a small portion of the finished product derived from the Church Co.'s output which averages a million gallons monthly during the season.

Ling Fishing



by H. P. Vogt

Safety Inspector, Riverton Project, Wyo., Region VI

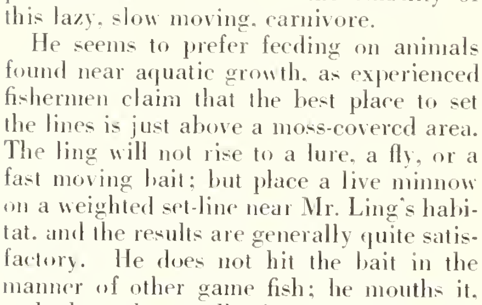
Ocean Lake, commonly called the Ocean, that 6,300-acre natural basin filled with a year-round supply of drain water from the irrigation system, lies within the heart of the Riverton, Wyo., project. It offers fishing opportunities the year round—perch, crappies, blue-gills and bass—but during the winter season, when the ice really forms, it becomes the mecca of the ling fisherman.

The ling is a member of the codfish family and the only American member of that family inhabitating fresh water. It is thought to be a native of the Wind River headwaters and peculiar to this area. To the uniformed, he appeared as a hybrid—a hyphenated version of a fish, with an eel body and a catfish mouth.

The mottled, olive-colored skin is best removed with a pair of pliers, revealing a chicken-white meat firmly adhering to the well defined backbone. The general appearance is no tribute to the edibility of this lazy, slow moving, carnivore.

He seems to prefer feeding on animals found near aquatic growth, as experienced fishermen claim that the best place to set the lines is just above a moss-covered area. The ling will not rise to a lure, a fly, or a fast moving bait; but place a live minnow on a weighted set-line near Mr. Ling's habitat, and the results are generally quite satisfactory. He does not hit the bait in the manner of other game fish; he mouths it, and then the swallowing process starts. Devotees of this sport often have the experience of losing a ling the moment his large mouth leaves the water. As soon as he breathes the fresh air, the fish opens his mouth and falls back immediately, indicating that it was merely holding the bait.

These conditions and characteristics make fishing through the ice the great sport that it is at Ocean Lake, just 15 miles west of Riverton on the road to Yellowstone Park. It lures people from all parts of the country.



The ice hole digger at work.

Although the ling is caught during the day, the confirmed fisherman claims he feeds better at night. Local authorities contend that clear, cold nights are preferred; the ice should be at least 10 inches thick, with very little snow covering; the less wind the better, and with a rising barometer you have perfect ling-fishing conditions.

Upon arriving at Ocean Lake, the members of the fishing party will hurriedly set up camp unless they are cummuting back and forth between a nearby camp, ranch, or town. Then comes the labor of cutting the holes for the set lines. No party will be satisfied with less than 20 lines. The chalk lines are then baited with live minnows (preferred length, about 6 inches), weighed, and tied to a stick which rests across the holes. (Incidentally, it is illegal to use carp minnows in Wyoming.) Then at about 3-hour intervals, the lines are "run," the fish are taken off, and the hooks are rebaited. Rebaiting is not always necessary if the ling hasn't swallowed the minnow.

It is no uncommon sight to see several cars traveling slowly on the ice, while the headlights are used to "run" the lines. This is by no means a mild experience. Leaving camp is no feat, but after traveling on the ice for the better part of an hour with other cars in the distance, the landmarks become indistinct. After returning to camp, sometimes only by the guidance of other more orientated fishermen, the party will spend its time consuming gallons of hot coffee and probably using a deck of cards to determine the dishwasher for the following day. After about 3 hours, the lines are run again. Should it be an exceptionally cold night, a roaring sagebrush fire is extremely appropriate. The next morning the lines are run for the day and preparations made for the next night's luck, probably by cutting more holes in a different area.

The 20-mile shore line of Ocean Lake offers ample opportunity for free fishing. If the adjacent land is privately owned, all that is necessary is for the fisherman to get permission to cross. Some areas are still public domain and "no trespassing" signs are not the general rule.

The Wyoming State Game and Fish Department has acquired a tract joining Ocean Lake which is to be developed into a State park. This is in accordance with the trend to keep this area free of private and Federal isolation. The Missouri River Basin staff of the United States Fish and Wildlife Service has made preliminary studies, evaluating the wild-life resources, in keeping with such programs wherever water impounding is planned.

However, some commercialization has invaded even this area. About 10 years ago one of the project farmers whose land was partly inundated by the then rising waters of Ocean Lake, recognized its commercial possibilities. He put up a few cabins and offered meal service, but his greatest drawing card was the fact that he had minnows for sale. He recently sold his place, which was not valued for its farming potentialities, for a considerable sum. Another camp nearby is going into the business of catering to the ling fishermen in a big way. A satisfactory restaurant, a dozen cabins, and above all, a mechanical ice hole digger, are featured attractions. Week-end reservations must be made in advance. This digger, with a hole drilling attachment, is available for fishermen at a dime a hole. This is probably the only one of its kind in use, as the auger had to be specially fitted with saw teeth.

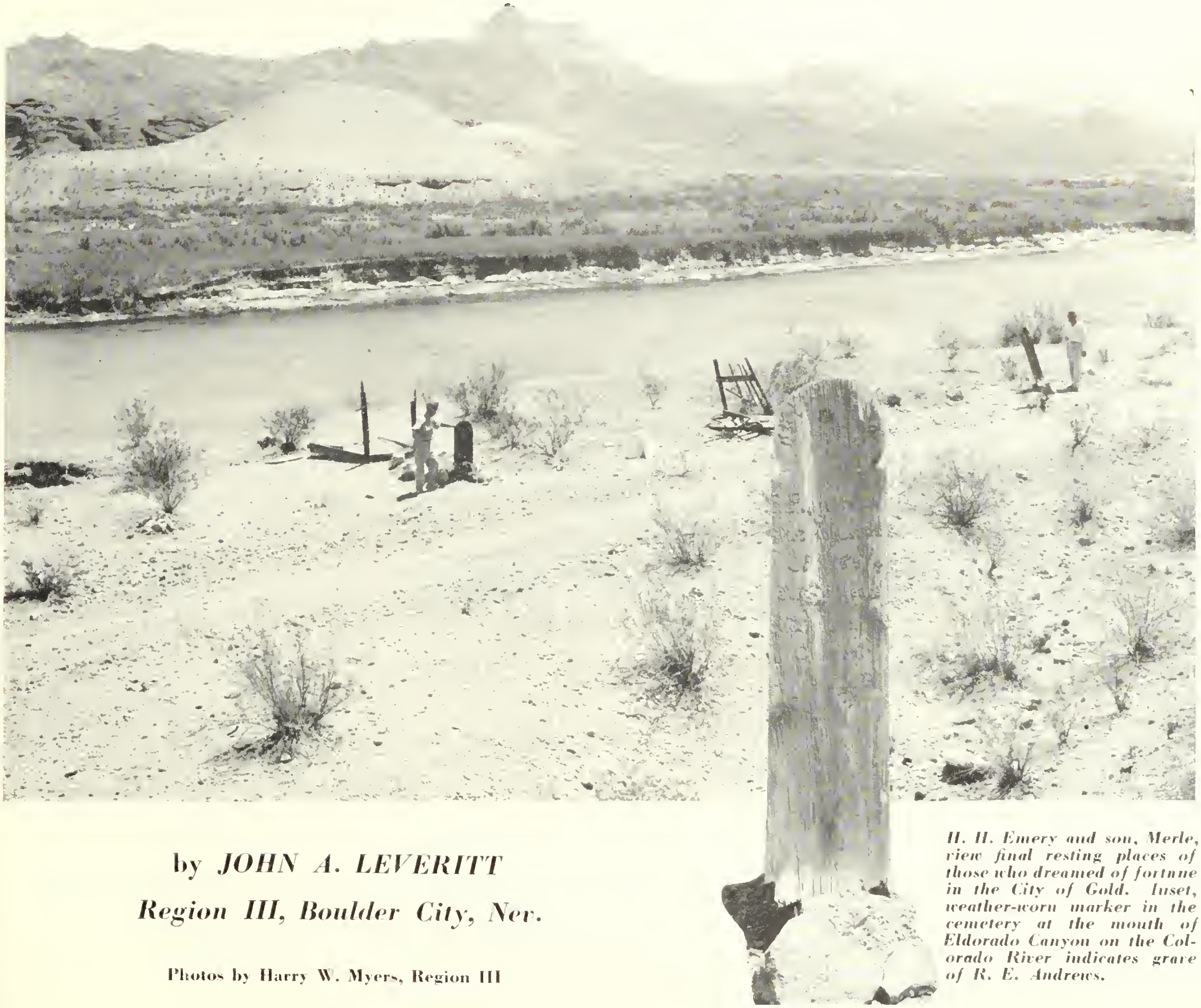
The matter of supplying minnows has become more than a passing problem. They can be purchased at the fishing camps for $0.75 a dozen. One of the owners of the camps one season employed two men full-time to spend their time keeping his tanks stocked with minnows. These two camps will use, during a poor season, several thousand dozen minnows for their customers. Several people have made the sale of minnows their principal winter income in Riverton. One of these stated that he could sell up to 10,000 dozen if he were equipped to handle them properly. These minnows are caught in the streams of Freemont County and then hauled to the ocean. Some authorities feel that an opportunity for minnow farms exists here.

It is estimated that 10,000 ling are taken each season, which is principally between December and February as the ling spawn in early March. They generally vary from 1 to 14 pounds, the average being about 4 pounds. Some fishermen contend that the ling are fewer and smaller than they were a few years ago. This may be a matter of conjecture, but the State Game Department points out that the failure to "run" the lines causes the greatest waste of fish. The Department estimates that a thousand ling die each season simply because they are left on the lines—a serious potential menace according to these authorities.

They point out that this may cause a condition experienced in another State. Dead fish were washed up by the waves and piled 3 and 4 feet on the shores. Neighboring farmers were forced to vacate. Game officials wearing masks cleaned the area at an enormous expense. This is the reason Ocean Lake fishing is encouraged the year-round under proper procedure. It is estimated that only a tenth of the crappie, for

(Continued on inside back cover)

Thirteen Graves in Eldorado



H. H. Emery and son, Merle, view final resting places of those who dreamed of fortune in the City of Gold. Inset, weather-worn marker in the cemetery at the mouth of Eldorado Canyon on the Colorado River indicates grave of R. E. Andrews.

by ***JOHN A. LEVERITT***

Region III, Boulder City, Nev.

Photos by Harry W. Myers, Region III

Romantic tales of an almost forgotten mining camp on the Colorado River 30 miles below Hoover Dam are being brought to light by the construction of Davis Dam by the Bureau of Reclamation.

This rambunctious camp, located at the mouth of Eldorado Canyon and known as Eldorado, thrived for about 50 years and then withered. It was established by some of the lusty pioneers who roamed the West during the mid 1800's in a mad search for precious gold and silver deposits.

During an investigation of the area which will be inundated when Davis Dam is completed, Bureau engineers looked over the few remaining vestiges of the once riotous community and discovered that the camp's cemetery would be near the reservoir line—in danger of being washed away.

Since the cemetery, which lies on a gravel bluff overlooking a fishing dock now known as Emery's Landing, would have to be moved, attempts have been made to identify the occupants of the thirteen remaining graves. This has been difficult, as only three of the graves are marked and existing records of the camp are scanty, but the search has uncovered some interesting legends.

It is not known definitely when Eldorado was established, but gold was probably first found in the canyon in 1857 when the Honest Miner mine was discovered. Claims were made between 1857 and 1859 for some of the other better mines in the canyon such as the Techatticup, Wall Street, Quaker City, and Mockingbird.

The mines were up the canyon from the river, but the main camp was established on the river bank since water was necessary for the mill and bringing supplies in by river boat from Yuma. There is a highly improbable estimate that by 1863 there were as many as 1,500 people in the area. No one can prove it, however.

Those who first laid out the camp underestimated the strength of the Colorado. Most of the camp was built right on the river and the site is now the bed of the stream—the river changed its course during one of the high floods. Merle Emery, who runs the fishing dock at Eldorado, says that wagon wheels, mill equipment and other property from Eldorado may still be found on the river banks downstream.

About all that remains of Eldorado are two of the mill buildings which were on higher ground, an antiquated steam tractor which was designed to pull the ore wagons from the mines to the mill, and the cemetery. A large stack of broken whisky bottles adjacent to the cemetery seems to prove a saloon was once nearby.

For more than a half century the 13 remaining graves have baked in the desert sun and weathered the rare but torrential downpours. It is said that two-thirds of the cemetery was washed away when the river was on one of its rampages before Hoover Dam was constructed in 1931–36.

Some of the mounds have been so weatherbeaten that they are hardly discernible. Two of the markers are of wood and the epitaphs are barely legible. Apparently the names and other information were painted on and now, although the paint has faded, the printing stands out in faint relief against the weather-worn wood.

The other marker is a neat, white marble headpiece incongruously standing in this drab, cheerless spot. The stone marks the last resting place of Cornelius Conover who died May 26, 1888, at the age of 56. Despite the influence Conover must have once had to rate such a comparatively elaborate marker, nothing has yet been learned about him.

The other two marked graves are those of R. E. Andrews, who died August 25, 1881, and Lars Frandsen, who died May 12, 1897. Frandsen is the only one of the three who died in such a fashion that his demise is remembered in legend.

The handful of oldtimers who live in the area still recount the yarn occasionally as they loaf away an evening at the Twin Gables general store at Nelson, Nev., the town which replaced Eldorado as headquarters for the area about the turn of the century.

On May 12, 1897, Frandsen and another teamster were driving two of the huge ore wagons down the canyon from one of the mines to the mill at Eldorado. The teamsters stopped at Huess Spring, 1 mile below Nelson, to rest and water their horses. On a bluff overlooking the spring hid Avote, a surly Paiute Indian who had worked around the area for some time and was well known for his jealousy concerning his good-looking squaw. The story goes that he had been heard muttering threats regarding his suspicions of Frandsen and the other teamster. As the men mounted their wagons to leave, Avote blazed away and shot them both.

When the wagons were overdue for several hours, a man was sent to investigate and found one man mortally wounded and the other dead. After this shooting, Avote apparently decided to wipe out all the white men in the canyon and give it back to the Indians. He ran amuck. His next victim was Charlie Nelson, for whom the town of Nelson was named.

Later he sneaked up to the cabin of Charlie Monohan, a partner in the mining firm of Monohan and Murphy, and killed him. The next morning Judge Morton was preparing breakfast in his cabin. He had not heard of the killings. From his doorway he saw Avote coming over the hill and put on some extra beans and coffee for the Indian. Avote accepted the hospitality and then, quite inhospitably, shot the judge.

By this time the whole canyon was up in arms and after Avote. A posse of white men was formed, but was unable to locate the wily Paiute. It took an Indian to track an Indian, and so the posse—as was often done in those days—resorted to that stratagem. A party of Indians, threatened with dire consequences if they did not capture Avote dead or alive, found him on Cottonwood Island, several miles downstream, and brought his head back in a burlap bag to save their own skins.

This story, one of many of murder and mayhem in the canyon, is told by Yeoman Briggs, a former accountant from the East who has several claims in the area and has worked them himself since 1931. Briggs, a gregarious chap, has collected a great deal of the lore of the canyon, but he admits that much of the information and many of the stories probably are not too accurate. He presumes that the other teamster (name unknown) was also buried at Eldorado, but has no way of proving whether the others Avote shot might be among those who were buried in the unmarked graves of Eldorado.

Briggs has a chronological history of the camp gained from mining company records, the few published works mentioning the canyon which he has been able to find, and from talking with the older residents. During the Civil War and only a few years after gold was discovered, the camp probably was about as large as it ever became.

A few years after the war, the Barker brothers of Philadelphia purchased the Techatticup mine and formed the South West Mining Co. In a short time the company controlled all of the proven mines in the canyon. Until 1900 this company dominated the life of the whole community.

The Barkers were absentee owners and so the managers of the company were the bigwigs of Eldorado during this period. Perhaps the most famous of these managers was Charlie Gracey who first worked as a blacksmith in the camp. Gracey was a religious man and deplored the morals of the rip-roaring mining camp. There is a story that Gracey insisted upon two cemeteries, one for Christians with a chance for Heaven, and the other for the renegades. Only two gained admission to the Christian cemetery. Briggs says there is no factual basis for this story, that it was originated to illustrate Gracey's piety and the general cussedness of the rest of the camp.

The era of the South West Mining Co. ended in 1900. The next generation of Barkers became involved in a mining deal in South America and mortgaged the property to finance it. They lost out and the property was sold to Joseph Wharton of the Wharton Steel & Iron Co.—a dominant figure in the nickel-mining business. A Philadelphia Quaker, Wharton was one of the richest men in the country and his three visits to his property in Nevada were big events. (Continued on inside back cover)

MUTE EVIDENCE *of the fact that there was once a large gold mining settlement at the mouth of Eldorado Canyon is this old steam tractor. It was used to move ore to the mill, located near the river because of the availability of water.*

AFGHANISTAN'S
Reclamation Program

Afghanistan, in mid-Asia half a world away, has much in common with the United States when it comes to Reclamation.

In a recent visit with Commissioner Michael W. Straus, in Washington, D. C., His Excellency, Mohammad Kabir Ludin, Minister of Public Works, who, only a decade ago, was a State Department trainee placed with the Bureau of Reclamation, discussed such mutual problems as repayment policies, acreage limitation, and river-basin developments.

Mr. Ludin is proud of being a "graduate" of the Bureau of Reclamation. Ten years ago when he was completing his Master of Civil Engineering degree at Cornell University and contemplating work towards a doctorate, one of his professors advised him that 1 year with the Bureau of Reclamation would be worth two Ph.D.'s in engineering.

After a year in Reclamation's Denver, Colo., office, where he studied all fields of operation under such able teachers as former Chief Designing Engineer Jack Savage and Mr. Ivan Houk, Mr. Ludin returned to his own country. There, carrying with him memories of what Bureau engineers had accomplished in the West, he had visions of entering public service and doing the same to benefit his countrymen. Mr. Ludin was named Chief of the Bureau of Reclamation of Afghanistan and rapidly rose from this position to the one he now holds as Minister of Public Works. In this latter capacity he has laid out a modern and efficient irrigation development.

Mr. Ludin told Commissioner Straus that Afghanistan has started on a $17,000,000 program for irrigating the Helmund and Kabul River Valleys. Power is to be a byproduct of reclamation and its sale will help pay construction costs for the development. The repayment period for farmers to pay construction costs will be 35 to 40 years. The charge will be interest free. Settlers will be limited to an acreage of some 20 to 30 acres. Thus, it can be seen that in many ways Mr. Ludin is putting into effect practices similar to those of our western States.

When it comes to river-basin developments, Mr. Ludin expressed great interest in the Bureau of Reclamation's world-famous plans, such as the Columbia and the Missouri River Basins.

This is another way in which this Middle Eastern country and the United States are similar in their river-basin developments.

Photo by Glenn Peart, Dept. of Interior photographer

U. S. Commissioner of Reclamation Michael W. Straus talks over future irrigation developments with His Excellency Mohammad Kabir Ludin of Afghanistan.

Irrigation is nothing new among the Afghans. Mr. Ludin spoke with pride of a 1,000-year-old dam that was in good working order till about 70 years ago. Most amazing of all, when engineers started to construct a new dam downstream from the ancient 100-foot-high masonry structure, the original wooden outlets of the first were found to be still in good condition. This dam was built on a tributary of the Helmund River in the time of Sultan Mahmood of Ghazni. The foundation of the structure, Mr. Ludin said, followed the zigzag course of the natural contour of a rock outcrop, making it an early model of a keyed-in gravity dam.

New irrigation works in the Helmund and other valleys will be coordinated with present systems. The first jobs will be built near centers of population. Mr. Ludin explained that Afghanistan has massive mountains which make road building difficult. There are no railroads in this far corner of the globe. All transportation is motor borne.

As Minister of Public Works, Mr. Ludin is also head of road building in his country and is embarked on a vigorous, well-rounded program of economic development. He looks forward to the time when great highways will make it possible to increase Afghanistan's exports, primarily to India and the United States. He says they now do a very good business with America in the sale of caracul furs and chemical herbs, such as asafetida.

This little country, the size of Texas, exports some 2,600,000 caracul skins a year to America. The skins range in price from $10 to $15. According to Washington, D. C., furriers, it takes about 30 to 40 of these skins from newborn lambs to make a full-length Afghan lamb coat which retails here in the $600-to-$800 bracket plus the 20 percent Federal tax on furs.

Afghan cattle raisers, just like our western stockmen, depend on irrigated pastures and alfalfa crops to feed their stock. Other crops grown in fertile, artificially watered, valleys of Afghanistan are apricots, figs, peaches, plums, grapes, and pomegranates. The yield from these is comparable to that of crops grown on Reclamation's Yakima project in the State of Washington, where agricultural values average $800 to $1,000 an acre.

Mr. Ludin says that the fertility of Afghanistan lands has not decreased with the centuries of constant irrigation. He attributes this to the use of fertilizer and the fact that farming is done in small family-size units with very few large land holdings.

Although irrigation farming comprises 40 to 50 percent of agricultural enterprise in Afghanistan, in good years wheat is a profitable dry-farming crop. Rainfall in Afghanistan's irrigated areas averages 4 to 12 inches a year with 15 to 20 inches in the hilly sections.

Afghan farmers who depend on muscular energy for much of their power look forward to the day when electrical energy from the rivers will help do their work for them. Mr. Ludin says his country now has 12,000 kilowatts of hydroelectric power and expects to increase this 20 times over within the next 12 years. In addition to domestic and industrial needs, he explained an important use of hydropower will be in the electrolysis of minerals.

The Helmund River plan, now under construction, is the first great project in Afghanistan's $17,000,000 irrigation, hydroelectric power and road-building program. This calls for the development of 20,000 kilowatts of electricity and 200,000 acres to be brought under ditch. In the next 10 years, Afghanistan plans to spend $100,000,000 on irrigation and hydroelectric power development. This is the forerunner of a long-range development program, plans for which have not yet been completed.

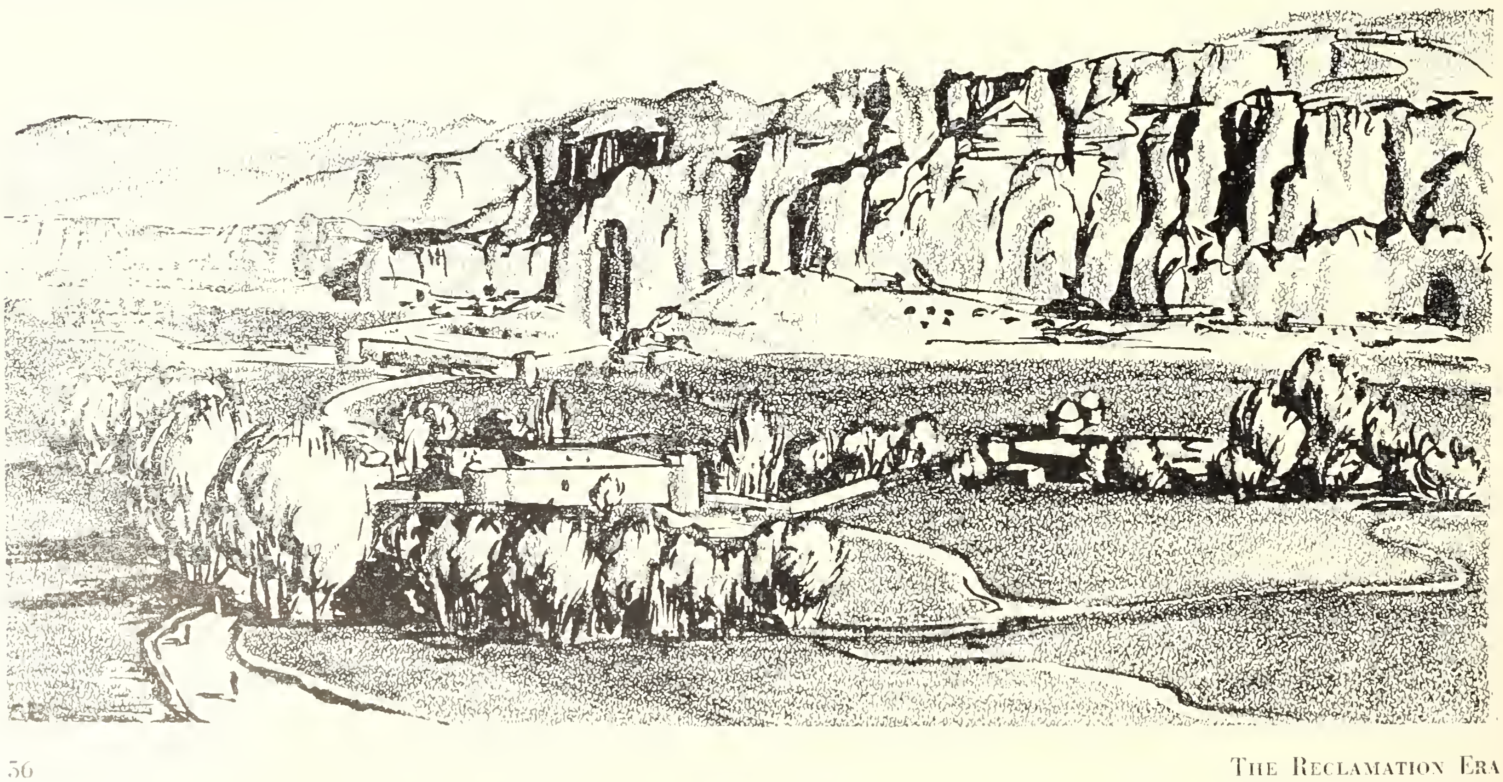
Reclamation in the United States has contributed richly to forwarding the development of Afghanistan's river resources. Through his training in the Denver office, and contacts made in this country, Mr. Ludin has been able to draw upon American engineers and contractors for assistance in carrying out a sound Reclamation program in his own country.

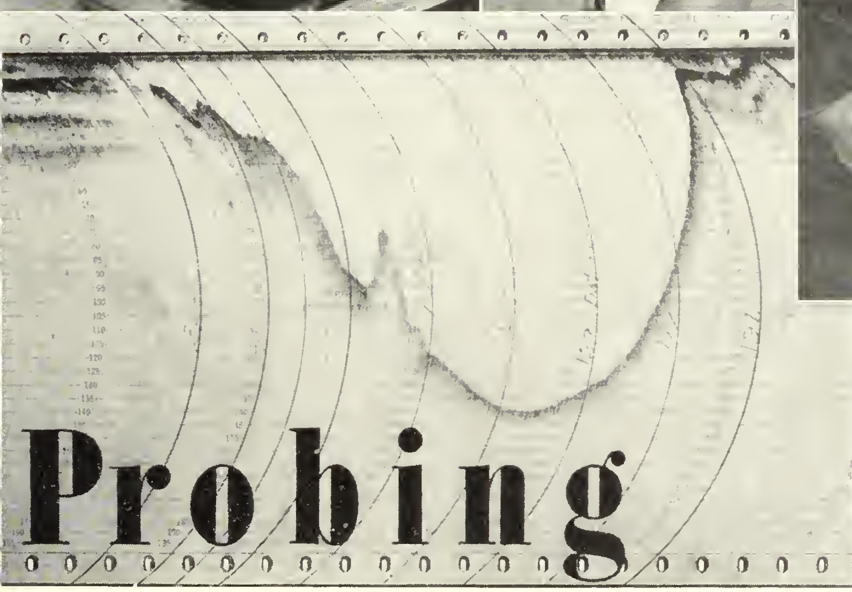
He believes that his country has benefited many times over from his "post-graduate course" with the Bureau of Reclamation. He spoke with pleasure of the recent visits to Afghanistan of two American engineering consultants, Mr. Jack Savage and Mr. S. O. Harper. The former once was Chief Design Engineer and the latter was former Chief Engineer of Reclamation.

When he posed with Commissioner Straus before a map of Coulee Dam, Mr. Ludin became interested in pointing out the designs that he, personally, had helped to work out when he was studying in Denver.

The Minister of Public Works in Afghanistan says he keeps up on current Reclamation developments by reading the RECLAMATION ERA. His visit to this country has a twofold mission: To discuss contracts with American firms who are building irrigation and power works in Afghanistan and to arrange for other young Afghans to have the same opportunity that he did to study with the Bureau of Reclamation and learn new techniques in river taming.

Bamian Valley, Afghanistan.





Top left: Depth readings are indicated in fathometer, operated by Richard Redmond. Top right: Aboard the sounding vessel, Lawrence Miller, left, and Harley Nygren, right, sight shore markers through sextants as Dave Whipp, rear, plots boat's position, and Wallace Short, seated, records angles and readings. Lower left: Fathogram of bay floor. Lower right: Mechanical "fish."

All photos by H. W. Fuller, Region 1

Probing The Depths of Lake Roosevelt

by Wafford Conrad, formerly employed at Coulee Dam, Wash., Region 1

Lake Franklin D. Roosevelt, one of the longest man-made waterways in the world, is being sounded and charted by the Coast and Geodetic Survey, the Federal agency charged with preparing nautical charts for navigable waters controlled by the United States.

The Bureau of Reclamation reservoir stretches 151 miles from Coulee Dam, Wash., to the Canadian border. Large boats can navigate the lake its entire length, and small boats can continue on up the Columbia River from the lake to Revelstoke, British Columbia, nearly 200 miles farther north.

Lake Roosevelt was formed in 1942 by Columbia River water backed up behind Grand Coulee Dam. Three years later the United States Coast Guard installed directional lights along the waterway to mark the main channel for skippers of the runabouts, sailboats, hydroplanes, excursion boats, logging tugs, and other craft on the lake.

The war's end created a need for detailed surveys of the reservoir and its approximately 600 miles of shoreline. The Bureau of Reclamation, which built the dam and purchased a narrow strip of land all around the reservoir, wished to know the extent of shore erosion and the location of possible new slide areas. The National Park Service needed additional data to carry out its plans for developing the recreational resources of Lake Roosevelt. Both agencies realized that eventual drawdown of the reservoir by Columbia Basin project power developments would make navigation hazardous unless a nautical chart were available.

The Coast and Geodetic Survey is making both topographic and hydrographic surveys to obtain data for a nautical chart showing water depths, menaces to navigation, shore features, and artificial aids to navigation.

To the landlubber, the taking of echo soundings is the most interesting phase of the work. By bombarding the floor of the lake with sound waves and measuring the time required for their echoes to reach the surface, a nearly continuous profile of the lake bottom is obtained.

Millions of soundings will be required to map the lake floor, but that's not as big a job as it sounds because the electrical device used makes 12 soundings a second.

The device, known as an 808 Fathometer, produces the sound waves, receives and amplifies their echoes, measures the time interval, and converts this interval automatically into units of depth measurement, such as feet, fathoms, or meters.

The 808 Fathometer is a semiportable instrument for hydrographic surveying from small vessels. It consists of three separate units: The power-producing batteries, a recorder cabinet, and a streamlined submersible housing called the "fish." The "fish," which sends out the sound waves and catches their echoes, is suspended from the side of the boat and resembles a baby torpedo as it bores through the water just under the surface.

Key gadgets in the recorder cabinet are a motor generator which converts direct current from the batteries into high voltage current, a condenser, a vacuum-tube amplifier, a timing mechanism, a rotating stylus arm, and a Fathogram.

The acoustic transmitting and receiving units are inside the hollow wooden "fish." Each consists of a bundle of laminated nickel plates wound with rubber-covered wire and resembling a transformer core. They are immersed in water which enters the "fish" through holes in two thin metal plates on its underside.

Electrical impulses cause the laminated plates in the "fish" to vibrate and emit sound waves. Their echoes, reflected from the lake floor, are picked up by the receiving unit in the "fish," converted back into electrical impulses, amplified in the recorder cabinet, and recorded on the Fathogram.

The Fathogram is a revolving roll of calibrated paper, coated on its underside with aluminum or copper. The electrical impulses travel down the stylus needle to the paper and burn a jagged carbon path in making electric contact with the metalized underside. The carbon trail is a graphic record of the profile of the lake bottom over which the sounding vessel has traveled.

In evaluating the Fathogram record, allowances must be made for the temperature of the water because the Fathometer is calibrated at 4,640 feet per second—the speed of sound in fresh water at approximately zero Centigrade. Lake Roosevelt water varies from about 14° to 15° C. (57.2° to 59° F.), and at these temperatures the sound waves travel approximately 4,775 feet per second. Water temperature is tested at intervals by lowering a combination thermometer and water sampling cup into the lake from the sounding boat. The water samples are tested for salinity, which also influences the speed of sound in water. The salinity factor is negligible in Lake Roosevelt.

Deepest sounding made so far is 65 fathoms, or 390 feet.

Soundings are taken from a converted Navy landing craft. Crew members live on a Bureau of Reclamation dormitory barge which was used in reservoir clearing operations during the building of Grand Coulee Dam.

The course of the sounding vessel up and down the lake is determined by sighting through sextants at markers which have been placed about every 400 yards along the shores. Whitewashed rocks, metal drums painted white, varied-colored flags, and cheesecloth-covered wooden pyramids serve as markers.

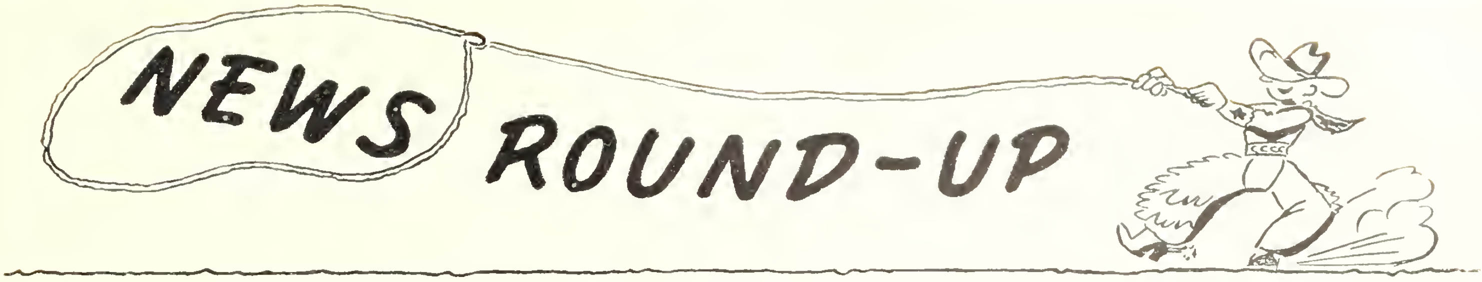
A topographic survey crew establishes the markers. This crew is divided into three parties. One, working from a 36-foot Bureau of Reclamation launch, erects the hydrographic signals and compares the shoreline with aerial photographs made from a Coast Guard plane in 1946. A shore party locates triangulation stations established by the Bureau before the reservoir was created to determine what land areas would be inundated. These old stations are then located on the aerial photos. Another shore party contacts residents of the reservoir area to check the accuracy of local names given adjacent canyons, flats, and other natural features, makes recommendations for naming unnamed geographic features, and classifies area roads as to type for mapping purposes.

Both the hydrographic and topographic surveys are directed by Lt. Commdr. J. T. Jarman of Meridian, Miss., who joined the Coast and Geodetic Survey in 1927 upon obtaining his degree in civil engineering from the University of Mississippi. Commander Jarman knows the value of nautical charts. During World War II he spent more than 3 years on a Navy survey ship mapping the uncharted battle areas of the South Pacific.

When the Coast and Geodetic Survey completes its work in the fall of the year, the data will be used by the National Park Service in compiling a master map of the reservoir area for purposes of long-range planning and administration. Besides indicating underwater and shoreline contours, the map will show towns, highways, and railroads in the reservoir area, boundaries of Bureau of Reclamation, Indian Service, and Forest Service lands, navigational lights, safe harbors in event of storms, suitable landing places and picnic spots, fueling facilities, and lake resorts.

Claude E. Greider, director of the Park Service's Coulee Dam office, says a special map then will be made up to provide complete information for tourists, fishermen, picnickers, and others wishing to take advantage of Lake Roosevelt's oustanding recreational opportunities. ●

ECHOES ***from Grand Coulee Dam to Canada recorded at Franklin D. Roosevelt Lake, Wash., aboard this Coast Guard cutter.***



First Missouri Basin Municipal Water Contract Approved

The form of the first contract for municipal water service under the Missouri Basin plan has been approved by Assistant Secretary of the Interior William E. Warne and forwarded to the city of Dickinson, N. Dak., for execution. The form of the contract was informally approved by city officials before it was submitted to the Department of the Interior for final approval as to form.

The contract is written under authority of section 9 (c) (2) of the Reclamation Project Act of 1939, and under its terms the city of Dickinson will receive a city-unit water supply at the outlet works of Dickinson Dam.

Farm Land Values Reach Peak

According to the United States Department of Agriculture, the period 1942–47 brought a greater percentage increase in farm real estate values for the United States as a whole than any 5-year period in the last 36 years. There are no data for earlier periods. Between March 1942 and March 1947 values of farm real estate rose 75 percent compared with 65 percent from 1915 to 1920, the 5 consecutive years with the greatest value increase during the World War I period.

Riverton and Shoshone Heart Mountain Drawings Held

Governor Lester C. Hunt of Wyoming was the principal speaker at the public drawing held on December 4, 1947, in Riverton, Wyo., which established selection preference for 55 public land farms in the Riverton project.

This is the first postwar public land opening on this project. More than 2,700 inquiries were received after July 10, 1947, when the opening was originally announced, and almost 500 persons from 27 States and the District of Columbia filed applications for the Government farms.

Governor Hunt in his message to the group at Riverton stressed the vast changes in the West brought about by Reclamation. He said "reclamation is a vital element in increasing production, and must go forward vigorously. No other agency has accomplished such positive results, added so much wealth, or carried on its operations in such a democratic way as the Bureau of Reclamation."

Governor Hunt drew the first name (Yeats W. Causey of Hemingford, Nebr.). Mayor William B. Glass of Riverton; Preston Brooks; Dr. J. A. Vincent of Riverton, commander of the Power River Post, Veterans of Foreign Wars, and Ralph H. Workinger, acting district manager of the Big Horn district, each drew a name from the bowl and Miss Joye Stagner, rodeo queen of Fremont County, selected the remainder of the names of those found eligible for participation in the drawing.

Shoshone-Heart Mountain

On January 6 of this year, Governor Hunt again presided over a similar drawing on the Shoshone-Heart Mountain project held at Cody, Wyo.

Widespread interest was also shown in this public land opening with a total of more than 6,000 inquiries being received and 632 applications for 31 farms actually filed by closing time.

Regional Director Kenneth F. Vernon of the Bureau of Reclamation was on hand for the drawing along with Paul Purvis, commander of the Cody Post of the Veterans of Foreign Wars, and Jack Stahn, representative of the Powell Post of the American Legion. Vernon emphasized the value of the vast acreages in the West as one of the Nation's greatest assets to produce the foods so badly needed to "feed a hungry world."

He then reviewed briefly the Bureau's activities in the Missouri Basin and emphasized the benefits that would accrue to this great midland empire through the full conservation, control, and utilization of the Basin's water resources.

A Way With Waterweeds

Details of a chemical formulation for controlling waterweeds in irrigation channels will be included in the revised publication of the Bureau of Reclamation, "Control of Weeds on Irrigation Systems." (See p. 39 FEBRUARY RECLAMATION ERA.)

This is an example of recent finding from research work conducted in the Bureau's chemical laboratory in Denver. If the chemical proves to be as effective in general as initial tests indicate, it will reduce considerably the cost of controlling these pests.

Also much more has been learned about the comparatively new weed control chemical 2, 4–D through the research program and tests conducted by the Bureau's Regional weed specialists. The revised edition will contain a broader discussion of this chemical which has been found to be of particular value in reducing the costs of willow control on ditchbanks.

Shasta Power Returns $3,000,000 Plus

The sale of power generated at Shasta Dam, a key feature of the Central Valley project in Calfornia, plus rent from the Orville transmission line brought a revenue of $3,530,896.87 for fiscal year 1947. Most of the revenue will go toward repaying the construction cost of the project.

For comparative purposes the cost of operating the Shasta power plant and appurtenant structures during the 1947 fiscal year (June 1946 to July 1947) was $471,073.40. This amounts to approximately one-seventh of the revenue received from these works during the calendar year of 1947.

Hathaway Succeeds Straus As Head of Large Dams Committee

Gail Hathaway, special representative to the Chief of Engineers, Department of the Army, and vice president, Zone II, American Society of Civil Engineers, was elected chairman of the American National Committee of the International Commission on Large Dams at the organization's meeting in Washington, D. C., January 16. Mr. Hathaway, who succeeds Commissioner of the Bureau of Reclamation Michael W. Straus, will take office July 1.

Election of Mr. Hathaway to the committe's chairmanship climaxed a program devoted largely to completing plans for participation by the United States at the Third International Dam Congress next June in Stockholm, Sweden. At least 35 American engineers plan to meet with other delegates from 25 foreign countries.

Nineteen papers were selected by the National Committee for presentation at the World Power Conference. Subjects of the papers include cement for large dams, dams on frozen foundations and reactive aggregates.

The Stockholm conference will be the first since the end of World War II. The American National Committee had been reactivated last year under the direction of Commissioner of Reclamation Straus.

Plans for the Stockholm conference include a study tour to several Swedish dams and hydroelectric plants.

Food Production Plan

(*Continued from page 18*)

accrue from the normal reclamation program will be speeded by an accelerated program.

Additional Expense Involved

The principal factor increasing costs would be the resorting to "speed up" methods of contracting, such as cost-plus-a-fixed-fee, which might be necessary in some cases, and to the use of employees inexperienced in Reclamation construction, assuming that material prices and wages do not materially increase. Otherwise, in high-speed construction such as building a 4-year project in 2 years, there are many savings, principally in overhead and investment charges, that tend to offset increases.

Taking all of these factors into consideration, it appears to be a reasonable assumption that increased costs would probably not exceed 25 percent of the normal expected cost of the project.

Use of Critical Materials

Reclamation projects are ordinarily classed as "heavy" construction. That is, work involving massive masonry, earth moving operations, and the like, as opposed to the "light" construction of buildings, homes, industrial plants, etc., that require relatively large amounts of processed material in this construction. In dam construction, earth and rock-fill types predominate.

Concrete dams use locally processed cement, which is not believed to be of significant export importance, and the aggregates are usually found at or near, the site. Structures such as canals consist almost entirely of excavation.

A study made in the spring of 1946, in cooperation with the Civilian Production Administration, disclosed that the Bureau did not use significant amounts of building materials in relation to total national production. Items such as brick, wall board, structural tile, clay and cast iron pipe, gypsum board, etc., are incidental.

Lumber is used to a greater extent for concrete forms and for temporary buildings but is not now considered critical in the western areas.

A study of our requirements in connection with "National Resources and Foreign Aid" by Secretary of the Interior J. A. Krug, report dated October 9, 1947, indicates that some trouble might be expected in the following items:

(*a*) Reinforcing steel;

(*b*) Electrical materials;

(*c*) Construction equipment, especially automotive cars, trucks, tractors;

(*d*) Gates, valves, and other heavy machinery and control devices.

The extent to which our needs for the above items would conflict with other essential uses can only be estimated in their relation to the total production of such items. If it can be safely assumed that uses more essential than food will not absorb the entire production, then no serious problem would be presented.

Reclamation by Drainage

Any estimates of additional land that could be placed into production by the Bureau of Reclamation within the next few years would not be complete without reference to the desirability of reclaiming land by drainage.

In many areas of the country, particularly in the South Central and Southeastern States, where rainfall is ample, there are many thousands of acres of fertile land that can be placed into production in a short time by drainage projects. This land is now waterlogged and unproductive.

The work required in reclaiming lands by drainage is very similar to that of reclamation through irrigation.

Information is not available on which estimates of costs could be prepared at this time, but plans for increased food production both in the present crisis and in later years should not overlook this tremendously fertile field of operations. In addition to repayment, all of the other benefits of reclamation by irrigation, such as increased taxation, decentralization, settlement opportunities for veterans, and others, would undoubtedly accrue were such drainage projects to be undertaken.

The basis for the achievement of the accelerated reclamation program to the extent shown depends upon the following factors:

- that the necessary funds will be made available within the next few months;
- that existing restrictions on personnel, methods of contracting, force-account work, Denver office design work, and similar items will be lifted; and
- that an administrative organization will be permitted that can carry out such a program in an efficient and expeditious manner. * * *

DENVER SCIENTISTS AWARDED PRIZE

Last January, one of the highest engineering awards in the country was given to R. F. Blanks, Division Chief, and H. S. Meissner, Head, Basic Concrete Research, Office of the Chief Engineer, Denver, Colo., for their paper entitled "Deterioration of Concrete Dams Due to Alkali-aggregate Reaction," which was published in Volume 111 of "Transactions," and at the presentation was termed the outstanding paper on construction.

The highly competitive award was the Thomas Fitch Rowland prize, the third oldest established by the American Society of Civil Engineers, having been instituted by the Society in 1882. The award this year was the sixty-second by the society. The prize consists of $60 in cash (to be divided between the authors), with engraved certificates signed by the president and executive secretary. In awarding the prize, preference is given to papers describing in detail accomplished works of consruction, their cost, and errors in design and execution.

The president of the ASCE, Edgar M. Hastings, presented the award to Mr. Meissner, who received the certificates and the prize in behalf of himself and Mr. Blanks at the January 21 morning session of the annual meeting of the American Society of Civil Engineers held in New York City.

Among the distinguished guests was His Excellency Mohammad Kabir Ludin (see story on p. 45 of this issue) who was asked to speak, and gave a brief résumé of the schooling he had received in this country, followed by his training in the Bureau.

R. F. Blanks and H. S. Meissner.

NOTES FOR CONTRACTORS

Contracts Awarded During January 1948

Specification No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
1950	Columbia Basin, Wash	Jan. 6	Radial gates and hoists	Northwest Marine Iron Works, Portland, Oreg	$22,713
1950	do	do	Radial-gate hoists	Western Gear Works, Seattle, Wash	13,612
1960	Davis Dam, Ariz.-Nev	Jan. 15	Circuit breakers and disconnecting switches for Mesa switching station.	Westinghouse Electric Corp., Denver, Colo	39,097
1990	do	Jan. 23	Air compressors, aftercoolers, and air receivers for Davis power plant.	Worthington Pump & Machinery Corp., Denver, Colo.	17,937
2011	Columbia Basin, Wash	Jan. 21	Hydraulic turbines for Grand Coulee power plant, schedule 1.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	2,503,929
2011	do	do	Governors for Grand Coulee power plant, schedule 2.	Woodward Governor Co., Rockford, Ill	122,875
2023	Missouri Basin-Frenchman-Cambridge unit, Nebraska.	Jan. 15	Construction of Medicine Creek Dam and access road.	C. F. Lytle & Amis Construction Co., Sioux City, Iowa.	1,270,006
2027	Colorado-Big Thompson, Colorado.	Jan. 9	Steel structures for switchyard at Estes power plant.	Bethlehem Steel Co., Bethlehem, Pa	12,300
2034	Central Valley, Calif	Jan. 28	Structural steel for 230-kilovolt switchyard at Keswick power plant.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	36,829
2050	Columbia Basin, Wash	Jan. 21	Structural steel for emergency bulkhead for drydock, Grand Coulee Dam.	Gunderson Bros. Engineering Corp., Portland, Oreg.	11,101

Construction and Supplies for Which Bids Will Be Requested During March and April 1948

Project	Description of work or material
Boise, Idaho	Electric heaters and miscellaneous equipment for Anderson Ranch power plant.
Boise-Payette, Idaho	Earthwork and structures for Sand Hollow and Willow Creek wasteways.
Central Valley, Calif	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado	Construction of about 50 miles of 69-kilovolt wood-pole transmission line from Brush to Yuma, Colo.
Do	Construction of about 16 miles of 69-kilovolt wood-pole transmission line from Loveland to Longmont, Colo.
Columbia Basin, Wash	Completion of Grand Coulee pumping plant, warehouse B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of feeder canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, and water storage reservoir for mason addition streets, sidewalks, and curbs; assembly of caisson seat form and face caisson; and rock excavation for feeder canal between headworks and station 35+25.
Do	Deicing motor generator set for Grand Coulee left switchyard.
Do	2,000-kilovolt ampere transformer for Grand Coulee switchyard.
Do	Metal canopy for right control bay, Grand Coulee power plant.
Do	Steel doors for right control bay, Grand Coulee power plant.
Davis Dam, Ariz.-Nev	Construction of 14 miles of 34.5-kilovolt wood-pole transmission lines near Yuma, Ariz.
Do	Construction of 30 miles of 115-kilovolt wood-pole transmission lines, with overhead ground wire, from Coolidge dam to substation ED5.
Do	22- by 19-foot radial gates (high head) for Davis Dam.
Deschutes, Oreg	Completion of construction of Wickiup dam and relocation of forest service road near Lapine, Oreg.
Do	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base.
Gila-Wellton-Mohawk, Ariz	Construction of check and turnout on Gila Gravity Main Canal.
Hungry Horse, Mont	Air compressors for Hungry Horse power plant.
Klamath-Tule Lake, Oreg-Calif	Construction of earthwork and structures for Coppeck Bay Area.
Klamath, Oreg-Calif	Improvements of about 7 miles of Lost River Channel through Poe Valley.
Lewiston Orchards, Idaho	Equipment for water treatment plant.
Mirage Flats, Nebr	Erection of office building, three prefabricated residences, warehouse, utility buildings, well pump-house and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin-Angostura, S. Dak	50 by 30-foot radial gates for Angostura Dam.
Missouri Basin, Colo	Erection of 16 prefabricated residences at Narrows Dam Government camp.
Missouri Basin, Nebr	Construction of approximately 2,500 feet of 63-inch monolithic or 69-inch precast concrete siphon for Cambridge Canal.
Do	Construction of Meeker diversion dam, a temporary pile and timber structure, and canal excavation.
Missouri Basin, Nebr.-Wyo	Construction of approximately 38 miles of 115-kilovolt wood-pole transmission line from Cheyenne to Pine, Bluffs, Wyo.; construction of approximately 45 miles of 115-kilovolt transmission line from Gering to Alliance Nebr.
Missouri Basin, Kans	Erection of 25 prefabricated residences, office building, warehouse, laboratory and utility buildings; furnishing and installing utilities for Cedar Bluff government camp.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Provo River, Utah	Construction of steel pipe line and structures for Big Cottonwood section.
Provo River-Aqueduct, Utah	72-inch diameter Big Cottonwood siphon, Salt Lake aqueduct.
Riverton, Wyo	Construction of 12 apartments at Riverton, Wyo.

LING Fishing

(Continued from page 52)

example, are taken that should be caught to keep an optimum fish population.

But this ocean is still the winter fishermen's paradise. It is a matter of record that an addict set his line with a 5-inch minnow. A 14-inch large-mouthed black bass got hooked. An 8-pound ling couldn't resist this tempting meal, and the result was two big fish, all in the matter of 4 hours. To the uninitiated, this may sound profane, but local addicts are not scoffers of such tales, as they all know these things are apt to happen when fishing for ling on Ocean Lake. •

Eldorado

(Continued from page 54)

Records of the Post Office Department, in the National Archives in Washington, show that a post office was established in Eldorado on January 23, 1879, and the last postmaster was Charles Gracey when it was discontinued August 31, 1907, 2 years after the big flood of 1905. Thereafter the mail was sent to Nelson.

The moving of the post office to Nelson probably marks the end of Eldorado as a settlement of any consequence in the area. There are no indications that the camp was flooded while it was still occupied by very many of the miners. Probably it had already lost its significance and was practically a ghost town when the 1905 flood struck. It might be said that the Colorado River created the settlement and then wiped it out. The history of the river is full of such incidents which occurred until the Bureau of Reclamation brought the unruly stream under control by the construction of Hoover Dam. •

Our Back Cover

MOUNT SHASTA as seen from the desert side in Siskiyou County, Central Valley Project, California. This photo was taken by J. E. Fluharty of Region II.


Mt. Shasta

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APRIL
1948

Featuring:

The Life of Hoover Dam

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Flame Throwers *versus* WEEDS

•

Reclamation in Switzerland

•

THE Reclamation ERA

GOVERNMENT PUBLICATIONS APR 1948

Reclamation Place Names in this Issue

United States Department of the Interior

J. A. Krug, Secretary

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Assistant Commissioner ---------- Kenneth Markwell
Assistant Commissioner ---------- Wesley R. Nelson
Assistant to the Commissioner—Engineering ---------- T. W. Mermel
Assistant to the Commissioner—Management ---------- G. S. Ellsworth
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REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Letters to the Editor

Box 100, Jerome Stage,
Prescott, Arizona,
February 7, 1948.

Dear Editor:

Enclosed is a check for $3 for which please extend my subscription to the Reclamation Era.

I inspected your Gila project a short while ago. Those fellows are doing a wonderful job there. On January 23, I saw a crew of men getting ready to line a ditch with concrete just south of the railroad tracks at Avalon. Altho there must have been 30 or 40 men working there, and various types of equipment were being used, not one fellow was idle for a minute, no one was waiting for someone else, to begin his part of a job. There was team work with efficiency seldom seen

(*Continued on Page 78*)

Reclamation ERA

April 1948 **Vol. 34, No. 4**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, *Editor*

OUR FRONT COVER

Succulent Sorghum

Proving the photogenic qualities of sorghum, this unusual close-up reveals nearly matured Bonita Grain grown on the W. C. Austin demonstration farm. The photograph was taken by Ray M. Reynolds, former Region V photographer, and for more information about sorghums, turn to page 67.

Credits

The interesting drawings which appeared in the March 1948 issue on pages 45, 49, 51, 52 and 56 were the work of Shirley Briggs of the Drafting and Graphics Section in Washington, D. C., who also prepares the map showing reclamation place names for this and forthcoming issues. Shirley Briggs' line drawings appear on pages 64, 67, 71, and 74 of this issue.

The Life of Hoover Dam

by E. W. LANE,
Consulting Hydraulic Engineer, Office of the Chief Engineer,
and
J. R. RITER,
Chief, Hydrology Division, Branch of Project Planning, Denver, Colo.

How long will it be before Lake Mead fills with silt?

How long will the Hoover Dam power plant continue to generate hydroelectric power?

Many people, knowing that some reservoirs have rapidly filled with sediment and become worthless, have been uselessly worrying about the life expectancy of Lake Mead and Hoover Dam power plant on the lower Colorado River. An examination of the facts, however, amply demonstrates that these fears are not justified, and that this reservoir can be counted on to be highly beneficial to the Southwest for centuries to come.

The rate at which the reservoir will fill with silt depends upon the weight of sediment carried into it each year, and how much reservoir space a ton of sediment will take up, on an average. It also depends upon how much sediment will be carried out of the reservoir along with the water.

All of the sediment coming into a reservoir does not flow smoothly down and level itself off like water. Much of it accumulates in a delta-like formation at the upper end of the reservoir, and builds itself up above the reservoir level. Because of this sloping deposit, it takes more sediment than water (by volume) to fill a reservoir, and anyone who estimates the filling time of a reservoir, on the basis of its water storage capacity, is estimating much too low.

A number of different people have studied the rate at which Lake Mead will be filled with sediment. They are unanimous on the point that it will have a long, long life. However, there is considerable disagreement on how long a life this will be, based on uncertainty about how much value should be assigned to each of these four factors:

- the average annual weight of sediment inflow,
- the average weight of sediment per unit volume,
- the average annual outflow of sediment and
- the sediment storage above the spillway level.

The different viewpoints on these individual factors cause the wide variation in estimates.

In planning Hoover Dam, the Bureau of Reclamation made an extremely conservative estimate to the effect that if no

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sediment flowed out of the reservoir, if none was deposited above the spillway level, and no reservoirs were created upstream, it would take more than two hundred years to fill the reservoir, at a rate of filling of about 137,000 acre-feet per year. Even this estimate is known to be too low, although it has remained the official prognostication, pending the availability of additional, up-to-date, specific data.

This estimate, however, must be taken with a grain of silt, when you consider the density currents—currents of heavy muddy water which tend to flow as a stream along the bottom of the reservoir under the clear lake water above. As soon as the reservoir fills to the lowest gate in the outlet towers, these density currents, laden with sediment, reach the dam, then the lower gates of the outlet towers and then begin to flow out through the power plant. The amount will increase as the reservoir fills, eventually becoming a very large factor in self-silt removal. Also, the level of the sediment surface at the head of the reservoir when it is completely filled will certainly be higher than the spillway level, perhaps as much as a hundred feet or more. Both of these actions will add considerably to the life of the reservoir.

A detailed survey of the volume of sediment deposits in Lake Mead has recently been started. When this is completed, it will be possible to make a more accurate estimate of the future filling rate than is possible at present.

Another factor which may lengthen the initial estimate is the sediment erosion control measures to be taken in the Colorado River watershed. This will considerably reduce the sediment load. The Department of the Interior and other Federal agencies are actively interested in measures to reduce the erosion of the soil in this watershed, not only for the reduction of the sedimentation of Lake Mead and other projects, but also because of numerous other resulting benefits. Although at present no one knows exactly how much soil erosion control will be carried out, any such measures would help prolong the life of this reservoir.

However, to a considerable extent, estimates made at the present time on the life of the project have little importance. It is safe to say that long before the silt deposits of Lake Mead cause any worry as to its reservoir capacity, the regime of the river will be completely altered.

There is very little doubt that it will be necessary to construct additional dams upstream to provide the storage necessary for flood control, water supply, irrigation and power, long before the time silt accumulates to a point where it is detrimental to the functioning of Lake Mead and the Hoover Dam and power plant.

If the necessary storage for water supply and flood control is provided at sites upstream from Hoover Dam, the electric power which could be generated at the dam, in the extremely remote event that the reservoir becomes completely filled with sediment, will be as great as if the reservoir were not sediment filled. In fact, an even greater amount of power would be generated with a filled reservoir, since the total fall available at the dam could be used continually, while now it is used only for the very small part of the time when the reservoir is full.

When the original studies for the Boulder Canyon project were made, it was expected that the development of the resources of the lower Colorado River would proceed steadily through the succeeding years, and it was estimated that dams would be built upstream which would so reduce the sediment inflow that only about 10 percent of the reservoir capacity would be filled in 50 years.

The demand for power in the Southwest is growing rapidly and the need for additional power sources is already being acutely felt. Studies are now being actively carried on to investigate the desirability of constructing dams on the main river above Lake Mead, at the Bridge Canyon and Glen Canyon sites. At this latter site a storage capacity of more than twice that in Lake Mead will be possible if the rock is found to be strong enough to support so high a dam.

In any case, a very large reservoir here is possible, which would keep most of the sediment out of Lake Mead for a century or more. Reservoirs above Lake Mead for the specific purpose of storing sediment are under consideration on the San Juan and Little Colorado in connection with the construction of the Bridge Canyon Dam and the development of additional irrigation in the Colorado River watershed. It therefore appears likely that additional storage structures will soon be constructed above Lake Mead and that the estimate of 10 percent of the reservoir capacity filled in 50 years made by the original planners of the project will not be far from the actual result.

It is evident, therefore, that the life of the Boulder Canyon project is assured for centuries to come and that the benefits of this great project of Southwest will be felt without diminution for as long as, in this day of rapidly advancing science, it is worthwhile to try to look ahead. •

____
(Date)

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Washington 25, D. C.

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Flame Throwers

versus

WEEDS

by STANLEY E. JONES

and L. B. SHINN

Tulare Basin District, Calif., Region II

No "blowblack" with flame thrower gun. *Ben Glaha Photo.*

Peacetime prospects in store for many of the lethal weapons of World War II appear mighty slim. Doomed to a future of inactivity under a cover of cosmoline and rust inhibitors, many a weapon that helped the war is now lying idle for want of a peacetime use.

Take the Army flame thrower for instance. Its deadly prowess in the recent Pacific campaign will be vouched for by any Marine or doughboy who personally had to rout out a stubborn enemy from pillbox or cave. Its influence over enemy resistance is unquestioned. Adaptation to some worthwhile peacetime use is another thing entirely. Sure—some funster was seen using one during the record New York City snowstorm last Christmas week, but it is extremely doubtful that the United States Army Flame Thrower M2-2 will replace the United States civilian snow shovel.

When the Bureau of Reclamation asked the United States Army Chemical Warfare Division for the loan of two flame throwers, the idea was not snow, but weed, eradication. The spectacular flame thrower had been a challenge to weed control men since it was first issued by the Army, so when the opportunity came to borrow the equipment, ex-Marine and Army personnel in the Bureau staff at Bakersfield, Calif., lost no time in getting experiments under way to test the adaptability of the flame thrower in killing weeds on ditchbanks and around works inaccessible to conventional weed burning equipment.

The Buena Vista Water Storage District of Kern County at the southern end of California's great Central Valley afforded a good place to test the flame thrower along its 205 miles of ditches. While not a recipient of Bureau of Reclamation water, the Buena Vista water storage district has always been cooperative and eager to aid the Bureau in testing any promising device or material that would also aid them in their fight against weeds. Weed problems of the area are as severe as that of any district in the West. Canals and ditches are choked with tules, pond weeds, and other water weeds; their banks are lined with smartweed, willow, quack grass and Johnson grass.

Although many methods of weed control are now used, and the discovery of more and more efficient chemicals has increased the popularity of chemical weed control, burning weeds on ditchbanks still has its place under some conditions. Sportsmen and wildlife conservationists may rest assured that particular care is taken to prevent injury to wildlife during the burning process. The Bureau of Reclamation realizes that tall weeds and shrubs furnish protection and cover to wildlife, but in view of the narrowness of the ditchbank area, and the necessity to remove weeds from drain and canal banks in order to operate and maintain the irrigation system efficiently, it is believed that those who understand both the menace of weeds and the urgent need for free-flowing irrigation water will agree that weed-burning along ditchbanks is justifiable.

Weed burning trials with the flame thrower on the district's canals were made with the following purposes in mind:

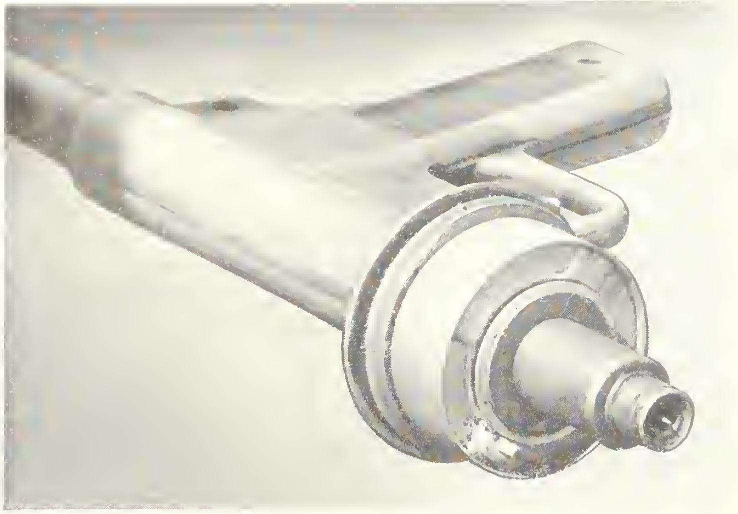
1. To determine its feasibility as an eradicator of weeds common to ditch banks around irrigation structures in areas which ordinarily cannot be reached by conventional weed-burners and heavy equipment.

2. To test the effectiveness of various fuel mixtures in killing and retarding weed growth.

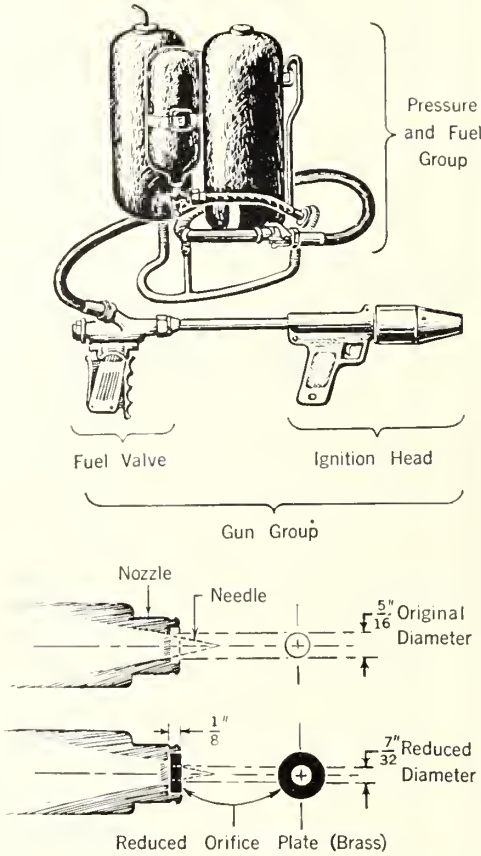
3. To determine costs of operation, considering the degree of burn, the area covered, and the relative costs of fuel mixtures.

4. To determine modifications and improvements that would enhance its practicability as a weed eradicator to be used by the Bureau along the 156 miles of the Friant-Kern Canal.

The burning trials were performed under variable conditions using several different fuel mixtures. First used was



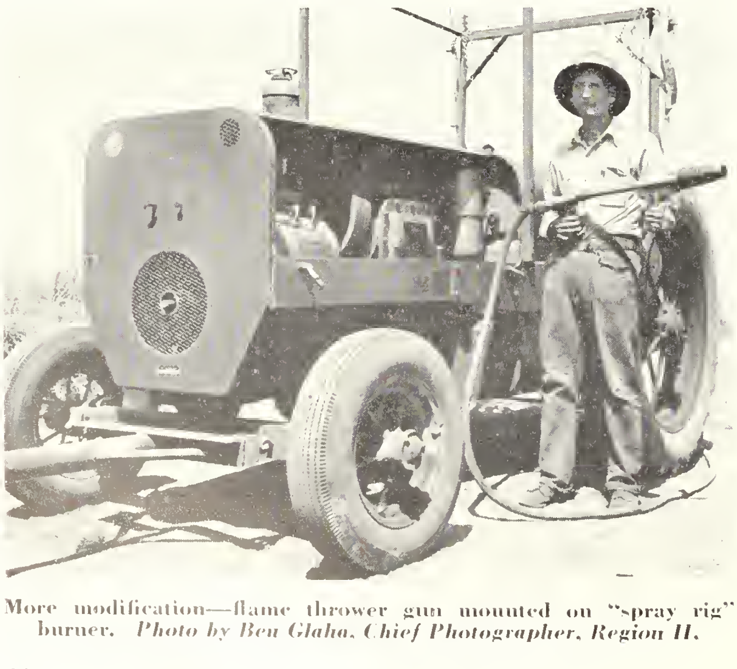
At left, the flame thrower gun with shield off, showing the modification made in the orifice, consisting of a ring fitted inside the center "point" of the gun. At top right, the original United States Army flame thrower M2–2, and below, diagrams showing how the orifice plate was reduced in order to assure a constant pressure of 250 pounds per square inch. *(Original sketches submitted by Region II, finished art work by Shirley Briggs.)*



the Chemical Warfare Service's formula for wartime purposes—a fuel consisting of a mix of 3 gallons of 100 octane gasoline, 1 gallon of diesel oil, and 1 pound of napalm thickener (a glycerine-like substance of high cohesive quality) with the pressure tank charged with 1,200 pounds of nitrogen per square inch. The burn, using this fuel, though spectacular and intense in initial appearance, was far from complete, merely charring most of the vegetation. Close examination of willows, for example, showed little more than searing of the outside layers of the stems with no permanent damage to growth.

The most satisfactory results were obtained in another test when equal parts of 100 octane gasoline (2½ gallons) were used with one pound of napalm and 1,300 to 1,700 pounds pressure of nitrogen per square inch. The mixture provided a prolonged burn of 3 to 5 minutes which resulted in partial to complete charring of the more resistant woody vegetation.

In an attempt to determine the value of cheaper fuels, diesel oil alone and a mix of diesel and crankcase drainings were used. In both cases the initial burn appeared intense and enduring. However, an examination of the smoke-scarred woody tissues after the trials indicated only partial destruction with no complete killing effect.



More modification—flame thrower gun mounted on "spray rig" burner. *Photo by Ben Glaha, Chief Photographer, Region II.*

A trial using 2 gallons of 72 octane gasoline, 2 gallons of diesel oil and 1 pound of napalm at 1,300 to 1,700 pounds pressure of nitrogen per square inch was made on vegetation growing on an airplane bomb revetment of an abandoned wartime airfield. This vegetation consisted of Bermuda grass, Needle grass (Stipa species), Crested Wheat grass, Filaree, Inkweed, Cattle Spinach and Russian Thistle—approximating the vegetation that will be encountered eventually on the slopes of the Friant-Kern Canal along its southern route. The results proved fairly satisfactory, with a partial to complete burn of green vegetation and destruction of 75 percent of the seeds of annual plants.

From the foregoing, the reader has probably formed an idea that the flame thrower is a fairly lethal weed killer. However, there are a number of disadvantages which weigh heavily against this equipment coming into common use as a weed killer. They are:

1. The fuel supply is too limited. Operating pressures of 1,300 to 1,700 pounds per square inch expend the 4 gallon fuel supply contained in the tank in less than 10 seconds. As a result, too much of the operator's time must be spent in recharging and refueling the equipment.

2. Too much of the flame is dissipated upward. The greater part of the flame, traveling 70 to 90 feet in each burst, is lost upward and, therefore, is not effective in killing weeds.

3. The gun, without modification, is too dangerous to operate. Although mechanical operation is simple, the flame thrower is dangerous in untrained hands, necessitating rigid safety precautions and limiting its use to thoroughly trained operators.

(Continued on page 73)

Reclamation in Switzerland

Rapid procedure of Switzerland's reclamation program. Background—excavation of main drainage canal; middle—tile drainage; foreground—cultivation of drained land.

by **DR. H. SCHILDKNECHT.**

Federal Institute of Technology, Zurich, Switzerland

Switzerland's agricultural productivity is limited by nature, since half of the total area of the country is unproductive, consisting of woodland, lakes, glaciers, and rocky wastes.

In addition to this, a rather great part of the agriculturally productive land is situated in the mountains where the land is used primarily in an extensive way as pasture.

With this the case, there is only about seven-tenths of an acre of fully productive land for each person in Switzerland. Therefore, it is understandable that under normal conditions, one-fourth of the food supply requirements of the Swiss population must be covered by imports. The importation of food stuffs in peacetime was not difficult. But, the outbreak of World War II altered these relations fundamentally.

Of course, great supplies of food were stored away by the government and private individuals, but this supply would only cover the needs of the country for a short time.

Because of the unfortunate military collapse in France, Switzerland became completely enclosed by the powerful Axis nations, Germany and Italy. The Swiss people, with their democratic feeling, rejected with utmost clarity the political theories of their neighbors. The political relationship between Switzerland and these fascistic states became worse and worse.

It was clear that from no side was help to be expected for the alleviation of pressing food shortage difficulties in the future.

It was feared much more, and with good reason, that a food shortage in Switzerland might be utilized by both of her neighbors in order to effect political pressure.

In the interests of the preservation of independence of the country, one of the most important problems was to make Switzerland less dependent upon imports by increasing the agricultural production within Swiss territory.

Agricultural experts calculated that under the establishment of a strictly administered rationing system, about 1,250,000 acres of arable land were necessary in order to make the country more or less self-sufficient; and at the be-

Typical example of how property holding within a Swiss village is improved and new settlements are created. Shaded areas indicate the consolidation of holdings by three main landowners.

ginning of World War II there were only about 500,000 acres of arable land in Switzerland.

The first step was to plow under a considerable amount of pasture land. It was not the intention to bring about too severe a reduction of pasture land, because that would have had a serious effect on cattle breeding and dairy production. The only possibility of creating additional arable land was through reclamation, by which new land was gained by drainage of swamps, irrigation, and clearing of not too profitable woodland. And in addition to this, it was also necessary to carry out these projects as quickly as possible, so that the land could be made to yield in the shortest time.

The foundation for the realization of this reclamation program was already laid. The Federal government and the cantonal administrations (comparable to State governments in the U. S. A.—Ed.) contained a well organized agricultural engineering service.

Reclamation laws had already been passed and a sufficient number of agricultural engineers, trained in the Swiss Institute of Technology, stood by.

With great speed the necessary drainage canals were built and the adjacent land was tile-drained, so that during the course of the war nearly all swamps disappeared from the landscape.

In spite of the rapid performance of this task, attention was given to careful planning and construction. With the exception of a few failures, which were caused by abnormal soil properties or water conditions, this work continued to full success. These drained areas are today among the richest farm lands of the country.

Although the clearing of forests and conditioning of such land usually lead to high costs, which gave reason for opposition, a far-reaching clearing program was carried out, in spite of all obstacles.

The irrigation of irrigable land was practiced by means of overhead sprinkling equipment. Through the realization of this reclamation program, it was possible during the war to convert 240,000 acres of previously more or less worthless land into good farm land.

But even at that, the work of the agricultural engineers had not yet come to a close. There was a possibility of increasing productivity through the improvement of farming conditions. The main drawback to intensive farming lay in the fragmentation of agricultural property.

Fragments of Property

As a consequence of the old three-fallow system and unwise division of inherited property, the farm land was divided in many farming areas of Switzerland into numerous tiny lots of unusual and irregular shape. According to the agricultural census of the year 1929, an average of 11 lots, each with an average surface of a little more than 1 acre, was the share of each farmer in Switzerland. In addition to this the farmers often live together in villages and their farm land is situated some distance from their homes. Since there is a lack of adequate roadways the farmer is obliged to cross over other property in order to get to his own lots. These rights of trespass are a cause of much crop damage.

In areas with excessive fragmentation of property the utilization of farm machinery was almost impossible and therefore the yield and the profitability of the land was way under par.

These unfavorable farming conditions could only be improved by fundamental changes in property holdings. The old property boundaries have been completely abolished and an attempt has been made to portion out to each farmer the

(Continued on page 76)

Sorghums

by L. M. Sloan, ***Superintendent, Garden City Agricultural Experiment Station, Branch of Kansas Agricultural Experiment Station, Cooperating with United States Department of Agriculture, Garden City, Kansas.***

ALTHOUGH sorghum seeding time was still a few months away, several inquiries for seed supplies were coming across my desk as early as January this year, as well as inquiries regarding certification of seed, storage problems, and methods of irrigation. This off-season activity is proof of the rapidly growing interest, particularly, among operators on irrigated farms, in the already immensely important and popular sorghum crop.

All classes of livestock make efficient use of sorghums in some form, which in turn has helped create a demand for sorghums as cash grain, as well as a feed crop. As dry feed or silage, sorghum roughage contributes much to the beef, dairy, and sheep feeding industries. The sorghum grain when fed to sheep, cattle, hogs, and poultry is about equal to corn in feeding value.

Sudan grass, also a sorghum, has proved its value as a pasture and hay crop.

The sweet (or forage type) sorghums can be grown in most of the States, but the crop as a whole is not adapted to the higher altitudes of the western Mountain States or to the cold temperatures of the New England and northwestern States.

Grain sorghum is most extensively grown in the Southwest in an area approximately 400 miles wide and 1,000 miles long. This region lies in the shape of an oval like a giant egg upon the map, reaching southwestward from Southern Nebraska, across Kansas, including all of Oklahoma and parts of eastern Colorado, Southwestern Missouri, Northeastern New Mexico, and Texas. This area includes the

Combine maize makes harvesting easier. This variety, known as "Martin's Combine Maize" raised on the Salt River project, can be harvested before the frosts. ***Photo by Harry W. Myers, Region III.***

panhandle country of Oklahoma and Texas, one of the most important grain sorghum areas. (See map on inside front cover.)

Outside this oval, except for certain areas in Arizona and California, sorghum is chiefly grown for silage, bundle forage or syrup. The area of adaption, however, is growing larger as a result of an intensive selection and breeding program.

Grain sorghums were first grown in the United States in 1874 when brown and white Darra were introduced to California from Egypt. Two varieties of kafir were brought into the United States in 1876 from South Africa. In 1895 a selection which had been grown in Oklahoma under the name of "black hulled white kafir corn" was grown in Kansas and became the progenitor of the modern black hull kafirs. In 1905, a new kafir later known as "pink kafir" was introduced from Africa.

Milo, a yellow-seeded, highly palatable grain type, was first introduced into the United States about 1880 and was first grown in South Carolina and Georgia. The variety probably came from Africa, but this is not definitely known. Milo was first grown in the Great Plains about 1890. It is this type of sorghum which has provided much of the parent material for the improved grain, and the combine grain types of sorghum now being grown in the Southwest.

Sorghums grow best when the weather is hot and an abundance of soil moisture is present. This makes it a "natural" for the irrigated sections of the Southwest with its deep rich soils and high summer temperatures. Under such conditions forage sorghums, such as the Atlas variety in Kansas, will produce 15 to 20 tons of first class silage per acre, or one of the combine milo types will produce 75 to 100 bushels of grain per acre.

Dr. L. L. Jones and his son Taylor of Garden City, Kans., store upwards of 2,000 tons of sorghum ensilage each year, feeding it during the winter to their herd of purebred Hereford and several hundred feedlot steers. This is only one instance of its wide use as a feed crop in the sorghum belt.

In 1944, a year of above average rainfall in southwest Kansas, thousands of acres of summer-fallowed land on which wheat was not seeded due to a dry fall, were seeded to Westland milo. Yields of 60 to 80 bushels per acre were not uncommon and J. E. Baldwin, ditch superintendent for the farmers' ditch company, reported an actual yield of 120 bushels per acre of Westland milo on his farm which had been drilled in 10-inch rows on irrigated alfalfa ground.

The development of the so-called "combine grain" types which permits the use of combines, with subsequent decrease in labor requirements, represents a considerable advance over the former tall types. These require harvesting with a corn binder and a great deal of hand labor. This reduction in labor and harvesting cost has been the main reason for the rapid increase in popularity of the grain sorghums of the combine type. John B. Seiglinger of Oklahoma was the first of the plant scientists to hybridize and obtain a dwarf (or combine type) grain sorghum. Other plant breeders who have contributed to the industry by producing new and improved strains of combine type milos that are high yielding, resistant to disease, and stiff-stalked are Karper and Quinby of Texas, Swanson, Lowe, and Coles, of Kansas, and several others.

During World War II, industrial needs stimulated by a lack of imported raw materials, revealed new uses for the sorghum grains, as a substitute for tapioca, in the manufacture of industrial alcohol, corn syrup, and several types of starches extensively used for industrial purposes.

Proof of the expanding demand for sorghum grains for industrial purposes is the announcement by a corn products refining company, of its plans to build a giant sorghum grain processing plant at Corpus Christi, Tex. The plant will produce dextrose, starches, and high protein feeds. It will have a grind capacity of 20,000 bushels per day, and company officials promise to have the plant ready for processing the 1948 crop. Other smaller plants are springing up throughout the grain sorghum belt.

Sorghums are particularly well suited to areas where the amount of irrigation water is limited, as maximum yields can be produced with relatively small quantities of water. At the Garden City Branch Experiment Station where the average annual rainfall is around 17 inches it has been found that 12 to 15 inches of irrigation water in a year of average rainfall will produce maximum yields. Most of this irrigating can be done during the winter or between crops, providing the soil is sufficiently deep and of such texture that it will hold large quantities of water. Sorghum roots usually penetrate 5 to 8 feet, therefore there is little danger of loss of irrigation water because of too deep penetration, except in shallow soils.

Sorghums require a moist warm seedbed for best germination. Under such conditions, irrigated sorghums require 6 to 10 pounds of seed, germinating 80 percent or higher. A. E. Lowe, Agronomist at the Garden City Experiment Station, has demonstrated that yields of grain sorghums can be increased up to 75 percent by seeding in rows from 10 to 24 inches apart instead of the conventional 42-inch rows. Unless the land is unusually free from weeds, planting in rows sufficiently wide enough to permit cultivation is preferable to seeding with a grain drill in close spaced rows. When seeded in rows 22 or 24 inches apart, the system will also permit corrugation between the rows for irrigation purposes. Sugar beet seeding and cultivating equipment is ideally suited for planting and cultivating the combine grain varieties when they are to be irrigated.

The grain must be well dried at combining time if heating in storage is to be avoided. Usually 13 percent moisture is considered a safe level. However, if the crop is to be sold and processed immediately, the moisture content may be somewhat higher.

The high yields of sorghums require that the land be enriched frequently with either barnyard manure; commercial fertilizer; by the turning under of a green manure crop, or by the growing of alfalfa or other legume crop. •

Water Worries?

Be sure to get next month's copy of the ERA which will carry a West-Wide forecast of 1948 water supplies. These data will be based on work of the western snow surveyors Paul A. Ewing and R. A. Work. The article will also carry the standard water tabulation showing storage in Reclamation reservoirs.

TOPOGRAPHY and Irrigation Farming

by **W. W. JOHNSTON,** Project-Development Supervisor, Columbia Basin Project, Region I

Draftsman Charles E. Yarwood puts the finishing touches on "before and after" scale relief models at right. Map below shows in detail how Columbia Basin project family-size farms are laid out to conform to physical features of the land. A natural drainage gully forms a boundary for four of the seven farm units, and an irrigation canal around the base of the steep slope in the upper left corner forms a boundary for three farm units. Other boundaries are determined by suitable farm size and by a county road running entirely around the section, thus giving each farm direct access to a highway. The tongue-shaped parcel of land near Yarwood's brush and extending toward the reader represents nonirrigable land. ***Photo by H. Wayne Fuller, Coulee Dam. Drawing by several Columbia Basin employees.***

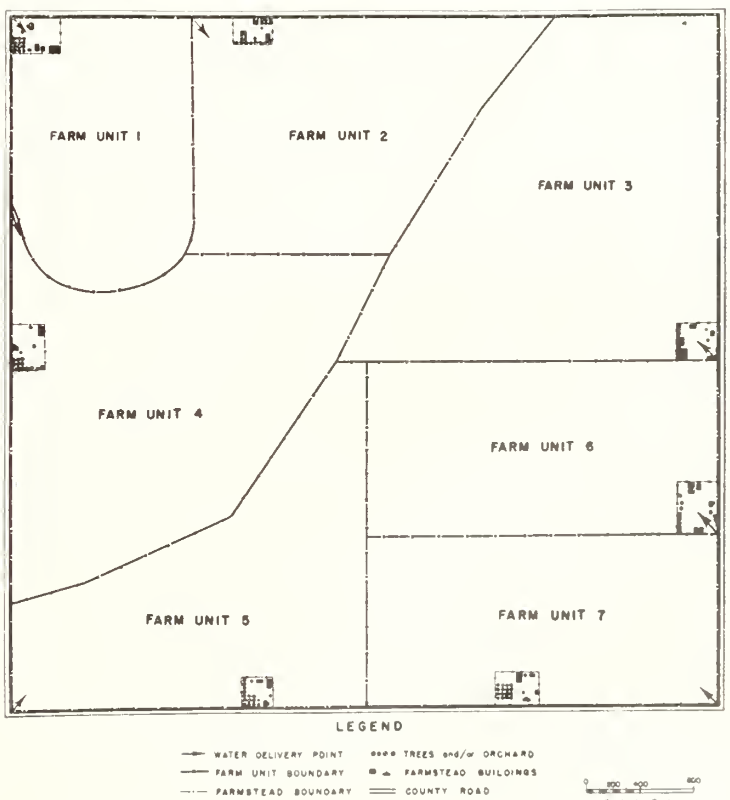
Irrigated farms served by one headgate, free of crossing roads or canals, and requiring only a minimum of expensive flumes and other structures—that is the pattern of farm-unit lay-out on the Columbia Basin project of Eastern Washington.

The Bureau of Reclamation is cooperating with landowners in the project area to avoid many of the difficulties which new settlers on other projects have faced because of farm lay-out based only on conventional survey lines.

The traditionally rectangular farm, with its "forties" and "eighties," is well adapted to irrigation only if the land lies on a regular, uniform slope. But when a farm includes land on each side of a draw, for example, the farmer has severe problems of water distribution. He must build a flume or pipe line across the draw, or else the agency supplying water to him must deliver it from two laterals and through two headgates, one on each side. Under such conditions, transfer of heads of water from one field to another is difficult and expensive.

Over a long period of years, some of these difficulties have been ironed out on the older projects through a gradual process of land purchase, sale, and exchange among owners who have realized the advantages of farm boundaries based on topography. It is a troublesome process, however, once the land is developed and producing under irrigation. As a

(*Continued on page 80*)



THE HOME with a future

by **HELEN NOYES,**

Extension Economist in Home Management, The State College of Washington

That bit of advice about a better mousetrap still makes sense. And out in the Columbia Basin project of eastern Washington, a new farm home often is a friendly snare for women who "hope to have something like it some day."

One farm home, in particular, is of exceptional interest to westerners because it is on the first development farm of the Columbia Basin irrigation project and appeals to the eye of every visitor.

We, of the State College of Washington, who participated in the planning of the Moses Lake development farmhouse, believe that this dwelling has many distinctive features designed to meet the needs of any farm family. We do not call it the perfect farm home of the future. Rather, we call it the home *with a future.*

Let us point out its features so you can compare it with your home or that home you are planning.

The Moses Lake development farm home was planned to be built in sections, if necessary. This would permit gradual expansion in keeping with a family's ability to invest more in a dwelling as the farm becomes more productive.

The home has a central hallway opening into every room in the house, thereby keeping family traffic from streaming through the kitchen.

There is a special place for doing the "dirty work" so that the kitchen isn't always upset.

EVERY CONVENIENCE BUILT IN—Mrs. Kenneth Hampton demonstrates the advantages of a 32-inch mixing table at the Moses Lake farm home. Other built-in working space is 38 inches high. ***Photograph by Harold Foss, Region I.***

The front door is placed so it will be used as a front door. It is just off the front driveway—and directly facing it. The front door is also close to the kitchen to make it easy for the homemaker to meet callers.

The rear door opens directly onto the farm court. The house has ample storage space for convenient, comfortable living.

Just as important as these features of good farmhouse planning is the location of the dwelling according to the lay of the land, the direction of the prevailing winds, and the farm buildings. The Moses Lake house is so located that the prevailing winds blow from the house toward the farm buildings. With regard to the lay of the land, the house is located so water will drain away from it.

The home itself is a basic, two-bedroom house with a full basement. In addition to the bedrooms, it has a large living room, a combined kitchen and dining area, and a bath. A coat closet is near the front door, and a workclothes closet is right by the rear door. The main-floor bath is also near the rear door. Each bedroom has a large wardrobe closet. The house has a linen closet at the end of the central hallway between the two bedrooms.

The hallway contains much of the home's storage space and its 4-foot width allows room for large objects to be carried through it. The door to the basement is also in the hall and so is the clothes chute which empties into the laundryroom in the basement.

All closets are designed in keeping with the articles to be stored and there is a proper niche for everything from sheets and towels to brooms, bedding, and school books.

The U-type kitchen adjoins the dining area, but is out of the way, in case the family wants to use the dining table for studying, or for working with farm accounts. Kitchen built-in features provide two working heights. The sink is 38 inches high and the mixing table, 32 inches. A built-in lapboard permits the housewife to sit down while she works.

Mrs. Kenneth Hampton, whose ex-service husband operates the farm for the Bureau of Reclamation, says she is especially partial to the 32-inch working height of the mixing table.

Another of the home's favorite features, as far as Mrs. Hampton is concerned, is the arrangement of the stationary

tubs in the basement. They are set out two feet from the wall and permit Mrs. Hampton to work on any side or at any angle she choses. Other laundry equipment includes a built-in water heater, sorting table, built-in shelves for supplies, and adjustable drying lines. The laundry also is used as a general utility room.

A fruit room, the furnace, and a shower-bath are also in the basement. The fruit room has a ventilator and ample storage space. Shelves are designed to hold two rows each of pint and quart jars.

To see the house certainly is a welcome sight after miles of sagebrush. It is difficult to believe it was only a blueprint a few months ago.

The planning process really got under way back in 1946. That was when the Bureau of Reclamation asked the Extension Service for assistance in working out a building plan for the development farm home. The request, naturally, was warmly received because it fitted in with our rural housing program and offered an opportunity to help demonstrate some of the principles of good farmhouse planning, especially to the people moving into the Columbia Basin. When this project is fully developed it will have more than 16,000 farm homes.

The building plan for the Moses Lake home represents the combined ideas of college staff members at the State College of Washington and members of the project development staff of the Bureau of Reclamation. The college contribution was made by a housing council headed by Stanley A. Smith of the Department of Architectural Engineering. Other departments of the college represented included agricultural engineering, mechanical engineering, home economics, and the Extension Service. The Extension specialists carried the ball back and forth from the housing council to the Bureau, acting in our usual capacity as traveling representatives of the College. And although the round-trip distance to be covered was some 280 miles, only 3 or 4 months were required to develop the plan.

Scale drawings of the floor plan of the Moses Lake house are shown in Extension Circular 113, which is available from the State College of Washington Extensi-- Service, Pullman, Wash. •

Plan made in cooperation with the Department of Architectural Engineering and Extension Service, Institute of Agricultural Sciences, The State College of Washington

Location

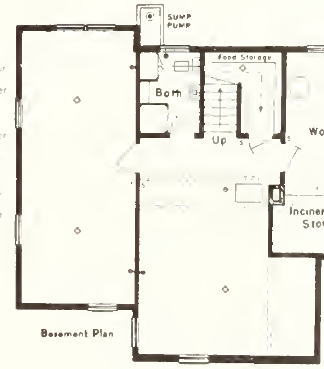
1. Front entrance faces the drive
2. Kitchen windows give view of the drive and the farm court

Traffic Lanes

1. Can go from back door to any room without going through another room
2. Can go from bedroom to the bath without going through another bedroom
3. Kitchen is arranged so that no traffic crosses the work area
4. Traffic enters the rear door and passes directly to the basement

Room Arrangement

1. Men can go to the basement to wash
2. Space to eat in one end of the kitchen
3. No two pieces of kitchen equipment more than six feet apart
4. Cross ventilation in each bedroom
5. Wall space allowed for large pieces of furniture and for kitchen cupboards

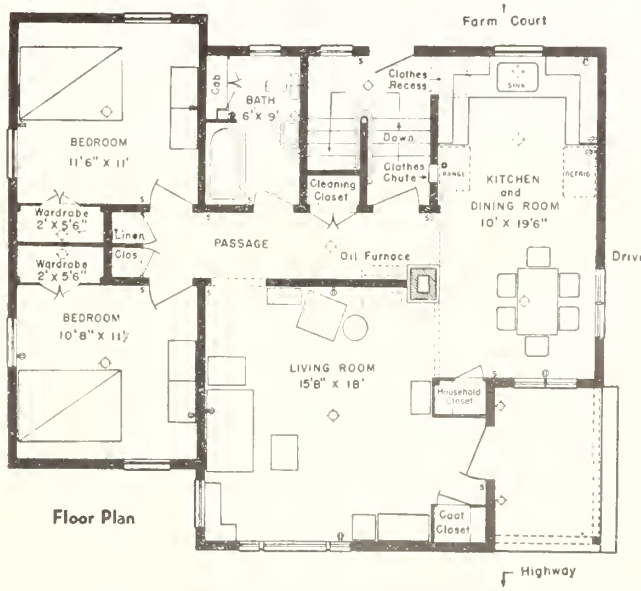


Storage Facilities

1. A closet in each bedroom
2. A closet for coats at the front and back doors
3. Storage for cleaning equipment, bedding, and bathroom supplies
4. Adequate kitchen cupboard space
5. Fruit room in Basement

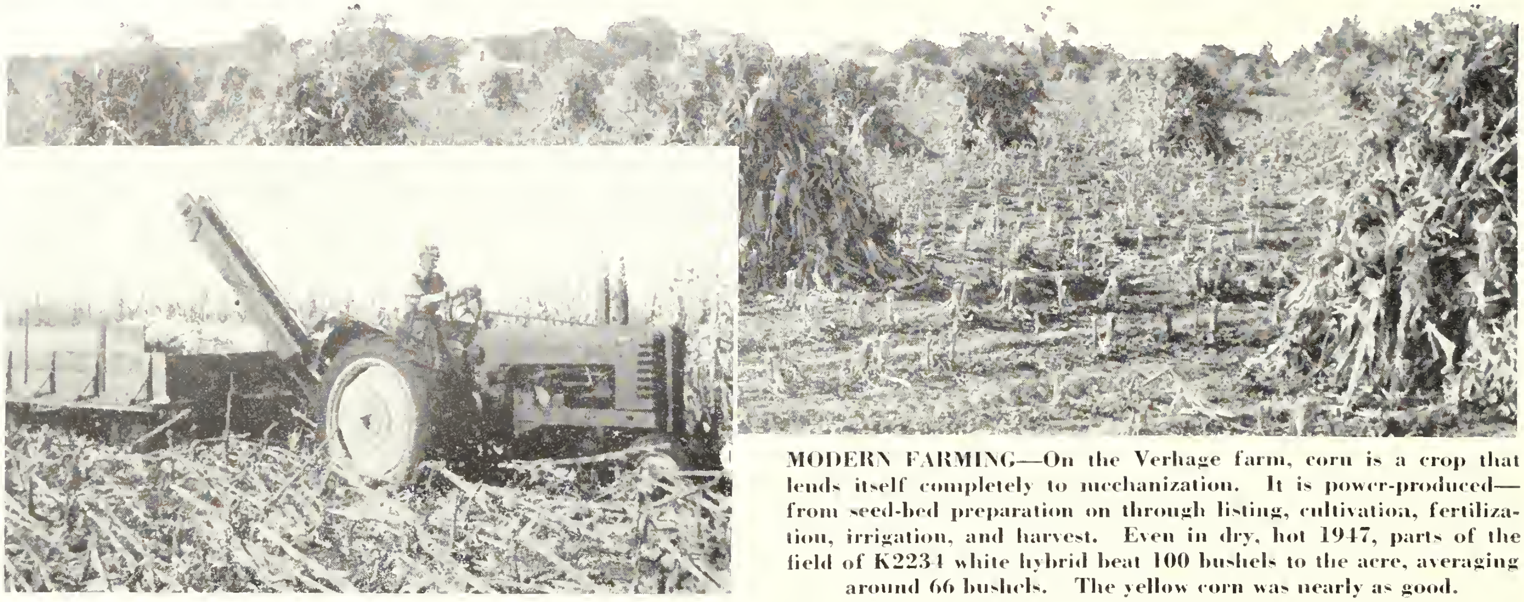
Adjustability

1. House may be built in three parts
   a. Basement
   b. Living room, kitchen and bath
   c. Bedrooms
2. Living room and bedrooms may be enlarged without changing basic plans of house
3. Chimney located so that either a heating stove or a furnace may be used
4. Kitchen may be planned for a wood or electric range



ROOM FOR EXPANSION—Above, basement plan of Moses Lake Development Farm House, and, below, floor plan, showing the nucleus of a modern home with a future. *From Extension Circular 113, the State College of Washington.*

A CORN KING in wheat country



MODERN FARMING—On the Verhage farm, corn is a crop that lends itself completely to mechanization. It is power-produced—from seed-bed preparation on through listing, cultivation, fertilization, irrigation, and harvest. Even in dry, hot 1947, parts of the field of K2234 white hybrid beat 100 bushels to the acre, averaging around 66 bushels. The yellow corn was nearly as good.

by **ROSE S. FLOREA**

OUT in the greatest wheat-producing state in the Union, a Kansas flying farmer took a flyer in corn and struck it rich.

He is Bas Verhage, near Downs in Osborne County, who first became a member of the 100-Bushel-Club in 1946 with a whopping yield of 102.71 bushels per acre. Just to show that it wasn't pure luck, Mr. Verhage duplicated the 100-bushel-plus yield in 1947, an extremely droughty year.

"Why did I try corn in this dry, wheat country?" asks Verhage. "Well, most of us farmers agree that this good, rich bottom land like mine is right for corn—if we can just have water in July and August. With the Solomon River near my field, I decided to take a try at supplying the moisture. And besides," continued Verhage, "if you've got water, corn's the better bet for a crop, even in this great wheat country."

Irrigation, plus good cultivation, is awfully good insurance, the way this Kansas farmer figures.

Mr. Verhage has gone strong for the Kansas-developed white hybrid (K2234) the past 3 years. "You know," he remarked, "white corn has come up in price the past few years. And this particular variety yields as well as any I've tried. What's more, it holds its ears well and you can pick it with a machine. Some of the yellow varieties drop their ears. In fact, I've found none that hold the ears like the Kansas white."

Verhage uses power machinery in listing, cultivating, and picking his corn. "I cultivate twice," he explains. "Like to blank list my fields early in the spring; then split the ridges when planting. Of course, I use a stalk cutter and disk before the blank listing. I don't rake and burn any stalks, so I have a pretty heavy growth to work into the soil."

To irrigate his corn, Verhage uses two pumping plants. A 6-inch pump irrigates a 31-acre field and an 8-inch pump furnishes water for another 90-acre tract.

In describing his equipment, Verhage said: "The small pump throws about 1,300 gallons a minute; the larger one 2,000 a minute. I usually irrigate twice. It amounts to around 15 inches of water. I aim to start the water at least a week before the corn shows any serious need of moisture. That's usually before the middle of July—about the time it is ready to tassel."

Not only does this successful corn grower water his corn, but he feeds it, too. He applies a 33 percent ammonium nitrate fertilizer at the rate of 125–150 pounds per acre. He puts this on either at the last cultivation, using an attachment on his cultivator, or adds it to the water at tasseling time.

Verhage expressed complete satisfaction with his corn project although he admitted that he and his family spent most of 5 weeks irrigating to produce the bumper 1946 corn crop. The average annual rainfall for that area is only 20 inches.

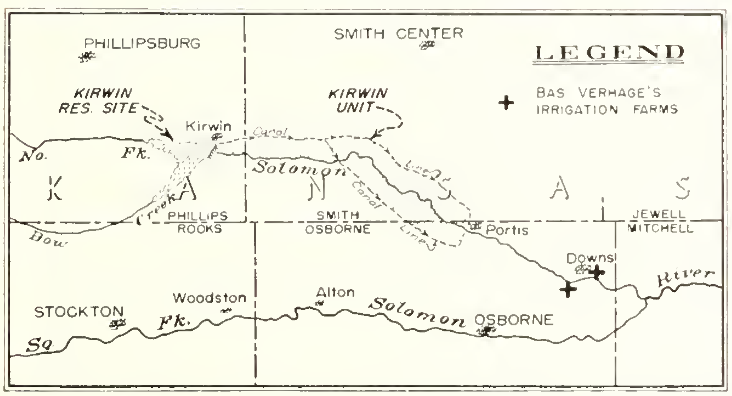
"It cost me around $5 an acre to irrigate that crop," Verhage figured. "But you've got to have the water to get corn. Take my dryland field! We had about 60 acres farmed by a tenant. It didn't do so well. Sold about half of it for silage at eleven bucks per acre. The other half made from 20 to 40 bushels. Some of it was down on the river bottom which now and then gets overflow from the river."

Since Verhage started his irrigation project in 1938, 15 other farmers in that vicinity have invested in pumping plants. Two years ago this group produced a total of 20,000 bushels of corn. Verhage said he'd hate to guess how many bushels of corn they would have had around Downs without irrigation—less than 5,000 bushels, maybe not even 2,000.

Verhage belongs to the Kansas Flying Farmers and pilots his own small plane. Active in community work, he is president of the local school board, and participates in activities of the American Legion Post and Business Men's Club. •

Reprinted from The Furrow, January–February 1948 issue, with the kind permission of the author, Rose Florea, and the publishers, Deere & Co. of Moline, Ill.

Irrigation has a bright future in Kansas based on Mr. Verhage's experiences as described in the article "A Corn King in Wheat Country." Mr. Verhage's farm is located by the North Fork of the Solomon River about 8 miles east of the lands of the authorized Kirwin, Kans., irrigation and flood control project. The reservoir site of the Kirwin project is located at the village of Kirwin, Kans., in southwestern Phillips County. The project lands to be irrigated are in the valley of the North Fork of the Solomon River in Phillips, Smith, and Osborne Counties between Kirwin and Portis. Like Mr. Verhage's land, the Kirwin project area is a fertile valley of bottom and terrace land that is suitable for irrigation development. It can be expected that many irrigators under the Kirwin project will be able to report large crop yields, similar to those of Mr. Verhage, after the dam and distribution works are constructed and water applied to the land. Other Kansas irrigation projects now authorized as units of the Missouri River Basin project also will make possible the production of high crop yields after the reservoirs and distribution systems are constructed and in operation.



Flame Throwers versus Weeds

(Continued from page 64)

4. The cost is too high. The combined cost of fuel and nitrogen gas at no time in the trials fell below 37 cents per hundred square feet of area burned, even when free crankcase drainings were used as fuel. By comparison, many conventional type weed burners operate at a cost of not more than 6 cents per hundred square feet of area burned.

On the other side of the picture there are a number of advantages in operation of the flame thrower which should not be overlooked:

1. It is portable. The equipment, with its reach of 70 to 90 feet, plus its portability, can perhaps burn areas not accessible to heavy weed burning apparatus.

2. It is durable. No time was lost during any of the trials because of malfunction. A minimum of time is necessary for adjustment, lubrication, and other maintenance work.

3. There is no danger of "blowback." The positive fuel shut-off valve guarantees cutting off the fuel as soon as pressure is released from the pistol-grip type valve, thus preventing the possibility of dangerous "blowback" of the flame.

Realizing that definite possibilities existed in the gun itself, the Bureau asked the Buena Vista Water Storage District burning crew to use the gun assembly attached to its regular diesel oil spray rig in normal burning operations, keeping a record of fuel consumption, coverage, range, ease of operation, mechanical stamina, and general suitability to canal bank burning operations.

The burner rig in use by the District had been operated with an ordinary orchard-type spray gun. Lack of a suitable cut-off valve had resulted in destruction of three rigs due to "blowback." Introduction of the flame thrower gun to their 400 gallon capacity weed burner was a distinct improvement as there was no "blowback," the fuel cut-off being positive and fast. The operator, a veteran of 5 years of weed burning, was heard to remark that it was the "best dern burner" he had ever used. Further questioning, however, brought out that during the 80 hours of operation the air compressor could not maintain adequate pressures for efficient burning. Operating costs, including labor and fuel, were much higher than with the ordinary sprayer gun as it took more fuel and more time to burn a specific area. It was apparent that the flame thrower gun needed to be modified before it could be used successfully in weed burning operations.

The correction was made by placing a brass ring on the external face of the original orifice thus reducing the diameter from five-sixteenths to seven thirty-seconds of an inch. With this modification, the gun maintained a constant pressure of 250 pounds per square inch, and the operating range of burning was increased from an erratic maximum range of 35 feet to a uniform maximum of 60 feet. The daily fuel consumption of the burning rig, using the modified flame thrower gun, was reduced from 1,100 gallons of diesel oil to 850 gallons per 8-hour day. Savings in fuel costs per day at 7 cents per gallon for diesel oil amounted to $17.50. The increased coverage and thoroughness of burn because of the much improved range permitted more rapid and economical coverage.

Experience with the gun by the Buena Vista Water Storage District has shown the need for an additional modification to make the flame thrower gun more applicable to use on weed burning equipment. The present spring is so strong that the operator's hands tire quickly while holding the gun in open position during burning operations. It is recommended that a spring of less strength be substituted in using the gun with conventional weed burning equipment.

As a result of these various investigations, an Ex-Marine and an ex-doughboy recommended that the United States Army flame thrower continue to be used for its original purpose of destroying the enemy in caves and pillboxes, but they do not recommend it as a single unit for destroying weeds.

However, the gun, which looks like an Army version of Buck Rogers' weapon, has definite possibilities—if it is used along with conventional weed burning equipment. •

Two of the Bureau's engineers, R. F. Blanks, Chief of the Division of Research and Geology, and H. S. Meissner, Head, Basic Concrete Research Section of the laboratories, were recently awarded the Thomas Fitch Rowland Prize of the American Society of Civil Engineers for a paper entitled "Deterioration of Concrete Dams Due to Alkali-Aggregate Reaction." (See last month's issue of the Era.) In this paper they describe numerous cases where cracking has been diagnosed and related to reaction between cement and aggregate. Here is a brief resumé of the subject, written especially for the Reclamation Era by one of the prize winners.

EXPANSIVE CRACKING IN CONCRETE

by **H. S. MEISSNER,**

Head, Basic Concrete Research Section, Division of Research and Geology, Office of the Chief Engineer, Denver, Colo.

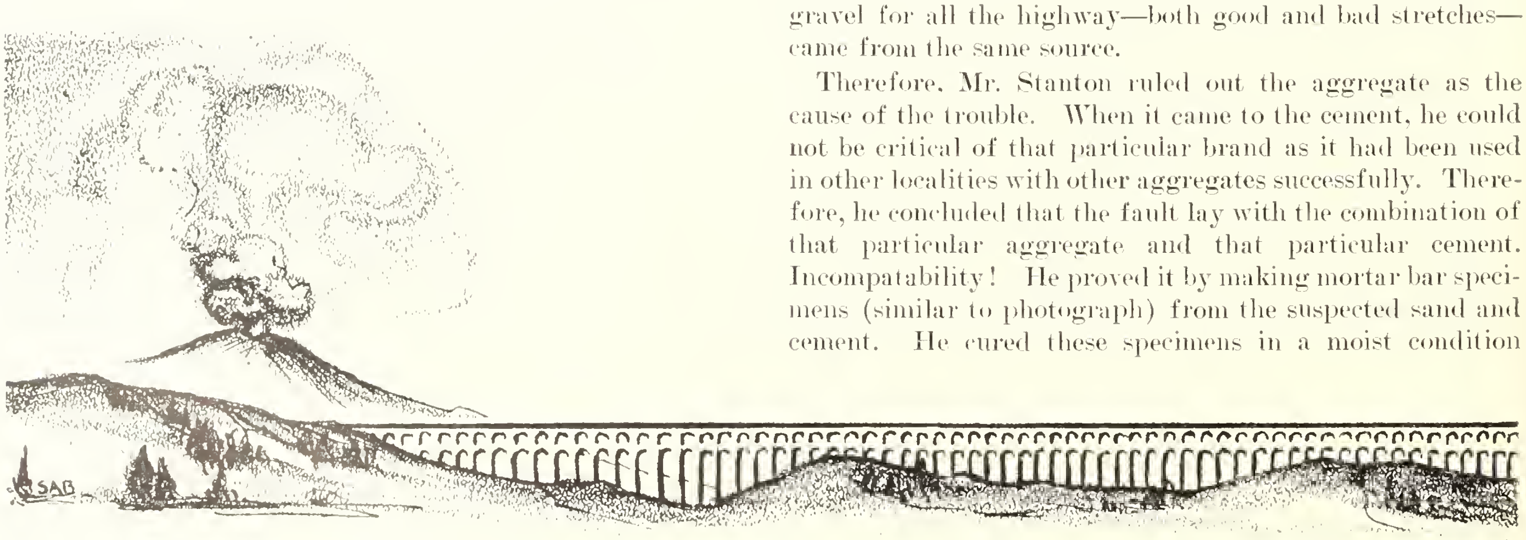
Every chemist, or cook, knows what happens when the wrong combination is made of the right ingredients, or the wrong ingredients are put together in the right combination.

So it is with concrete. The photograph in the upper right-hand corner illustrates what is known as "random-pattern" cracking caused by too much expansion in concrete.

The condition shown was due to the wrong combination—or "incompatibility"—between the aggregate (sand and gravel) and the cement used. Similar cracking, in some instances, has been related to unsoundness in the cement, or in the aggregate itself. In all such cases, the tell-tale evidence has been the "growing" or expansion of the concrete.

Fortunately, only a small proportion of manufactured concrete has been afflicted with this trouble, but the Bureau of Reclamation is taking steps to avoid it entirely in future work. Engineers in the laboratories of the Chief Engineer's office at Denver, Colo., are studying the causes of such deterioration and have devised methods of preventing it.

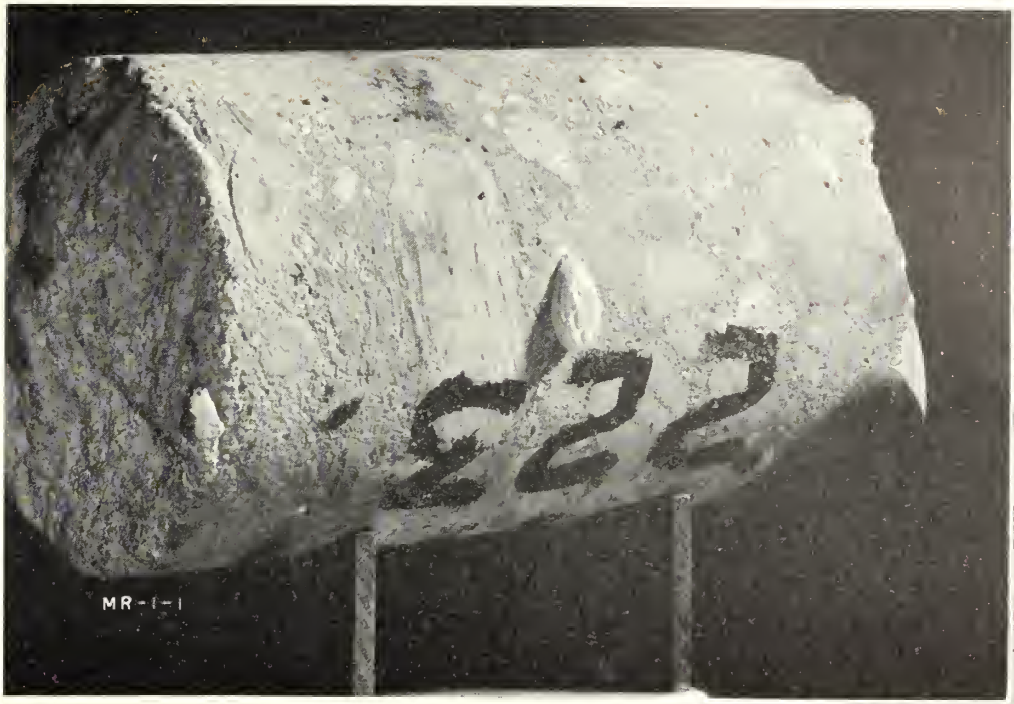
The Bureau's interest in this question arose when, 2 years after its completion, the concrete in Parker Dam (on the Colorado River between Arizona and California) began to crack. Instruments (known as expansion meters) were attached to the concrete and established conclusively that the concrete was swelling, or growing. Although this growth was slight, it was sufficient to stretch the concrete's non-growing, dry, outer skin and crack it.



Before this condition had been observed at Parker, Mr. Thomas E. Stanton, Materials Engineer for the California Department of Highways, had reported a case of expanding concrete, which he ascribed to the use of aggregates which reacted chemically to cement with a high alkali content. Bureau engineers believed his findings would throw light on the Parker Dam trouble because they knew the cements used in that structure were high in alkalies. When they analyzed the slow reaction between some mineral substances in the aggregate and the high-alkali cement used in the concrete, they found that this was the cause of the growing, expanding, and cracking concrete.

Mr. Stanton had noticed that certain stretches of a concrete road, built in California, were cracking and buckling at the expansion joints. Not all of the highway was affected—only those portions where a particular brand of cement had been used showed this condition. The sand and gravel for all the highway—both good and bad stretches—came from the same source.

Therefore, Mr. Stanton ruled out the aggregate as the cause of the trouble. When it came to the cement, he could not be critical of that particular brand as it had been used in other localities with other aggregates successfully. Therefore, he concluded that the fault lay with the combination of that particular aggregate and that particular cement. Incompatability! He proved it by making mortar bar specimens (similar to photograph) from the suspected sand and cement. He cured these specimens in a moist condition



NOT BUBBLE GUM—A concrete core showing sodic-silica jell oozing out of expanding concrete—the result of reaction between alkali in cement and reactive aggregates. At right, characteristic random pattern cracking caused by expanding concrete.

within closed metal containers and found that after a short period of time, sure enough, they expanded. In comparing the suspected cement with other brands, Mr. Stanton found its distinguishing characteristic to be a high content of alkalies, sodium oxide and potassium oxide. And when the aggregate was studied, it was found that it contained a small amount of the mineral, opal, which was chemically reactive with the high-alkali cement.

Reaction between aggregate and cement which causes expansion in concrete is now one of the major research problems in the Bureau's laboratories. Aggregates used in affected concrete are being investigated. Experiments are made on various pure minerals and rock types used as aggregates. In addition to the ill-fated opal, acid volcanic rocks, silicate glasses, chalcedony, tridymite, and some phyllites have been identified as minerals and rocks which are reactive to alkali. Experienced technicians, known as petrographers, can recognize these minerals easily, and now make routine examinations of all prospective sand and gravel to detect such potential troublemakers. Bureau technicians also give them try-outs in various combinations with high-alkali cement, to see if the aggregates can make the grade as sound mortar and concrete, or whether they are "expansionists."

Ordinarily, before the Parker Dam experience, it was not customary to analyze portland cement for its alkali content. The alkalies, sodium and potassium oxides, were considered as minor constituents. If alkali was present in cement, the small quantity was felt to be insignificant. However, some of the brands of cement used in Parker Dam were found to contain up to 1.42 percent sodium oxide. This is now recognized as an inordinate quantity and the Bureau is insisting that cement delivered to its projects (particularly where reactive materials are known or suspected to exist in the aggregates) contain no more than 0.60 percent alkalies. At present, this is considered the irreducible minimum.

As information on this subject has accumulated, it has been found that some pozzolanic materials, added to the concrete mix, will reduce or prevent the expansion between reactive combinations of aggregate and cement. Proof of the lasting qualities of concrete containing such materials has been found in the ruins of certain Roman aqueducts.

Present-day engineers marvel at the fact that these structures were not made of masonry, but of a concrete which has withstood centuries of use and abuse. The secret of their success seems to lie in the use of pozzolans—fine active siliceous materials. In the case of the ancient Roman concrete mixers, they used ash from the lava flow of volcanos. (Editor's note: An extremely reliable source informs us that the word "pozzolanic" has several spellings, due to its evolution through various Italian, German, French and English translations. The word is derived from the name of the town of Pozzoli, Italy, where Vesuvius-erupted pozzolanic materials presumably originated.)

Pumicite, calcined (burned) shale or clay, and fly ash (from burning pulverized coal) are other pozzolans which work in compatible combination with the lime in portland cement, giving the concrete added strength. A calcined diatomaceous (finely powdered) shale is now being used in the concrete for Davis Dam, which is being built upstream from Parker Dam. At the Davis site, unfortunately, the aggregates available for concrete work contain reactive aggregates.

Who knows? Perhaps the pozzolanic materials used in the Davis Dam structure will make the concrete as impervious to time as the Roman aqueducts. •

Reclamation in Switzerland

(Continued from page 66)

total amount of his previous property holding in one single lot. New settlements have been created by buying up a large number of small parcels of land. The necessary homes and farm buildings for family-sized holdings have been built. It is clear too, that with the redistribution of land a network of roadways had to be planned, so that each farmer could get to his land directly.

The best proof for the necessity of this concentration of property is the fact that the farmers never wish to return to the old conditions, when they see the advantages of the new system in increased output.

The benefit of such a consolidation lies in the fact that the farmer is able to save time and to use farm machinery. During the war more than 300,000 acres of land were improved through reparcelment, and an increase of food production was the result.

Simplified Laws Aided Program

In order to expedite the complete reclamation program the previous reclamation laws were amended and simplified. The original basic reclamation law specified that reclamation of land can be effected only if two-thirds of the property holders, representing at least half of the total area of the reclamation district, consented.

Several cantons improved this law so that only a one-half majority of the property holders was sufficient for reclamation procedures to begin. Even if the prescribed majority of property holders did not consent, it was in the power of Federal or cantonal legislature to decree that reclamation take place. But this last prerogative was never exercised, because the necessity of reclamation was obvious in itself.

Unrestricted fulfilment of this program was made possible due to the fact that the customary appeal to the courts was denied. All legal cases were brought before special commissions of appeal.

The planning was done by agricultural engineering offices of the cantons and by private agricultural engineers. The reclamation office of the Federal government had the single obligation of approving proposed projects and of auditing the accounts. Through an extensive standardization of planning, the final approval of the project was greatly simplified and speeded up.

In spite of the shortages in labor and material, reclamation work proceeded with little delay. Since a great part of the Swiss workingmen were in military service, there were considerable difficulties in obtaining a labor force. This state of affairs was overcome by granting leaves of absence for reclamation workers, by the introduction of a labor draft, and the institution of additional compensations for the workers.

Thanks to a well functioning rationing system for coal and other fuels, and the priority given to reclamation work, clay and cement tile, as well as fuel for the construction machinery were made available in spite of their shortage.

Since the reclamation program was considered to be one of the most important factors of national defense, the Federal government and the cantons granted substantial subsidies. These contributions did not have to be paid back. The subsidies of the Federal government ranged from 30 to 50 percent of the total costs, according to the type of reclamation.

In cantons, which could not sufficiently finance such undertakings, subsidies were raised to the level of 60 percent. Only after the canton had granted a subsidy, could the Federal government grant an additional subsidy. The subsidies of the cantons varied from 15 to 40 percent. It is estimated therefore, that an average of two-thirds of the construction costs was paid for by public funds.

Furthermore the whole banking system lightened the load of the reclamation districts by granting loans at a very low interest rate. In order to reduce the burden of interest, part-payments were made on the subsidies by the Federal government and the cantons.

The costs of reclamation work were relatively great, since a high standard was maintained in all planning and construction. *Swiss agricultural engineers and farmers together are convinced that long endurance and low maintenance costs of reclamation works, particularly that of tile drainage, can only be attained if the projects are carried out carefully and built permanently.* The average costs of tile-drainage, inclusive of canals, was 330 dollars per acre; and for overhead sprinkling systems 170 dollars per acre.

The total cost of the entire reclamation program during World War II came to approximately 138 million dollars. One can gain a better conception of the magnitude of the program by referring to the statistics given below:

Cost per capita of the Swiss population	$32
Cost per capita of the agricultural population	159
Cost per acre of total agriculturally productive land	26

The cultivation of this reclaimed land was given the utmost attention. A law stipulated that any private business with 50 or more laborers or office workers would be responsible for cultivating land. The businesses joined together in farming associations, headed by agricultural experts, and had to finance the cultivation of newly reclaimed land.

Competition Helped Production

Competition between the different farming associations sprang up because a part of the food produced was turned over to the workers of the business enterprises in addition to their normal food ration. Because of this added incentive, greater yields were the natural result.

At the end of World War II the reclaimed land could be turned over to the original owners in excellent condition, thoroughly worked and well fertilized.

There was another law by which the young people of the cities were to work on the farms for a short period each year. This had good results in that the city population gained a better understanding of agriculture in general and reclamation in particular.

The Swiss reclamation program during World War II is a good example of how the farmer and agricultural engineer can work together to make a country quite self-supporting, even when faced by adverse agricultural conditions. •

The Water Goes Underground

by W. H. FARMER
Yakima Project, Wash., Region I

Alvin Brandt regulating a valve on an underground pipeline at a stilling basin on the Garrett Schilperoot farm 5 miles north of Sunnyside, Wash. *Photo by Stanley Rasmussen, Region I.*

Gone are many of the wasteful water distribution methods of the early pioneer when water was plentiful.

In the Yakima Valley in the State of Washington, the open ditch is becoming a thing of the past along with the horse and buggy and the Model T Ford. It is now estimated that six out of every ten irrigated farms in this highly diversified crop-producing area have some pipeline deliveries for their irrigation systems and, in some cases, the entire system is under pipe.

The shift from open ditches to pipelines on farms has been taking place at an ever-increasing rate. Reasons for this change are many. The principal advantage gained is that several thousand feet of winding open ditches are eliminated on the average 60-acre farm by the use of underground pipeline. Also efficient use can be made of modern machinery because fields are not cut up into short runs by ditches. Furthermore, the yearly maintenance of open ditches is eliminated and ditchbank weeds are no longer a problem. Water transportation wastes are reduced to a minimum and the water is under control at all times. The cost of water and labor are both materially reduced.

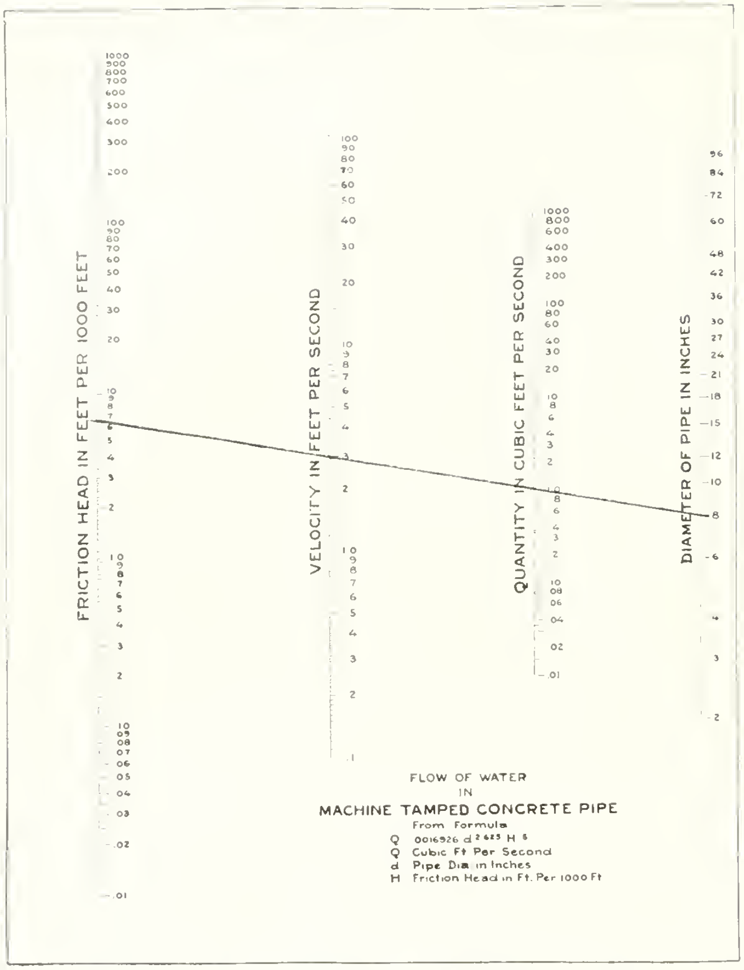
Most underground pipelines in the valley are made of concrete. The method of installing the pipe is extremely important to the permanence of any line. A cover of at least 18 inches of soil over the pipe is necessary to prevent frost damage in the Yakima Valley area and to avoid breakage by cultivation machinery. In areas where the climatic conditions are more severe, pipelines are installed at a greater depth. Under usual conditions a properly installed pipeline is permanent. Tests by the Bureau of Standards have shown that there are no areas here where there is alkali of sufficiently harmful quality or high concentration to injure good concrete pipe.

Very careful attention is given to the grade on which a pipeline is installed. This is a point quite often missed by farmers attempting to install their own lines on too flat a grade. Most engineers and irrigation specialists on pipeline layouts first determine the grade or fall available, so they can properly determine the size of pipe necessary for delivering water to a given acreage. Valley streams carry some sediment material so water traveling at a rate of less than two feet per second will usually deposit silt and sand in low spots along the pipeline, thus reducing the carrying capacity. Sharp breaks in the line grade are avoided wherever possible to prevent siltation and trapped air pockets. In traversing undulating topography, the pipeline is placed on a uniform grade.

Where sediment is a problem, a settling basin is installed at the intake of the pipeline. Weeds and other debris are eliminated by a trash rack and weed screens at the intake. An air vent is installed at the first joint below the intake to free air trapped by the water as it rushes into the pipeline.

The proper size of pipe to use is determined from the accompanying chart. For example, run a straight edge from the figure 6.5 in the first column, showing the grade or fall per 1,000 feet of lineal distance, to the figure 1 in the third column showing the per-second flow required. Then the fourth column on the graph shows the diameter of the pipe should be 8 inches and the second column shows that the velocity of flow in the pipeline would be 3 feet per second. By shifting the straight edge downward to the 6 inch diameter pipe, it is apparent that only one-half of the required quantity of water would be obtained with the same fall of 6.5 feet per 1000 feet. (See chart on next page.)

Experience has taught the farmer and the commercial pipe layer to do the following in laying pipelines.



Use a straight edge to figure the proper size of pipe. ***Chart prepared by Engineering Department of Oregon State College.***

- He digs the trench wide enough in the bottom to work in. This means a trench bottom width of at least 24 inches when installing an 8-inch pipe.
- He carefully finishes the bottom of the trench to grade so the pipeline will be firm and, therefore, no settling will take place later.
- He lays concrete pipe in a moist trench, but not in standing water.
- He gets a high strength quick-setting cement and mixes a mortar of one part of cement to two parts sand.
- He covers the collars with moist earth immediately after constructing them. If the earth is flour-like or dry, he places a strip of cement sacking paper over the fresh collars before covering them.
- He leaves 3 to 4 inches of earth over the pipe at least 48 hours before completely backfilling the line.
- He never tests the line by running water through it until after it has been completely backfilled. Usually when a head of water is run through a concrete pipeline that is laying uncovered, the sudden temperature change causes a contraction and results in cracked collars or pipe.

Excessive internal pressure is often the cause of fracture in steel, wood, plastic composition, and concrete pipe. Where excessive pressure is likely, the proposed line is surveyed, and the hydraulic pressure is determined before obtaining the pipe. The correct size and the shell thickness or reinforcement for the line can then be determined, and the system properly designed. Where a pipe line is installed through swales or valleys, thus effecting an inverted siphon, the proper placement of air vents has been found to be necessary. Two types of vents, the standpipe and the automatic valve are used in the Yakima Valley. The standpipe is one size smaller than the pipe line and extends vertically to a sufficient height to carry the static head in the pipe at that point. Where the pressure is great enough to make the standpipe impractical, an automatic valve is installed. Air vents are also installed to reduce the harmful effects of water hammer or surge in the lines when the flow is suddenly retarded by control valves.

Risers and valves are installed along the pipe line for water deliveries to fields. These valves serve from one to several corrugations, furrows, or borders, depending upon their size and make. Where deliveries are made from pipe lines running down steep slopes, other valves are often installed within the pipe line to equalize pressure and allow for equal water distribution to each row.

Drain and flushing valves are always installed at the end of the pipe line and usually at the bottom of large swales to remove sediment at intervals during the irrigation season, and to make certain that no water remains in the lines over winter.

Costs of farm pipe-line installations average $30 to $40 per acre, but may vary considerably from those figures, depending upon topography, pressure heads, size and shape of fields, the number of water-control devices, and irrigation methods required.

It should be made clear at this point that some valley land does not have sufficient slope to install pipe lines unless booster pumps are used. Where gradients are too flat for pipe lines, but not flat enough to prevent erosion in open ditches, flumes may be installed.

Irrigation farmers are receiving technical assistance in their pipe-line lay-outs from the State Extension Service, the Bureau of Reclamation, the Soil Conservation Service, and pipe manufacturers in the Yakima Valley. •

(The writer thanks Mr. E. Ellis Cummins of the Yakima Cement Products Company for the assistance given him in the preparation of this article.)

LETTERS (*continued from page 2 of cover*)

these days. I picked up a conversation with the engineer in charge. He said that due to failure of their ditch digging machine he had to lay off several men the day before. Further conversation revealed that this particular engineer has taken no annual leave for more than 2 years. An employee, more interested in the work he was doing, than his personal pleasure and recreation. I thought this wonderful in times like these.

Laborers are slowing up and doing less and demanding more and more through their leaders. . . . If all of the people in this grand country of ours would just work with determination of purpose, self discipline, and efficiency, so evident in your men working on that Gila project, these times would not be as hard as they are.

Mr. Gollenon, (J. C.) there answered all of our questions about the project, and then some, as did also the two girls in the office. Even the watchman at the gate was friendly and helpful as a man could be. We have seen so many who weren't.

The people of this country should be congratulated for having such nice fellows performing this service, setting such a good example, that others could follow if they would.

Conversation was had with a couple of old fellows who were irrigating. The land was so level, they seldom had to use their shovel. My little boy, 3 years old, could irrigate that land.

Sincerely yours,

HAROLD LINN.

Thank you, Mr. Linn.—Ed.

(*More Letters on Page 80*)

News Round-up

Irrigation in Sub-Humid Areas

Crop results on the W. C. Austin project in western Oklahoma are being watched closely as a guide to the future development of irrigatiton in subhumid areas. Some crops have been irrigated with water from the Altus reservoir in 1946 and 1947. The rainfall in those years was 24 and 26 inches, respectively. The benefits in increased income from irrigation are shown by the following table:

Average Gross Crop Income Per Acre

	1946	*1947*
Irrigated land	$130.72	$105.34
Nonirrigated land	22.09	43.86
Increase due to irrigation	108.63	61.48

The year 1946 demonstrated the advantages of irrigation with poor rainfall distribution. The 1947 season was more favorable for dry land farming. Nevertheless, irrigation increased the average crop value $61.48 per acre.

The results to date indicate that during most years the application of irrigation will create increased crop yields and income, and stabilize the farm economy of a project where rainfall may be slightly over 20 inches.

Bids Received for Hungry Horse—Biggest Postwar Job

April 1 was scheduled as the opening date for bids on Hungry Horse Dam (see February 1947 Reclamation Era), fourth largest concrete dam in the world, and the Bureau of Reclamation's largest single construction job since the war. The dam will be located on the South Fork of the Flathead River, 9 miles southeast of Columbia Falls, Montana.

The dam is designed to provide hydroelectric power, flood control, irrigation water for lands in Western Montana, and stream regulation for the Columbia River which will increase firm capacities of existing Columbia River plants.

Specifications call for the construction of a concrete arch dam approximately 520 feet above foundation, 2,115 feet long, with an arch radius of 1,200 feet. Approximately 3 million cubic yards of concrete will be used in the dam and appurtenant structures.

Other features of the project include a power plant with a 300,000 kilowatt capacity, a 30-foot roadway across the top of the dam, and a glory-hole spillway with a tunnel 24.5 feet in diameter through which will pass a flow of 53,000 cubic feet of water per second.

Peak employment is estimated to be between 3,000 and 4,000 workmen with an average monthly pay roll of $600,000.

Power Program Pushed

The revised Reclamation construction schedules provide for an increase of almost 3,000,000 kilowatts or 4,000,000 horsepower generating capacity in the West by June 30, 1953.

All of this power would be hydroelectric with the possible exception of a small steam generating plant with a proposed installed capacity of 160,000 kilowatts in the Central Valley project. These proposed developments would not only rapidly advance western river-basin development by using water now being wasted, but would also relieve the pressure on critically short fuel stocks through the substitution of hydroelectric power. In addition to these power developments the Bureau also hopes to provide new and supplemental irrigation water for an additional 4,000,000 acres of land by late 1953 or early 1954.

Riverton Crops at Peak

A new crop-production record was established on the Bureau of Reclamation's Riverton project, in Fremont County, Wyo., during the 1947 season when crops valued at $2,360,848.99 were produced on 38,594 acres under cultivation. The 1947 return averaged $61.17 an acre, an increase of $3.94 over the 1946 average of $57.23 per acre.

The gross value of crops raised on the Riverton project during the last 3 years exceeds the government's investment in the operating portions of the project by more than one-half million dollars. Crops raised during 1946 and 1947 alone were valued at more than 80 percent of the approximate $5,500,000 investment in the completed portions of the project.

The three leading crops in 1947 acreages planted and gross returns were:

Crops	*Acres planted*	*Gross return*
Commercial beans	11,361	$1,123,359.60
Sugar beets [1]	1,224	189,162.00
Oats	3,963	169,126.20

[1] During 1947 Riverton farmers also received Federal payments totalling $44,143.29 for their 1946 sugar beet production and soil conservation practices.

The greatest per-acre return, $204.13, was realized from 501 acres of white potatoes valued at $102,270. The return from sugar beets, including the value of the beet tops, ranked second in per-acre return.

Cereal grains of all types produced on the Riverton project in 1947 were valued at $422,254.95, an average return of $47.84 for each of the 8,827 acres planted in these crops.

A return of $47,916.15 was realized from 1,715 acres of seed crops, an average return of $27.94 an acre. Hay and forage crops valued at $413,523 were produced on 52,831 acres, or $7.83 an acre. The hay and forage crop value includes sugar beet tops and grain straw.

Vegetable and truck crops, which include commercial beans and potatoes, were valued at $1,243,849.60, a return of $102.55 from the 12,129 acres of these crops under cultivation.

Livestock, poultry, and equipment owned by Riverton project farmers were valued at $1,687,941. Of the total amount, the value for horses was $24,995; cattle, $369,620; sheep, $185,507; hogs, $56,112, and poultry, $44,932. Motor vehicles and farm equipment were valued at $1,006,775.

Topography and Irrigation Farming

(Continued from page 69)

result, many inefficient operating units still remain on most projects to plague both the operators of the irrigation systems and the farmers themselves.

On the million-acre Columbia Basin project, the adjustment will be made, where practicable, before irrigation water reaches the land. It is complicated enough to transfer small land parcels among affected owners, even before irrigation starts; but it is far easier to make the adjustment at such a time than to wait until the area is thickly settled by resident farmers.

On other projects, the Bureau of Reclamation has been handicapped in its efforts to lay out farm units on private land based on topographical considerations, because it could not do more than recommend the necessary transfers of land to the owners involved. On the Columbia Basin project, however, the adjustment is greatly facilitated by the Bureau's authority to acquire and sell land. This authority is provided to the Bureau under the terms of the Columbia Basin Project Act.

The farm pattern on the Columbia Basin project also involves access to a road for each unit and facility of service for each unit by electric and telephone lines. To minimize road mileage, units will be shaped to avoid the need for numerous crossroads; they will adjoin roads on the narrow side wherever practicable.

The logic of laying out irrigated farms in adjustment to topography was recognized in Reclamation Law back in 1906—the Act of June 27, 1906 (34 Stat. 519)—authorized irregular subdivision if necessary to permit practicable and economical irrigation. When planning for development of land in the Columbia Basin project was inaugurated in 1939, specific consideration was given to the subject. Problem 8, one of 28 in the Columbia Basin Joint Investigations, called for designating certain areas in the project within which farms should be laid out in adjustment to topography.

The report on Problem 8 was prepared by H. A. Parker, now Supervising Engineer of the Irrigation Division of the project, in cooperation with Harry G. Ade, former Assistant Regional Conservator of the Soil Conservation Service. It recommended that great blocks of land, principally in the rolling, eastern uplands of the project area, be subdivided into farm units based on topographical considerations. The report also suggested certain principles to be followed in farm-unit lay-out.

These principles are now being applied on the drafting boards of the lay-out engineers and land-development specialists. The first irrigation block in the project, the 5,361-acre Pasco Pumping Unit, has 84 farm units laid out largely in adjustment to topographical features. The boundaries of these units are formed by ridges and hollows, and by roads, canals, and laterals. Each unit will be supplied with water through one headgate at its high point.

Landowners in this area have supported the Bureau of Reclamation's objectives. The Bureau in return has given maximum recognition to the landowners' rights and wishes. Both have taken the viewpoint that even though small ownership transfers are tedious and time-consuming matters at any time, it makes good sense to shape up the farm properly before the costly process of farm improvement is begun.

The Pasco Pumping Unit, which is scheduled to receive its first water in the spring of 1948, is the precedent for a large proportion of some 16,000 family-size farm units which eventually will be laid out in the project.

As explained earlier, farms are being laid out in cooperation with the private landowners, who hold about 60 percent of the project's irrigable acreage. Every attempt is being made to comply with the landowners' desires. And wherever it will not result in inefficient irrigation practices, such as in the huge basins and slopes of the western part of the project, rectangular farms will be laid out. •

MORE LETTERS

Palo Verde Irrigation District,
Blythe, California,
February 28, 1948.

Dear Editor: In the February issue of the Era, I read, with appreciation, your announcement about the Bureau publication—"Control of Weeds on Irrigation Systems."

Ten years ago, when California's weed menace threatened to be a problem beyond our ability to control, I wrote an article that was widely published throughout the Southwest.

It was the opinion of some of my critics of 10 years ago that the United States Reclamation Bureau would not take kindly to certain remarks expressed in my article; and so I mailed a copy to Washington.

Mr. R. B. Williams—then Acting Commissioner—replied immediately, and his letter was very, very pleasing and encouraging to me.

Riverside County, California, largely due to wartime, efficient labor deficiencies, is again worried over its weed menace; and again we are trying to enthuse cooperation in a weed eradication campaign.

I regret the caustic criticisms of various publications that denounce the Department of the Interior for its failure to sell some of its marginal lands to veterans. During the past several years, I have deterred hundreds of veterans from expending their hard-earned savings for the acquisition of sand dunes, alkali areas, etc.

Sincerely yours,

Ed F. Williams

¶We are glad to see that reader Williams (whose biography was reprinted in the July 1947 Reclamation Era from DESERT magazine) continues to fight for reclamation essentials. Former Acting Commissioner R. B. Williams' letter of October 19, 1938, is well worth a quote or two:

I was especially interested in the statement: "It [weed control] is a job that necessitates the aid of the Federal Government and a job that must be started NOW! Millions are being expended in an attempt to reclaim new acreages. Why add new acreages to become propagating gardens for pests? The United States Reclamation Service must perform a new service—a service by which the saving of existing acreage must supersede the creation of new acreage."

We have felt for some time that the weed menace was a real problem and during the past few years in addition to working with other agencies in bringing to project settlers practical methods of controlling weeds, we have used CCC enrollees to carry on demonstration weed control projects. Along with the educational articles in the Reclamation Era *and the encouragement of similar articles in project newspapers, we have prepared slide-lectures on noxious weeds, which are given by leaders of the project at farm meetings in order to educate farmers concerning the source, spread, root habits, and eradication of perrenial weeds.*

In the 10 years since the two Williams (so far as we know, not related) discussed the need for weed control, the Bureau has continued to help reclamation farmers in their fight against weeds. We need and appreciate the continued support of men like Ed. F. Williams.—Ed.

U. S. GOVERNMENT PRINTING OFFICE 1948

NOTES FOR CONTRACTORS

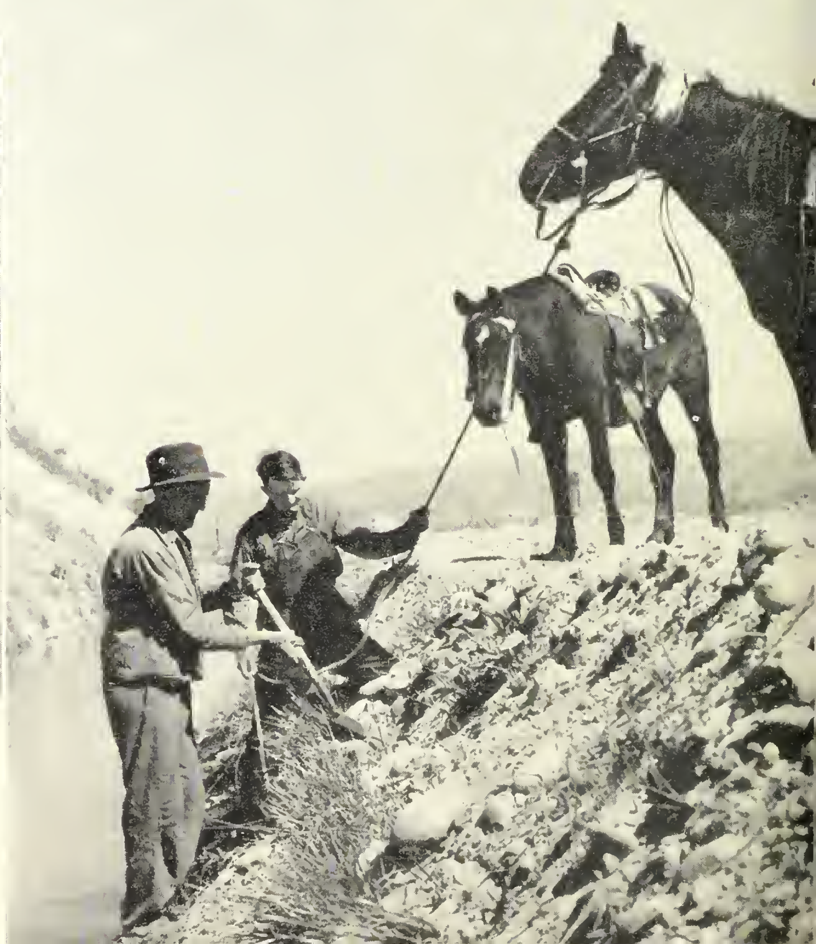
Contracts Awarded During February 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2005	Columbia Basin, Wash	Feb. 5	1 unit substation for service building, Grand Coulee power plant.	I T E Circuit Breaker Co., Philadelphia, Pa.	$11,160
2010	Davis Dam, Ariz.-Nev	Feb. 26	Station service and unit control and power equipment for Davis power plant.	Wolfe and Mann Mfg. Co., Baltimore, Md.	82,030
2014	do	Feb. 4	1 governor gallery crane for Davis power plant.	Star Iron and Steel Co., Tacoma, Wash	50,570
2016	Missouri Basin-Canyon Ferry unit, Mont.	Feb. 3	Construction of warehouse building at Canyon Ferry government camp.	Carson Construction Co., Helena, Mont	15,282
2017	Davis Dam and Central Valley, Ariz.-Nev.-Calif.	Feb. 6	One traveling crane for Davis power plant, item 1.	Euclid Crane and Hoist Co., Euclid, Ohio.	16,190
2017	do	Feb. 3	One traveling crane for Tracy pumping plant, item 2.	Moffett Mfg. Co., Albany, Calif	18,990
2029	Missouri Basin-Canyon Ferry unit, Mont.	Feb. 20	Erecting 14 prefabricated residences at Canyon Ferry government camp.	Dillon Construction Co., Bozeman, Mont.	55,882
2032	Central Valley, Calif	Feb. 16	Carrier-current line traps and coupling capacitors.	General Electric Co., Denver, Colo	108,200
2033	Columbia Basin, Wash	Feb. 11	Three air compressors for Grand Coulee power plant, schedule 1.	Worthington Pump and Machinery Corp., Harrison, New Jersey.	15,934
2036	Colorado-Big Thompson, Colorado.	Feb. 20	1 pump gallery crane for Granby pumping plant.	Star Iron and Steel Co., Tacoma, Wash	20,400
2041	Columbia Basin, Wash	Feb. 10	Three 108,000-kilovolt-amperes generators, for units R4, R5, and R6, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	5,328,000
2045	Klamath-Tule Lake division, Oregon-California.	Feb. 11	Construction of pumping plants, Copbeck Bay extension.	George R. Stacy, Tulelake, Calif	128,375
2046	Boulder Canyon, Nev	Feb. 24	Construction of supplemental water supply line for Boulder City.	N. P. Van Valkenburgh Co., South Gate, Calif.	511,056
2048	Columbia Basin, Wash	Feb. 10	Nine 43,000-kilovolt-amperes transformers for units R4, R5, and R6, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	1,088,686
2052	Owyhee-Mitchell Butte division, Oregon-Idaho.	Feb. 16	Construction of earthwork and structures for Locket Gulch wasteway (drop channel).	George B. Henly Construction Co., Caldwell, Idaho.	155,647
2058	Colorado-Big Thompson and Missouri Basin, Colorado-South Dakota.	Feb. 18	Fixed wheel gates for Angostura dam, items 3 and 4.	Northwest Marine Iron Works, Portland, Oreg.	20,338
2065	Missouri Basin-Frenchman-Cambridge unit, Nebraska.	Feb. 26	Hollow jet valves and erection equipment for Enders dam.	United Engineering Co., San Francisco, Calif.	39,690

Construction and Supplies for Which Bids Will be Invited During April 1948

Project	Description of work or material
Central Valley, Calif	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal.
Colorado-Big Thompson, Colorado.	Construction of about 50 miles of 69 kilovolts wood-pole transmission line from Brush to Yuma, Colo.
Columbia Basin, Wash	Completion of Grand Coulee pumping plant, warehouse A and B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.2, machine shop and central heating plant, addition to right training wall, and water storage reservoir for Coulee Dam; assembly of caisson seat form and face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
Davis Dam, Ariz.-Nev	Steel towers for 230 kilovolt transmission line at Davis Dam.
Deschutes, Oreg	Completion of construction of Wickiup Dam and relocation of forest service road.
Do	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base.
Gila, Ariz	Construction of check and turnout on the Gila Gravity Main Canal.
Klamath, Oreg.-Calif	Improvements of about 7 miles of Lost River Channel through Poe Valley.
Mirage Flats, Nebr	Erection of office building, three prefabricated residences, warehouse, utility buildings, well pump-house and elevated tank, and installation of utilities on State Highway No. 87, about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Kans	Erection of 25 prefabricated residences, office building, warehouse, laboratory, and utility buildings; furnishing and installing utilities for Cedar Bluff government camp.
Do	Construction of Cedar Bluff Dam, an earthfill structure, near Hays, Kans.
Missouri Basin, N. Dak	Construction of Dickinson Dam, an earthfill structure, Heart River Unit, near Dickinson, N. Dak.
Missouri Basin, Colo	Erection of 12 two-bedroom and 4 three-bedroom prefabricated residences at Narrows Dam government camp.
Missouri Basin, S. Dak., Wyo., Mont.	Furnishing and erecting prefabricated, precut, or sectionalized residences for government camps at Shadehill and Bixby Dams, S. Dak., Keyhole Dam, Wyo., and Moorehead Dam, Mont.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Provo River, Utah	Construction of steel pipeline and structures for Big Cottonwood section.

SPRING CHECK-UP—These familiar springtime scenes show: (top photo) Bert Patrick (left) and Tom Mayes patrolling a section of the canal; at right, Tom fills a gopher hole while Bert supervises; and above, Bert greets Lee Wilson, a third ditchrider, at their headquarters shack. Despite the popularity of modern cars, these men prefer to ride the ditches on horseback. The photos were taken on the Settlers irrigation district of the Boise project in southwestern Idaho by Stanley Rasmussen of Region I.



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MAY
1948

Featuring:

West-Wide
WATER
Forecast

A New Killer
for
Water Weeds

PLOW, PLANT
and PRAY
by
ROBERT S. KERR

GOVERNMENT PUBLICATIONS
MAY 15 1948

THE *Reclamation* ERA

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OUR BACK COVER

Aerial view of W. C. Austin project, Oklahoma, featuring the Altus Dam, key feature of this development, which will ultimately provide irrigation water for approximately 50,000 acres of previously dry-farmed land. This photo was taken by Preston W. George, Civil Engineer, Region V, on September 5, 1947, during the dedication ceremonies for the project.

Reclamation ERA

May 1948 **Vol. 34, No. 5**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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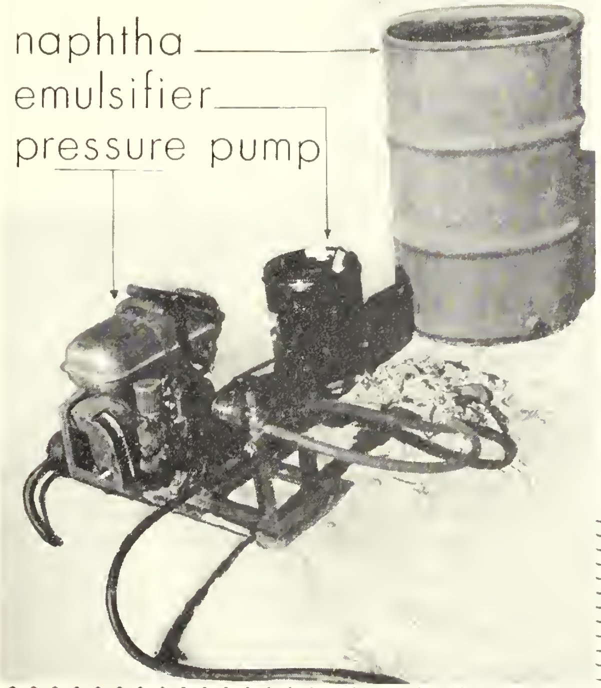
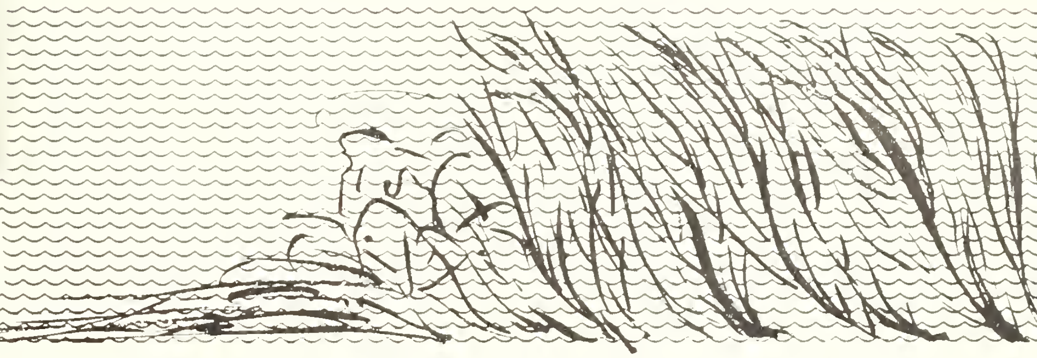
CONTENTS

Ruth F. Sadler, *Editor*

OUR FRONT COVER

SPRING CLEANING—New water weed killer described on page 81 does away with the necessity for this type of arduous labor. Here, on the Boise project we see workmen on a newly constructed boom pushing and prying loose the troublesome weeds so that they will continue along their path to the wasteway graveyard. Attached to the boom is an apron hanging two or more feet below the surface. This, plus the force of the current, directs the moss and weeds into the wasteway structure. This photo was taken by Phil Merritt, Region 1.





Above, early "extinguisher system" with which naphtha was applied to canals at 50 pounds pressure per square inch.

A NEW KILLER for Water Weeds

by W. T. MORAN and J. M. SHAW

Branch of Design and Construction, Denver, Colo.

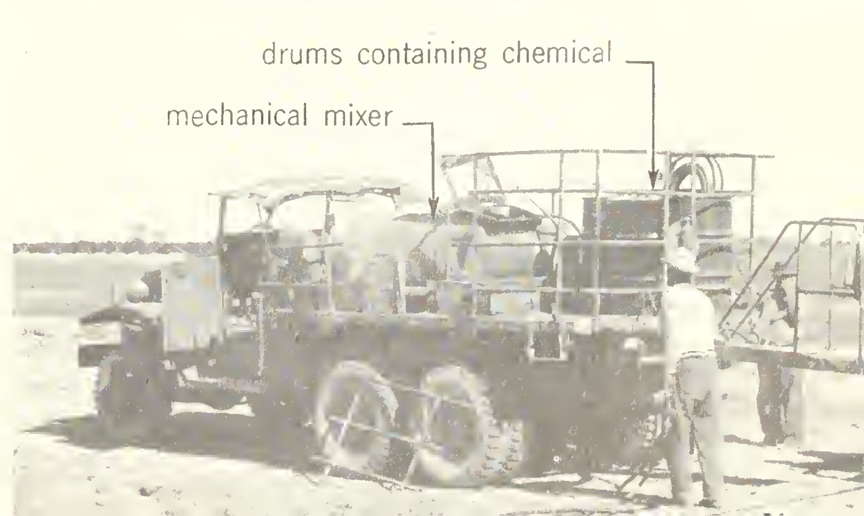
Western irrigation farmers spend millions of dollars every year for controlling submersed waterweeds (commonly called moss) in canals. Because most control methods used in the past were expensive and laborious, they often were not used until conditions became serious and irrigation canals were delivering but a fraction of the precious water they were designed to carry.

Relief from this costly waterweed infestation is now a definite probability. A simple treatment that can be accomplished at a very low cost promises to restore infested canals to their original capacity for carrying water. A chemical compound that goes to work on weed tissues and literally takes the life out of them has been developed through the weed research program being conducted cooperatively by the Bureau of Reclamation, Department of the Interior, and the Bureau of Plant Industry, Soils and Agricultural Engineering, Department of Agriculture.

You can fully appreciate the magnitude of the problem created by waterweeds when you consider the potential loss and damage they may cause. Besides cutting down the capacity of irrigation canals, waterweeds cause silt to be deposited which makes costly dredging necessary. Another toll taken by these weeds is loss of water through increased evaporation and seepage. When the canal water level must be raised above normal in an attempt to increase the flow of water (retarded by waterweeds), canal erosion and even canal breaks are common results which can be charged to waterweeds. Rank growths of waterweeds clog drains, cause them to function poorly, may keep potentially good land waterlogged, and increase alkaline deposits in the soil. In extreme cases, crop yields have been reduced when the former temporary, but often costly, methods were practiced too late to prevent pinching off part of the vital water, particularly in years when the supply was not too plentiful.

The Department of the Interior has applied for a patent for the new chemical mixture, which has had several field trials, with every indication that it is a powerful weapon not only in controlling certain aquatic weeds but also snails, crayfish, and mosquito larvae. Research so far has shown the mixture to be very effective on the stems and leaves of the plants tested, but some regrowth from the roots has been known to occur. It is too early in this stage of development and testing of the new aquatic herbicide to predict their eventual affect on the root systems of waterweeds. Much more information on this phase of the results should be obtained from field trials planned to be made this year.

This improved mechanized general purpose "extinguisher system" used by the Imperial Irrigation District features pump pressure capable of applying 450 pounds per square inch of the water-weed-choking naphtha to canals.



LEFT: New naphtha killer forms white blanket in Yokum Irrigation Ditch, Arvada, Colo. RIGHT: Same ditch 2 weeks after treatment. Note absence of water weeds at right.

But two warnings are necessary here and now: First, the new formulation, the physical properties of which are printed in a box accompanying this article, must be handled with caution; and second, tests thus far indicate the formula is toxic to fish. In other words, just as you can't have your cake and eat it, neither can you kill weeds with the new chemical and have all of your fish.

The research group in the Denver laboratory is continuing its work in developing more economical and permanent methods of weed control and it is hoped that eventually a chemical may be found that will be effective on plants but not injure fish. The Bureau has always been an advocate of wildlife conservation as attested by its many years of work with the Fish and Wildlife Service in helping develop refuges on irrigation reservoirs. However, the Bureau's first obligation is to the water users which it serves. For this reason it is not justifiable, in order to save a few fish, to practice water-weed control methods which may cost hundreds of dollars per mile when methods costing only a few dollars are available.

It isn't enough to develop a chemical to control weeds as a last resort when the ditches are completely choked. Irrigation district officials have been looking for a formula which can be produced at a cost which they can afford to pay for preventing such conditions before they get out of control. Bureau chemists are confident, and even enthusiastic, that they have this problem licked. The new formulation is so inexpensive that its use can be started at an early stage of the weeds' growth, and additional applications can be made as required during the season. This method would help maintain the full capacity of the ditches, hold down evaporation and seepage, and prevent much of the sediment collecting in the channels.

The first field test of the new mixture was conducted by the authors, with the aid of Region VII officials, in the main canal of the Riverside Irrigation Co. near Fort Morgan, Colo. The canal has a design capacity of 300 cubic feet per second but was so badly infested with a species of weed, know as the horned pondweed (*Zannichellia palustris*), that the maximum flow had been reduced by 50 percent. After carefully treating the canal with the new formula, the full carrying capacity was restored within 72 hours. Here's how it was done: To coal-tar naphtha (with a boiling point range of 135° to 208° C.) was added emulsifying agents consisting of equal parts of mahogany soap and sulfonated castor oil. This mixture was introduced into the canal beneath the surface of the water at a pressure of 50 pounds per square inch through a spray nozzle with a 0.02-inch opening. A small motor-driven pump was used to pump the chemical from drums into the canal.

Perhaps one of the most important features of the new mixture is its apparent ability to kill weeds regardless of the stage of growth. While practically all field tests were conducted when weeds were at their hardiest, an exception was made on the Yocum Ditch near Arvada, Colo. Because the season was so far advanced when the chemical was applied, the weeds were entering their dormant stage. A concentration of 185 parts per million of the same type emulsified naphtha used in the first field trial was maintained for 60 minutes. This test was so successful that within 72 hours after treatment the ditch was free of weeds for a distance of 1 mile below the point of application. Under ordinary conditions chemicals would not usually be applied at that stage of growth because the plants naturally begin to break loose by themselves.

During November of 1947 extensive tests were made on irrigation facilities of the Imperial Irrigation District of California and on the Yuma and Gila projects of the Bureau of Reclamation near Yuma, Ariz. The only change made in the mixture was to reduce the emulsifying agent, mahogany soap, from 10 to 5 percent by volume. All of the tests were eminently successful (*with the possible exception of the treatment of the canal on the Gila project where a combination of factors, principally inadequate mixing of ingredients, resulted in a rather weak kill of the weeds present*). They confirmed the laboratory investigations as well as the earlier field trials. Good mixing, pump pressures of 450 pounds per square inch, and small nozzle openings all helped to increase the efficiency of the treatments by causing better dispersion in the water, thus sending the emulsion further downstream before it broke and rose to the surface.

A similar test to those described was conducted in a canal of the Black Canyon irrigation district near Boise, Idaho, by J. M. Hodgson of the Bureau of Plant Industry, Soils, and Agricultural Engineering in cooperation with Bureau project personnel. Sago pondweed (*Potamogeton pectinatus*) was the predominating species but there were also scattered patches of horned pondweed and both species were in an advanced stage of maturity in this test made October 2, 1947. Seventeen gallons of coal-tar naphtha with 5 percent mahogany soap were sprayed into the canal carrying a measured flow of 3.1 cubic feet per second, enough for a concentration of 200 parts per million for a period of 1 hour. Ninety percent of the leaves and stems of sago pondweed had turned brown within 24 hours. Horned pondweed reacted more slowly but the final injury was about the same. Two weeks after treatment the water was turned out of the canal for the winter. At that time about one-third of the aquatic plants remained and were starting to produce new leaves. It was noted that injury to the pondweed was more severe from a point a few hundred feet below the application to three-fourths mile downstream than it was at the point of introduction. This observation emphasizes the need for thorough mixing of the chemical with the water in order to get the best effects. The advanced maturity of the weeds at the time of treatment probably prevented a more complete kill of the top growth.

Field trials so far have indicated that 185 p. p. m. (parts of chemical per million parts of water in the canal) gives satisfactory control when this concentration is maintained for 1 hour in contact with the waterweeds. To obtain 185 p. p. m. for an hour, 5 gallons of the chemical formulation must be applied to each cubic foot per second of flow over a period of 1 hour.

For example, if it has been determined that the canal or drain is flowing at the rate of 12 cubic feet per second at the time of treatment, it will require 60 gallons applied over a period of 1 hour or 1 gallon of the mixture per minute. Each gallon of chemical applied over a period of 1 hour to each cubic foot per second will give a concentration of 37 p. p. m. Therefore, when special cases seem to warrant higher concentrations, it is necessary only to divide the desired concentration by 37 to determine how many gallons of the chemical should be applied per cubic foot per second of flow per hour. Inasmuch as the amount of chemical necessary to control the weeds is directly proportional to the volume of water in the canal, it is always recommended that the flow be reduced at the time of treatment. However, it will be necessary to have the weeds completely covered.

Although it was found in the laboratory that many chlorinated hydrocarbons and other compounds will kill the stems and leaves of waterweeds, nothing has yet been found that will compete with the aromatic solvent naphthas in availability, efficiency, and cost. Prices of acceptable materials now range from 18 to 42 cents a gallon.

The Denver research group developed a screening technique for testing a large number of various chemicals and eliminating those which were not effective. They collected several species of waterweeds and let them grow under controlled laboratory conditions in large glass tanks containing circulating water. Then the technicians treated sections of stems, leaves, and bud ends of the various species of plants in beakers containing different concentrations of a specific chemical for a given time. They carefully watched and took notes on the effects of the material on the plant tissues. The reward for their patience, meticulous care and scientific methods was the discovery of the new mixture.

The research work conducted in cooperation with the Bureau of Plant Industry is only one phase in the over-all program of weed control launched by the Bureau of Reclamation under the direction of its agronomist, Robert B. Balcom. Working closely with Bureau weed control specialists, the Bureau of Plant Industry, Soils and Agricultural Engineering, has established field stations at Phoenix, Ariz.; Prosser, Wash., and Meridian, Idaho, under the direction of L. W. Kephart, senior agronomist in that Bureau. These stations make large-scale weed control tests under natural field conditions. Also, the Bureau of Plant Industry assigned one of their plant physiologists, Dr. R. S. Rosenfels, to full-time cooperation in the Bureau of Reclamation laboratories in Denver. In addition to waterweed control, the research program includes various investigations such as soil sterilization and toxicity studies of various chemical agents to crop plants.

An interesting sidelight of the weed control investigations has been snail control. Although snail control is of minor importance in the United States, it is a problem of no little significance to other countries. Egypt is vitally concerned because many species of snail serve as hosts for parasites such as blood flukes, liver flukes, etc. The disease caused by these parasites often reaches epidemic proportions along the Nile River. Snails feed on waterweeds; therefore, control of their food supply should reduce the snail population. More important, however, the Bureau's chemists discovered in field

(*Continued on page 93*)

R. F. Blanks, Chief, Denver Laboratories, explains experiment on water weeds to Under Secretary of the Interior Oscar L. Chapman.

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Photo by Harris & Ewing

Plow ~ Plant ~ and Pray

"~ Then will I hear from Heaven ~ and will heal their land." I Chronicles 7:14

by ROBERT S. KERR, former Governor of Oklahoma

When the '89ers swarmed over the plains and prairies of Oklahoma to take up homesteads, they found the red men had been well settled on the fertile bottom lands along the streams. This was, probably, because here was fuel, water and food—and, the richest soil under the sun.

Sixty years! And Oklahoma has made history and a name for herself. Today, she is famous for her fighting sons with the pioneer spirit of their forefathers; for her oil and her agricultural achievements. But, today, she is beginning to realize that the "drops of water and grains of sand" must be nurtured and cared for and not so ruthlessly treated as in those yesteryears.

Great progress has been made toward conserving her land and water resources but the job is not done, nor will it ever be done. We must keep on, if we are to get the most out of their use and leave similar opportunities for our posterity.

Those bottom lands of the red man, along our creeks and rivers, are today's challenge to strong-hearted men. They are the source of succulent harvests if we regiment them to our purpose.

The Oklahoma farmer's rule is plow, plant, and pray—pray that the rains will come—not too much, not too little, not too late, but just right to provide bountiful harvests.

We have in Oklahoma, 2,810,000 acres of fertile, alluvial lands in the flood plains of our streams. We have an additional 1,300,000 acres of second bottom lands. These bottom lands are all classified as superior soils. It is estimated that at least 1,000,000 acres of the land in the flood plains are not farmed because of the frequency of floods, and not because the soils are inadequate for agriculture. If the lands in the flood plains that are now cultivated were protected from floods, their productivity would be materially increased, and they could be farmed more intensively. The flood damage to agriculture in the State of Oklahoma is estimated to aggregate $6,000,000 a year. The orderly selective construction of impounding and protective works will bolster materially the resources of the lands in Oklahoma.

The average rainfall in Oklahoma varies from 17 inches annually in the extreme northwestern corner of Cimarron County to 55 inches in the southeastern corner of Oklahoma. Many studies have been made of the climatic conditions of the State, all producing about the same results as to rainfall and its distribution. Rainfall in the western half of the State, or the area west of the ninety-eighth meridian, although amounting to about 25 inches a year (which under normal conditions is ample to produce crops) is so poorly distributed as to render much of the annual total of little value to growing crops. In other words, torrential rains resulting in high intensity run-off produce flash floods during the spring. Therefore, they are not beneficial and often are detrimental to crop production.

A study of the frequent occurrence of droughts in the State of Oklahoma has revealed that the southwestern section of the State has suffered most severely from droughts and that the entire area of the State west of the ninety-eighth meridian probably could be classified as a chronic drought area. Droughts have occurred 13 times in 30 years serious enough to cut crop yields by 50 percent or more.

From this summary it is recognized that if the rain which falls could be stored when abundant and held until needed, there would be sufficient water to produce a good crop yield. A glance at the map of Oklahoma reveals a well-drained area. Conversely, we may add that this same identical drainage system, by and through skilled manipulation, can become an equally efficient watering system with which to dampen the parched acres along their course.

In light of this review of rainfall, run-off, flood, and drought patterns for Oklahoma, does not the answer to the old theory of "plow, plant, and pray" seem apparent? Obviously, insured crop production—stabilized farm income—by

A PRAYER IS HEARD as farmers see the first irrigation water come to "heal their land" on the Altus project in Okla. *R. M. Reynolds Photo.*

irrigation, is the answer. The soil is here, except the millions of tons which have been carried to and toward the Gulf since '89. The water is here in sufficient quantity to produce crops, supply municipal and domestic needs and to generate a little power if we but impound and harness the torrents. Other climatic conditions, temperature, growing season and the like are suitable for producing the base materials of agriculture and industry. Oklahoma has adopted an industrial slogan "you can serve best from the center." This applies likewise to the agricultural produce in relation to marketing. Notwithstanding great production of agricultural crops, we still import into the area a large part of the food that we eat in the form of fresh and canned fruits and vegetables.

Consider also some of the potential agricultural-industrial opportunities of Oklahoma, such as alfalfa mills, milk product plants, cornstarch factories, broom factories, peanut oil mills, cotton textile factories, new processing plants springing from chemurgic research, canneries, meat packing plants, cereal food factories, flour mills, commercial poultry and cattle feed manufacturing plants, commercial fertilizer plants, pecan and peanut candy factories, mattress factories and many others. All are based on a stable agriculture.

We spoke of "plow, plant, and pray." The farmer of Oklahoma has plowed, has planted, and has prayed that the rains would not come in floods, and that the droughts would not last long. Irrigation and flood control can answer that prayer.

In southwestern Oklahoma in the vicinity of Altus, the W. C. Austin reclamation project, the first Federal reclamation project to be constructed in the State, is now partially in production. Many are watching with a critical eye the results of this project in the great plains area. Its ultimate success will be a major factor in determining the destiny of other projects in like climatic areas throughout the Nation. As always, we in Oklahoma are optimistic about the outcome of this project. We know that it will be a success. We point at results thus far obtained to bolster our opinion. In 1946 while dry land farms in the area were producing on the average of $22.09 per acre, the irrigated lands of the W. C. Austin project produced $130.72 per acre.

Looking to the Bureau of Reclamation to guide us in our plans for other reclamation projects, we predict a new era for irrigated agriculture in the State of Oklahoma. END

____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

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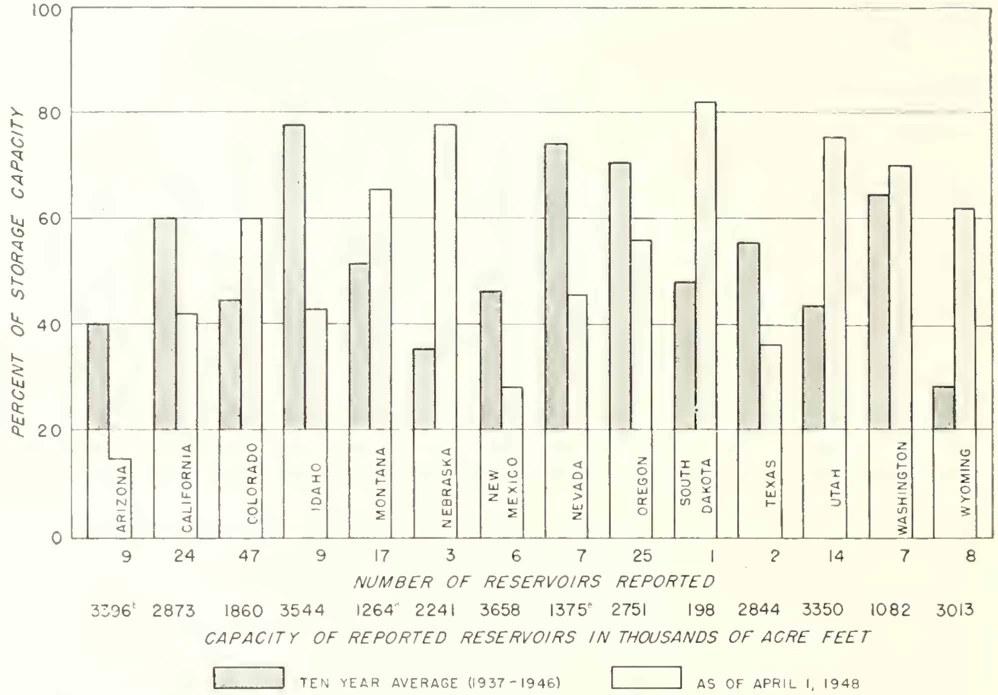
WATER REPORT

PERCENT OF RESERVOIR STORAGE CAPACITY
TEN YEAR AVERAGE (1937-1946) COMPARED WITH
STORAGE CAPACITY AS OF APRIL 1, 1948



Not all reservoirs in all States are reported, but enough are reported to give a reliable index of each State's storage supply.

(b) Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included.

(c) Does not include Narrows (Yuba River), Friant or Shasta reservoirs. April 1 storage in these three reservoirs combined is 3,334,000 acre-feet, which is 78 per cent of their capacity.

(d) Does not include Fort Peck reservoir (capacity 19,000,000 acre-feet); April 1 storage 13,440,000 acre-feet.

(e) Does not include Lake Mead (capacity 31,140,000 acre-feet); April 1 storage approximates 18,620,000 acre-feet.

West-Wide Forecasts of 1948 Water Supplies Based on Work of the Western Snow Surveys

By Paul A. Ewing, Senior Irrigation Economist, and R. A. Work, Senior Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture.

What Do You Mean, *SNOW?*

Well, it may be snow to most folks, but to Western farmers it's water—water, without which there won't be crops next summer. To plan things right, we have to know how much snow lies on the mountain slopes—how much and what kind of snow. That's why the Bureau of Reclamation is continuing its cooperation with the Soil Conservation Service. S. C. S., through its Division of Irrigation and Water Conservation, is the Federal coordinating agency for snow surveys; the snow surveys, made throughout the Western mountains each spring, are the basis for forecasts of run-off to appear in later months.

You can't tell what snow means in terms of water just by looking at it. Its density varies widely from time to time and from place to place.

It is this wide variation that makes almost valueless snow measurements based only on depth. It's the water content that holds the secret of summer stream flow. Early attempts to forecast water supplies from depth measurements failed to take proper account of densities, but modern snow surveyors have turned the trick by taking many hundreds of samples periodically throughout the West. The sampler most widely used is an extensible light metal tube with a sharp cutting point, which when thrust into the snow, collects a core or column. The tube is graduated in inches and has longitudinal slits through which the snow core can be observed, and its length noted. Then the snow-filled tube is weighed on a scale so calibrated as to show the inches of water in the measured snow. Analysis of the many records obtained in this manner provides the basis for the water-supply forecasts.

The following paragraphs summarize the water-supply prospects, State by State, as indicated by the April snow surveys. A pattern similar to that of 1947 is indicated. Severe shortages again appear in prospect for the Southwest, including Arizona, Nevada, and much of California, but with marked improvement, progressing from south to north. An alarming outlook for California, persisting through the winter, was somewhat eased in late March and the early part of April, but the summer supplies still threaten to be greatly below normal. A marked, though belated improvement has also taken place in New Mexico, where reservoir storage, though still abnormally low, is expected to improve greatly with the increase of spring run-off. Conditions in the Rio Grande, Upper Colorado and Columbia river basins are generally satisfactory as are also those on the slopes east of the Rocky Mountains.

The two charts accompanying this article further summarize the results of the April snow surveys.

Arizona.—The long-continued water shortage throughout the main irrigated areas still persists. Although snow-stored water on the higher elevations is, in general, equal to any previously recorded high on April 1 it is not enough to overcome the critically low storage in practically all reservoirs. Since available storage is the most important factor in Arizona's irrigation supply, the fact that the total amount of water held in the nine important reservoirs is only 10 percent of their total capacity has particularly gloomy significance. Apparently another season of heavy pumping from ground storage is in prospect.

California.—Although the State is still faced with a short water year, the outlook improved a lot during March. Snow surveys early in the month showed such a poor pack that the outlook was for a record dry year similar to 1924. However, during March more snow fell than during the three preceding months. Before the end of the month the outlook had improved until a year similar to 1939 could be expected, and by early April, continued improvement had raised the outlook to equal to or better than last year. Many areas received as much snow during the first eight days of April as they normally get during the entire month. Forecasts based on conditions surveyed at the end of March are therefore subject to some additional qualification on the favorable side.

The assured run-off from the combined areas of the Sacramento and San Joaquin Valley watersheds, on the improved basis, is expected to be 51 percent of normal. Last year the corresponding over-all run-off figure was 49 percent of normal.

Run-off will be relatively better in the Sacramento Valley than in the San Joaquin. For the tributaries of the Sacramento River the average is 56 percent of normal, while for the San Joaquin River tributaries the average is 49 percent. Last year's comparable figures were 49 percent for both the Sacramento and San Joaquin Rivers.

Snow surveys from the Kings, Kaweah, and Kern watersheds, tributaries of Tulare Lake, indicate 5 percent less run-off than last year.

With the exception of Shasta and one or two other reservoirs, water stored is less than last year.

Colorado.—The outlook is favorable. Summer flow of Colorado River and its tributaries is expected to be from 10 to 30 percent above normal. Snow cover is well above normal. On most tributaries the snow-water content is slightly above last year but on the San Juan, Animas, and Dolores Rivers it is substantially greater. Seasonal precipitation over the western slope has been much above average.

On the South Platte drainage, snow cover is slightly less than last year but substantially above the 13-year average. Above-normal flow is expected for all streams in this drainage. Reservoir storage is more than last year; many reservoirs are practically full already.

The outlook for the Rio Grande in Colorado is the best in years. Unusually heavy snows during February and March materially improve the outlook in this area. Reservoir storage is in excess of last year and there is a large amount of moisture stored in the soil. Above-normal streamflow is expected but flows will not reach flood proportions unless later weather conditions are abnormal.

Idaho.—State-wide prospects are mostly fair, but are slightly better than that for Clearwater River Drainage. An over-all improvement occurred during March, when an unusually heavy fall of snow in the southern mountains overcame the previous deficiency. On all southern drainages having storage facilities the supplies will suffice for irrigation with careful use. In northern areas where the extra heavy pack had previously indicated a possible flood hazard, the danger has been eased by a March snowfall below normal.

Montana.—Snow accumulation on the headwaters of Missouri Basin streams continues above average except on the Madison and Milk Rivers. Although summer flow of these two streams is expected to be light, in general flows will be from 10 to 20 percent above normal. Reservoir storage is about the same as last year but substantially above the 10-year average. Precipitation on the plains has been below normal but soil moisture conditions in the irrigated areas range from fair to good.

Nevada.—Water for irrigation will be in short supply throughout the State. Run-off from the Sierra will range from 25 to 50 percent of normal, and from normal to 60 percent of normal on headwaters of the Humboldt and its main stem. Snow-stored water on the Sierra is generally less than 50 percent of normal, but a 50 percent increase in snowfall during March brought the pack on the Humboldt headwater basin nearly up to normal. Reservoir storage is poor, being only about 45 percent of last year, and 55 percent of usable capacity.

New Mexico.—The heavy snows that blanketed southern Colorado late in the winter extended into New Mexico as far south as Santa Fe. Conditions in this area are the best since 1942. Stream flows substantially above normal are expected in the Rio Grande tributaries except Chama River. Snow cover on this watershed is not as good as elsewhere, and storage in El Vado Reservoir is below normal. Elephant Butte storage is also low, but the early run-off will add materially to it. Precipitation has been above normal throughout the area. Soil-moisture conditions are good except in the Carlsbad area and the lower Rio Grande.

Oregon.—The outlook has improved greatly since midwinter and 1948 will be comparable to the good water year of 1946 in many areas. All but about 3 percent of all irrigated lands have in sight good to fair water supplies with the best supplies provided by storage. Greatly deficient supplies are not expected to be faced by any section although there may be some late-season shortages in some areas. Water stored in all reservoirs is about 20 percent less than last year, 23 percent less than in 1946, and 16 percent less than in 1945. Only 56 percent of the more important reservoirs are half full or better.

Mountain snow cover is above average on nearly three-fourths of all measured snow courses and is greater than last year at all stations. Watershed soils are much wetter than average, which greatly favors run-off from the snow pack. Cropland soils are generally well wetted, with moisture penetration in the dry wheat lands equaling that of the wet year 1943.

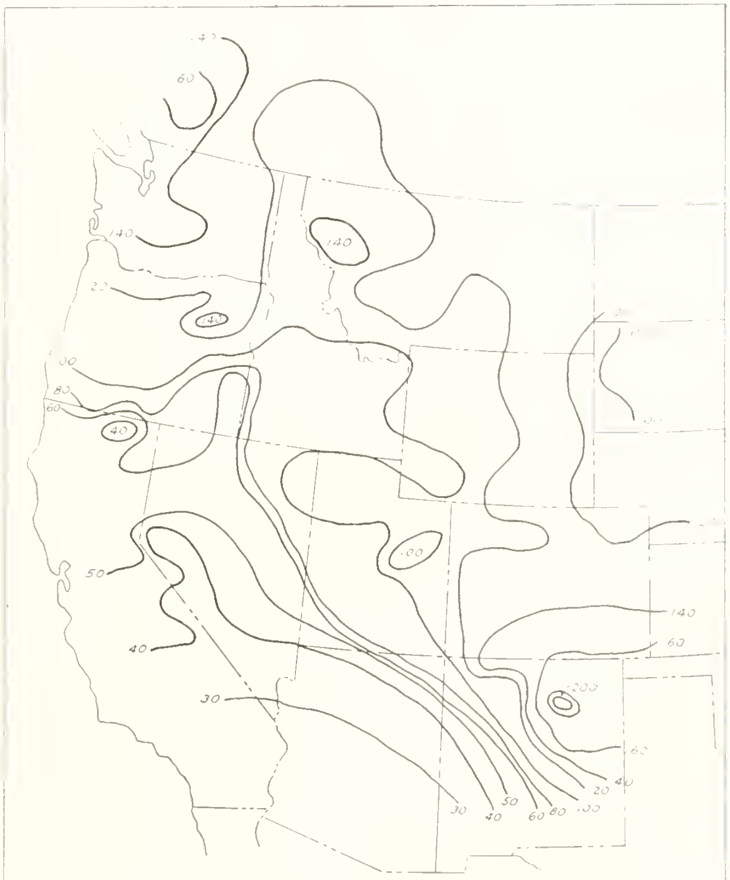
South Dakota.—Snow cover on the Black Hills is below average but 10 percent above last year. Recent precipitation has been deficient and soil moisture conditions are only fair. Storage in Belle Fourche Reservoir is greater than last year by 10,000 acre-feet.

Utah.—Most watersheds will produce run-off sufficient to meet irrigation needs. Practically all streams will discharge at least 80 percent of the average run-off. Flood discharges of most streams threaten to be enough higher than a year ago to damage some irrigation systems and farm lands during the spring months. Late-season supplies should hold up fairly well. Storage generally is at high levels, with the principal reservoirs at 75 percent of capacity.

Washington.—Enough water will be available for all purposes, including hydroelectric power generation at Grand Coulee and Bonneville. The possible flood hazard indicated in February has, however, been eased by lower than usual March snowfall. The April–September flow of Columbia River at The Dalles is forecasted at 94,000,000 acre-feet, which compares with a 10-year maximum of 112,591,000 acre-feet (in 1943) and a minimum of 57,320,000 acre-feet (in 1944).

Wyoming.—Flows of all streams east of the Rocky Mountains will be slightly above normal. On the west slope of the Rockies conditions are not so favorable and it is anticipated that the flow of the Green River will be 20 percent below normal. Snow cover is less than last year but somewhat greater than normal, except on the Green River. Because of the large carry-over storage in the North Platte reservoirs an ample supply of stored water is assured.

Reports detailing the results upon which the foregoing summaries are based may be obtained by addressing the Division of Irrigation and Water Conservation, Soil Conservation Service, College Hill, Box D, Logan, Utah. Requests should identify the State or drainage basin about which information is wanted. END



Prospective stream flow April–September 1948 in percent of 10 year average 1937–46

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet) Active capacity [1]	Storage (in acre feet) Mar. 31, 1947	Storage (in acre feet) Mar. 31, 1948
Region 1	Baker	Thief Valley	17, 400	17, 400	17, 400
	Bitterroot	Lake Como	34, 700	20, 400	17, 400
	Boise	Anderson Ranch	464, 200	97, 800	76, 200
		Arrowrock	286, 600	247, 800	171, 000
		Deadwood	161, 900	116, 900	85, 100
		Lake Lowell	169, 000	158, 200	162, 400
	Burnt River	Unity	24, 600	24, 000	12, 100
	Columbia Basin	F. D. Roosevelt	5, 220, 000	5, 108, 000	4, 660, 000
	Deschutes	Crane Prairie	50, 000	41, 200	29, 900
		Wickiup	187, 000	97, 900	148, 200
	Minidoka	American Falls	1, 700, 000	1, 618, 400	1, 670, 900
		Jackson Lake	847, 000	577, 900	629, 600
		Lake Walcott	95, 200	69, 000	97, 000
		Grassy Lake	15, 200	12, 800	14, 000
		Island Park	127, 300	132, 400	136, 600
	Okanogan	Conconully	13, 000	6, 100	4, 700
		Salmon Lake	10, 500	9, 400	4, 500
	Owyhee	Owyhee	715, 000	593, 600	397, 900
	Umatilla	Cold Springs	50, 000	50, 000	50, 000
		McKay	73, 800	66, 300	71, 000
	Vale	Agency Valley	60, 000	51, 900	45, 500
		Warm Springs	170, 000	136, 500	40, 800
	Yakima	Bumping Lake	33, 800	34, 400	13, 100
		Clear Creek	5, 300	5, 300	5, 300
		Cle Elum	435, 700	413, 000	296, 800
		Kachess	239, 000	220, 800	197, 300
		Keechelus	153, 000	154, 600	105, 300
		Tieton	197, 000	171, 300	140, 200
Region 2	Central Valley	Millerton Lake	503, 100	337, 600	112, 700
		Shasta	4, 389, 100	2, 758, 100	3, 030, 200
	Klamath	Clear Lake	437, 500	226, 700	152, 400
		Gerber	94, 300	42, 500	29, 000
		Upper Klamath Lake	524, 800	345, 100	330, 200
	Orland	East Park	47, 900	31, 700	18, 900
		Stony Gorge	50, 000	39, 800	25, 100
Region 3	Boulder Canyon	Lake Mead	27, 935, 000	16, 383, 000	18, 620, 000
	Parker	Havasu	688, 000	649, 000	607, 500
	Salt River	Bartlett	179, 500	10, 300	19, 600
		Horse Mesa	245, 100	234, 200	157, 600
		Horseshoe	67, 000	13, 700	10, 800
		Mormon Flat	57, 850	40, 600	23, 000
		Roosevelt	1, 398, 400	80, 600	54, 700
		Stewart Mountain	69, 800	52, 200	36, 500
Region 4	Fruit Growers	Fruit Growers	4, 500	2, 100	4, 600
	Humbolt	Rye Patch	179, 000	185, 900	120, 300
	Hyrum	Hyrum	15, 300	11, 900	10, 700
	Moon Lake	Moon Lake	35, 800	9, 000	13, 000
	Newlands	Lahontan	273, 600	241, 600	184, 900
		Lake Tahoe	732, 000	518, 400	261, 600
	Newton	Newton	5, 300	4, 900	4, 900
	Ogden River	Pine View	44, 200	14, 900	1, 100
	Pine River	Vallecito	126, 300	60, 100	57, 100
	Provo River	Deer Creek	146, 800	73, 400	127, 800
	Scofield	Scofield	65, 800	7, 600	15, 400
	Strawberry Valley	Strawberry	270, 000	115, 200	115, 200
	Truckee River Storage	Boca	40, 900	13, 800	4, 300
	Uncompahgre	Taylor Park	106, 200	70, 100	87, 400
	Weber River	Echo	73, 900	55, 300	38, 600
Region 5	W. C. Austin	Altus	140, 000	45, 500	72, 200
	Carlsbad	Alamogordo	128, 300	35, 600	37, 000
		Avalon	6, 000	3, 200	5, 300
	Colorado River	Marshall Ford	810, 500	497, 400	187, 600
	Rio Grande	Caballo	345, 900	266, 700	173, 300
		Elephant Butte	1, 817, 000	513, 900	395, 900
	Tucumcari	Conchas	300, 000	264, 900	271, 000
Region 6	Belle Fourche	Belle Fourche	177, 500	154, 800	161, 100
	Milk River	Fresno	127, 200	136, 700	77, 400
		Nelson	66, 800	27, 000	32, 200
		Sherburne Lakes	66, 100	23, 400	38, 500
	Riverton	Bull Lake	152, 000	69, 500	79, 400
		Pilot Butte	31, 500	15, 400	18, 100
	Shoshone	Buffalo Bill	456, 600	291, 900	307, 400
	Sun River	Gibson	105, 000	58, 600	64, 400
		Pishkun	32, 050	17, 200	20, 800
		Willow Creek	32, 400	15, 300	17, 200
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	64, 700	47, 300
	Kendrick	Alcova	190, 500	83, 700	109, 900
		Seminoe	970, 000	289, 200	535, 800
	North Platte	Guernsey	41, 050	31, 700	37, 800
		Lake Alice	11, 000	5, 800	0
		Lake Minatare	57, 000	20, 900	18, 000
		Pathfinder	1, 040, 500	472, 900	667, 800

[1] Available for Irrigation.

HOMESTEADING TIME in YUMA

by

William J. Williams

Special Assistant to Regional Director, Region III, Boulder City, Nev.

Everette Eugene Harman likes the looks of alfalfa and date trees growing on his homestead. *Photo by Samuel B. Watkins, Region III.*

The fertile Yuma Valley in southwestern Arizona and southeastern California is again feeling the homesteader's plow.

Beginning this spring, 26 World War II veterans will be farming alongside oldtimers who homesteaded on the project in the early days. The new homesteads comprise 1,297 acres and range in size from 28 to 82 acres.

The drawing, which was held on March 10, 1948, at Yuma, Ariz., was the first to be held in Region III since the end of the war, and represents the tenth postwar land opening held by the Bureau of Reclamation. Since the Yuma opening, the second Tule Lake drawing has been held, making a total of eleven postwar public land openings to be held by the Bureau, covering a total of 34,097 acres which provided farms for 401 veterans.

About 300 spectators were present when the glass jar containing 541 capsuled names was unsealed in the American Legion hall. The homesteaders' names were drawn in rapid succession by representatives of veterans' organizations in the Yuma area and posted on a huge blackboard at the front of the hall. Fourteen of the 26 homesteaders were from Arizona, 8 from California, and one each from Washington, Oregon, Idaho, and Pennsylvania. Only five of these, all of the Yuma area, were present when the names were drawn. The first capsule contained the name of John C. Snyder, of Dalmatia, Pa.

The first six names which were drawn were those of homesteaders outside the local area. But No. 7 went to Yuma Veteran Everette Eugene Harman, a marine veteran of Guadalcanal and other South Pacific campaigns.

The No. 9 drawing brought forth the name of Fred Eugene Simons, Jr., of nearby Somerton. At that moment young Simons was working in the basement of a store only a few doors from the Legion Hall. A thoughtful friend hastened to break the good news to him and in a few minutes he strode into the hall to claim his farm.

Carlos F. Colvin, No. 13, heard the good news over the radio as he was eating lunch at his home in Eden, Ariz. The next day he drove to Yuma to look over his farm which proved to be part of the Bard town site. He has been doing quite well in the Safford Valley of Arizona growing cotton on 60 acres of leased land but water is short there and the prospect of fertile land in the Yuma Valley with a full water supply is mighty inviting.

No. 15 was claimed by sandy-haired Hayden Van Mitchell, of Arkansas, who had been farming leased land in the valley for the past 2 years. His new farm is only 5 miles from where he lived at the time of the drawing.

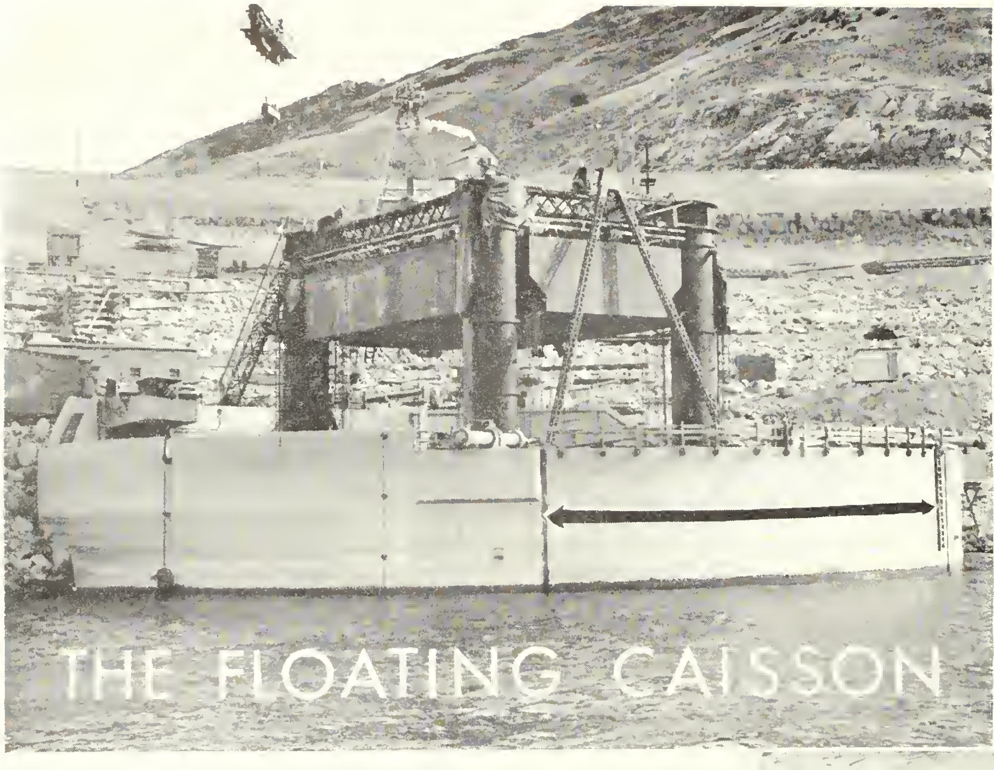
No. 18 was considered an unexpected and welcome wedding gift by Elgy A. Kryger and his bride of a few weeks.

When the name of Martin Reuben Ross, No. 20, of Yuma, was called, Ross, a lanky Texas veteran, leaped to his feet at the rear of the hall and whooped: "THAT'S ME!" With his wife and baby, he made his way dazedly to the front. It was a great day for young Ross, as he had come to Yuma 1 year ago expressly to work on an irrigated farm to add to the experience required for homesteading.

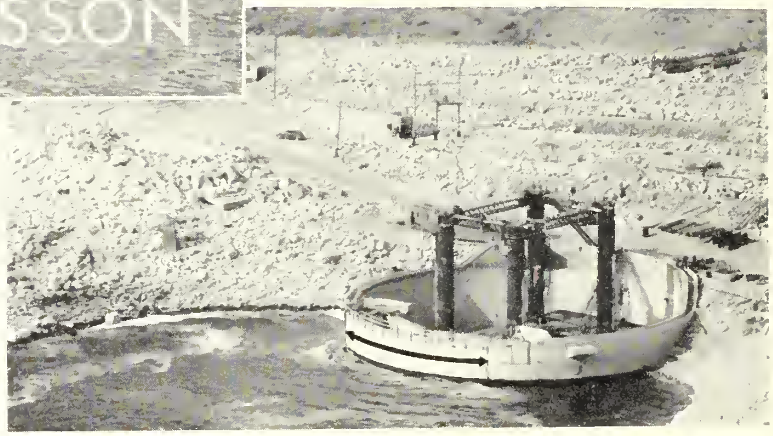
The gleam of hope in the eyes of many of the applicants who were present slowly died as their chances grew slimmer. And as the last name was called, the disappointed filed slowly out of the hall. "Perhaps I'll be lucky when the Mesa homesteads are drawn," one was overhead to remark. Some of the unlucky applicants for Yuma project farms may be more fortunate when names are drawn in Yuma this summer for 54 farms, comprising nearly 5,000 acres, on the Gila project's Yuma Mesa Division just east of Yuma.

In addition to Snyder, Harman, Simons, Colvin, Van Mitchell, Kryger, and Ross, the Yuma Project homesteaders are: Charles Burrell, Thatcher, Ariz.; June E. Pritchett, Santa Ana, Calif.; Leslie G. Todd, Davis, Calif.; William Owen Hilton, Pacific Grove, Calif.; Alward F. Fenn, Safford, Ariz.; Arthur Edward Martin, Tulelake, Calif.; Charles Cooper, Phoenix, Ariz.; Edward F. Conrey, Yuma, Ariz.; Lawrence G. Arnold, Orland, Calif.; Henry Charles Williamson, Jr., Sumner, Wash.; Alfred Maharry, Tulelake, Calif.; Albert Snyder, Somerton, Ariz.; James P. Richardson, Van Nuys, Calif.; Frank E. Brown, Compton, Calif.; Creighton Briggs Eggleston, Shedd, Oreg.; Albert R. Face, Yuma, Ariz.; Wilford Leo Allen, Tolleson, Ariz.; Wesley A. Davis, Somerton, Ariz.; Roy E. Freeman, Wilder, Idaho.

The above veterans, after filing applications for their homesteads, paying necessary filing and water fees, substantiating the data submitted with their applications and if necessary, appearing personally before the board of selection, will set up housekeeping on Yuma project homesteads on this, the oldest reclamation development on the lower Colorado River. END



Left: Close-up of circular drydock at Coulee Dam with floating caisson stored inside. Barge part of caisson has been raised to top of access shafts, in position it will occupy when caisson is in place on concrete of spillway of the dam. One section of drydock (see arrows) will be cut loose and dropped into the river to permit caisson to be floated from drydock. Below: View of circular drydock at Coulee Dam, showing partially floating caisson inside. *Photos by F. B. Pomeroy, Region I.*



THE FLOATING CAISSON of Grand Coulee Dam

by W. I. MORGAN

Hydraulic Engineer, Columbia Basin Project, Washington, Region I

The Columbia is a mighty river, for untold centuries free to cut and wear through the deep, hard lava beds and the great granite reefs along her way. The Grand Coulee Dam is a mighty structure which stands squarely across her path demanding toll before she can move on.

Grudgingly, the Columbia puts her "shoulder to the wheel" of the giant turbines and growls and whines as she spins out the power to light the million lamps of distant cities and to drive the gears of industry. That part of her which cannot squeeze through the whirling turbines must pass over the long spillway and tumble to the river below the dam.

The Columbia has left her mark on man's largest masonry dam. During construction days, when the flow of the river was shifted from side to side to permit work to continue, powerful cross-currents tossed big boulders and gravel into the spillway bucket. (See Reclamation Era, February 1947.) Like millstones, these wore down sections of the bucket.

But like the boisterous Columbia, man is cunning, too. When the winter season of lowest flow occurs on the river, man will set forth with ingenious tools to repair the damage.

These tools which will permit workmen to labor in normal atmospheric conditions beneath 70 feet of icy water are of many kinds. The biggest and most important is the "Floating Caisson."

The floating caisson is built of structural steel, and weighs 1,300 tons. It has a curved bottom so that when it is taken to the toe of the spillway section of the dam and sunk, it will fit closely to the concrete surface on which it comes to rest. Rubber sealing strips contact the concrete surface. The working chamber, now about 70 feet below the river surface, can be pumped dry, and the repairs carried on at the eroded areas.

Each time the caisson is sunk and unwatered, 6,750 square feet of concrete surface will be accessible for repair. Repeated moving and sinking of the caisson will expose any area desired.

The floating caisson has two principal parts: the portion which can be sunk beneath the river surface to the concrete below, and the barge which remains afloat. Four hollow shafts, seven and one-half feet in diameter, extend above the river surface at all times and connect the barge with the working chamber. In two of these steel shafts is duplicate pumping machinery for unwatering the working chamber, a third shaft houses an electric elevator to carry men to and from the interior, and the fourth is a clear hoistway for passage of construction materials. The barge is confined within the area between the shafts, and operates on guides mounted on these shafts.

The hull of the barge is twelve feet deep. Hoisting equipment is mounted on the deck, and the necessary electrical

equipment is in the hull. The barge and the sinking portion are connected with heavy cables so the working chamber can be lowered slowly to the concrete surface, or raised, floated to a new position, and again sunk.

The caisson lies so deeply when afloat that at least 30 feet of water is required for safe movement. Before the caisson could be constructed at the Grand Coulee Dam, a circular concrete drydock sufficiently large to contain it was built. The drydock has a huge gate, 55 feet high, which opens to let the caisson in or out.

During the flood season of the river, the caisson is placed in the drydocks and sunk for protection from the force of the swirling waters. The drydock, with the sunken caisson inside, is often also submerged completely during June and July.

Maneuvering an unwieldy 1,300-ton combination barge and working chamber will prove to be a ticklish job on the Columbia. Although it is tamer during the low-water season, it still must be considered treacherous. Powerful winches, permanently located on the river banks and at each end of the 1,600-foot spillway with heavy cables attached to the caisson, pull it to the desired place. Radio communication to the operator of each winch will coordinate all movements.

This big repair job on the spillway bucket of the Grand Coulee Dam is not a simple one nor a short one. The work may require 10 years to complete. END

Top photo: Working model of the floating caisson in its test tank at Coulee Dam. Note: Bottom of caisson has been curved to fit spillway bucket snugly. Before being seated, it will be moved slightly to the left for proper fitting. ***Photo by H. Wayne Fuller, Region I.*** **Above: Water, during flood season, covers caisson and circular drydock. Former had been anchored to latter and its barge part had been lowered and filled with water. When in working position at the spillway, caisson will appear similar to this photo except its barge will be above water.** ***Photo by F. B. Pomeroy, Region I.***

School Was *NEVER* Like *THIS!*

by Wayne L. Smith

Instructor, "Veterans On-the-Farm Training Program," Heart Mountain Division, Shoshone Project, Wyoming

The author adds a light note to a serious topic which is enjoyed by Governor Lester C. Hunt, of Wyoming, Region VI, Regional Director Kenneth F. Vernon, and Mayor Ora Beaver, of Powell, Wyo.

"School was never like this," was the comment of a veteran homesteader taking "on-the-farm" training at Heart Mountain, Shoshone project, Wyoming.

If I had been a little doubtful about how the instruction had been received, my confidence was restored by this remark. We had tried from the beginning to get away from the atmosphere of formal schooling or teaching farming from a book.

The average veteran had been told what to do, and how and when to do it, for so long that it would have been a mistake to set the training program up on a formal basis. The many remarks I had heard farmers make about "book farming" and those who taught farming from a book—all of them far from complimentary—came to mind. The realization that, to a large extent, this attitude is justified, influenced the decision to make the training as informal as possible but not informal enough to develop into a common "bull session."

I received a homestead in the drawing held at Powell, Wyo., in February 1947, to establish priority of selection on 83 units open for settlement at that time on the Heart Mountain Division of the Shoshone project. In July I accepted the job of instructor of Institutional On-the-Farm Training under Public Law 346, commonly known as the GI bill of rights, and placed myself in the embarrassing position of trying to tell my neighbors how to farm.

It is an unwritten law of long standing that you do not tell your neighbors how to farm, not if you want them to have a neighborly feeling toward you. It is one thing for a county agent or vocational agriculture instructor to offer advice. It is something else for a farmer to tell other farmers how to farm, until he has demonstrated over a period of 15 or 20 years that he knows what he is talking about. The only way I could get out of this difficult situation and still draw my salary, was to call on others to do the telling. This was perhaps a cowardly way out, but it has, I believe, resulted in a training program that will compare favorably with any GI training class in the State.

The "on-the-farm" training program was established to enable qualified veterans to receive institutional training in agricultural practices. The veterans are eligible for one year of training plus an additional month for each month spent in the armed forces not to exceed four calendar years.

Smith receives undivided attention as he leads classroom discussion on latest developments in farming practices. This may not be the last word in classrooms but it's the up-to-date in truction that counts.

V. C. Condie demonstrates technique of using power saw to veterans in the shop room. Machine-age farmers must be mechanics these days.

All photos by T. R. Broderick, Region VI

During the training period, subsistence payments to veterans enrolled in the agricultural courses are provided by the Veterans' Administration.

The veteran homesteaders at Heart Mountain have all had some farm experience, but having come from all parts of the country many of them have never had experience in irrigation. Much of the knowledge they had acquired could not be applied here because of the difference in soil conditions, climate, length of growing season, and crops grown.

The most logical place to look for practical information was among the farmers in the area—older settlers who had learned from experience and had demonstrated their knowledge by specializing, to some extent, in a particular farm enterprise and making a success of it. The old saying that experience is the best teacher is perhaps more applicable to farming than any other vocation. But why not learn from the experience of others?

With this in mind, a great part of the instruction program now in force has consisted of informal talks by experienced farmers who have been very cooperative in volunteering their time and services. Usually such talks are followed by general discussions. A particular effort has been made to use specialists from the University of Wyoming when they are in this area. Visual instruction, proven by educational leaders to be a very effective means of teaching, also helps to relieve the monotony of lectures. This part of the training is carried out by the use of educational films available from various companies, and film libraries of the University of Wyoming and Colorado State College. Films are available that deal with many phases of farming.

The Vocational Division of the Wyoming State Department of Education, which supervises the training, was fortunate in obtaining the services of another instructor experienced in shop work. About one-third of the 200 hours of classroom instruction required per year is devoted to shop instruction. Although equipment is far from adequate, a number of useful articles such as hog and brooder houses, gates, cabinets, feeders, and saw filing clamps, have been made by the trainees. Several automobiles and trucks have been overhauled in the shop which was formerly the school shop for the Heart Mountain Relocation Center. Two electric welders were recently secured for instruction in welding—a knowledge necessary on any farm.

Another phase of instruction, still in the planning stage, is the construction of precast concrete irrigation structures. The engineers and settlement specialists with the Bureau of Reclamation are cooperating in designing and testing the structures. A number of these structures are being tested at the present time. Those that meet the requirements and prove satisfactory will be made in quantity in the shop for use by the trainees on their homesteads.

The "on-the-farm" part of the instruction consists of demonstrations of improved practices and crop, feeder, and dairy tours to observe practices actually in use. Special emphasis has been placed on planning the farmstead. No greater opportunity has ever existed to plan a farmstead for economical operation than on the new homesteads where all the improvements are yet to be made.

All parts of instruction are strictly informal and flexible to meet emergencies. The home of one of the trainees recently burned and the class volunteered to move a section of one of his barracks to his farm and spend three days making it over into a four-room house. This will be done according to a drawn plan. It is hoped that this will serve as an example of how the barracks from the former Heart Mountain Relocation Center can be made into practical farm homes.

Special mention should be made of the cooperation received from the County Agent, F. H. A. County Supervisor, Bureau of Reclamation Settlement Specialists, A. A. A. representative, and representatives of other agencies. Their services have helped immeasurably in improving the on-the-farm training program at Heart Mountain. END

A New Killer for Water Weeds

(Continued from page 83)

trials that snails found in streams and irrigation canals in this country were even more susceptible to the new formula than waterweeds, thus the snail population could be eliminated directly. The Egyptian Government has already asked for information on the new formula for the dual purpose of controlling waterweeds and snails. It also has possibilities for killing mosquito larva and crayfish. The burrowing habits of the latter have caused the washing out of structures in some irrigation systems.

A word of caution: The new formula is inflammable and should be kept away from open flames. Also, avoid excessive breathing of the naphtha fumes. The naphthas may cause trouble to the skin through prolonged or frequent contact but you can avoid this difficulty by a thorough washing with soap and water. From the few preliminary tests made to determine the effects of the naphtha-treated water on crop plants, no injury was observed at concentrations used for controlling waterweeds. However, a more comprehensive study is now being made in the field and in the greenhouse, and pending the results of these investigations it is suggested that the use of treated water for irrigation purposes be avoided as much as possible.

Dr. R. S. Rosenfels, plant physiologist, formerly with the Bureau of Plant Industry, Soils and Agricultural Engineering, was stationed at the Bureau of Reclamation chemical laboratory in Denver during the laboratory tests described in this article. Equal credit is due him and the Reclamation chemists for the initial discovery of the value of the naphtha compounds for controlling waterweeds.

PHYSICAL PROPERTIES OF THE NEW MIXTURE DISCUSSED IN THIS ARTICLE

The material is predominantly aromatic and may be of either coal-tar or petroleum origin. It is composed of the higher homologues of benzene, not more than 10 percent of which shall have a boiling point below 287° F.

Flash point °F. not less than	87
Aniline point minus °F. lower than	39
Kauri-Butanol value, ml. higher than	80
ASTM D-86 distillation °F.:	
Starting point	278
Not more than 10 percent at	286
Not less than 90 percent at	385
End point, not higher than	420

For an emulsifying agent the use of mahogany soap of approximately 5 percent by volume is recommended and should be thoroughly mixed prior to application.

The physical properties listed above can be used as a specification for purchasing the material.

IRRIGATION

in the Province of Alberta, Canada

Western Irrigation District Dam on Bow River at Calgary, Alberta. Photo courtesy of H. Pollard, Calgary, Canada.

by P. M. SAUDER, Colonization Manager, Department of Water Resources, Government of the Province of Alberta, Canada

Alberta is blessed with thousands of acres of fertile soil, but parts of the southern portion of the Province suffer from a lack of sufficient rainfall. Not only is precipitation relatively light but it is also variable, unreliable, and unpredictable. It fluctuates above and below the critical point for crop production and even a slight decrease in amount from one year to the next may seriously reduce the yields of unirrigated crops. Withering drought, possible in any year, may destroy dry land crops over wide areas. As a result, agriculture is not reliable in Southern Alberta except where irrigation is available.

There are, however, individuals and corporate bodies operating large wheat farms quite successfully even when wheat is selling at its lowest price. With up-to-date power machinery, it is possible to produce wheat on large areas at a small cost per bushel. Usually these larger farmers only crop half of their land each year and summerfallow the other half. The summerfallow conserves the moisture and they have practically two years' moisture to produce one crop. By this method, they are almost sure to have a fairly good yield.

The story of the man with one quarter section or a half section is different. He cannot produce wheat nearly as cheaply because he cannot buy the large economical machinery and his acreage is too small for economic farming. He usually falls behind and gets deeper in debt until finally he loses his land and the large farmer buys it at a low price. The small farmer is disappearing from the semiarid areas and is being replaced by a few successful and prosperous large farmers.

There are also large areas occupied by cattle and sheep ranchers who help to produce a lot of the wealth of the Province but in the semiarid regions they are replacing the small farmer, with the result that the population is decreasing and there are large areas so sparsely populated that it is impossible to maintain schools and improve roads. Here again, the small farmer cannot make a decent living.

The primary purpose in providing irrigation is to increase production and eliminate the hazard of drought and crop failure. The control of moisture through irrigation affords a high degree of stability in production which gives irrigation an important advantage over dry land farming. This advantage is fully demonstrated by the greater density of population, adequately supported on irrigated as compared to dry land by the thriving agricultural communities, and the prosperous urban centers in the irrigated sections. Irrigation provides for a wide diversity of crops and for the growing and feeding of livestock. It provides opportunity for home building, for maintaining a higher standard of living, and for improved educational facilities and social advantages made possible by a greater density of population.

The marked increase in the density of population where water is made available for crop production, for home building, and the growing of food in large and certain quantities, thereby maintaining a high standard of living, is no doubt the major benefit of irrigation, and is shown in a comparison of population under dry-land and irrigation conditions in Alberta.

The census returns for 1936 show the number of persons in wholly dry farming areas east and south of Lethbridge as averaging 3.5 persons per square mile. The partly irrigated areas averaged 12.7 persons per square mile, and the irrigation areas averaged 29.7 persons per square mile. The tendency is for the density of the population to increase in the irrigated areas and to decrease in the dry farming areas. The specialized crops such as sugar beets mean smaller farms and more help, often two families on a farm.

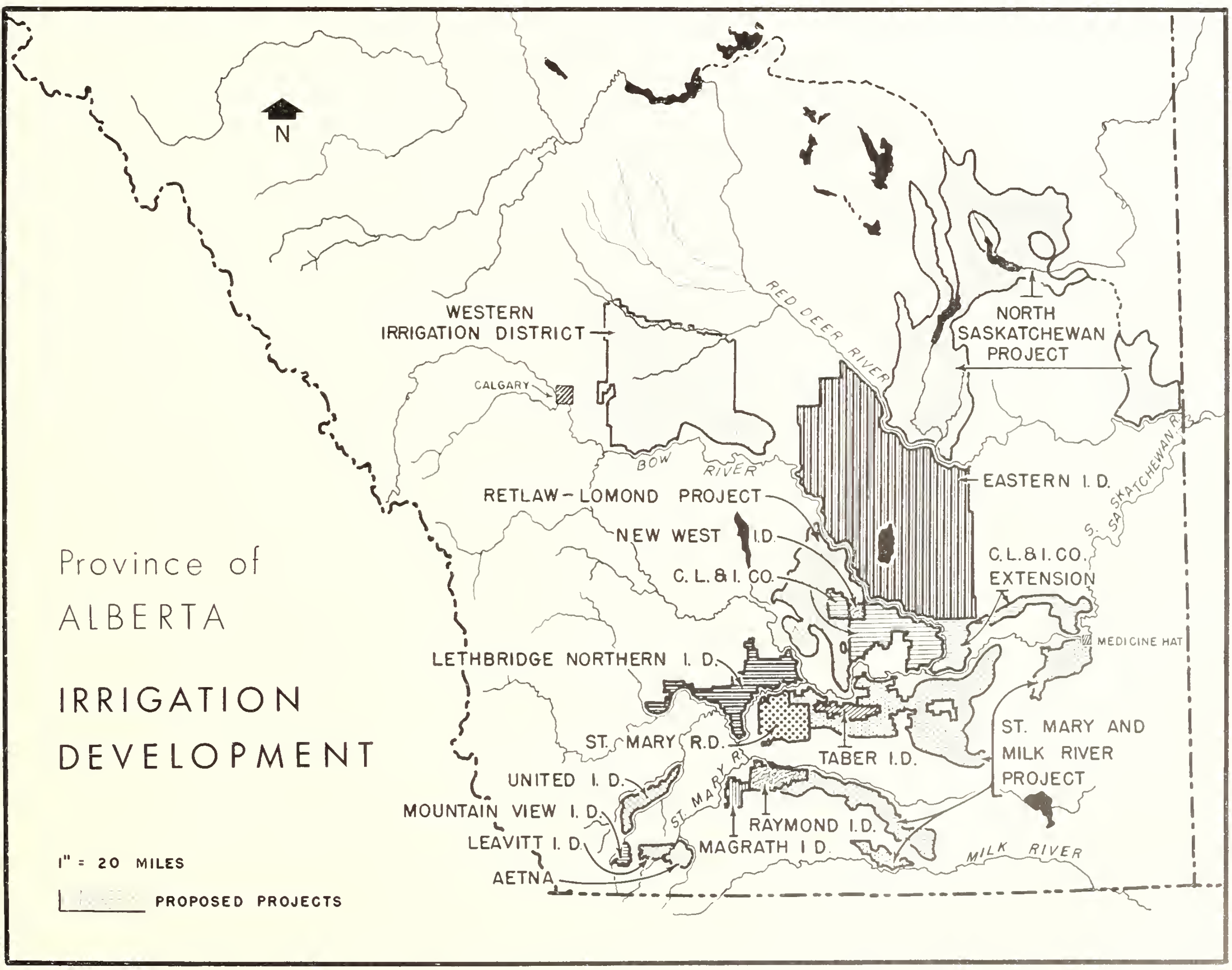
Industrial developments resulting from irrigation are contributing in a very substantial measure to the general welfare of southern Alberta and to Canada as a whole. The main developments of this nature include sugar beet factories, canning factories (where a wide assortment of products are processed), seed cleaning and grading plants, alfalfa meal mills, commercial apiaries, cheese factories, and plants for producing dairy, meat, and poultry products.

Some 508,600 acres of land are actually served by existing irrigation works of the 11 larger projects in southern Alberta and there are about 5,000 irrigation farmers operating on this area. In addition, there are a large number of small projects operated by the owners of the land. In all, about 70,000 acres can be irrigated by these small projects.

The area that can be irrigated is much greater than the supply of water available will irrigate, and further development must be based largely on storage of high and flood waters of the streams. Large quantities of water flow down the streams in the spring and early summer which should be stored in reservoirs and spread on the land later in the season when the crops are suffering from drought.

Our Governments, Federal, and provincial, which of course only carry out the wishes of the people, have been slow to realize the great advantages of irrigation in the past. It looks now, however, as if works will be constructed in the near future to serve a considerable additional area. In fact construction has already started on works to serve an additional 345,000 acres in the St. Mary and Milk Rivers drainage basins at an expenditure of about $20,000,000. A program involving an expenditure of $100,000,000 in 10 years is also being seriously considered. This, however, is only a small program when compared with the program of the Bureau of Reclamation.

Irrigation has, of course, been practiced in the United States much longer than in Canada and to a much greater extent and Canadian engineers engaged in irrigation work have learned a lot from their American cousins. Our visits to the United States have been very limited in recent years because of the War. However, C. S. Clendening, district manager of the Lethbridge northern irrigation district and G. S. Brown, assistant manager, St. Mary and Milk Rivers Development and I seized an opportunity to pay a hurried visit to irrigated areas in Wyoming, Colorado, Nebraska, and Montana. Here are a few comments on our observations.



The crops grown with irrigation in Alberta are similar to those grown in the four States visited. Alberta is further North but our irrigated areas are only 2,900 to 3,200 feet above sea level. The irrigated lands in the four States visited are at much higher altitudes.

The United States projects have more drains than Alberta projects, largely because the irrigated land in the United States projects is valued considerably higher and more drainage is provided to prevent loss of the use of the land through seepage, waterlogging and alkali. More of the canals on the United States projects are lined with concrete to prevent leakage and consequent damage to the land.

Manner of Financing the Larger Irrigation Projects in Alberta

In the early stages of irrigation development in Alberta, those who settled on the land were expected to pay the total cost of the construction of the irrigation works, but it was found that while irrigation enabled them to produce more and better crops, the water charges were too great a burden.

The cost per acre varied greatly on the different irrigation projects. The total capital charges due to irrigation have varied from a few dollars per acre in the case of the Mountain View project to $55 per acre in the Lethbridge Northern. The annual charges, for capital costs, maintenance and operation varied correspondingly, from 30 cents per acre to $5.25 per acre. Some of the higher rates were later reduced. Summaries of the charges made on some of the typical projects will be given hereunder.

St. Mary and Milk Rivers Development

This, the first large project undertaken, was constructed by the Alberta Railway & Irrigation Co. to irrigate a tract of land owned by the company and lying south and east of the site of the present city of Lethbridge. Most of the land was sold at $5 per acre for the land and $35 per acre aditional for a water right for the areas that could be irrigated. Payments were usually on a crop share basis of one-fifth of the sugar beet crop, one-third of the other crops, and 6 percent interest per annum on the unpaid balance of the purchase price. Some difficulties were experienced during the periods of low prices for farm produce but most of the purchasers have paid up and the proceeds from the sale of the water rights have reimbursed the company for the cost of the construction of the works. The service charge, amounting to $1 per irrigable acre, is a first charge against the crop share for the operation of the main and large branch canals. The farmers operate their own distribution works individually or cooperatively at a cost of 25 cents per irrigable acre.

Eastern Irrigation District

A large portion of the irrigable land on this project, which lies east of the city of Calgary, was held by farmers under agreements to purchase from the Canadian Pacific Railway Co., builders of the works, at prices ranging from $25 to $40 per acre, when the project was transferred to the farmers. Subsequent to this transfer all contracts were adjusted and reduced to approximately one-fifth of the original amounts. The water service charge levied by the irrigation district has varied from $1.60 to $1.75 per irrigable acre but there has been no levy for the water right.

The railway company really recovered very little of the cost of the works and also absorbed deficits in operation and maintenance during the period that it operated the works before they were transferred to the farmers. The railway company did not, however, suffer seriously because of the increased railway traffic after irrigation was started.

Lethbridge Northern Irrigation District

This project serves a semiarid area north of the city of Lethbridge, which, when the project was constructed, was privately owned and used for wheat growing. The owners formed an irrigation district and sold bonds, bearing 6 percent interest and guaranteed as to the payment of interest and principal by the government of Alberta.

Because of the high construction costs prevailing when the project was developed, the cost of the works averaged $55 per irrigable acre. In 1924, the first levy was $1.48 per irrigable acre for water service charges and $3.77 per irrigable acre to pay interest, exchange, etc., on the bond issue (water right payment), a total of $5.25 per irrigable acre. It soon became apparent that the farmers could not pay these rates and an appeal was made to the provincial government for assistance.

In 1925, the government gave temporary financial assistance but the matter had to be reconsidered and in 1930, the provincial government assumed part of the construction cost and part of the water service charges.

During the early thirties when the prices of farm produce were very low, further assistance became necessary and the Government assumed an additional portion of the construction costs, leaving $17 per irrigable acre for the water right to be paid by the settler. The service charge has been set each year according to requirements and has averaged $1.25 per irrigable acre per annum. The farmers growing sugar beets and other specialized crops have not had much difficulty in meeting these payments, but when grain only is grown, payment has been difficult.

Taber Irrigation District

This is the first irrigation district erected under the present Irrigation Districts Act. It serves an area of privately owned land east of the city of Lethbridge and adjoining the town of Taber. The original works cost an average of $16 per irrigable acre. This cost was later reduced to $12.59 per irrigable acre by serving an additional area with works that cost less per acre than the original area. The rate of interest on the unpaid balance was originally 6 percent per annum, but this was reduced to 5 percent per annum in 1935. The annual payments for water right and service charges have varied from $1.50 to $2.60 per irrigable acre and averaged slightly less than $2 per irrigable acre.

This district has proven an outstanding success because the farmers went in for growing specialized crops as soon as possible and because of the low capital and operating costs.

Summary of Repayment Practices

The story of these four projects is sufficient to show the varied experience in financing irrigation projects in Alberta. Some of the inability of the farmers to pay the capital cost of the works is due to the reluctance of the settlers to abandon straight wheat growing and go in for diversified and specialized crops. It, however, takes time and experience to change from dry land farming to irrigation farming and experience has demonstrated that the settler should not be saddled with high water right (levy for costs of works) and service charges. He should also receive assistance in preparing his land for irrigation and expert advice in his farming program.

In view of past experience, there is no doubt that the future settlers will get a better deal. It is proposed but not yet agreed that the new settler should receive water service free of charge for 1 or 2 years and that his land should be leveled free of charge. Also that the water right payment should not exceed $10 to $15 per irrigable acre, that payments should not start until the third year and that the rates of interest payable on the unpaid balance should be very low. In order to achieve these low rates, the Federal Government will construct the diversion dam, the main canal, the storage reservoirs, and connecting canals as a contribution to irrigation. The provincial government is to construct the distribution system, provide the free water service and the agricultural advice, level the surface of the irrigable land and only charge $10 to $15 per irrigable acre payable at the rate of 50 cents per acre per annum for the water right. It is agreed that the balance of the capital cost and free services should be paid out of the general revenue of the province.

The organization, administration, and management of irrigation districts in Alberta is similar to that of irrigation districts in the States visited. Any area in Alberta where the irrigation works can be operated as a single unit may be outlined as an irrigation district and obtain the right of self-government in the maintenance and operation of the irrigation works in that area. The business of an irrigation district is supervised by a board of trustees elected by the water users of the district. The board usually employs a professional engineer, experienced in irrigation work, to obtain and direct the necessary help to maintain and operate the irrigation works.

While we were a little hurried, we enjoyed our trip and found it very interesting and instructive. All officials of the Bureau of Reclamation and the irrigation districts were very courteous and obliging and we wish in closing to express our thanks to them. We particularly enjoyed a day that was spent in the Bureau's offices and laboratories in West Denver.

END

The PARSHALL Measuring Flume

by Ralph L. Parshall

The water measuring device called the Parshall measuring flume was developed at the hydraulic laboratories of the Colorado Agricultural Experiment Station, Fort Collins, in cooperation with the United States Department of Agriculture.

The first experiments were conducted in 1915 by V. M. Cone, who was then in charge of the cooperative irrigation investigational work in Colorado.

This device, in its original inception, consisted of three parts—converging, throat, and diverging sections. When viewed from above, the structure resembled somewhat an hourglass. The upstream converging and downstream diverging sections were identical in taper and similar in dimensions. These two sections were joined by a throat having a length of one foot in the direction of the flow of water. The walls of the structure were vertical and the floor was level throughout.

The original tests were confined to structures having throat widths of 1, 2, and 3 feet and capacity of discharge of about 15 second-feet for the larger flume. This measuring device was at first known as the Venturi flume. The name "Venturi" was rather appropriate because of the identity of the general principle or law underlying the hydraulic relations of the flume and the Venturi meter perfected by Clemens Herschel in 1887. In 1797 Giovanni Battista Venturi, an Italian engineer, experimented with the flow of water through tapering tubes and about 100 years later Herschel adapted the findings of Venturi to perfect the Venturi meter for measuring the discharge of water under pressure in pipe lines. The Venturi flume, where the flow of water is measured in a channel, fully exposed to atmospheric pressure, was the next step.

The original design of the Venturi flume, having equal angles of convergence and divergence, and a relatively short throat section, was found by further experimentation to be not wholly satisfactory. To correct certain inconsistencies in the law of discharge, alterations in the design were suggested as based on these later experiments. The improvements consisted in the change of the angle of convergence from 18°26′ to 11°19′, also the angle of divergence from 18°26′ to 9°28′, increasing the length of the throat section and introducing a downward sloping floor in the throat of the structure. These alterations resulted in having the downstream end of the floor of the diverging section lower in elevation than the crest—which is the line joining the level floor of the converging section and the throat floor. These improvements were made in 1926. After fully verifying this new design, calibrations were made on flume sizes ranging from 6 inches to 8 feet and the results published under the title of "The Improved Venturi Flume."

Mr. Parshall and his flume.

THE AUTHOR

By Frank J. Shideler, Colorado A. & M. College, Fort Collins, Colo.

Ralph L. Parshall, who retired February 1, 1948, has gained world-wide fame as an irrigation engineer while serving with the United States Department of Agriculture stationed at Colorado A. & M. College. He is a native Coloradan and spent his boyhood in the mining region near Idaho Springs.

Parshall was born in Golden, Colo., July 2, 1881, and graduated with honors from Colorado A. & M. in 1904 with a degree of bachelor of science in civil engineering. From 1904 to 1912 he worked for Colorado A. & M., first as an instructor and later as associate professor in the civil and irrigation engineering department. In the summers of 1906 and 1907 he attended the University of Chicago, taking special work in physics, mathematics, and astronomy. He began work with the United States Department of Agriculture in the Irrigation Investigation Section in February 1913.

The Parshall flume, one of his best-known contributions, was the result of many years' work to devise a solution to the problem of measuring and distributing irrigation water to farmers. It was developed in the early 1920's and soon was adopted on a world-wide basis.

Sand traps for removing silt from irrigation canals, designs of recorders of water stages and integrators, surveys on return seepage water from rivers, snow surveying as a basis for forecasting irrigation water run-off, preliminary economic surveys for the Colorado-Big Thompson project, bulletins on water measurement and irrigation subjects—these, and many more subjects have been a part of the work Ralph L. Parshall has accomplished during his 35 years of valuable service in irrigation.

He continues to maintain a desk in the Engineering Building on the Colorado Aggie campus, working on studies of particular interest to himself. He plans to continue in the role of consultant in trying to assist anyone who has a problem connected with irrigation.

In between times, Parshall devotes more time to his chief hobby—painting.

"Rendering a service to the public is the finest thing I can accomplish," says Parshall of his long association with irrigation. "The State of Colorado gave me an education, and what I have accomplished I hope will serve as some compensation for that education."

Mr. and Mrs. Parshall plan to continue living in Fort Collins in the same home they moved into in 1907. END

Through a recommendation of the Committee of the American Society of Civil Engineers on Irrigation Hydraulics, 1930, and with the approval of the cooperating agencies under which this device was developed, the name was changed to the Parshall measuring flume.

The need of a more practical water measuring device was recognized prior to the first experimental work on the Venturi flume by Cone in 1915. The simple weir of relatively small size suitable for measuring the flow in a farmer's lateral, was almost universal in its application for farm deliveries. Many such weirs were installed in these laterals where the grade of the channel was flat and high submergence resulted at the time of the measurement of the flow. It was of course obvious that with a high water surface downstream from the structure the rate of flow would be less than if no submergence existed. Because of limited data for calculating the discharge when submerged, or just plain indifference on the part of the operator, the head on the weir was taken as the index of flow whether the condition was submerged or free discharge. Other factors regarding the setting of the weir structure, which affected somewhat the discharge, were often given no consideration and on the whole the weir was finally regarded as impractical under general farm practice. Farm deliveries usually range from 1 to 10 second-feet.

The problem of measuring canal and ditch diversions from streams or reservoirs where the flow might range from 10 up to 800 or 1,000 second-feet or more presented a condition or requirement exceeding the application of the weir for this purpose. Since the time of the adoption of State water laws, regulating the diversion by decreed rights from streams, the ordinary rating flume had been recognized as the official measuring device. Such a structure, either wood or concrete, was of varying length depending on the amount of water to be measured and the width and depth of the channel. Such a flume generally would be 12 to 16 feet long, 20 to 30 feet wide, and 4 to 5 feet deep with a level floor and either vertical or outward inclined side walls. A simple graduated scale in feet was attached to the wall indicating the depth of water. By means of a current meter the discharge in second-feet was measured and the depth on the gage staff noted. Measurement of different rates of flow and the corresponding depths permitted the fixing of a rating curve for the particular flume. Theory pointed out that as the depth increased the rate of discharge was proportionally more. For stabilized channels this relation was true. In irrigation practice, however, experience pointed out that it was often the case that sand and silt accumulated in the bed of the channel and on the floor of the rating flume to the extent of having the water depth on the staff gage increased and the actual discharge decreased. Sometimes scouring would occur and the reverse would be true; that is, more water at a lesser depth. Checks in the channel, weed, moss, grass, willows, and other causes in combination resulted in questionable indicated rates of discharge. Some canals, 600 to 800 second-feet in capacity, have been found to vary as much as 100 second-feet for the same indicated staff reading in a few hours, such a condition being due to scouring out or filling in with bed sand.

The development of the Venturi principle into what is now known as the Parshall measuring flume has been the means of correcting many of the evils of the past. Over the years the flume has been perfected in various details and now may be recommended for use. Small flumes having a 3-inch throat will measure accurately to a minimum of about 0.01 second-feet. A 40-foot flume has been in operation in the Fort Lyon Canal, near La Junta, Colo., since 1928, with a capacity of more than 2,000 second-feet. Nominal capacity of this canal is 1,600 second feet.

The 3-inch flume is best suited for experimental work in measuring delivery and waste from agricultural irrigated field plots. Flumes ranging from 1 to 4 feet are suitable for ditches and laterals, while for canals the size of structures varies from 8 to 40 feet. The 6-, 9-, 12-, and 18-inch flumes are best adapted to the measurement of farm deliveries from ditch or lateral.

The recent development of the portable form for casting small-sized flumes—3-, 6-, and 9-inch monolithic reinforced concrete structures—has made it possible to build these at a very reasonable cost.

The flumes may be made of either metal, wood, or concrete. Metal flumes are generally of the smaller sizes while the large structures are made of reinforced concrete.

Since 1926 the use of this measuring device has been rather extensive and it is found serving a useful purpose in practically all the irrigated areas throughout the world. The flume was intended for irrigation practice but because of certain advantages it was found to be useful in the field of sanitary engineering and industrial plants, particularly paper mills.

Much of the success of this measuring device is to be credited to Mr. Carl Rohwer, who assisted in conducting laboratory and field experiments, preparing the text of bulletins, diagrams, tables, and illustrations of various kinds, all having to do with the successful adoption of the flume in serving a useful purpose in the field of irrigation and elsewhere in meeting the problems of water measurement. One other thing should be mentioned in connection with the success of our flume. It was not a one-man job. Credit is due to Dr. Charles A. Lory and Director C. P. Gillette, both of whom gave constant encouragement and had faith in the work which finally proved out. Also, to S. H. McCrory, formerly Chief of the Bureau of Agricultural Engineering and Mr. W. W. McLaughlin, formerly Chief of the Division of Irrigation, my supervisors. These four men did much in promoting the success of our work in the laboratories and field. As for myself, I lay no claim as the inventor. My contribution was to correct the design and promote the use of this measuring device. For further reference, those interested might consult the following bulletins:

The Venturi Flume, by V. M. Cone. An extended report appearing in the Journal of Agricultural Research, Vol. IX, No. 4, April 1917.

The Venturi Flume, by R. L. Parshall and Carl Rohwer. Bul. 265, 1921 Colo. Agri. Expt. Station publication.

The Improved Venturi Flume, by R. L. Parshall. Bul. 336, 1928 Colo. Agri. Expt. Station publication.

Parshall Flumes of Large Size, by R. L. Parshall. Bul. 336, 1932 Colo. Agri. Station publication.

Measuring Water in Irrigation Channels, by R. L. Parshall, Farmer's Bul. 1683, 1932, Rev. 1941, U. S. Dept. Agri. publication. This bulletin is to be again revised soon, possibly during the latter part of 1948.

Improving the Distribution of Water to Farmers by Use of the Parshall Measuring Flume, by R. L. Parshall. Bul. 488, 1945 Colo. Agri. Expt. Station publication. END

News Round-up

Tracy Pumping Plant—"Heart" of CVP—Now Under Way

Construction crews near Tracy, Calif., are digging a hole large enough to accommodate Hoover Dam. This activity is part of the Central Valley project. To be specific, four and one-half million cubic yards of earth will be excavated and removed in order to permit the construction of the 2½ mile intake canal and the giant Tracy pumping plant, "heartbeat" of the Central Valley project. This plant is the connecting link between the water resources of the Sacramento Valley with those of the San Joaquin Valley which makes the Central Valley project possible. The above photograph, taken by W. J. Heron, shows a general view of the excavation with pile-driving operations in progress at the far end. See RECLAMATION ERA, page 213, October, and page 257, December, 1947, for details on plan and bid opening.

New "Land Economics" Includes Housing

Land Economics is the new title of the almost 25-year-old Journal of Land and Public Utility Economics, a quarterly published by the University of Wisconsin.

The February issue was the first to appear bearing the new title. While the editorial policy will remain the same, the board is adding subject matter on planning and housing as fields of scientific interest, and has incorporated a subtitle "A Quarterly Journal of Planning, Housing, and Public Utilities."

Robbins Named Regional Director

Howard E. Robbins who has been serving as Acting Regional Director of Region V, Amarillo, Tex., since his predecessor Wesley R. Nelson became Assistant Commissioner, was recently named Regional Director.

He has jurisdiction over the reclamation developments in Texas, Oklahoma, most of New Mexico, and parts of Kansas and Colorado. More than 1,500,000 irrigable acres of farm land are included in authorized projects, in various stages under his supervision. Among the projects in his region are the Rio Grande and Carlsbad, two of the most early reclamation developments, and the W. C. Austin in Oklahoma, which enjoys the distinction of being the easternmost Federal irrigation project in the Nation.

Robbins, a career employee, joined the Bureau in 1916 and worked his way up through the ranks. Among some of his more important previous assignments were as project engineer, Valley gravity project, Texas, construction engineer, W. C. Austin project, Oklahoma, office engineer on the Colorado Big Thompson project, Colorado, and Salt River project in Arizona, and a period of service in the designing section of the Office of the Chief Engineer, when Hoover Dam was designed.

Club Presents Technical News

The first issue of the *Technical News*, a non-Government publication of the Reclamation Technical Club appeared in February of this year. Subscription rates are $1 per year, or to members of the club 75 cents, which is included in the annual dues of $1. Requests for memberships or subscriptions should be mailed to Secretary, Reclamation Technical Club, P. O. Box 2582, Denver 15, Colo.

Sugar for the Freedom Train

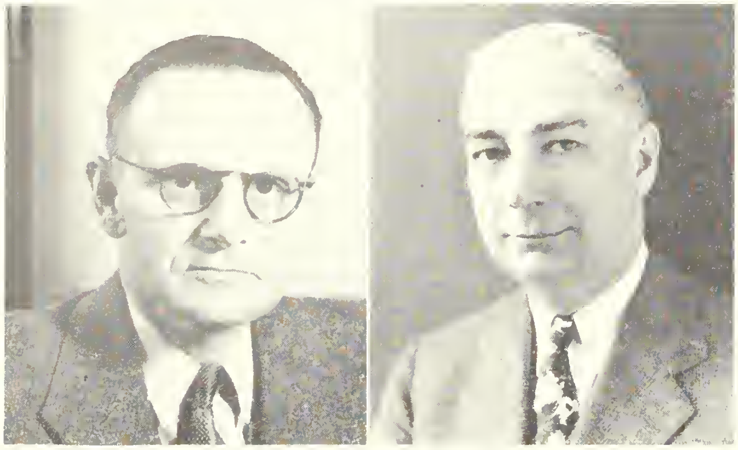
Belle Fourche project farmers donated an entire carload of sugar to the Abraham Lincoln friendship train for European relief.

World Relief Day was held on February 7, 1948, in the town of Newell, S. Dak., to raise money to contribute to the relief train, which started from Lincoln, Nebr., on Abraham Lincoln's birthday. The train moved east through Iowa and Illinois to Chicago where the South Dakota cars joined the train. The organization responsible for the South Dakota participation was South Dakota World Relief, of which Dr. A. A. Schade is cochairman.

On World Relief Day at Newell, merchants and other citizens of the project donated articles which were auctioned off to the highest bidders in the afternoon. That evening Dr. Schade lectured on conditions in Europe and showed motion pictures which depicted the dire need of the European peoples. A well-attended benefit dance followed. Proceeds from the auction, the dance, and contributions totaled about $2,000—enough to pay for a carload of sugar. This money, combined with that raised in other parts of the State, resulted in eight carloads of food being sent to join the Abraham Lincoln friendship train at Chicago.

Dr. Schade contacted the Butte County Farm Bureau and service organizations in all of the project towns and it was through their cooperation that the World Relief Day was staged in Newell.

McClellan Succeeds Walker R. Young



Walker R. Young (left) and his successor, Leslie N. McClellan

Walker R. Young, Chief Engineer of the Bureau of Reclamation, Denver, Colo., will retire on June 30 upon completion of 37 years of service with the Bureau. L. N. McClellan, also of Denver, now Assistant Chief Engineer, will succeed him.

Secretary of the Interior J. A. Krug, commenting on Mr. Young's decision, said: "The retirement of 'Brig' Young is a great loss to western resource development. It will be ameliorated some by his consent to continue serving with the Bureau as a consultant on engineering matters.

"Mr. McClellan, who also began work with the Bureau in 1911, is another outstanding engineer with a lifetime background in Reclamation which thoroughly qualifies him to take over direction of Reclamation's design and construction."

Mr. Young's Reclamation career began as an engineer on the construction of Arrowrock Dam in Idaho, then the world's tallest dam. Ever since then, his work has been identified with structures and projects of unprecendented size, always requiring the utilization of the most current technical engineering skill. In 1921 he was assigned the responsibility of finding a site and of preparing designs and estimates preliminary to the construction of Hoover Dam and power plant. Later he served as construction engineer on this Dam, the highest in the world. (726 feet.)

He worked on numerous other first-magnitude planning, designing, and construction jobs such as construction engineer on the Kittitas Division of the Yakima project, Washington, and supervising engineer on California's huge Central Valley project. He became the Bureau's Assistant Chief Engineer in November 1940. In January 1945, he was appointed Chief Engineer. During his term in office, such structures as the 13-mile-long Alva B. Adams Tunnel in Colorado, world's longest irrigation tunnel; Davis Dam, on the Colorado River; the Tracy pumping plant, in the Central Valley project, California, and many other notable structures have gone forward.

Reclamation Commissioner Michael W. Straus commented, "Under his skilled engineering guidance, forces and work procedures organized to carry a construction program of less than $100,000,000 per year have been reshaped to carry, with a high degree of success, a construction pace now exceeding a quarter of a billion dollars per year."

Mr. McClelland was born in Middletown, Ohio, in 1888. He was graduated from the University of Southern California in 1911 with the degree of bachelor of science in electrical engineering, and shortly afterward began work for the Bureau on the Salt River project in Arizona.

Thus, Mr. McClellan brings to his new job a lifetime of experience in water-resource development as well as his technical background in hydroelectric development.

As Assistant Chief Engineer for the past 3 years, he has been closely associated with Mr. Young in directing the design and construction aspects of the broad Reclamation program. Upon Mr. Young's retirement, he will take over the responsibility for the design and construction phases of the Bureau's 22 active projects, involving contracts aggregating $260,000,000 in value.

Mr. McClellan is fellow and past Vice President of the American Institute of Electrical Engineers, and past chairman of the Denver section of the American Institute of Electrical Engineers, the Colorado Society of Engineers, and of the United States International Conference on Large Electric High-Tension Systems. He was a United States delegate to the World Power Conference in Paris in 1946. (See Reclamation Era, February 1947.) END

NOTES FOR CONTRACTORS

Contracts Awarded During March 1948

Spec. No.	Project	Award Date	Description of work or material	Contractor's name and address	Contract amount
2007	Central Valley, Calif	Mar. 5	Construction of steel and precast concrete pipe for Tracy pumping plant.	Stolte, Inc., Oakland, Calif	$2,552,302
2008	Missouri Basin-Canyon Ferry, Mont	Mar. 12	Construction of buildings and residences for Canyon Ferry Government camp.	Dudley Construction Co., Great Falls, Mont	324,259
2010	Davis Dam, Ariz.-Nev	Mar. 19	Main control boards, battery chargers, unit substation, and transformers for Davis power plant, schedules 2 and 6.	Westinghouse Electric Corp., Denver, Colo	326,468
2015	Columbia Basin, Wash	Mar. 5	3 5,000 ampere bus structures for units R1, R2, and R3, Grand Coulee power plant.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	224,145
2021	Davis Dam, Ariz.-Nev	Mar. 29	3 30,000/40,000-kilovolt-ampere transformers for Parker switchyards, schedule 1.	Allis-Chalmers Manufacturing Co., Denver, Colo.	549,000
			12 circuit breakers and 7 lightning arresters for Parker switchyards, schedules 2 and 4.	Westinghouse Electric Corp., Denver, Colo.	603,061
2022	Klamath-Tule Lake, Oreg.-Calif	Mar. 11	2 pumping units for pumping plants E and F, schedule 1	Crane O'Fallon Co., Denver, Colo.	22,152
2926	Central Valley, Calif	Mar. 30	58 disconnecting switches for Tracy switchyard and Elverta substation, schedules 1, 2, and 3.	Graybar Electric Co., Inc., Denver, Colo	242,268
2031	Missouri Basin-Canyon Ferry, Mont	Mar. 4	Construction of electrical distribution system at Canyon Ferry Government camp.	Allen Electric Co., Helena, Mont	15,596
2035	Missouri Basin-Power Transmission Lines, Unit, Nebr.	Mar. 3	4 transformers, 3 circuit breakers, and 7 lightning arresters for Sidney substation, schedules 1, 2, 4, and 8.	Westinghouse Electric Corp., Denver, Colo	131,170
2037	Colorado-Big Thompson, Colo	Mar. 12	Switchgear assembly, spare circuit breaker removable element, line-control board, and current transformers for Granby pumping plant.	do	64,212

Contracts Awarded During March 1948—Continued

Spec. No.	Project	Award Date	Description of work or material	Contractor's name and address	Contract amount
2043	Missouri Basin-Power Transmission Lines Unit, Nebr.	Mar. 11	Transformers, step-voltage regulator, metering outfit, and lightning arresters for Bridgeport substation, schedules 1, 2, 3, 4, 9, and 11.	Westinghouse Electric Corp., Denver, Colo	$191,156
		do	Circuit breakers for Bridgeport substation, schedule 6	General Electric Co., Denver, Colo	45,912
		Mar. 12	Disconnecting switches and fuses and fuse cut-outs for Bridgeport substation, schedules 7 and 8.	A. B. Chance Co., San Francisco, Calif	24,193
2051	Columbia Basin, Wash	Mar. 5	Switch-gear unit, motor control boards, heating contractor board, battery control, board, distribution board, battery charges, and test cabinet for Grand Coulee right powerhouse, schedules 1, 3, 4, and 5.	Westinghouse Electric Corp., Denver, Colo	143,141
		do	2 lighting and heating unit substations and 10 power unit substations for Grand Coulee right powerhouse, schedule 2.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	181,677
2053	Boise, Idaho	do	Completion of Anderson Ranch Dam and power plant	J. A. Terteling & Sons, Inc, Boise, Idaho	2,499,364
2058	Colorado-Big Thompson, and Missouri Basin, Colo.-S. Dak.	Mar. 12	1 fixed wheel gate and frame for Prospect Mountain conduit and 2 fixed wheel gate frames for Angostura Dam, items 1, 2, 5, and 6.	Johnson Machine Works, Inc., Chariton, Iowa	23,655
2061	Columbia Basin, Wash	Mar. 11	Control boards for units R1, R2, and R3 and 230 kilovolt Snohomish line, Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo	78,053
2062	Colorado-Big Thompson, Colo	Mar. 25	1 unit substation with dry type transformers for Granby pumping plant, item 1a.	I-T-E circuit Breaker Co., Philadelphia, Pa	25,744
2066	Yakima-Roza, Wash	Mar. 22	1 55-inch plate steel penstock and 1 38-inch plate steel pump discharge pipe.	American Pipe & Construction Co., Portland, Oreg.	80,585
2070	Fort Peck, Mont	Mar. 31	Construction of McCone County Electric Cooperative (Circle) 1,500 kilovolt-ampere substation.	C-L Electric Co., Pocatello, Idaho	114,669
2071	Kendrick and Missouri Basin, Wyoming	do	Construction of Medicine Bow-Hanna and Glendo-Lusk 34.5 kilovolt transmission lines.	J. R. Foree, Topeka, Kan	44,503
2075	Columbia Basin, Wash	Mar. 26	Completion of control bay, control cable tunnel, and parking area for right power plant; and construction of transformer circuits, tie circuits, and right switchyard for Grand Coulee Dam.	Morrison-Knudsen Co., Inc., and Peter Kiewit Sons Co., Seattle, Wash.	2,789,284
2076	Klamath-Tule Lake, Oreg. Calif	Mar. 5	Construction of earthwork for South Maine dike, B dike, and North Main dike.	Tyson & Watters Co., Sacramento, Calif	35,867
2078	Boulder Canyon-All-American Canal, Ariz.-Calif. Nev.	Mar. 25	Construction of earthwork, wasteway lining, and structures for wasteways 2 and 3, Coachella Valley flood protection.	Macco Corp., Clearwater, Calif	605,655
2082	Colorado-Big Thompson, Colo.	Mar. 23	6 butterfly valves and 6 grease pumps for Granby pumping plant, items 1, 2, and 4.	Premier Gear & Machine Works, Portland, Oreg.	128,090
2087	Missouri-Basin-Frenchman-Cambridge, Neb.	Mar. 3	Embedded metalwork for 6 radial gates at Enders Dam	Schmitt Steel Co., Portland, Oreg	16,170
2092	Missouri Basin-Angostura, S. Dak	Mar. 23	5 radial gate hoists for Angostura Dam.	Monarch Forge and Machine Works, Portland, Oreg.	74,937
2095	Colorado-Big Thompson, Colo	Mar. 26	1 108-inch diameter plate steel pipe for Horsetooth Feeder Canal.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	45,300
2100	Columbia Basin, Wash	Mar. 23	3 sets of seal base assemblies for penstock coaster gates, Grand Coulee Dam.	Johnson Machine Works, Inc., Chariton, Iowa.	11,850
2102	Missouri Basin, N. Dak	Mar. 31	High pressure gates, hydraulic hoists, gate hangers, conduit lining, and conduit lining transition for outlet works, Heart Butte Dam.	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	32,950
2111	Central Valley, Calif	Mar. 24	Construction of warehouse building at Tracy pumping plant.	Luther Adams & Giles N Chittenden, Auburn, Calif.	39,030

Construction and Supplies for Which Bids Will Be Requested During May and June 1948

Project	Description of work or material
Boise, Idaho	Electric heaters and miscellaneous equipment for Anderson Ranch Dam power plant.
	Relocation of domestic water supply for village of Cascade, Idaho, and construction of a standby pumping unit.
Boulder Canyon, Ariz.-Nev	Generators for units A3 and A4, Hoover power plant.
	Power transformers for units A3 and A4, Hoover power plant.
	Turbines and governors for units A3 and A4, Hoover power plant.
Central Valley, Calif.	Radial gates and hoists for Friant-Kern Canal.
	Grading and paving substation area and construction of railroad spur at Elverta substation.
	Construction of earthwork, lining, and structures for 17.2 miles of Friant-Kern Canal, near Porterville, Calif.
Colorado-Big Thompson, Colo.	Radial gates and hoists for Olympus Dam.
	Construction of about 50 miles of 69-kilovolt wood-pole transmission line from Brush to Yuma, Colo.
	Construction of 30 miles of 115-kilovolt wood-pole transmission line from Loveland to Greeley, Colo.
Columbia Basin, Wash.	Extension of 6,900 volt station service switchgear XLS, Grand Coulee left power plant.
	Unit substations, unit control boards, and miscellaneous distribution boards for Grand Coulee pumping plant.
	Elevators for Coulee Dam and power plant.
	Completion of Grand Coulee pumping plant, warehouse A and B, right abutment crane recess, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, water storage reservoir for Coulee Dam; assembly of caisson seat form and face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
	Construction of lining and structures for 6.6 miles of main canal from Long Lake Dam to bifurcation structure to West and East low canals, near Stratford, Wash.
	Construction of earthwork and structures for 15.3 miles of the West canal near Ephrata, Wash.
	Construction of 12,000 feet of concrete and steel siphon near Soap Lake, Wash.
	Construction of earthwork and structures for approximately 8.3 miles of Potholes East Canal near Norden, Wash.
Davis Dam, Ariz.	Power transformers, oil circuit breakers, and disconnecting switches for Phoenix substation.
	Construction of 80 miles of 115-kilovolt wood-pole transmission lines from Tucson to Cochise, Ariz.
	Trashracks for Davis Dam.
	Erection of river gaging station and cable way at Davis Dam.
	Erection of steel structures for approximately 260 miles of 230-kilovolt transmission lines from Davis Dam to Phoenix via Prescott.
	Erection of steel structures for 70 miles of 230-kilovolt transmission line from Davis Dam to Hoover Dam.
	Constructing and furnishing equipment for 10,000 kilovolt Cochise substation.
Deschutes, Oreg.	Completion of construction of Wickiup Dam and relocation of forest service road near Lapine, Oreg.
	Rehabilitation of buildings, including alteration, repair, painting, and decorating at Madras Air Base, Jefferson County, Oreg.
Hungry Horse, Mont	Power transformers for Hungry Horse power plant.
	One 250-ton powerhouse crane.
	Construction of telephone and fire-alarm systems at Hungry Horse Government camp, 6 miles east of Columbia Falls Mont.
	Erection of 40 x 200-foot steel quonset type garage and fire station; construction of 24-room dormitory building; construction of 36 x 128 temporary office building; construction of 12 5-room and 6 6-room residences; construction of 1 10-car garage; construction of a guard headquarters building for Hungry Horse Government camp, 8 miles east of Columbia Falls, Mont.
Kendrick, Wyo	Erecting foundation and 115- and 57 kilovolt bus structures for Casper, Wyo., substation.
	Construction of about 50 miles of 115-kilovolt transmission line from Seminoe to Casper, Wyo.
Mirage Flats, Nebr	Erection of office building, 3 prefabricated residences, warehouse, utility buildings, well pump house and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Wyo.	Construction of 17 miles of 69-kilovolt wood-pole transmission line from Garland to Lovell, Wyo.
	Construction of 40 miles of 115-kilovolts wood-pole transmission line from Lovell, Wyo., to Yellowtail, Mont.
	1 22,500-pound gantry crane for Kortes Dam.
	Elevators for Kortes Dam and power plant.
Missouri Basin, Colo.	Construction of Bonny earthfill dam, on the South Fork of the Republican River, west of Hale, Colo.
Missouri Basin, Nebr.	Construction of the Superior-Courtland Diversion dam, a concrete overflow gravity structure, on the Republican River near Guide Rock, Nebr.
Missouri Basin, Wyo.	Constructing and furnishing equipment for the Pine Bluffs, Wyo., 6,000-kilovolt-ampere substation.
Missouri Basin, Wyo.-Nebr	Construction of 160 miles of 115-kilovolt transmission line from Casper, Wyo., to Gering, Nebr.
Missouri Basin, Nebr.	Constructing and furnishing equipment for the Alliance, Nebr., 10,000-kilovolt-ampere substation.
	Furnishing and erecting 30 residences and installing utilities at Trenton Government camp, Trenton, Nebr.
Missouri Basin, Wyo.	Furnishing and erecting 16 residences for Government camp at Mills, Wyo.
Missouri Basin, N. Dak.	Construction of Dickinson dam, an earthfill structure near Dickinson, N. Dak.
Newton, Utah	Construction of concrete spillway for Newton Dam.
Paonia, Colo.	Construction of Spring Creek earthfill dam, on East Muddy Creek about 20 miles northeast of Paonia, Colo.
Provo River, Utah.	Construction of about ¾ of a mile of 6 foot 6 inch diameter concrete lined tunnels approximately 10 miles northeast of Provo, Utah.
	Construction of steel pipeline and structures for Big Cottonwood section, near Provo, Utah.
Rio Grande, N. Mex.	Construction of 80 miles of 115-kilovolt wood-pole transmission line from Socorro to Albuerque, N. Mex.
Riverton, Wyo.	Painting dwellings and other buildings at Riverton Government camp, Wyo.
San Luis Valley, Colo.	Construction of Patoro earthfill dam, on the Conejos River about 30 miles northwest of Mogote, Colo.
Tucumcari, N. Mex.	Construction of earthwork and structures for Conchas Canal (Mile 59.4 to Mile 77.3) and Lateral Unit No. 6 southeast of Tucumcari, N. Mex.

W. C. Austin Project
Altus, Oklahoma

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JUNE
1948

Featuring:

School Days at Shoshone
by John D. Abrahamson

KANSAS Pioneers in *Irrigation*
by William C. Brady

Reclamation in JAPAN
by Lindsey A. Brown

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THE *Reclamation* ERA

Letters to the Editor

Assistant Commissioner Nelson recently received the following letter from Evan W. Hall, agricultural agent of the Chicago, Milwaukee, St. Paul & Pacific Railroad, Spokane, Wash. The article to which he refers was "Silt—Despoiler of the Soil." We agree with Mr. Hall, and were proud to have the privilege of printing Mr. Nelson's article.

ROOM 15, UNION STATION,
SPOKANE 8, WASH., *April 3, 1948.*

DEAR MR. NELSON: Your article in the March issue of THE RECLAMATION ERA is of outstanding importance and you have set forth the situation in a fine, clear, and easily understandable way. I am glad you made this contribution of sound thinking about our big reservoirs. We have passed over the silting problem much too lightly in the past. I think the Garrison Dam in North Dakota is going to be a real problem. I was raised on the Missouri River near Garrison and have sensed trouble ever since they talked about this reservoir.

I liked your comment at Phoenix and wish I could have the opportunity to know you better.

Sincerely,

EVAN W HALL.

Still Disappointed?

STAR ROUTE, 33,
FREEHOLD, N. J.,
January 26, 1948.

DEAR EDITOR: I just received my first issue of RECLAMATION ERA, and am somewhat disappointed. What I was looking for was pictures and experiences of settlers already on their land. For instance, in the Yuma project, army barracks were given away by the Government free to each settler, who in turn had to move them to the land himself. Were the barracks jacked up and moved as a whole, or did they all have to be dismantled?

Your picture and explanation of spiles was very good. Actually a spile is a crude valve that always leaks somewhat. In areas where there is a severe water shortage, have previous settlers found these spiles inefficient in the conservation of water? Has anyone devised a more efficient valve?

Settlers on the Yuma project had their land all planted in alfalfa when they arrived. Did any of them leave it in alfalfa? If any settlers did cut the alfalfa, what average yield did they get per acre per year? How many cuttings did they make? How much did they sell it for? Did it cover their first year's costs and living expenses? Did they rent machinery to cut and bale it, or did they have their own, or each buy their own?

Some settlers may have run out of ready cash. Since Reclamation land is United States property until all homestead laws are complied with and the land patented, no mortgage can be gotten on this land. How have local banks cooperated in situations of this sort?

You undoubtedly have a fairly large list of subscribers by now. Perhaps you could select at random about a dozen names from each of the various projects and send them a list of my and other questions, request photographs, giving them a small cash award or a year's subscription free, for their trouble. Unless you have reporters to do such work.

Respectfully,

LEONARD RICHMAN.

Sorry to read of Reader Richman's disappointment—but the ERA must cover various phases of the Bureau of Reclamation's program and cannot be exclusively devoted to settlement stories. His suggestion in the last paragraph delights our editorial hearts—the cash award of course is prohibited in a Government publication, but we have a standing offer of a free subscription for 1 year to anyone who contributes an article accepted for publication. We need and want material which answers such questions as posed by Mr. Richman. We do not have reporters to do the work. Contributors to the ERA write articles in addition to their regular duties or on their own time.

Replying to his questions, in their order:

ARMY BARRACKS—see RECLAMATION ERA April 1947 (*The Bureau Reclaims Its Own*), May 1947 (*Homes for Veterans*); June 1947 (*Reclamation and the Housing Shortage*); November 1947 (*Spotlight on the Pioneers*), and February 1948

(*Continued on next page*)

Reclamation ERA

June 1948 **Vol. 34, No. 6**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, *Editor*

OUR FRONT COVER

HUNGRY? YES, BUT HUSKY AND HEALTHY. These youngsters of the Powell School's first grade dig into a well-balanced meal of meat, potatoes, vegetable, fruit, and milk which will give them the energy required to study and play hard as is the custom at Powell. The little blond fellow seems to have a monopoly on the coeds. This photo was taken by Charles A. Knell, Sr., Region VI.

June 1948

Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation
Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management,* G. S. Ellsworth; *Chief Counsel,* Clifford E. Fix; *Chief Information Officer,* Leonard W. Mosby; *Chief Personnel Officer,* Glenn D. Thompson; *Director, Programs and Finance,* Alfred R. Golzc; *Director, Branch of Operation and Maintenance,* Goodrich W. Lineweaver; *Director, Branch of Power Utilization,* Harvey F. McPhail; *Director, Branch of Project Planning,* John W. Dixon; *Comptroller,* William F. Kubach; *Director of Supply,* S. W. Crosthwait

DENVER OFFICE OF THE CHIEF ENGINEER: United States Department of the Interior, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Walker R. Young, Chief Engineer and Director, Branch of Design and Construction

Chief, Legal Division (Office of the Chief Counsel), Robert B. Starke; *Chief, Hydrology Division (Branch of Project Planning),* John R. Riter; *Chief, Power Field Division (Branch of Power Utilization),* E. C. Schurch; *Chief, Denver Finance Division (Office of the Director of Programs and Finance),* Archie M. Rankin; *Associate Director of Supply (Office of the Director of Supply),* J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller),* Wendell Bramwell, Chief, Personnel Field Office (Office of the Chief Personnel Officer) Everett K. Gould.

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director,* J. Lyle Cunningham; *Assistant Regional Director,* H. T. Nelson; *Regional Engineer (Branch of Design and Construction),* Grant P. Gordon; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* W. H. Tuller; *Regional Power Manager (Branch of Power Utilization),* Don S. Campbell; *Regional Planning Engineer (Branch of Project Planning),* E. N. Torbert; *Regional Programs and Finance Officer (Programs and Finance Division),* A. W. Empie; *Regional Information Officer (Information Division),* H. C. Blonk; *Regional Land Officer (Land Acquisition),* W. B. Wallace; *Regional Counsel (Legal Division),* H. R. Stinson; *Regional Personnel Officer (Personnel Division),* V. L. Rushfeldt; *Regional Supply Officer (Supply Division),* James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Anderson Ranch Dam construction office	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Payette pump unit construction office	R. W. Adams	Construction engineer	Caldwell, Idaho.
Cascade Dam construction office	Earl Harmon	do	Cascade, Idaho.
Payette division O. & M. office	Theodore Nelson	Irrigation manager	Notus, Idaho.
Owyhee project O. & M. office	J. F. Spofford	do	Nyssa, Oreg.
Vale project O. & M. office	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes project	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hungry Horse project	C. H. Spencer	do	Columbia Falls, Mont.
Lewiston Orchards project	Wilfred L. Karrer	do	Weisberger Bldg., 5th and Main, Post Office Box 621, Lewiston, Idaho.
Minidoka project	S. R. Marean	Superintendent	301 North Hansen Ave., Burley, Idaho.
Palisades project	I. Donald Jerman	Project engineer	Post Office Box 1259, Idaho Falls, Idaho.
Yakima project	O. W. Lindgren	Superintendent	Federal Bldg., Yakima, Wash.
Planning Offices and Independent Field Stations			
Kalispell planning office	Charles S. Hazen	Planning engineer	13 East 2d St., Post Office Box 97, Kalispell, Mont.
Medford planning office	F. C. Hart	do	123½ W. Main St., Post Office Box 1389, Medford, Oreg.
Salem planning office	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla planning office	M. Boyd Austin	do	McCaw Gen. Hospital, Veterans' Adm. Reservation, Post Office Box 718, Walla Walla, Wash.
Rathdrum Prairie project, Post Falls unit, independent field station.	E. A. Lavonture	Watermaster	Route 2, Post Falls, Idaho.
Missoula Valley project, Big Flat unit, independent field station.	Pierre J. LaCasse	do	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Umatilla project, independent field station.	C. L. Tice	Reservoir superintendent	McKay Dam, Pendleton, Oreg.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director,* R. S. Calland; *Assistant Regional Director,* Phil Dickinson; *Assistant to the Regional Director,* U. J. Gendron; *Regional Engineer (Branch of Design and Construction),* A. R. McGinness; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* J. G. Lindley; *Regional Power Manager (Branch of Power Utilization),* B. W. Creim; *Regional Planning Engineer (Branch of Project Planning),* S. A. Kerr; *Regional Finance Officer (Finance Division),* J. F. Kastl; *Acting Chief (Land and Right of Way Division),* Joe H. Leech; *Regional Information Officer (Information Division),* Max Stern; *Regional Counsel (Legal Division),* L. O. Graham; *Regional Personnel Officer (Personnel Division),* H. F. Osborne; *Regional Supply Officer (Supply Division),* H. F. Halliday

	Official in charge		Address
	Name	Title	
District Offices			
Delta district	C. H. Kadie, Jr	District manager	Post Office Box 1407, Sacramento 10, Calif.
Klamath district	Raymond R. Best	do	Post Office Box 312, Klamath Falls, Oreg.
Lower San Joaquin district	J. W. Rodner	do	Post Office Box 1270, Merced, Calif.
	O. G. Boden	Construction engineer	Antioch, Calif.
	L. J. Lang	Engineer	Post Office Box 1372, 1115 Eye St., Modesto, Calif.
	G. C. Imrie	Resident engineer	Tracy, Calif.
Sacramento Valley district	James K. Carr	District manager	Post Office Box 302, Chico, Calif.
	William J. McCrystal	Construction engineer	Redding, Calif.
	C. L. Brown	Acting superintendent	Post Office Box 30, 114 Second St., Colusa, Calif.
	R. W. Hollis	Watermaster	Orland, Calif.
Tulare Basin district	Robert B. Cozzens	District manager	406 Patterson Bldg., Fresno, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.
Project Planning Offices			
Santa Barbara	J. H. Fertig	Engineer	201 La Arcada Bldg., 1114 State St., Santa Barbara, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director*, L. R. Douglass; *Assistant to the Regional Director*, J. D. Earl; *Regional Engineer (Branch of Design and Construction)*, C. A. Bissell; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, A. B. West; *Regional Power Manager (Branch of Power Utilization)*, R. V. Sprague; *Regional Planning Engineer, (Branch of Project Planning)*, E. G. Nielsen; *Regional Finance Officer (Finance Division)*, M. E. Rains; *Regional Counsel (Legal Division, Los Angeles, Calif.)*, R. J. Coffey; *Regional Supply Officer (Supply Division)*, O. J. Littler; *Regional Personnel Officer (Personnel Division)*, M. H. Mitchell; *Regional Progress Control Officer (Progress Control Office)*, D. A. Dedel; *Chief, Office of River Control*, C. P. Vetter.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
Gila (Construction)	Murray J. Miller	Construction engineer	Yuma, Ariz.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
All American Canal (Coachella division)	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	Post Office Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	Project engineer	Parker Dam, Calif.
San Diego	R. E. Burnett	Engineer	Escondido, Calif.
Project Planning Offices and Design Units			
Escondido planning office	R. E. Burnett	do	Post Office Box 357, 414 West 3d St., Escondido, Calif.
Overton planning office	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix planning office	V. E. Larson	Assistant regional planning engineer	337 West Washington, Phoenix, Ariz.
St. George planning office	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.
Davis Dam design unit	H. I. Fitz	Head, design unit	Box 2071, Aviola Corp. Bldg., Phoenix, Ariz.
Davis transmission system design unit	A. J. Ecker	do	Do.
Coachella design unit	H. R. Voris	do	360 South San Gorgonio Ave., Banning, Calif.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant Regional Director*, C. D. Woods; *Regional Engineer (Branch of Design and Construction)*, C. H. Carter; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, D. S. Stuver; *Chief, Resources and Development (Branch of Power Utilization)*, L. E. Mathews; *Regional Planning Engineer (Branch of Project Planning)*, Reid Jerman; *Regional Finance Officer (Finance Division)*, F. J. Farrell; *Regional Counsel (Legal Division)*, J. S. McMaster; *Procurement Officer (Supply Division)*, E. G. Bywater.

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Paonia	R. W. Jennings	do	Post Office Box 623, Paonia, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area and Field Offices			
Fallon	W. H. Slattery	Engineer	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Hedderman	Area engineer	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 780, Grand Junction, Colo.
Kemmerer	P. B. Delong	Engineer	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	Area engineer	46 East Center, Post Office 294, Logan, Utah.
Salt Lake City	R. C. Johnson	do	211 Federal Bldg., Post Office Box 360, Salt Lake City 8, Utah.
Spanish Fork	P. R. Neeley	do	Post Office Box 71, City Hall, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Texas

Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *Assistant to Regional Director*, J. A. Buchanan; *Special Assistant to the Regional Director*, E. T. Giles; *Regional Engineer (Branch of Design and Construction)*, O. I. Craft; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, R. S. Bristol; *Regional Power Manager (Branch of Power Utilization)*, A. H. Sullivan; *Regional Planning Engineer (Branch of Project Planning)*, Rex R. Reed; *Assistant Regional Programs and Finance Officer (Programs and Finance Division)*, C. L. Harris; *Regional Counsel (Legal Division)*, S. L. Baird; *Regional Personnel Officer (Personnel Division)*, H. F. Kirby; *Regional Supply Officer (Supply Division)*, I. G. Campbell; *Regional Safety Advisor*, G. F. Peterson.

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	J. A. Callan	Project engineer	Altus, Okla.
Balmorhea	J. A. Maveety	Engineer in charge	Balmorhea, Tex.
Carlsbad	H. H. Kidder	Project superintendent	Carlsbad, N. Mex.
Rio Grande	L. R. Fiock	do	U. S. Courthouse, El Paso, Tex.
Elephant Butte Power & Storage	Labon Backer	Acting division superintendent	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta	F. D. Postle	do	Ysleta, Tex.
San Luis Valley	W. H. Sweet	Acting project engineer	117 Jefferson St., Monte Vista, Colo.
Tucumcari	R. J. Lyman	Project superintendent	Tucumcari, N. Mex.
Valley Gravity	John C. Thompson	Project engineer	McAllen, Tex.
Project Planning Offices			
Albuquerque	J. L. Mutz	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	H. P. Burleigh	do	Littlefield Bldg., Austin, Tex.
Oklahoma City	M. G. Barclay	do	Post Office Box 495, 516 Oklahoma National Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Yale Building, Post Office Box 2130, Billings, Montana

Regional Director, Kenneth F. Vernon; *Assistant Regional Director,* W. E. Rawlings; *Assistant to the Regional Director,* George O. Pratt; *Regional Engineer (Branch of Design and Construction),* C. G. Anderson; *Acting Regional Supervisor (Branch of Operation and Maintenance),* E. F. Landerholm; *Regional Power Manager (Branch of Power Utilization),* J. R. Walker; *Acting Regional Planning Engineer (Branch of Project Planning),* C. T. Judah; *Regional Programs and Finance Officer (Programs and Finance Division),* Duncan Mills; *Regional Land Officer (Land Acquisition Division),* W. N. McCormick; *Regional Counsel (Legal Division),* W. J. Burke; *Chairman, Interior Missouri Basin Field Committee,* W. G. Sloan; *Chief, Reports Coordination Division,* Edwin E. Wilson; *Regional Personnel Officer (Personnel Division),* A. W. Gaede; *Regional Supply Officer (Supply Division),* Fred W. Gilbert; *Safety Engineer (Safety Division),* Charles C. Parsons; *Chief, Municipal Water Supply Investigations Unit,* Stanton J. Ware.

	Official in charge		Address
	Name	Title	
District and project offices			
Yellowstone district	Donald C. Ketcham	District manager	Box 1264, Billings, Mont.
Fort Peck	Allen Mattison	Resident engineer	Box 1245, Fort Peck, Mont.
Yellowstone pumping unit	R. B. Kuebler	Engineer	Box 720, Miles City, Mont.
Hardin unit	R. F. Herdman	Construction engineer	Box 516, Hardin, Mont.
Buffalo Rapids	A. H. Whitmore	Acting construction engineer	Terry, Mont.
Moorhead Dam	R. F. Herdman	Construction engineer	Gillette, Wyo.
Upper Missouri District	Harold E. Aldrich	Acting district manager	Box 1629, Great Falls, Mont.
Milk River	H. W. Genger	Superintendent	Malta, Mont.
Canyon Ferry	William P. Price, Jr	Construction engineer	Box 517, Helena, Mont.
Sun River	C. L. Bailey	Superintendent	Fairfield, Mont.
Big Horn district	R. H. Workinger	District manager	Box 839, Cody, Wyo.
Shoshone-Heart Mountain	W. F. Kemp	Acting project engineer	Box 900, Cody, Wyo.
Boysen and Owl Creek	R. S. Lieurance	Project engineer	Box 1111, Thermopolis, Wyo.
Riverton	T. A. Clark	Acting project engineer	Riverton, Wyo.
Missouri Souris district	Bruce Johnson	Acting district manager	Box 1050, Bismarck, N. Dak.
Missouri Souris	G. J. Cheney	Engineer	Box 1869, Minot, N. Dak.
Cannonball Dam	Floyd Jensen	Construction engineer	Elgin, N. Dak.
Dickinson Dam	W. W. Brenner	do	Glen Ullin, N. Dak.
Heart Butte Dam	do	do	Do.
Missouri Oahe District	Joseph W. Grimes	Acting district manager	Box 825, Huron, S. Dak.
Angostura and Rapid Valley	H. V. Hubbell	Project engineer	Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Newell, S. Dak.
Bixby Dam	H. M. Crowell	Construction engineer	Faith, S. Dak.
Keyhole Dam	F. W. Goehring	do	Moorcroft, Wyo.
Shadehill Dam	D. M. Forester	do	Lemmon, S. Dak.

REGION VII: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director,* W. E. Blomgren; *Regional Engineer (Branch of Design and Construction),* Herbert E. Prater; *O. & M. Supervisor (Branch of Operation and Maintenance),* John N. Spencer; *Power Manager (Branch of Power Utilization),* Harold R. Lee; *Planning Engineer (Branch of Project Planning),* John A. Keimig; *Regional Finance Officer (Programs and Finance Division),* Kenneth L. Smith; *Land Officer (Land Acquisition Division),* Mark W. Radcliffe; *Regional Counsel (Legal Division),* Clarence Eynon; *Personnel Officer (Personnel Division),* Albert R. Novak; *Supply Officer (Supply Division),* William F. Sha; *Administrative Officer, (Administrative Division),* H. S. Varner, Jr.; *Safety Engineer (Safety Division),* Alton T. Cromwell.

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Casper (North Platte Basin)	do	do	Do.
Glendo	Murel M. Starr	Construction engineer	Glendo, Wyo.
Guernsey (power)	John T. Hicks	Engineer	Guernsey, Wyo.
Guernsey (irrigation)	Nels P. Nelson	District irrigation superintendent	Do.
Kortes	C. S. Rippon	Construction engineer	Casper, Wyo.
Seminoe Dam	E. T. Walters	General foreman	Seminoe Dam, Wyo.
South Platte River district	E. S. Huntington	District manager	Building 11, Denver Federal Center.
Colorado-Big Thompson	Vacancy	do	Estes Park, Colo.
Fort Morgan	G. W. Hall	General foreman	Fort Morgan, Colo.
Grand Lake	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Green Mountain Dam	Lyle E. McIntosh	Power manager	Green Mountain Dam, Colo.
Horsetooth Reservoir	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	C. E. Klingensmith	do	Loveland, Colo.
Blue-South Platte project	J. H. Knights	District engineer	Building 11, Denver Federal Center.
Narrows Dam	Charles Seger	Construction engineer	Fort Morgan, Colo.
Kansas River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Bostwick Unit	Paul E. Strouse	Construction engineer	Superior, Nebr.
Enders Dam	U. V. Engstrom	do	Imperial, Nebr.
Medicine Creek	Clifford L. Mutch	do	McCook, Nebr.
Cambridge Diversion Dam and Cambridge Canal.	C. M. Jackson	do	Do.
Cedar Bluff	R. J. Walters	do	Ellis, Kans.
Culbertson Dam	Ellis L. Armstrong	do	Trenton, Nebr.
Bonny Dam	Wayne S. Byrne	do	St. Francis, Kans.
Ainsworth (Niobrara Basin)	C. E. Burdick	Area engineer	Ainsworth, Nebr.
Grand Island (Platte River investigations)	P. L. Harley	do	Grand Island, Nebr.
Pueblo (Gunnison-Arkansas and Upper Arkansas River Basin).	B. F. Powell	do	Box 515, Pueblo, Colo.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent.	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	W. J. Farrell	Boise, Idaho.
Boise (Payette division, Notus unit)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent.	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	O. E. Anderson	Superintendent.	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	do	Ralph L. Scheffer	Huson, Mont
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	R. B. Gregory	Austin Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo	Carl Hicks	do	C. J. McCormick	Grand Junction, Colo.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo	J. J. Flanagan	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	do	W. A. Long	do	Elmer Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Peter F. Anker	do	Clarence L. Young	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	J. D. Large	Superintendent.	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew.	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Districts 1 and 2	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mrs. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent.	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery.	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	John T. White	St. Anthony, Idaho
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	Superintendent.	Louie Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hiibel	do	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	S. F. Griffin	President	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent.	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	William T. Davis	Brigham City, Utah
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	O. L. Norman	Manager	J. F. Griswold	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgenson.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Rudolph Hope	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo Clark	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	John D. Franklin	Manager	Geo. L. Ferris	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	Ed Nunn	do	P. B. Smith	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellenburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	David C. Brooks	do	Pauline Osterhout	Sunnyside, Wash
Yakima (Tieton division)	Yakima-Tieton irrigation district	Yakima, Wash	Guy Finley	Manager	Guy Finley	Yakima, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1948

(*Golden Harvest at Klamath*). In general, it was considered best to move the barracks as a whole if they were to be used as units (house, barn, etc.) but to dismantle them if the material was to be used in building structures which could not utilize the basic construction of the barracks.

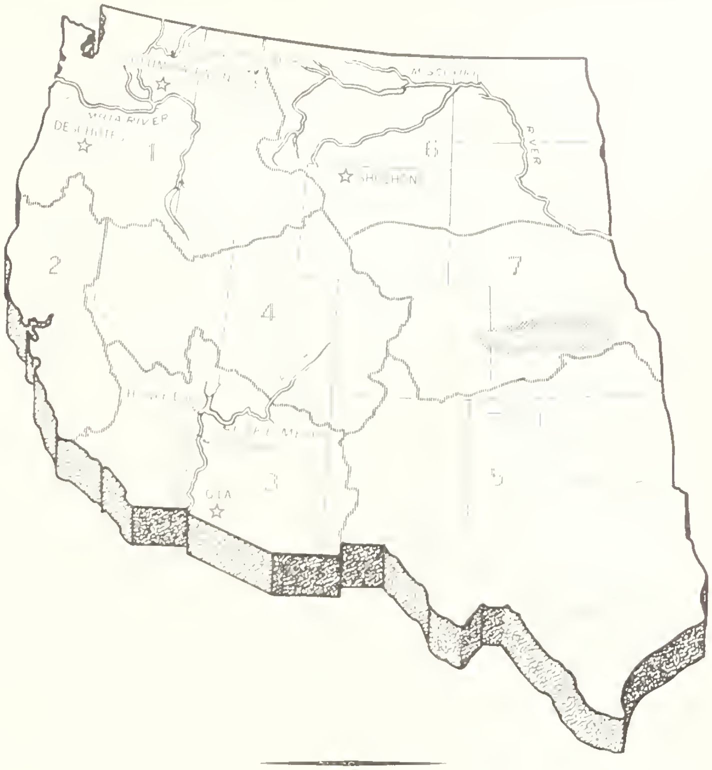
Spiles—Settlers have sometimes found spiles inefficient—although they are still in wide use. The plastic siphon is gaining in popularity although it is comparatively new and it is too soon to draw comparisons.

Yuma project settlers—Mr. Richman is probably referring to the public lands in the Yuma Mesa Division of the Gila project in Arizona. This area has not been settled yet. The closing date for simultaneous filing for one of these farms was March 30, 1948. However, the Government planted alfalfa on these public lands prior to their being made available for settlers and we do have some statistics as a result.

The crop averaged 5 tons to an acre and was cut between five and seven times during the year. At the last Government sale, alfalfa brought $22 per ton. Custom machinery is available for baling of alfalfa by settlers in this area.

Loans—Loans on public lands for which patents have not been obtained, can be secured through the facilities of the Farmers Home Administration and local banks. The farmer pledges his chattels and crops as security. See "*Golden Harvest at Klamath*" for an example of the fine cooperation local banks have shown to reclamation settlers.—Ed.

Reclamation Place names in this Issue



Rooting for Root Systems

Cooperative Extension Work in
Agriculture and Home Economics,
State of Utah—Logan
February 25, 1948.

Dear Editor: I was very much interested in Mr. L. R. Fiock's article, "How to Conserve Irrigation Water" and agree with practically every thing he says except the statement on page 26 of the February issue, "Plants should be forced to develop a deep root system during the early part of the growing season."

For 25 years I have thought we could do this very thing by keeping the moisture content very near the wilting point and because the moisture was low it was my opinion the roots would push down to seek moisture.

According to data recently secured by the Bureau of Plant Industry here at this College, this is an erroneous assumption. They found where sugar beets were allowed to become dry early in the season that no matter what the water treatment later, the result was a decreased yield. These results, however, were obtained in a climate with limited growing season and may not apply where the growing season was sufficiently long.

In other words, the interpretation I put on the results is that the only way to "force" plants to develop a good root system is to keep "optimum" water content in the soil neither too dry or too wet. I know from past experience that almost the universal idea among Utah farmers (and I shared the same idea until recently) has been to force plants to develop a good root system by starving them for water while young and thereby making the roots go deeper for water. Possibly Mr. Fiock only intended to emphasize the fact that young plants should not be over irrigated, to which I subscribe wholly, but let us not mislead people into believing that we can make plants grow without giving them the proper amount of moisture.

Very truly yours,

James R. Barker,
Extension Irrigation Specialist.

Reader Barker is absolutely right. Mr. Fiock *was* emphasizing the fact that young plants should not be over irrigated—but did not intend to imply that they should be made to suffer through water starvation. No plant will develop a root system in dry soil, and if moisture is available in the deep subsoil, crops will develop a normal root system, in which endeavor they should be encouraged—but not at the risk of stunting their growth through underwatering. To quote Mr. Barker, "the *proper* amount of moisture" is the answer.—Ed.

(Date)

The Commissioner,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

Sir: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ____________ for a ________ year subscription to the Reclamation Era.

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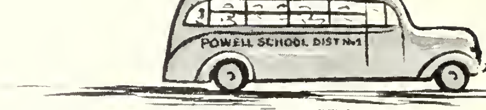
121866

School Days at Shoshone

by JOHN D. ABRAHAMSON, Economist
Branch of Project Planning
Region VI, Billings, Mont.



A visitor to the Shoshone project in Wyoming soon hears from some enthusiastic resident (and they all seem to be enthusiastic) that the Shoshone project is the garden spot of Wyoming. Before the visitor has an opportunity to wedge in a word the resident is sure to follow up with, "and we have the best school system in Wyoming, too."

You do not need to remain long to be impressed, particularly by the school system. Any school day between 8 and 9 in the morning and at 4 o'clock in the afternoon a seemingly endless line of busses pass by—loaded to the doors with children headed to and from the Powell consolidated school.

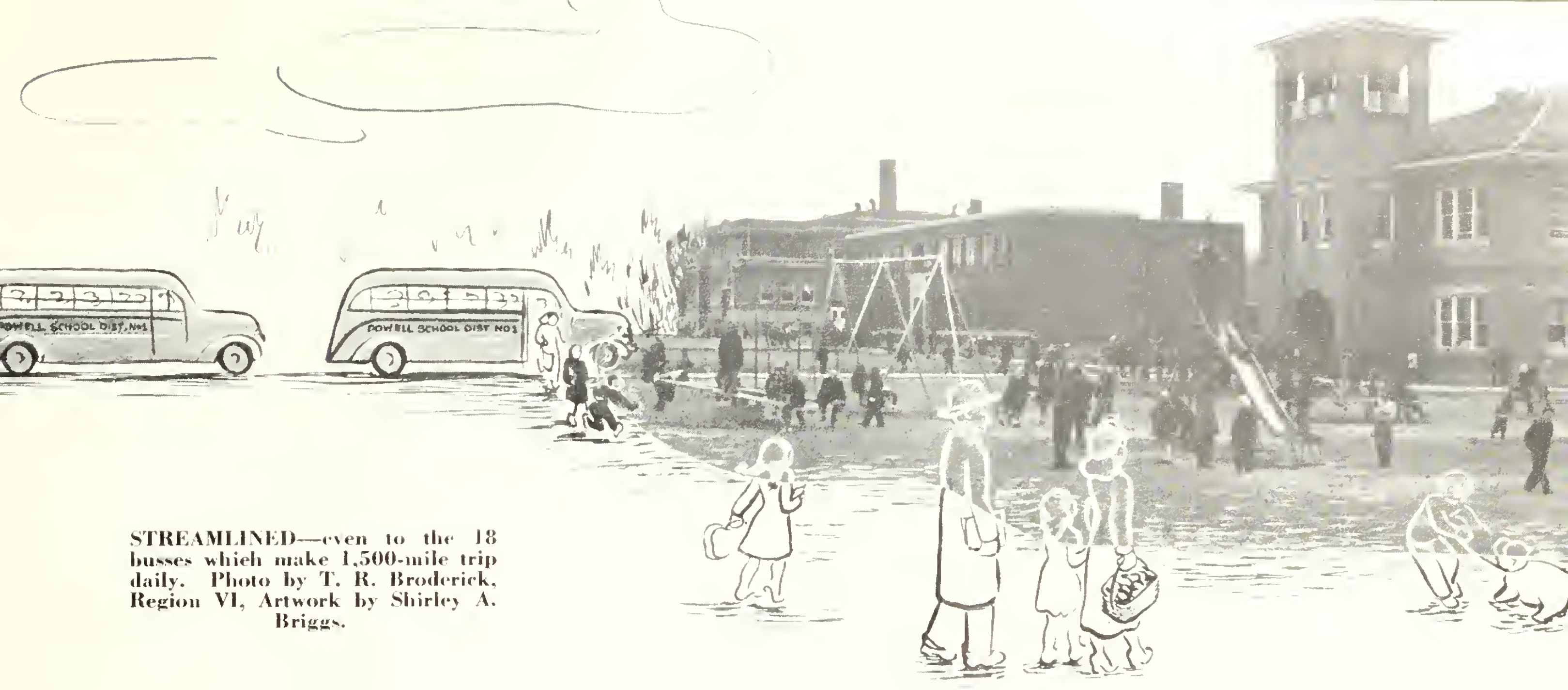
The Powell school is located in the town of Powell in the heart of the Shoshone project, Wyoming. The school provides courses from the primary grades through junior college, with a system organized on a 6–2–4–2 plan. This means that there are six grades in the elementary school, 2 years in junior high school, 4 years in high school, and 2 years at the college level.

The college is a part of the University of Wyoming even though it is housed in the high school and uses the school's laboratories, library, commercial department, and shops. It is referred to as the University of Wyoming, northwest center. The arrangement with the university provides many benefits. Courses at the university center are similar in content and have the same standards as those given at a well established university. Course credits have the same college entrance value as at the university—being similarly accredited.

The Powell school plant consists of three brick buildings. The oldest building (which at one time housed the entire school) has been refinished and now contains the first four grades of the elementary school. The other two buildings are of recent construction and have incorporated in them the latest in school design. One of the two is occupied by the remaining portion of the elementary school and the junior high school. The main building houses the high school and college. A new bond issue recently voted will provide $520,000 for additional buildings.

The enrollment for the entire system now totals 1,625. There are 60 teachers with an average load of 27 pupils each. As you can see, the number of pupils per teacher is carefully

LEFT, Dolores Peet and Dick Honeysett in the chemistry laboratory. BELOW, Instructor Robert J. Bishopp gives a group of juniors some tips on acetylene welding. L. to R.: Bishopp, Duane Edwards, Joe Kawano, Thayer Cox, and Lloyd Myers. Photos by Charles A. Knell, Sr., Region VI



STREAMLINED—even to the 18 busses which make 1,500-mile trip daily. Photo by T. R. Broderick, Region VI, Artwork by Shirley A. Briggs.

controlled to avoid excessive load. However, if circumstances do not permit an adjustment to a lighter load of a standard number of pupils, the teacher's salary schedule provides for additional compensation. Teachers' salaries range from $2,000 to $3,800, with 5 days' sick leave allowed each year. The sick leave is cumulative up to 15 days if unused. Attractive to the married teachers is an annual family allowance which is granted by the board of trustees. For superior merit the board awards special salary increase to any teacher.

The results of such a salary schedule, with sick leave provisions, family allowances and awards for merit is obvious in the enthusiasm and loyalty that the teachers have for their school. An esprit de corps not often observed exists in the faculty.

Superintendent of Schools C. W. Richard and Director C. C. Moore of the northwest center explain that the function of the school is to prepare young people for life and the curriculum of the school is organized accordingly. The pupil has the opportunity of selecting a college preparatory curriculum or one which will introduce him to a vocation.

Beginning with high school, young people can acquire substantial training in a broad assortment of fields which they can carry through college.

A high school pupil selecting an agriculture course receives practical training in all phases of agriculture. He spends a required period of study in a modern well-equipped shop. There he learns how to handle blacksmith tools and forge, how to weld with acetylene, and electric arc, and how to repair farm machinery by actually performing the job.

In the classroom he studies livestock and crops and learns the practical application of his knowledge through the Future Farmers Club of the school. The club conducts a cooperative farming program whereby the members cultivate a 20-acre irrigated plot near the school. In the 1945–46 school year the plot was seeded to field beans. In the same year the club purchased and fattened a carload of lambs.

Powell's modern high school curriculum encourages Barbara Van Buskirk (left) and Doris Booze to ready themselves for the business world.

Third graders Wesley Wilson and Ronald Rickard enjoy lunch. No coaxing needed here. Both photos by Charles A. Knell, Sr., Region VI.

Top photo. **Adult students learn building in night classes.** *Center.* **Principal Henry Rebbe makes announcement over public address system to students in all class rooms while Superintendent of Schools C. W. Richard looks on.** *Bottom.* **Jean Sand, left, and Claudia House, learning the fundamentals of Home Economics. (Top photo by T. R. Broderick, other two by Charles A. Knell, Sr., Region VI.)**

The income from the work-study program is used to buy farm equipment and to finance club activities, and the club now owns farm equipment valued at $4,000. Through the club, the school is represented by judging teams in every State and local agricultural contest and it also sponsors annual judging contest of its own. The National Association of Future Farmers rates the club as one of the 21 best in the United States.

The pupil's agriculture study, although already very thorough, does not discontinue there. The school plant includes a slaughter room. There the agriculture pupil delivers his live hog, beef, or lamb and under instruction performs each step to the final chop, steak, or roast and renders lard in a 40-gallon steam-heated vat.

When his vegetable and fruit crop is mature in the late summer, he delivers it to the school. Under faculty direction he prepares his produce and places it into 1 of 12 blanching vats. After canning, the tins are placed in a rack, transported by an overhead crane to one of six retorts where they are cooked. Three of the retorts have a capacity of 118 cans and three a capacity of 88 cans.

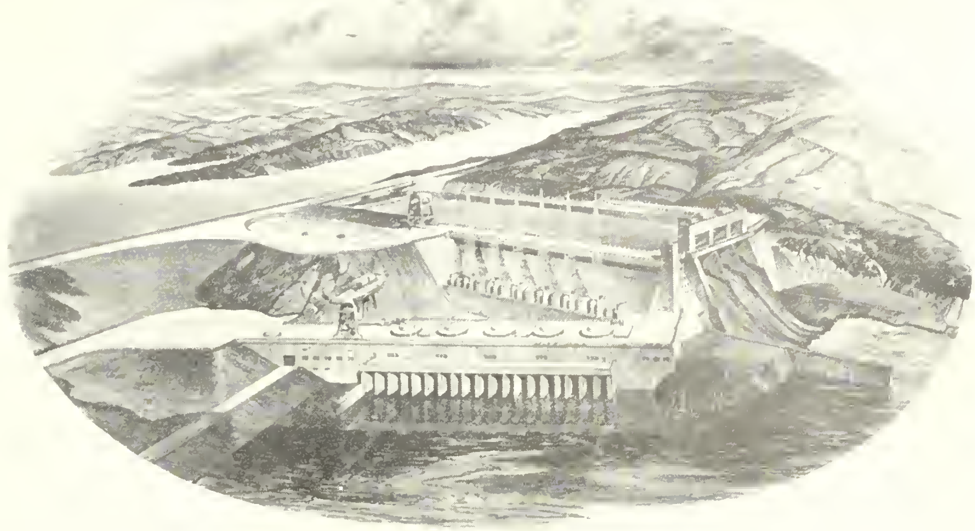
Although a pupil receives thorough training within a selected curriculum the broader aspects of education which fit him for life in a democracy are not overlooked. His background after high school includes study in the physical science, biological sciences, social science, and the humanities.

A well-balanced program is offered in each of these fields of knowledge. In the field of humanities the school maintains an enviable record. Over the years a music library has been established and a collection of musical instruments has been made for band and orchestral use. The music library now consists of 250 overtures and selections, 300 marches, 15 standard symphonies and a miscellany of ensemble music. Two bands, one of 90 pieces and the other of 80 pieces are maintained. The 90-piece band is composed of beginners who are transferred to the 80-piece band as they become accomplished. A girl's chorus of 102 voices and a boy's chorus of 40 voices represent those who have attained accomplishment in voice.

The community influence of the school is widespread. It reaches so often into so many homes that it is an integral part of life. College courses running until 10 o'clock in the evening permit adults to continue their education or to take selected courses. Adult classes in music are conducted. This year adult classes in shop will be resumed. Courses offered will consist of a course in farm machinery repair, general carpentry, cabinet making, and millwork. The canning center was utilized by 125 families last fall. It is anticipated that in the next canning season more than twice that number will use the facilities.

Mass transportation is the keystone of the Powell school system. Without it the school would be just another rural school. Of the 1,625 pupils in attendance 45 percent are transported from country homes distributed over an area of about 350 square miles. Eighteen busses are required. They cover a route estimated to be 1,424 miles long. Each bus is operated by a part-time driver who may otherwise be a mechanic, a farmer, or a clerk. The busses begin their runs at 7:30 in the morning and arrive at the school between

(Continued on page 108)



Reclamation Engineer J. MacGilchrist, of Denver, Colo., has drawn this conception of how Davis Dam will look when completed. The dam embankment at left spans the Colorado River 67 miles below Hoover Dam. The power plant is at the bottom left, and the diversion, spillway, and forebay channel and the spillway are in the center and right foreground.

DETOUR at DAVIS*

by H. F. BAHMEIER

Construction Engineer, Davis Dam Project, Region III

They are throwing the switch next month at the Davis damsite to sidetrack the Colorado River.

For the fourth time in history industrious man is moving the Colorado out of its age-old bed and running it around a site on which he is building a dam. To do this he has dug a huge 4,500-foot ditch called a diversion, forebay, and spillway channel. It is a case of detouring the river for all time as the channel is a permanent feature of the Davis Dam project.

The Colorado's new route leaves the river just below Bullshead Rock (for which the project originally was named) makes a quarter-moon arc around the Arizona abutment of the dam, and reenters the old river channel some 500 feet below the downstream end of the power plant. Part of the channel is excavated in solid rock to a depth of 200 feet.

Man accomplished a similar feat at Hoover and Parker Dams with huge tunnels driven through the canyon walls, and at Headgate Rock Dam, an Indian Service project, through an open channel where the river leaves the canyon confines. At other dams on the lower Colorado—Laguna and Imperial—the river was alternately juggled to flow over some sections of the structures while work was being carried along on others.

The switch which will put the river on the new main line at Davis Dam will be a cofferdam constructed simultaneously with the removal of two temporary earth plugs in the diversion channel. The switchman will be the main contractor, the Utah Construction Co., supervised by engineers of the Bureau of Reclamation.

Those who envision a torrential rush of water through the diversion channel will be disappointed. While the operation will be worth observing, the action will be gradual and unspectacular, extending over a period of several days. Significance of the event lies not in the physical act of diverting the waters but rather in the knowledge that man again will have proved himself to be master of the mighty river. He is accomplishing one more step in his program of harnessing the Colorado and making more secure his existence in the southwest desert.

Here's how the diversion will take place: First, the contractor will remove the earth plugs in the diversion channel with draglines. As the huge machines chew away the plugs opposing entrance of the river, the water will "trickle" into the entrance of the channel. Upstream at the Hoover powerplant the water releases through the turbines will be slowed down to reduce the flow at the Davis damsite to the minimum necessary for irrigation and power requirements. Thus Hoover Dam, the first conqueror of the river, plays a major part in effecting each successive control.

Simultaneously with the removal of the plugs, huge Euclid trucks will shuttle across the trestle which occupies the site of, and will be buried by, the upstream cofferdam. The trucks will first drop huge rocks into the river between the trestle bents. Then smaller material will be dropped until the bridge is embedded and the barrier sealed. The entire flow of the river will then be forced through the channel.

Construction will be started immediately after the initial diversion on another cofferdam below the damsite and just above the point where the channel delivers the river back to

(*Continued on page 108*)

*See "How to Sidetrack a River," in June 1946 issue of the ERA.

RECLAMATION in *JAPAN*

by LINDSEY A. BROWN

Land Reclamation Specialist, Natural Resources Section, Supreme Commander for the Allied Powers

Published with the permission of the Chief, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers.

Aerial view of stream valley built up with paddies surrounded by unirrigated crop land. The small round areas are irrigation water storage ponds. Scale about 2500: 1. Near Tokyo. ←

JAPAN waged an aggressive war and one of her objectives was to obtain more food.

For many decades agricultural authorities throughout the world had assumed that Japan had more completely developed her food-producing resources than any other major country.

Yet within her own borders, there were untouched potentialities for increasing the food supply as much as 30 percent.

These are the facts, which surprised United States occupation forces in 1945 when defeated Japan found herself far short of sufficient crop production to feed her expanding millions. For the population of Japan is a little more than 78,000,000, and is increasing at the rate of over 1,000,000 per year.

Under the guidance of American technicians, an extensive land-development program has been initiated. While the successful completion of this program will not solve the food problem completely, it will furnish partial relief for one or two decades, to give Japan time to adapt her economy to new conditions. Even with intensive efforts to produce more food, if the present rapidly expanding population trend continues, Japan will remain dependent on foreign trade for over 20 percent of her food supply.

The program, which carries the highest priority for funds and materials, includes plans to increase the food supply as much as 30 percent by land reclamation and improvement. Irrigation development, land improvement, and conservation are coordinated into a single land development program. Irrigation and drainage facilities will be improved on over 5,000,000 acres, 700,000 new irrigated acres will be developed, and over 3,000,000 acres of forest and grassland will be brought into cultivation without irrigation. About 17 percent of the program has been accomplished in the past 2 years.

Sixteen percent of Japan's area is under cultivation and approximately 5 percent more is susceptible of cultivation in the future. Over half of the cultivated land in Japan is under irrigation and is used for the production of rice. Most of the water for irrigation is obtained by direct diversion from streams. Reservoirs, wells, and springs furnish irrigation water locally. The supply varies from excessive to inadequate depending on precipitation and the nature of the water source. Japan's mean annual precipitation is 40 to 100 inches. High mountains with short distances traversed by streams in reaching sea level has given rise to torrential streams and severe flood hazards to valley farm lands during periods of heavy precipitation.

Reclamation in Japan differs from that in the United States in several basic features. First, the need for additional food is extremely intense, so the highest priority for funds and materials is granted for projects designed to increase food production. Second, it includes the preparation of land for cultivation without irrigation, the improvement of drainage and irrigation facilities for irrigated rice land, the construction of irrigation facilities for production of rice, and the protection of agricultural land from flood hazards. And third, all irrigation development is for the purpose of producing paddy rice, since normal precipitation is adequate for production of other crops.

The improvement of irrigation and drainage facilities on 5,000,000 acres of paddy land in Japan will increase the food production potential by about 15 percent. In terms of increased food production per unit of critical materials used in construction, these improvement projects are among the most economical planned. They include diversion works, canal construction, and improvement projects similar to many in the United States.

Water warming projects, although unique, are common in the northern part of Japan. The water is warmed for use on paddies by holding it in shallow basins exposed to the sun until its temperature has been raised several degrees. Some small reservoirs suffice for water warming, but in other projects the water is conducted slowly through a maze of broad shallow channels before being released on the paddies.

Over 200,000 acres of shallow water areas near river deltas are scheduled for conversion to farm land. The land is above low tide and below high tide. The method of reclaiming such land has been in use in Japan for many decades. A sea wall is constructed high enough to hold back the highest tides and waves. Drainage canals are then constructed to empty at gates in the sea wall. The gates are hinged at the top in a manner which allows them to open at low tide and close at high tide. Within 1 years after good drainage is established, soluble salt concentrations can be reduced below the toxic level by leaching, due to the high precipitation.

The cost per unit area is high for reclaiming shallow water land from the sea. But it results in adding to the most fertile farm land in Japan. The soils are exceptionally high in nutrients, and fertilization does not become a problem until 5 to 10 years after farming is started. This is in sharp contrast to newly reclaimed upland soils. These must be improved by adding large quantities of fertilizers and lime before satisfactory crop yields can be produced.

The Japanese National Government and local agencies wage an endless battle to control all streams at high stages. Levees, pumping plants, and by-pass channels in the lower reaches of the larger rivers are the chief flood control weapons. Check dams and flood control dams along the upper stream courses furnish important controls. Forest and soil conservation methods also lend major support to control measures on the upper watersheds.

The methods used in drainage, flood protection, and irrigation in delta areas of the larger rivers produce high returns in increased crop production potential at a low maintenance cost. The Ogura-ike project near Kyoto illustrates this type of project.

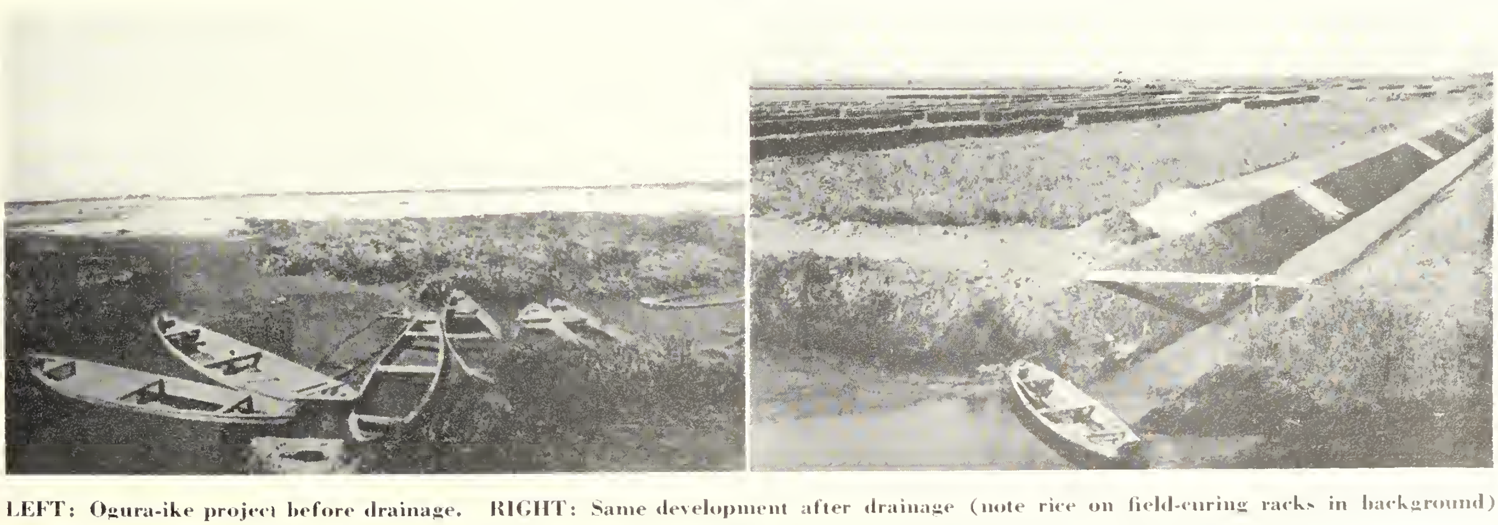
In this area 1,500 acres were under water a large portion of each year and 10,000 acres of cropped land had poor drainage or were damaged frequently by floods. A pumping plant, consisting of 12 electric-powered pumps capable of discharging 1,140 cubic feet per second, was constructed on the Lodo

Foreground, hand-smoothing of paddy before transplanting rice; background shows horses serving same purpose.

River levee. Three systems of drainage canals, each at a different discharge level, were constructed to the pumping station. Irrigation is provided by still another canal system. The low-level system goes directly to the pumping sump and the canal contents are pumped into the river at all times. The middle level canal discharges water from higher lands into the river by gravity while the river is at low stages, but is pumped in at high and flood stages. The high level system drains the highest land and discharges into the river by gravity at all times except during flood stages when it is pumped. Drainage or river water is conducted into the irrigation canal system as river stage and water needs dictate.

The system provides for heavy use of hydroelectric power at peak production stages and a low demand on firm power.

Japan's experience, proving that she could increase her food production considerably through land development—at a fraction of the cost of war—indicates the intense need for the world as a whole to reexamine and utilize its land resources. Land development in most countries can aid greatly in alleviating food shortages and thus taking another step along the road to peace. END



LEFT: Ogura-ike project before drainage. RIGHT: Same development after drainage (note rice on field-curing racks in background).

School Days at Shoshone

(*Continued from page 104*)

8:30 and 9 a. m. At 4 p. m. the busses concentrate at the school, and, as they are loaded, pull out one by one to deliver each child to his home.

The Powell school stands as a tribute to reclamation and to the men and women who had the fortitude and endeavor to pioneer the Shoshone Reclamation project. Back in 1904 the area which made possible and now sustains this educational institution was an area of cactus and sagebrush flats capable of providing a living for little more than prairie dogs and rattlesnakes. The people have ample reason for being so enthusiastically proud of their project and the merits of Powell School, district No. 1—an institution of learning. END

Detour at Davis

(*Continued from page 105*)

its present bed. After completion of the upstream and downstream cofferdams the construction area in the old river bed will be unwatered, and excavation for the dam foundation will begin.

Davis Dam is being constructed by the Bureau of Reclamation as another step in the development of the Colorado River, taking its place along with Hoover, Parker, Headgate Rock, Imperial, and Laguna Dams in conserving and utilizing the potential resources of the stream. The project's name was changed from Bullshead Dam to Davis Dam in 1942 in honor of Arthur Powell Davis. As director of the Reclamation Service from 1914 to 1923, Davis helped lay the foundation of the planned development of the river. The project serves the following purposes:

- fulfillment of Mexican Treaty provisions for the division of the waters of the Colorado and Tijuana Rivers and the Rio Grande;
- production of hydroelectric power which is urgently needed in the power-short southwest; and
- reregulation of the irregular water releases from the Hoover power plant for the benefit of irrigated areas downstream. In addition the reservoir created by the dam will provide recreational advantages such as fishing, boating, and swimming.

Under construction since April 1946, Davis Dam is scheduled to be substantially completed within the next 2 years. Progress to date includes excavation of over 3,000,000 cubic yards of rock and earth to form the diversion, forebay, and spillway channel; grouting of the foundations for the intake, spillway, power plant, and other structures; and placing of concrete in the forebay section of the channel and in the intake and spillway structures.

Placing of the concrete has been carried out to a height sufficient to permit the diversion. Initially, the diversion will be through six openings that have been left in the spillway structure. Later the openings will be filled with concrete and the diversion will be through two outlet gates on either side of the spillway. Completion of the spillway crest, the intake and power-plant structures will be effected while the dam embankment is being placed across the old river bed.

Davis Dam will be an earth- and rock-filled embankment, rising 138 feet above the normal river bed. It will create a 4-mile-wide reservoir of 1,820,000 acre-feet, extending to the Hoover Dam power plant tailrace. The embankment will have a crest length of 1,600 feet and a crest width of 50 feet, across which a two-lane east-west highway will run. Almost 4,000,000 cubic yards of earth and rock fill will be required to form the dam and about 565,000 cubic yards of concrete and 20,000,000 pounds of steel reinforcing bars will go into the forebay, spillway, and power-plant structures.

The Davis power plant, with five 45,000 kilowatt semi-outdoor-type generators, will have an installed capacity of 225,000 kilowatts and an annual output of about a billion kilowatt-hours. Through interconnections with the Hoover and Parker power plants, Davis power will supply pumping plants on the Gila project in southwestern Arizona and power users in central and southern Arizona, southern Nevada, and southern California.

The author is construction engineer on the Davis Dam project for the Bureau of Reclamation and is assisted by Field Engineer J. R. Walton and Office Engineer H. R. Orr. H. E. Williams is project manager and T. L. Terry is general superintendent of the Utah Construction Co. END

Sun River Crops Reach New High

Crops produced during 1947 on the Sun River project near Great Falls, Mont., largest operating project in Region VI, were valued at $3,086,692.56. This marked an increase of more than a half million dollars over the 1946 figure, a record year up to that time.

The net area under cultivation during 1947 was 81,788 acres, making an average per acre return of $37.74. The gross crop return includes $73,829.26 in Federal and factory payments for last year's sugar beet production and for soil conservation practices carried on during 1946.

Wheat led all other crops produced on the project in gross returns, with the 18,947 acres planted bringing a gross return of $1,106,644.92 or $58.41 an acre. The flaxseed crop was second with a total value of $526,521.40. Flaxseed was produced on 8,155 acres and brought an average return of $64.56. The third top money crop was alfalfa hay—valued at $452,380 and produced on 13,642 acres, an average return of $33.16.

The leading crop in per-acre return was white potatoes, with 312 acres bringing 52,476 or $168.14 an acre. Sugar beets, valued at $95.92 an acre including the beet tops, were second high in average return. The sugar-beet crop, planted on 925 acres, was valued at $88,726.75. Twenty-eight acres of the beet crop were a total loss because of a late spring freeze. Flaxseed was third high in average return.

The 31,631 acres of Sun River project lands planted in cereal grains produced crops valued at $1,619,805.76 or an average return of $51.21 an acre. Seed crops, including the previously mentioned flaxseed, were valued at $690,004.12, an average of $56.92 from the 12,123 acres planted.

Hay and forage crops, including the duplicated beet tops, grain, and pea straw and some alfalfa pasture, were valued at $540,734.17, or $21.25 an acre from the 25,443 acres planted in these crops. The 127 acres of gardens planted on the project produced crops considered worth $24,738 or $195.42 an acre.

KANSAS Pioneers in *Irrigation*

by WILLIAM C. BRADY

Area Planning Engineer, Kansas River District, Topeka, Kans., Region VII

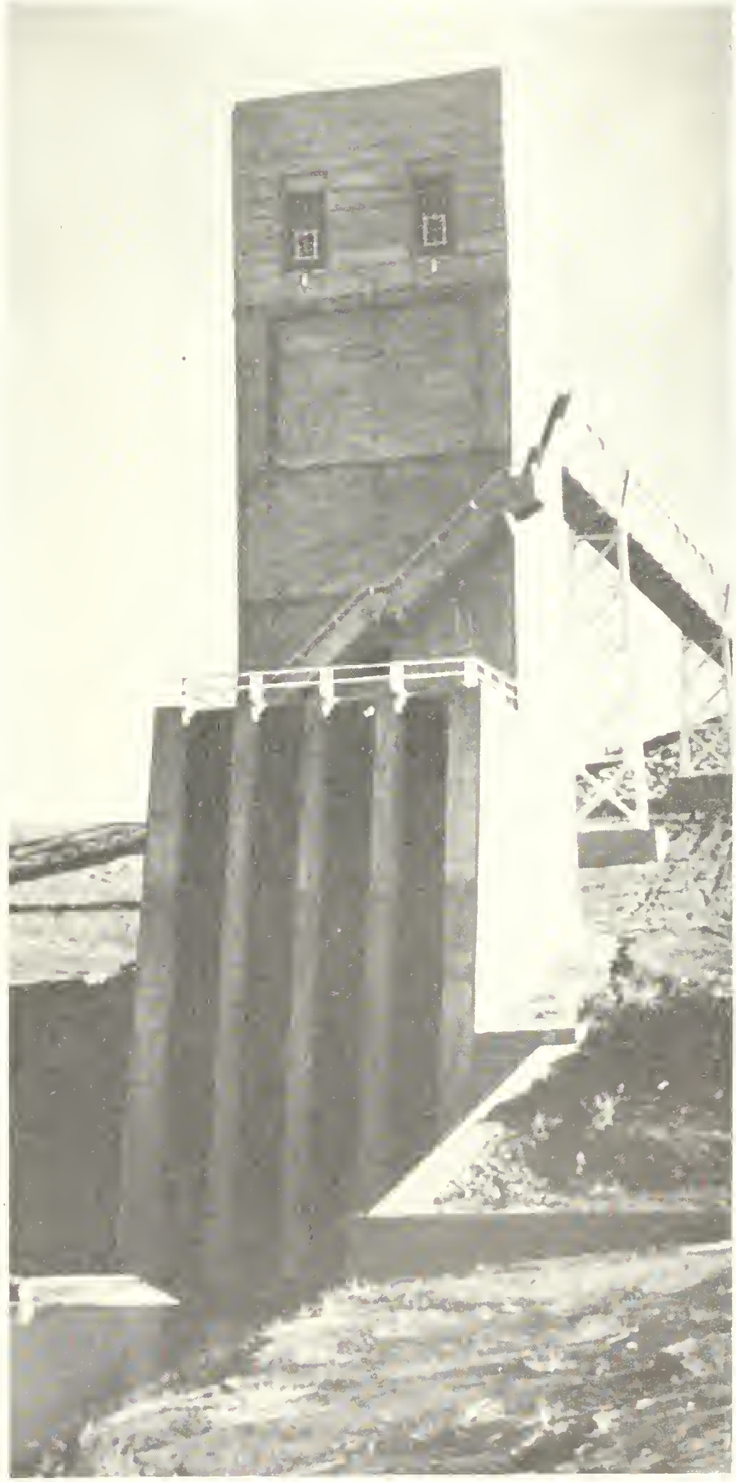
The years roll by, the wars take their tolls, and millions are left in hunger and want. Kansas, the greatest wheat producing State in the Union, continues to do its magnificent part in feeding our great Nation and those foreign nations in need of our help.

There are periods of plenty and periods of drought. There are wet years which produce an excess of crops which are shipped to other areas. There are many years in which there is sufficient rainfall to grow most crops, but during some years there is no rain during the growing season when it is most needed. Then there are dry years when nothing is raised. Day after day the sun beats down, dries up the land, withers the crops, and leaves them begging for water. This is the time when everyone realizes there is a need to utilize to their fullest extent mother nature's gifts to this earth: to nurture and protect what one has, and to produce good fields of corn and forage to feed the cattle. In the final analysis, these needs call for a crop insurance to protect one's interests, and with this insurance, the opportunity to plan for the future by using experiences of the past.

The Indians made a success of irrigation in Kansas as far back as 1650. A small band was driven out of its home in New Mexico, by the Spaniards, and migrated to the beautiful valley that is the present site of Scott County State Park. Here the Indians found an abundant spring, which they diverted, and set up a small irrigation system to water their crops. They lived there peaceably for a few years, and their descendents would probably be there yet except for the Spaniards who had followed them. The Spaniards were not particularly interested in the welfare of the natives. They were after gold, and could not be bothered by any scruples as to how they got it. They destroyed the Pueblo in the valley, and drove the Indians back to Taos, N. Mex.

Many decades later, white settlers moved into this valley and found the ruins of the Pueblo, with evidences of the irrigation that the Indians had done. They cleaned out the Indians' ditches and reconditioned them for their own use. The early American Indian, as primitive as he was, believed in irrigation and passed his meager knowledge on to the white man.

At Old Fort Wallace, located on the Smoky Hill River near the mouth of Rose Creek and the present town of Wallace in Wallace County, the early settlers and soldiers of the fort also



Intake tower, Kanopolis Dam, Kans., now under construction by the Corps of Engineers.

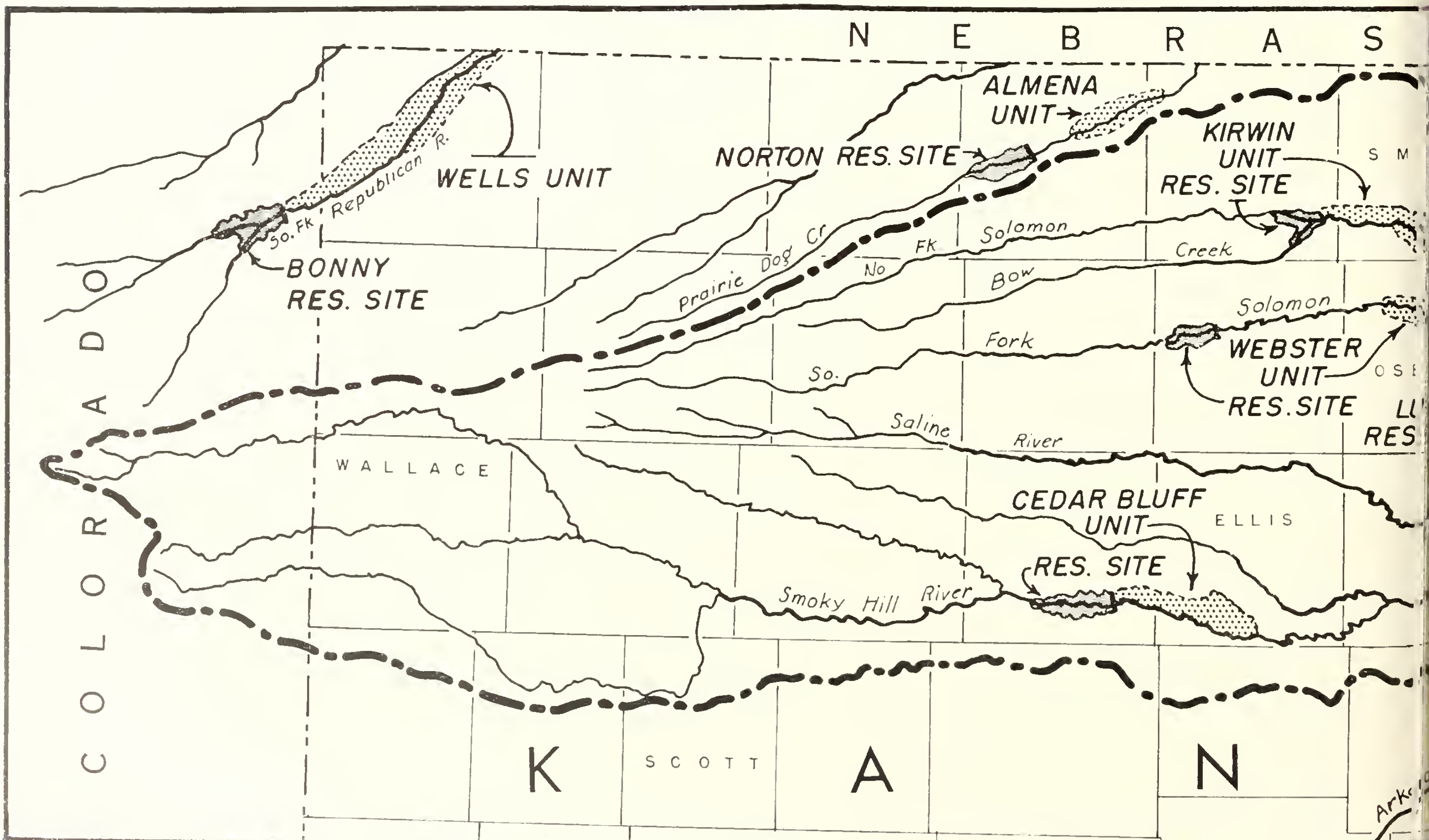
realized the value of irrigation. Most of them had come from far Eastern States, where they left green fields and pastures, to open this great territory of the West. They saw the need for supplemental water in this semiarid region. In 1870, a visitor to the fort reported as follows:

"The water of the Smoky here (Fort Wallace) runs quite a stream. Across it the soldiers have made a dam, which not only furnishes water for the fort, but ice in winter and a chance for irrigation, which opportunity is used to fertilize a garden of about 4 acres, in which they grow all kinds of vegetables, melons, etc." (Excerpted from the Western Home Journal, Lawrence, Kans.—1870—From the files of the Kansas State Historical Society.)

The State of Kansas has had its trials and tribulations, has conquered its problems of the past, and has emerged a leader in this great commonwealth of States. During the middle and late thirties, Kansas experienced a period of very severe drought. There were many months of little or no rainfall whatsoever. During the growing season for the years 1934 through 1938 at Salina, Kans., there were 19 extended dry periods, in which time one-half inch or less of precipitation fell in 20 or more consecutive days. Some of these periods continued for as long as 50 consecutive days. Farther west, at Hays, the conditions were still more severe. In the summer months, during these periods of drought, the temperatures ranged from the nineties to extremes of 121°. Many tried and true homesteaders, who loved Kansas, left their homes and farms because they could no longer survive there. They had no feed for their livestock, so thousands of head of cattle were killed. A few people moved to States where they were able to raise better crops and could feed their stock. Many other farmers had to sell their valuable herds of purebred cattle very cheaply or lose them to the ravages of nature. There were many who migrated who would have stayed on their land and kept their cattle if there had been any facilities available for storing and using water to raise forage.

This severe drought of the thirties convinced many of the need of irrigation. It created a lasting impression, and issued a challenge to those interested in the future of their land. This challenge was met by a few pioneers of irrigation on an untried and experimental basis. As an outgrowth of the efforts of these pioneers, their neighbors have seen the remarkable results obtained, and crop insurance by irrigation is spreading.

In the town of Downs in Osborne County, Kans., one often hears of Bas Verhage who irrigates 120 acres. (See April Reclamation Era for "A Corn King in Wheat Country"). In 1946, he made 102 bushels of hybrid corn to the acre and duplicated the feat in 1947, an extremely dry year. He became interested in irrigation a number of years ago and irrigated alfalfa for a while before turning to corn. When his neighbors saw the results that Bas Verhage got from his irrigated corn, they became seriously interested and started experimenting for themselves. These attempts to better their crop production proved very beneficial, and many are increasing the number of acres which they originally had under irrigation. The farmers in this region are irrigating mostly hybrid corn, alfalfa, grain, and forage sorghums, and getting most satisfactory results. The irrigated land is yielding



from 55 to over a 100 bushels of corn to the acre. Some nonirrigated bottom land in the same area last year produced from 10 to 20 bushels per acre, while upland and other bottom land had a complete crop failure. This is proof enough for them.

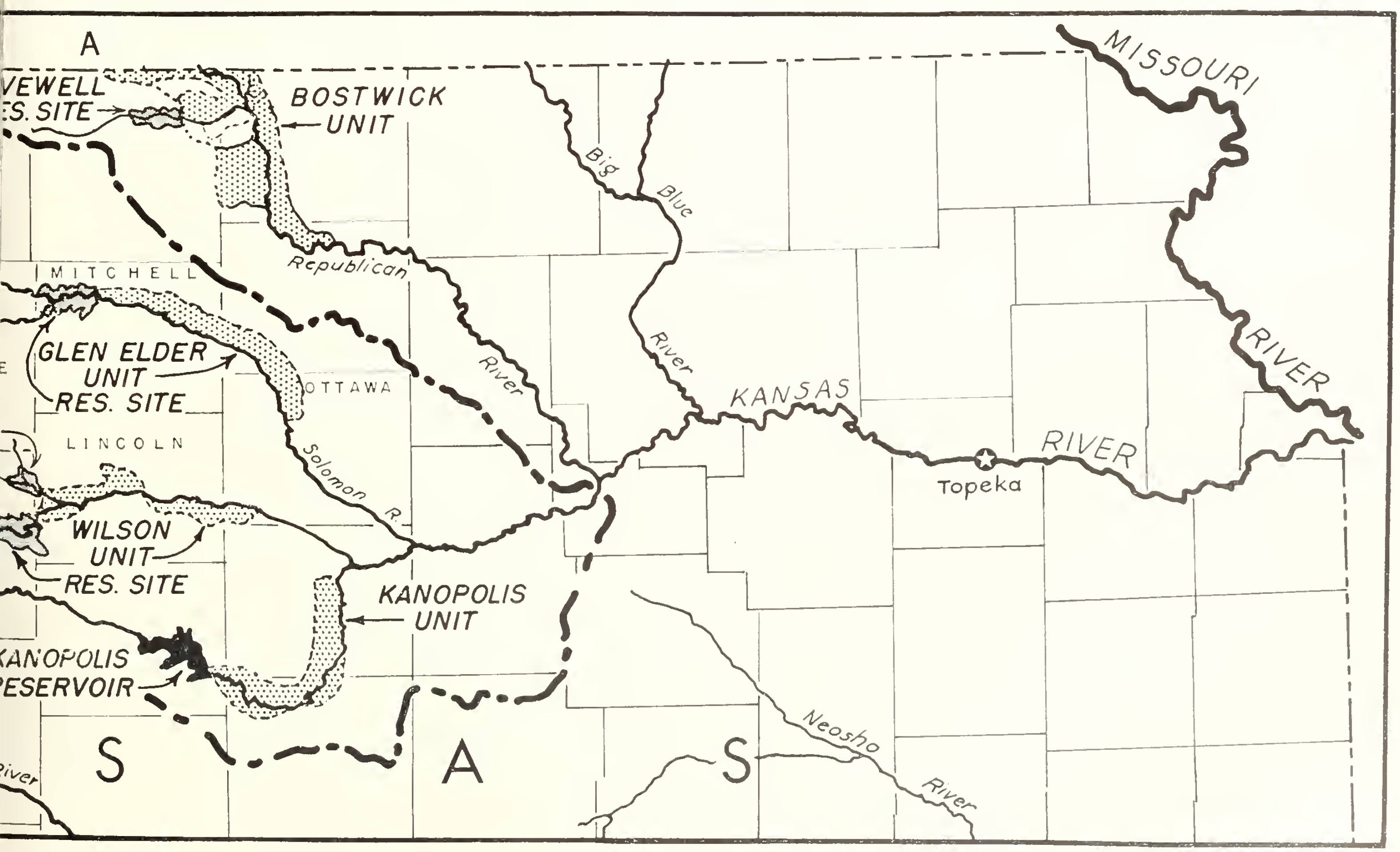
The trend toward irrigation in the Downs area can best be shown by the number of irrigation pumping units sold by Mr. Harm Voss in his farm implement business at Downs. In 1947 he received 29 irrigation pumping units which were readily sold. He has been promised delivery for 11 plants early in 1948 which are already sold. He feels that he could sell an unlimited number of these units in the near future, if he could be supplied by the manufacturers.

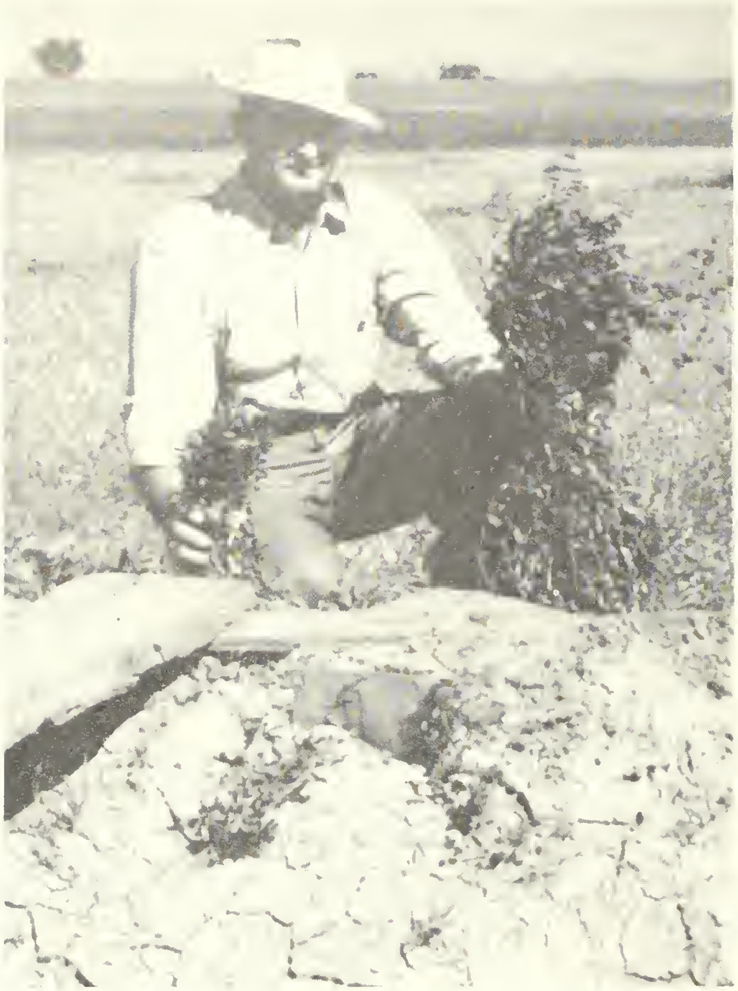
The values and benefits derived from irrigation are further shown in this county. Mr. J. C. Stephenson, who owns a herd of purebred livestock, planted 5 acres of alfalfa which he irrigated in 1947. He was very proud of the quality and production achieved and the Osborne County agent is using picture slides and comparison values obtained from this alfalfa stand to indicate to other farmers the gains that can be made by irrigating.

These pioneers of irrigation in Kansas, in Smith and Osborne Counties, have watched and studied the irrigation experiments of their neighbors. They have become convinced that irrigation yields promising results, and are endeavoring to get water, which is scarce in this section especially during dry periods, from whatever source available. For this reason, they are pumping from rivers, creeks, and farm ponds to irrigate their crops. Several have proved to themselves that the benefits derived from irrigation in only one dry season will easily offset the extra expense incurred in building a small creek dam, and pumping from this small reservoir to their land.

As one continues farther east along the Solomon River, there are irrigators near Beloit in Mitchell County and near Minneapolis in Ottawa County. There are irrigators on the Saline River, near Sylvan Grove, in Lincoln County. In Ellis County, on Big Creek alone, there are 18 irrigators between the towns of Ellis and Hays, and several on the Smoky Hill River near Russell with others on down the river to Junction City.

East of this basin along the Kansas River (locally called the Kaw River) there are irrigation farmers in areas which have an average rainfall of 32 inches or better per year. One of these irrigators, Mr. Howard Jackson, who farms in the Kaw Valley near the State Capitol at Topeka, started irrigating in 1932 and since then has used water every year except one. He has obtained corn yields of 75 to 100 bushels per acre, while his neighbors who did not irrigate were getting less than 25 bushels. Some even had complete crop failures. Mr. Preston Hale, the Shawnee County agent, has knowledge of at least 35 such irrigation farms in this high rainfall area that make a practice of annually insuring their corn, potatoes, and vegetable crops by irrigation and are receiving dividends in increased crop yields. The Topeka and Salina Chambers of Commerce are both promoting experimental irrigation for the 1948 crop season in their respective areas. They know the value of irrigation, even in these high rainfall areas which frequently experience a rainless period of 20 or more consecutive days in a normal rainfall year.





"See the difference!" says J. C. Stephenson, holding alfalfa grown on his farm just east of Downs, Kansas. His right hand holds alfalfa grown on a nonirrigated section, and his left holds the irrigated variety. He raised four times as much alfalfa under irrigation.

Irrigation in Kansas, as elsewhere, presents its problems. These are recognized by workers at both Kansas State College and the Kansas Extension Service at Manhattan, who are experimenting with diversified farming and various ways of irrigating in order to be able to help the Kansas irrigator. They are also determining the best crops which will readily respond to irrigation, and are making estimates of the approximate costs for various types of irrigation.

The Smoky Hill Basin is comprised of the Smoky Hill River which rises in eastern Colorado and flows eastward about 320 miles to its confluence with the Republican River at Junction City, Kans., to form the Kansas River. Forty to fifty miles west of Junction City, the Smoky Hill River is joined by the Saline and Solomon Rivers, its principal tributaries. As the Kansas River flows eastward it becomes a direct tributary to the Missouri River at Kansas City.

The State of Kansas is an integral part of that group of 17 Western States which are included in the National Reclamation Act. It was therefore inevitable that the influence and results obtained by these pioneers of irrigation in Kansas would further the needs for more irrigated land in the Smoky Hill River Basin, and has resulted in the basin being included in, and becoming an important part of, the vast Missouri Basin Project to utilize water, conserve land, and stabilize industry and agriculture in the Midwest by storing and using flood waters that now cause tremendous damage on their long journey to the ocean.

That part of the Pick-Sloan plan which refers to the Smoky Hill Basin in Kansas includes the development by irrigation of about some 120,000 acres by six units. Supplemental planning in this basin discloses several other smaller units that will probably increase the total irrigated area by several thousand acres. Many people of the basin are anxious for its early development both for irrigation, flood control, and other benefits, such as recreation. They realize that development by private initiative is very limited and that not much can be accomplished unless flood waters during wet periods can be stored for drier years.

The Kanopolis Dam, on the Smoky Hill River, being built primarily for flood control by the Corps of Engineers, is nearing completion and about 41,000 acres can be irrigated from this reservoir, since the Bureau of Reclamation will provide supplemental flood storage in its upstream Cedar Bluff Reservoir where another 11,500 acres can be irrigated. Irrigation districts and modern water appropriation laws are new to Kansas, but the people are proceeding with organizations of districts and determination of the legality of their laws in order to get the Missouri River Basin project in Kansas constructed and put to useful purposes. Once this is accomplished, the Smoky Hill Basin may well justify the faith of those hardy pioneers who believed in, practiced and benefited by, irrigation farming in Kansas. END

Tomlinson in Italy

George E. Tomlinson, assisant director of the Branch of Project Planning, Bureau of Reclamation, was recently detailed to the State Department to assist in planning proposed irrigation projects in Italy under the European Recovery Program.

During the latter part of April, Tomlinson and other members of the American committee of experts met with Italian experts, at which time a subcommittee was appointed to coordinate activities. Engineer Marco Visentini, President, Council for Public Works, was appointed the opposite (the Italian counterpart of the position) to Tomlinson. Engineer Visentini was also named chairman of the subcommittee. On field trips Engineer Francesco Sensidoni, Chief, Division Dams Council Public Works, will represent Visentini. Counsel Loni of the Foreign Office and Mr. Brand of American Embassy will be present on all field trips.

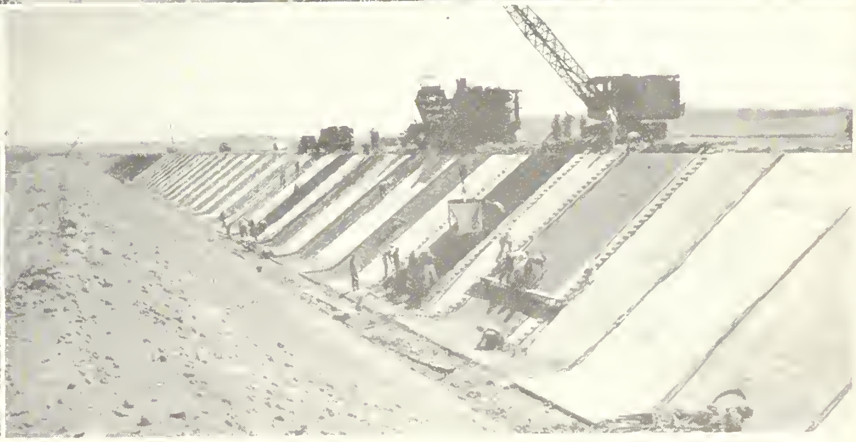
The Working Subcommittee left Rome by air April 21 for a 4-day inspection of reclamation and power projects in Sardini. After a short meeting on their return to Rome on April 25 they left by air for an extended trip through Puglia, Lucania, and Calabria, including visits to Tavogliere, Metaponto, Sibari, Neto River, and San Eufemia land reclamation projects and to dam developments in Sinni and Crato Rivers and on La Sila Mountain. A 4-day trip to Sicily followed after which the group was scheduled to return to Rome on May 6 for a final meeting of the whole committee and the preparation of reports.

"the Land of Dreams Come True"

by Elma Hill Neal

When I was a little girl, my lessons in geography were made interesting by a teacher who gave us descriptive names for the States. The State of Washington was known as the "Evergreen State." We dwelt extensively upon the verdant rain-ridden coast country, with its big cities, and the Cascade Mountains with their mighty stands of Douglas Fir and Ponderosa Pine.

Little was said of the huge interior of the State—of that great Columbia Plateau country that spreads itself like a vast Mesopotamia cradled in a giant bend of the Columbia River. In fact, little could be said of that country, for it was a contradiction of wasteland, a nonproductive region that lay like a barrier between the rolling Palouse wheatlands of eastern Washington and the mountains. Even the pioneers skirted their crawling caravans far to the south.



"In this barren desert, engineering and agriculture are joining hands in a manner that defies all known Hollywood adjectives." **Dreams are coming true as one sees the sagebrush land plowed and leveled into fertile fenced fields while we witness the gigantic canal construction program which makes possible this miraculous conversion. Photo at top right by F. B. Pomeroy, others by A. W. Banman, Region I.**

Left: "Soapsuds" fringe the water at Soap Lake, Wash., a common scene when water has been churned all night by high velocity winds, especially in cold weather. Town of Soap Lake is in the background. *Right: "Spectacular Dry Falls, where the Columbia was once a mighty cataract that dropped more than 400 feet, with the power of a hundred Niagaras."* Right photo by A. W. Bauman, left photo by Harold E. Foss, Region I.

The geography books written for my grandchildren will tell a far different story. And there are many reasons why.

For it is in this barren desert that engineering and agriculture are joining hands in a manner that defies all known Hollywood adjectives. From the town of Pasco, where the waters of the Snake flow peacefully into the broad Columbia northward, the country shows signs of the breaking up of the old order.

Probably to no greater extent on the face of the globe does the spirit of the twentieth century show itself than in this corner of the world. Across the Columbia, north and west, is the atomic bomb plant at Hanford, with its mushroom town of Richland and intervening villages of tents and trailer houses. Fanning out, north and east of the Columbia, is the Columbia Basin project. And in this respect, it is still a land of contradiction, for potential destruction and construction are only a river-breadth apart.

Across the project, one travels a broad, oiled highway that winds in and around outcroppings of lava, over rolling hills and across Paradise Flats, which is so named for no obvious reason. One passes between clusters of houses on either side of the road that present a bedraggled, defeated appearance, but are nevertheless full of possibilities. At least one or more lively towns are expected to spring up in their vicinity, for the soil is a light volcanic ash and when properly watered is capable of producing bumper crops. It is the land of imagination, without a thing in the world to harness one's dreams, a wide, limitless expanse, desert today—but what, tomorrow?

It is said Mount Rainier can be seen to the southwest, and with the aid of one's imagination, there it is, snowcapped, high and alone in the haze, where the sky and the earth come together. And to make a pseudo Flash Gordon scene a little more real, out of the distance come striding the towers of a transmission line, with its hundreds of thousands of kilowatts of power, promenading all the way from the Grand Coulee Dam to Portland, Oreg.

As we pass under the wires of these luminous, straddling skeletons, a minor inward panic suddenly possesses me. They represent power beyond imagination. They are indicative of the change that will come all over this country that has been used to nothing more significant than a lone, lurking coyote or a shy, loping jackrabbit. One looks and thinks, and thinks and looks, until the mind is weary from the enlarging projection.

One center of Bureau of Reclamation activities is located at Ephrata, probably named for a small town in Pennsylvania years back, and which today is often mispronounced and misspelled. Possibly the spelling is subconsciously confused with the Euphrates River in Asia that was supposed to have formed one of the boundaries of the Garden of Eden. The Book of Genesis tells us that it was well-watered and a pleasant place to dwell. Needless to say this has a psychological bearing, for it is in Ephrata, Wash., that there is a concentration of people, who, because of their close association with the idea and their unflagging efforts, see a vision of Edenlike productivity for this region.

It was a sleepy little dry-farming town, nestled under a protecting sagebrush ridge at the turn of the century. It is now expanding mightily. There is no slum district and its wide streets are lined with modernly constructed business blocks. Its residential sections are laid out with a future in view. Because of its long hot summers, almost anything from semitropical plants to fir trees beautify the gardens and landscapes. There is a subdued excitement in the air, for everyone is living with a plan. Other towns are similarly affected—Moses Lake, Soap Lake, Quincy, Othello, and several more.

Beyond Ephrata, the road takes to the Grand Coulee, and what a grand coulee it is! To most people, a coulee is a rather romantic name given a topographical peculiarity in a Zane Grey novel. Cattle were supposed to graze on abundant sweet grass that grew on its floor and waterfalls spurted over its embankments. The Grand Coulee is all this and more.

It is the grandest coulee of all. Its bottom is a series of lakes, from Soap Lake to the impounded waters at the South dam, for it is the remnant of the Columbia of a past geologic age. As one nears it, he is struck by the purple-blue haze that hangs over it and the great ramparts of columnar basalt that rise like battlements. At intervals, what appear at first to be tiny waterfalls, but which, at closer view, become streams of hundreds of inches of water, are flung in filmy veils over the walls. Some are sparkling clear with a rainbow shimmering on their surface. Others are like giant handfuls of muddy water scattering a dusty spray. Every curve in the coulee wall reveals a changing panorama of wonder and awe.

About 20 miles from Soap Lake is the spectacular Dry Falls, where the Columbia was once a mighty cataract that dropped more than 400 feet, with the power of a hundred Niagaras. One climbs the grade and looks out over a desolate parapet of the Coulee to the peaceful lakes that have formed in the potholes of the old glacier-fed river. Here the Coulee is 3 miles wide. Here the past is evident to one who knows no geology.

But farther up at Grand Coulee dam, the future is so evident that one need not be an engineer or an expert agriculturist to sense the import. All the surrounding scenery is dwarfed by the gigantic dam. Ordinary sound is blotted out with the crushing roar of the waters. One little mind is weazened by the combined intellectual effort behind the colossal plan. The vibrations reach out and one's very soul quivers.

I could go into infinite detail and tell of the millions of tons of water that will be backed up into the old coulee; of the enormous Bacon Tunnel that is already under construction; of the huge siphons that will carry irrigation water through the low places; of the monstrous machinery that is used, one machine in particular that lines a 50-foot canal with concrete at one swoop, like a painter making a sweep with his brush. But I will leave that to the planners and the economists and those who love the exact sciences.

I carried away with me two big ideas that can be simply told.

I was impressed with the fact that any great creative force of nature is a challenge to man, and how near he approaches God in his combined strategy and tactics. The other idea is just as big and requires as much effort, but is the endeavor of a century. It is a slow process of labor and love.

For in this land of imagination where dreams are coming true, one sees the sagebrush land plowed and leveled off into fertile fenced fields. One sees a homeland dotted with houses, wherein babies grow to youth and maturity sustained by the land that will produce wheat and potatoes and sugar beets and corn. One can feel the leafy coolness of trees in summer and hear the ripple of water in an irrigating ditch that was once snow in the Selkirks. One sees the Evergreen State completely evergreen. One sees security and peace in a world hungry for both. END

The first delivery of irrigation water to the Columbia Basin project lands occurred on May 15, when water began to flow on the Pasco Unit, just 44 years after the first investigation had been made by Reclamation engineers to determine the future of the Columbia Basin area. The Pasco Unit, No. 1 block in the project, will ultimately embrace an area of approximately 5,600 acres. By 1952, according to the plans, water will be available for 216,000 acres in the project. A complete account of the Pasco event will appear in next month's issue.

"*In this land of imagination one sees security and peace in a world hungry for both.*" Kenneth Hampton, manager of the Bureau's experimental farm at Moses Lake, his daughter Kathleen, and Mrs. Hampton walk through a field of netted gem potatoes, with hybrid corn in background. Photo by A. W. Bauman, Region I.

DRAINAGE PROBLEMS

in the Rio Grande Valley

by CHARLES R. MAIERHOFER, Engineer, McAllen, Tex., Region V

THE DRAINAGE PROBLEM is the most serious threat to local economy that has ever faced the valley.

This is a strong statement. Yet only a few men take the condition seriously, and at present an air of complacency prevails.

This is probably based on inflated incomes from agricultural products—the valley's good fortune in the last years. It is human nature to feel secure while one's income exceeds all previous expectations.

When our water supply problems are *solved*, we will not be worse off for having had the problem. When the local marketing and maturity problems have become a memory, there will remain no permanent mark affecting the lives of future generations. But deterioration of lands due to inadequate, improper, and insufficient drainage, cannot be classed with the problems just mentioned. Reclamation of salted and waterlogged lands is generally slow and costly. Some lands can never be returned to their original productive capacities.

The results of continued neglect of drainage will leave a permanent scar on a valuable resource—a mark against the men who have profitably used this area for the past 40 years and to whom the next generation can point an accusing finger and say that we have not kept faith with nature. We have upset the balance.

Other irrigated areas—Babylon, Egypt, the European lowlands—have left their indelible and tragic marks to prove this to be true. Even our own Southwest rose and fell in a cycle parallel to its irrigation development before recorded history.

In order to understand the drainage problems of the valley, we must know the conditions contributing to them. The most important are:

- The "water table."
- Accumulations of salts in the soil.
- Present operations.

Let us examine these problems individually.

The Water Table

The term "water table" is generally taken to mean the surface of free water in a hole, well, or pond deep enough to collect water from subsurface sources. This is a static level; that is, the point at which the water comes to rest after the well is drilled.

The water table in the valley is not found as a level surface, but is generally undulating or wavy. The valley water table slopes generally from west to east, except north of La Feria and Harlingen, where it slopes to the northeast.

Most irrigated valley lands have a water table near enough to the surface to require additional drainage works. A total of 552,000 acres is irrigated. During the 12-month period ending September 1947, the area having a water table within 5 feet of the surface varied from a minimum of 110,000 acres to a maximum of 245,000 acres.

This area, 245,000 acres, undoubtedly requires immediate attention. Investigations have shown that rainfall and irrigation determine the extent of such areas. In September 1946, after an extended dry period when transpiration and evaporation were at a maximum, and the river flow was low, less than 50,000 acres had ground water within 5 feet of the surface.

After general rains late in that month, the area increased to 200,000 acres.

Again in July 1947, after an extended dry period, the area with ground water within 5 feet of the surface was comparatively low, 127,000 acres, as compared to the previous low of 50,000 acres in September 1946. In August 1947, heavy rains again occurred. After these rains, the area increased to 245,000 acres as compared to the previous high of 200,000 acres with dangerously high ground waters.

What could be more conclusive? Yet, it is easy to forget. The significant fact is that each year, the water table mushrooms. Every high-and-low cycle finds the "floor" of the water table rising a little higher, and the "ceiling" moving upward. The much-to-be-desired September 1946 low of 50,000 acres may never exist again unless extensive remedial measures are taken to relieve the cause of high ground water with its adverse effects.

Accumulation of Salts in the Soil

Excessive quantities of salt injurious to plant growth are found in many areas. Areas with such salt accretions correspond to those where saline ground water has been near the surface over extended periods. Where ground water lies at a safe depth, no appreciable quantities of salt are found.

The major cause of the increasing salinity within the root zone of plants and at the surface of the soil, is the physical phenomenon of capillarity. This force is continually bringing the highly mineralized water upward through the soil from the existing water table. In areas where a high water table exists, the water is being forced upward until it reaches the surface where it evaporates, leaving its heavy salt load.

Under such conditions productive lands soon become barren.

It is evident that salts in valley soils originate from the Rio Grande through irrigation. Available data indicate that before irrigation was practiced, valley soils in a typical area of approximately 155,000 acres averaged only about 0.05 percent of soluble salts. By 1925 this concentration had reached 0.13 percent. In 1945 it was 0.28 percent. During periods of excessive precipitation, the ground water in this area is less than 3 feet from the surface over about a third of the area, and less than 5 feet over most of the remainder.

During the period 1925 to 1945, while salt content of the soil in a part of the valley more than doubled, it is estimated that losses in income amounted to $400 per acre.

At the present rate of deterioration, a complete drainage system, including tile on 200 feet spacing, the necessary outlet drains, and lateral drains at one-half mile spacing, can be paid for with the sum equivalent to the losses in the past 6 years. It is hoped that property owners who feel that they cannot afford the necessary drainage works will seriously consider these statements.

Analyses of salt crusts at the surface of valley soil indicate a predominance of soluble calcium salts, principally calcium chloride which is readily soluble. In addition, calcium ions are generally considered as having a preservative and restorative effect on the physical properties of soil. Fortunately no "black alkali" (sodium carbonate) has been found.

The general status of valley soils with respect to soluble salt content, then, does not present a hopeless problem. From a physical standpoint, reclamation is practical, and, when satisfactory drainage conditions prevail, the seriousness of the salinity problem can be greatly reduced. The problem is serious, and reclamation will be slow and costly, but, from an economic standpoint, it is feasible and should be vigorously pursued in order that productive ability be not further lowered.

Present Operations and John Doe

The problem "present operations" has been so termed for want of a more descriptive name. It is a very important problem, however, so I will attempt to define it more clearly by an actual case.

John Doe, as we will call him, lives in another State. He was reared on a farm but has been working in a large city for about 20 years. During this time he saved some money, enough to fulfill a lifelong ambition of owning his own farm. After looking around the country, he decided that the Rio Grande Valley was the place to spend the rest of his life. This was in 1944.

Mr. Doe invested his life's savings in 18 acres of 4-year-old orange and grapefruit trees. The soil was fine sandy loam, and the trees looked good. John took no chances in buying this land, because it was sold to him by an old and trusted friend. The friend acted in good faith.

In the early spring of 1946, it was still cold where John lived. He and Mrs. Doe thought it would be nice to visit the valley, inspect their orchard, let their snow-bound bones soak up some sunshine, and begin making plans for building a home on the tract. When they saw their place, they noticed several of the young trees were dying. They didn't worry about this and had them replanted. Then the grove looked fine again. Because building costs were still high, the Does went home, planning to return the next spring.

DEATH STRIKES in unusual fashion. This orchard in the Fort Sumner project, New Mexico, was the victim of too much water. Seepage started 30 to 60 days after water was released from the main canal, approximately 1/4 mile from the orchard, and killed all but six trees. Photo by A. E. McCloud, former Region V photographer.

Grove not the Same

In March 1947, the Does returned to the valley. Their grove didn't look the same. Many more of the trees were dead. Mr. Doe was very concerned. He inquired among local people and found that the valley had what was called a "water table." He also found that when a high water table existed, the land became "salty" and trees died. Upon inquiring further, he was told that all one had to do to relieve such a situation was to install a tile drainage system. He found that costs were not excessive compared to his investment in the land. Mr. Doe felt better. He contracted to have the work done by a man who said he could put the grove back in good condition.

At this point the Bureau of Reclamation with which I am connected asked Mr. Doe if he objected to our making some studies to determine the value of the work. We had no desire or authority to influence the methods or location of the system. Our information would be confidential and available to Mr. Doe alone. He was very pleased and offered his full cooperation.

A study of the soils showed the top foot to be sandy loam, the next 4 feet to be sandy clay loam with only a small percentage of clay. Thus, the top 5 feet were readily permeable. Below these soils were relatively impervious clays for at least 22 feet.

Ground-water studies showed depths to range between 5 to 6 feet from the surface over most of the area. Ground-water movements were found to be toward three well-defined points within the grove. Capillarity was at work as indicated by surface moisture over most of the tract.

Soluble salt studies of the soils showed concentrations to be high.

General Kuldell (see "Too Much Water," *Reclamation Era*, September 1947) inspects a part of the drainage system he designed for his Chenango plantation, near Brazoria County, Tex. Cattle now thrive on these lands which had been so depleted by the production of sugarcane and cotton. Photo by Dale A. Hovey, formerly of Region V.

The tiles were placed at a depth of about 7 feet, or about 2 feet in the impervious clay. This depth was used because the contractor had used it successfully in other areas. Certainly no consideration was given to soil textures. While the trench was being dug, there was a very appreciable flow of ground water into it, indicating that conditions were conducive to rapid and effective drainage reclamation.

After the trenches were completed, the tiles were carelessly laid in one or two feet of muddy water, as the outlet was kept closed. There was no way of knowing whether or not alignment was satisfactory. If one tile near the outlet end had been placed off-line the whole system would be entirely ineffective.

To cap off this series of malpractices, the impervious portion of the excavated material was used for the initial backfill. If this did not entirely seal the joints between the tile, the method used in completing the back fill certainly did. The trench was filled by dumping the excavated material into the several feet of water in the ditch. This corresponds to a method purposely used when impervious backfills are desirable, and is known as "puddling."

Since completion, the system has been carefully observed, and ground-water studies have been made monthly. After 7 months, the tile line has remained dry, even though there are 2 feet of saturated soil above; no flow has been recorded at the outlet, and water table has steadily risen. There is obviously no need to check salt contents of the soil. When Mr. Doe visited the valley last August, he was a thoroughly disillusioned man.

It is not to be inferred that such methods are used in every case. Certainly some well qualified engineers and responsible contractors in the valley do work of the first order. The fact remains, however, that for each subsurface drain in the valley that functions properly, there are one or more which do not.

Causes Evident—Basic Research Necessary

The causes for this are evident. A negligible amount of basic research concerning proper drainage practices under local soil conditions has been performed. Intensive research is not only desirable but necessary, in order that consultants can be given a course to follow in designing drainage works. This is not an individual problem, but one requiring the concerted effort of all people in the valley associated with agriculture. We must educate ourselves to turn to reliable professional men and public agencies for the answers. Only in this way can reclamation be effected within the ability of the lands to repay. The valley cannot afford one drainage system which does not function and later another which does. Every dollar spent must yield results.

Four-Point Drainage Program

Here is a basic four-point program toward solving our drainage problem:

1. Outlet designs.—Construct in the most rapid, economical, and feasible manner, a system of deep outlet drains. This is fundamental, as surface and ground waters must be moved out of the area.

2. Lateral drains.—Coordinated with excavation of the outlet drains, diligently pursue a program of lateral drain construction. This will require the closest cooperation between the landowners and their irrigation district officials. Each problem area must be provided with suitable outlets for farm unit drains.

3. Education.—The outlet and lateral drains systems will show a striking improvement in many areas. These improvements will form a nucleus for an educational program whereby landowners can be shown the valuable results of drainage. When the farmers become convinced that expenditures for drainage works will yield increased returns, their participation will be assured.

4. Research.—A program of subsurface drainage research is imperative. Little is known as to proper depth, spacing, and type of drains to be provided for best results. Practically nothing has been done to determine the value of pumping from wells to relieve local ground-water conditions. Certain characteristics of valley soils indicate that this method may prove to be more desirable than drains in many areas.

For these reasons, it would appear wise to move slowly on subsurface drainage construction until more facts are established.

The problem is in your hands. The task is great, but not hopeless. END

(This article is adapted from a paper presented at the annual Citrus and Vegetable Institute, November 18, 1947, at Weslaco, by the author. The institute was sponsored by the Rio Grande Horticultural Club and the Texas Extension Service.)

News Round-up

Second Year Brings Four-Fold Increase

A return of almost four times the gross per acre crop value was recently reported by the north unit of the Deschutes project in Oregon. This is the north unit's second year of Reclamation-served irrigation water.

In 1946, the first year the north unit received water from Bureau facilities, 6,988.5 acres were irrigated and the average gross per acre was $27.82, while in 1947, project farmers brought 13,497.7 acres under irrigation and realized a gross value return of $99.97 for each acre.

Science to Solve Silt Problem

A scientific survey by the combined technical forces of the Departments of the Interior and the Navy has been started at Lake Mead, created by Hoover Dam, to determine what sedimentation is going to do to the world's largest artificial lake. (See *Life of Hoover Dam*, April 1948 Era.)

A miniature fleet has been transported by the Navy overland 300 miles to the middle of the desert in Arizona-Nevada. The "fleet" is being manned by a lieutenant and six chief petty officers who have been assigned to the survey by the Navy Bureau of Ordnance from its ordnance disposal unit at Indian Head, Md. Especially trained scientific technicians are being made available from the Navy's Electronics Laboratory, San Diego, Calif., and its Underwater Sound Laboratory, New London, Conn. Engineers and geologists of the Interior Department's Geological Survey and the Bureau of Reclamation have general technical responsibility for the investigation on the key reservoir in the multi-million-dollar reclamation development in the Southwest.

When work is completed, in approximately 10 months, the Bureau of Reclamation expects to have answers to many of the operating questions posed by the steady accumulation of sediment in the 32,000,000-acre-feet-capacity reservoir. On the basis of these answers, the Bureau will know the volume of water available for power production at various reservoir levels and for water releases for irrigation and flood control.

Corfitzen Named Commissioner of Water Economy in Greece

W. E. Corfitzen, experienced water resources engineer of the staff of the American Mission for Aid to Greece, has been appointed Commissioner of Water Economy in the new Directorate of Water Economy in Greece.

Mr. Cortfitzen will assist in the selection of reclamation projects and in the training of Greek personnel in modern techniques. He has been working in Greece under the direction of the U. S. Army Corps of Engineers since last fall. He was loaned to the American Mission by the Bureau of Reclamation, where he has been employed since 1933. In recent years, Mr. Corfitzen has worked with engineers of 31 nations who have asked the United States for help in developing reclamation programs. He was a frequent contributor to the Reclamation Era and has been instrumental in arranging for the exchange of information regarding reclamation between many foreign countries and the Bureau.

The cooperative reclamation program is the result of an agreement completed in March 1948 by the American Mission and the Greek Government. The program is designed to increase domestic food production by bringing more land under cultivation. The program will be administered by a new directorate that previously handled hydraulic projects. It will be financed by an allocation of 19,705,000,000 drachmae from the AMAG consumer goods fund. The new agreement will make possible better coordination of the reclamation work already begun under the direction of the Ministry of Public Works. Reclamation projects in all parts of Greece have been supported by AMAG's 19,705,000,000 drachmae allocation since November 1947, a little more than $2,000,000 in United States Currency.

Warne Sees Hydro Power as Oil Conservation Measure

Assistant Secretary of the Interior William E. Warne in a recent discussion pertaining to the conservation of oil through the development of hydroelectric power in the Washington, Oregon, and California area said "It is estimated that by 1957 approximately 18,000,000,000 kilowatt-hours of hydroelectric energy can be produced annually in that area. Immediately upstream from Hoover Dam are undeveloped projects: Bridge Canyon with a proposed installation of 750,000 kilowatts, Kanab Creek with 1,250,000 kilowatts, and Glen Canyon with 400,000 kilowatts. The market which now absorbs 13,000,000,000 kilowatt-hours will require 25,000,000,000 kilowatt-hours by 1957, provided fuel or hydroelectric power for use on the Pacific coast and in the Southwest is no longer a question of conserving oil only; but it is also a question of either developing hydropower or retarding the growth of industry and population.

"The Federal Government under the existing critical fuel shortage and cost situation should not be in the position of having hydro developments trail the demand for energy. These developments should be made in advance of the market in order to relieve the fuel shortage to the extent possible in the coming decade and provide some leeway for national defense."

Plans for Interior Centennial

A Senate Joint Resolution (175) has been introduced by Senators Butler of Nebraska and Hatch of New Mexico to provide for the preparation and completion of plans for the observation on March 3, 1949, of the one-hundredth anniversary of the creation of the Department of the Interior as an executive department of the Federal Government.

Hungry Horse Contract Signed

When Secretary of the Interior J. A. Krug in Washington, D. C., signed the contract for the construction of the 520-foot Hungry Horse Dam, located on the south fork of the Flathead River, near Kalispell, Mont. on April 21, it marked the second largest contract in the 46-year history of the Bureau of Reclamation.

The $43,431,000 contract was awarded to the General Construction Co. of Seattle, Wash., The Shea Co. of Alahambra, Calif., and the Morrison-Knudsen Co., of Boise, Idaho. It provides for the construction of the fifth highest and fourth largest concrete dam in the world. It is estimated that it will take about 6 years to complete the dam and power plant, which will provide water for new hydroelectric power development, and other uses. It will firm the capacities of existing downstream hydroelectric power plants, and provide for flood control.

Irrigation lawmakers attend the signing of the Hungry Horse Dam contract, marking another milestone in the history of the project. Seated left to right, Senator James E. Murray of Montana, Secretary Krug, and Senator Zales N. Ecton of Montana. Standing left to right, Representative Henry M. Jackson and Senator Warren G. Magnuson of Washington, Representative Abe M. Goff of Idaho, Senator Joseph C. O'Mahoney of Wyoming, Representative Wesley A. D'Ewart of Montana, Representative Homer D. Angell of Oregon, Representative Walt Horan of Washington, Mr. James J. Sullivan, Administrative Assistant to Representative Mike Mansfield of Montana, Representative John Sanborn of Idaho, and Representatives Russell V. Mack and Homer R. Jones of Washington.

The signing of the contract was considered so important that the ceremony was attended by a large congressional delegation.

Commenting on the contract, Secretary Krug said, "this gigantic dam marks one of the greatest boosts for the growing economy of the Pacific Northwest to date, a region which is making unprecedented history in the development of the Nation. It will ultimately mean about a million kilowatts more firm power for an area whose homes and industries are already demanding more energy than is available, in addition to other benefits of river regulation."

Commissioner of Reclamation Michael W. Straus said, "Hungry Horse Dam is a key structure in the over-all, long-range development of the Columbia River Basin. The large increase in the firm power capacities of the power plants installed or likely to be installed downstream on the Columbia is a basic illustration of the value of coordinated reclamation development of the entire Basin. Integrated basin-wide development spells multiple benefits for all.

"Flood protection will be made a reality in the Kalispell Valley by the storage capacity in the reservoir back of Hungry Horse Dam."

Assistant Secretary of the Interior Wm. E. Warne, formerly Assistant Commissioner of the Bureau of Reclamation, and long an advocate of the project said, "The Hungry Horse power plant not only will be an important addition to the energy resources of the Columbia River Basin, which even now is experiencing a power shortage, but it also will serve a potentially important market in the general area which would encourage development of mineral resources such as silver, copper, lead, and alumina clays. There are stands of pulp timber nearby which, with reforestation, could produce 200 tons of paper a day if sufficient power is available."

Al Winkler, chairman, and Don Treloar, secretary, of the Flathead Valley Citizens Committee, Kalispell, Mont., wired their contgratulations and appreciation to Secretary Krug and Commissioner Straus on the splendid manner in which their staff carried forward the Hungry Horse project to the contract stage and called it a fine tribute to both of them as well as an example of good Government operation. They concluded by saying that untold benefits will come to the Nation from this great development. END

OUR BACK COVER

THE "RELUCTANT WATERFALL," better know as "Martin Falls" or the "Devils Punch Bowl." Spring thaws bring rushing waters over the Coulee walls while March winds blow the misty water back over the walls forming this waterfall in reverse. See "the Land of Dreams Come True," page 113. Photo was taken by F. B. Pomeroy, Region I, in March of this year.

Credit for Kansas

William C. Brady, author of Kansas Pioneers in Irrigation on page 109 of this issue, is also responsible for making arrangements for the appearance in the April issue of A Corn King in Wheat Country and for preparing the map on page 73 which accompanied that article.

The photographs which appear on pages 109 and 112 in connection with the current Kansas story are enlargements in black and white of Kodachrome slides submitted by Mr. Brady.

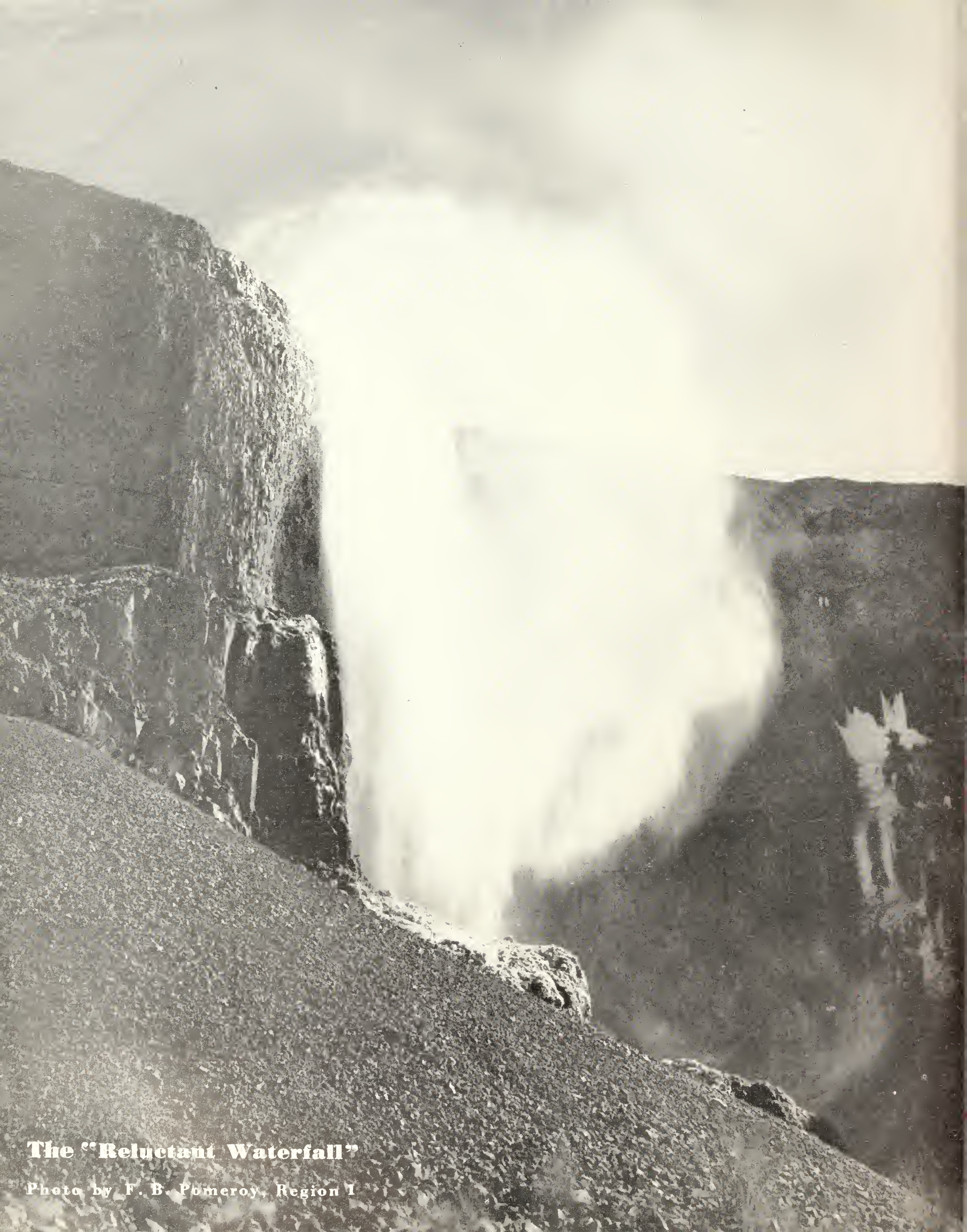
NOTES FOR CONTRACTORS

Contracts Awarded During April 1948

Specs. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2021	Davis Dam, Ariz	Apr. 27	Disconnecting switches for Parker switchyards	Delta-Star Electric Co., Chicago, Ill	$71,673
2026	Central Valley, Calif	Apr. 2	Lightning arrestors for Tracy switchyard and Eleverta substation and meters for Shasta substation.	General Electric Co., Denver, Colo	31,201
2026	do	do	Instrument transformers for Shasta substation	Westinghouse Electric Corp., Denver, Colo.	52,683
2056	Colorado-Big Thompson, Colo	Apr. 8	Electric elevator for Granby pumping plant	Otis Elevator Co., St. Louis, Mo	30,567
2059	Central Valley, Calif	do	Control boards for Tracy switchyard	Westinghouse Electric Corp., Denver, Colo	82,957
2059	do	Apr. 5	Unit substations for Tracy switchyard	Allis-Chalmers Mfg. Co., Denver, Colo	49,410
2062	Colorado-Big Thompson, Colo	Apr. 14	Power boards for Granby pumping plant	Cutler-Hammer, Inc., Milwaukee, Wis	10,581
2072	do	Apr. 13	Switchboards, battery chargers, and transformers for Marys Lake power plant.	Westinghouse Electric Corp., Denver, Colo.	41,273
2072	do	Apr. 2	Control equipment for Marys Lake power plant	Control Corp., Minneapolis, Minn	13,275
2074	Central Valley, Calif	Apr. 22	Construction of 14.7 miles of Friant-Kern Canal	Otto B. Ashbach & Sons, Inc. and Steenberg Construction Co., St. Paul, Minn.	4,826,543
2077	Missouri Basin, N. Dak	Apr. 2	Construction of 7,500-kva. substation at Beulah	Elliott Construction Co., Omaha, Nebr	174,848
2096	Central Valley, Calif	do	Fixed wheel gate at Friant Dam	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	25,725
2104	Davis Dam, Ariz.-Wyo	Apr. 30	Construction of 5 22-foot diameter penstocks for Davis power plant.	Southwest Welding and Manufacturing Co., Alhambra, Calif.	935,000
2109	Lewiston, Orchards, Idaho	Apr. 5	Construction of chute and siphon	Poe Brothers, Clarkson, Wash.	16,730
2110	Gila, Ariz	Apr. 13	Construction 4 residences and garages	H. P. Adams Construction Co., Yuma, Ariz	51,162
2112	Missouri Basin, Wyo	Apr. 5	4 tanks for Kortes power plant	Berkeley Steel Construction Co., Berkeley, Calif.	18,887
	Davis Dam, Ariz.-Nev	do	2 tanks for Tucson substation		
	Boise, Idaho	do	4 tanks for Anderson Ranch power plant		
	Columbia Basin, Wash	do	2 tanks for Grand Coulee power plant		
2115	Davis Dam, Ariz.-Nev	Apr. 20	Steel towers for 230-kilovolt Davis-Parker transmission line	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	470,941
2118	do	Apr. 1	Radial gates for Davis Dam	Virginia Bridge Co., Denver, Colo	84,000
2121	do	Apr. 29	Furnishing breaker, switches, and transformers, Tucson substation.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	20,888
2122	Hungry Horse, Mont	Apr. 21	Construction of Hungry Horse Dam, power plant, roads, and parking areas.	The General Construction Co., Shea Co., Morrison-Knudsen Co., Inc., Seattle, Wash.	43,431,000
2124	Lewiston Orchards, Idaho	Apr. 30	Equipment for Lewiston Orchards water treatment plant	Dorr Co., Inc., New York, N. Y	14,600
2125	Missouri Basin, Nebr.-Wyo	Apr. 2	Construction of Gering-Alliance and Cheyenne-Pine Bluffs 115-kilovolt transmission line.	Utilities Construction Co., Nashville, Tenn	663,252
2126	Boulder Canyon, Calif	Apr. 8	Construction of Unit No. 1, Coachella distribution system, All-American Canal.	American Pipe and Construction Co., Los Angeles, Calif.	1,593,462
2134	Colorado-Big Thompson, Colo	Apr. 23	3-84 inch butterfly valves for Estes power plant	Willamette Iron & Steel Co., Portland, Oreg	111,834
2140	Riverton, Wyo	Apr. 30	Construction of Wyoming Canal, station 1350+75 to station 1354+50, and Sheep Camp drain into Five Mile Creek.	James Trummel, Nyssa, Oreg	34,968
2140	do	Apr. 27	Construction of north pavillion lateral system	United Engineers, Inc., Ogden, Utah	219,900
2154	Columbia Basin, Wash	Apr. 30	6 Radial gate frames for Main Canal headworks	Geo. T. Gerhardt Co., Inc., San Francisco, Calif.	11,520
2156	Missouri Basin, Nebraska	Apr. 30	Construction of Oxford Siphon, station 1549+46.30, Cambridge Canal, Frenchman-Cambridge unit.	Rentlor Co., Inc., Grand Island, Nebr	119,393
2157	do	Apr. 22	Construction of earthwork and structures, Meeker Canal rehabilitation, Frenchman Cambridge Unit.	W. A. McNeel, Hershey, Nebr	35,150
2160	Columbia Basin, Washington	Apr. 30	Furnishing aluminum doors and windows for control Bay-R, Grand Coulee power plant.	General Bronze Corp., Garden City, N. Y.	21,940
2162	Colorado Big Thompson, Colo	Apr. 16	Structural steel roof framing, crane girders and crane rails for Estes power plant.	Virginia Bridge Co., Denver, Colo	23,000
2169	Davis Dam, Ariz.-Nev	Apr. 30	Embedded metal work for two 22-foot by 19-foot high-head radial gates for Davis Dam project.	Schmitt Steel Co., Portland, Oreg	10,240
2194	Boulder Canyon-All-American Canal, Calif.	Apr. 30	50,000 barrels portland cement for Coachella Valley distribution system.	Monolith Portland Cement Co., Los Angeles, Calif.	187,500
R1-10	Deschutes, Oreg	Apr. 7	Four residences and garages, north unit, Main Canal	R. P. Syverson, Bend, Oreg	28,340
Read. 9 & 10.	Lewiston Orchards, Idaho	do	Asphalt coated welded pipe and couplings	Armco Drainage & Metal Products Co., Inc., Portland, Oreg.	266,886
R4-5	Paonia, Colo	Apr. 29	Construction of outside utilities for Government Camp at Paonia	Landon Construction Co., Casper, Wyo	14,872
R6-Bis.-5	Missouri Basin, N. Dak	Apr. 14	Construction of sewerage and water-distribution systems for Heart Butte Government camp.	Tri-State Excavating Co., Fargo, N. Dak	20,616
R6-Hur-1	Missouri Basin, S. Dak	do	Construction of outside utilities and erection of prefab. houses for temporary Government housing, Huron.	W. E. Bartholow & Son Const. Co., Huron, S. Dak.	14,793
R7-NP-1277	Missouri Basin, Wyo	Apr. 15	Transformers, circuit breakers, etc. for Lusk substation	General Electric Co., Denver, Colo	17,771

Construction and Supplies for Which Bids Will Be Requested During June and July

Project	Description of Work or Material
Boise, Idaho	Construction of transmission line from Anderson Ranch Dam to Mountain Home, Idaho.
Boulder Canyon, Ariz.-Nev	Generators for units A3 and A4, Hoover power plant.
	Power transformers for uuits A3 and A4, Hoover power plant.
	Turbines and governors for uuits A3 and A4, Hoover power plaut.
Boulder Conyon-All-American Canal, Calif.	Construction of concrete pipelines and structures for unit No. 5 of Coachella Valley distribution system.
Central Valley, Calif	Grading and paving substation area and construction of railroad spur at Elverta substation.
	Construction of earthwork lining, and structures for 27 miles of Friant-Kern Canal, near Porterville, Calif.
	Construction of earthwork and structures for about 15 miles of Delta-Mendota canal near Patterson, Calif.
Colorado-Big Thompson, Colo	Coustructiou of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on the Big Thompson River, 1 mile of tunnel, 12 concrete siphons, 1 steel siphon, and other structures, near Loveland, Colo.
Columbia Basin, Wash	Coustruction of earthwork and structures for 15.3 miles of the west canal uear Ephrata, Wash.
	Construction of earthwork and structures for approximately 8.3 miles of Potholes East canal, near Norden, Wash.
Davis Dam, Ariz	Erectiou of river gaging station and cableway at Davis Dam.
Fort Peek, Mont	Construction of and furnishing materials for 2,000-kilovolt-ampere substation at Savage, Mont.
Kendrick, Wyo	Erecting foundation and 115-kilovolt and 57-kilovolt bus structures for Casper, Wyo., substation.
Missouri Basin, Wyo	Construction ot 17 miles of 69-kilovolt wood-pole transmission line from Garland to Lovell, Wyo
	Construction of 40 miles of 115-kilovolt wood-pole trausmission line from Lovell, Wyo. to Yellowtail, Mont.
Missouri Basiu, Wyo.	Elevators for Kortes Dam and power plant.
Missouri Basin, Kans	Construction of Cedar Bluff Dam.
	Construction ot Bonny earthfill dam, on the South Fork of the Republican River, west of Hale, Colo.
Missouri Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot-long concrete overflow structure, on the Republican River, uear Guide Rock, Nebr.
Missouri Basin, Wyo.	Constructing and furuishing equipment for the Pine Bluffs Wyo., 6,000-kilovolt-ampere substation.
Missouri Basin, Wyo.-Nebr	Construction of 170 miles ot 115-kilovolt wood-pole transmission line from Casper, Wyo., to Gering, Nebr.
Missouri Basin, Nebr	Constructing and furnishing equipment for the Alliance, Neb., 10,000-kilovolt-ampere substation.
Missouri Basiu, S. Dak	Coustruction of about 3 miles of access road to Bixby Dam.
Missouri Basin, Mont	Coustruction of Cauyon Ferry Dam and power plant, 15 miles northeast of Helena, Mont
Missouri Basin, Nebr	Construction of telephone system from Cambridge, Nebr., to Medicine Creek dam site.
Missouri Basin, Colo	Construction of about 9 miles of access road at Bonny Dam, Yuma County, Colo.
Missouri Basin, Nebr	Furnishing and erecting 30 residences at Trenton Government Camp.
Paonia, Colo	Construction of Spring Creek Dam, an earthfill structure on east Muddy Creek, about 20 miles from Paonia, Colo.
Provo River, Utah	Construction of about 1 mile of 69-inch diameter steel or concrete pipe line for the Big Cottonwood section of the Salt Lake aqueduct.
Riverton, Wyo	Construction of earthwork and structures for portions of Wyoming Canal and Muddy Ridge Caual, including Muddy Ridge Tunnel and 1 lateral.
San Luis, Colo	Construction of Platoro Dam, an earthfill structure, on the Conejos River about 20 miles northeast of Paonia.



The "Reluctant Waterfall"

Photo by F. B. Pomeroy, Region 1

JULY
1948

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THE
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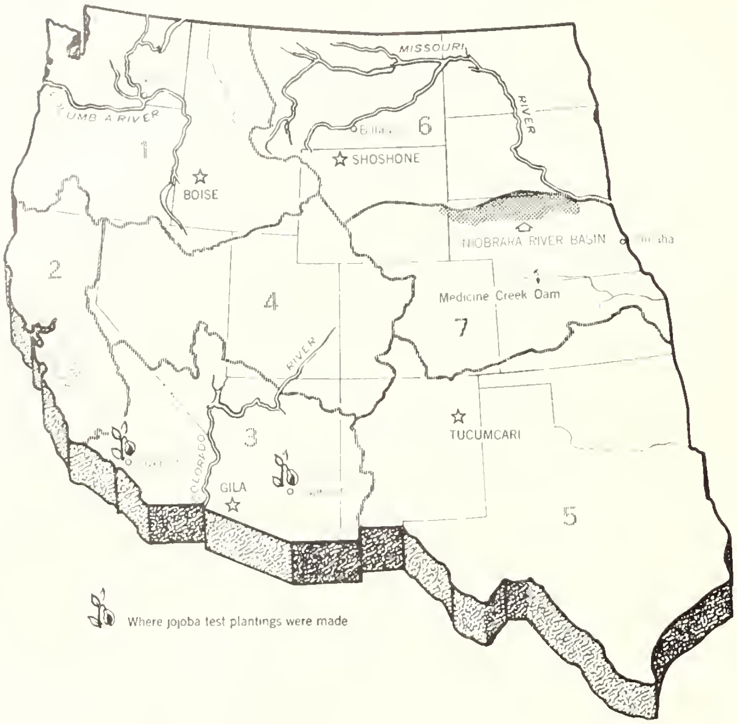

Letters to the Editor

Undue Credit to Riter

UNITED STATES DEPARTMENT OF THE INTERIOR,
BUREAU OF RECLAMATION,
BRANCH OF PROJECT PLANNING, HYDROLOGY DIVISION,
DENVER FEDERAL CENTER,
Denver, Colo., April 12, 1948.

GENTLEMEN: I feel that I have been given undue credit by having my name shown as joint author with Mr. E. W. Lane for the article entitled "The Life of Hoover Dam." Mr. Lane in cooperation with Mr. Whitney Borland of this office prepared the material which was used (with changes) in preparing the published article. After the material was prepared Mr. Maddock and I merely reviewed it and made a few suggestions to Mr. Lane. It seems to me, in fairness to Mr. Borland, that he should be given credit for joint authorship rather than me.

Sincerely yours,

JOHN R. RITER,
Chief, Hydrology Division.

A Contributor's Comment

P. O. Box 825,
Huron, S. Dak.

DEAR EDITOR: While I am writing this letter to have my address for the ERA changed, I also want to compliment you on the very fine paper you are putting out. I was not a regular reader of the ERA until I came with the Bureau of Reclamation in September 1946, but I can now state that it is a "must" here in the irrigation States, and that goes for not only Bureau employees, water users, and all other people intimately tied with irrigation and reclamation problems, but also for the majority of the citizens of these States.

South Dakota is not so definitely tied to irrigation, with respect to her agriculture, as most of the other Western States (that is, States beyond the western boundary line of South Dakota), but the irrigation and reclamation works proposed for that State definitely put it in the States vitally concerned with these matters.

Just a few words in regard to the articles that appear from time to time in the ERA, concerning reclamation matters in other countries, than the United States. I greatly enjoy them, and the one in the

(Continued on page 122)

Reclamation ERA

July 1948 **Vol. 34, No. 7**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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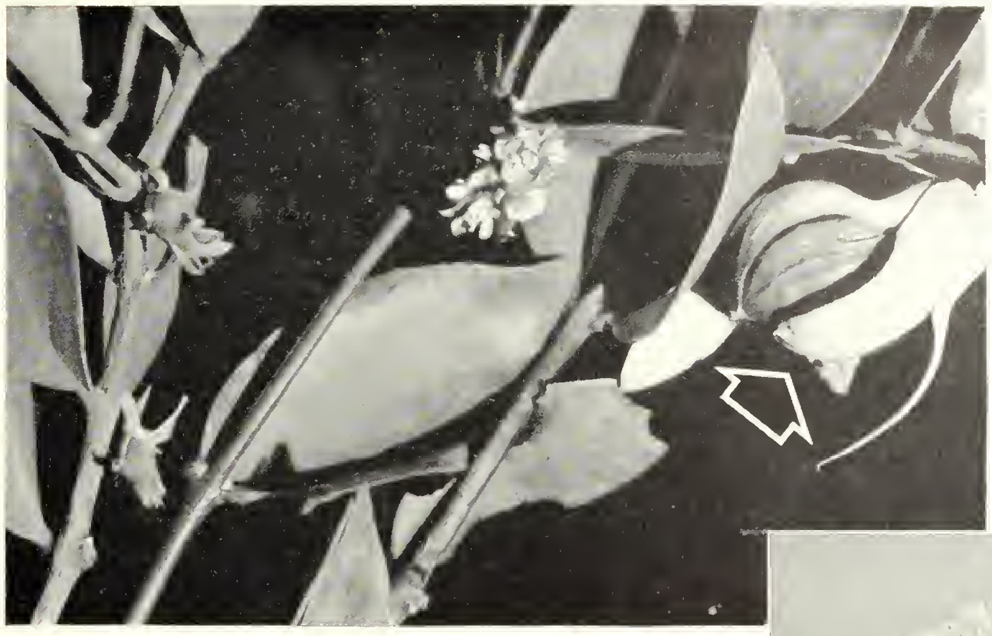
Ruth F. Sadler, *Editor*

OUR FRONT COVER

SEDIMENT SOLVERS: Members of the United States Navy ready to get to the bottom of the sedimentation problem by engaging in diving operations at Lake Mead. (See Life of Hoover Dam, April ERA and Science to Solve Silt Problem, June ERA.) Shown in this photo, prior to beginning operations, are left to right A. B. "Abbie" Holmes, C. M. N.; H. E. "Swede" Knudson, C. M. N.; J. D. M. "Pancho" Freitas, C. M. N.; and G. B. "Cookie" Labagnara, C. B. M. This photo taken by Wm. S. Russell, Region III, on May 1, 1948.



Left: Arrow points to close-up of jojoba berry from which oil is extracted. Below: The jojoba, a potential desert crop for irrigated crops deficient in water supply. The shrub in the picture is approximately 5 feet high. However, many jojobas grow as tall as 10 feet. They have a gray-green foliage and in the fall of the year the female bushes bear a crop of nutlike berries from which oil is extracted.

Jojoba —

POTENTIAL DESERT CROP

by Ralph O. Baird, Reclamation Economist, Project Planning, Phoenix, Ariz., Region 3

EDITOR'S NOTE: On and adjacent to most irrigation projects are areas either permanently or temporarily short of water required for full crop production. Many other areas are in a similar predicament. The discovery, the testing, and the pilot crop planting of new crops, native or from foreign lands, suitable for these areas, constitute one of the great and promising frontiers in the further development of the West. Some of the possible crops require but one or two supplemental irrigations during the season. The initial work with these new crops properly belongs to the United States Department of Agriculture and the State experiment stations. Pilot crop planting well may be the concern of industrial firms interested in special crop products which may be produced.

The development of water-stretching measures such as that accomplished by sprinkler irrigation, under test on many projects by the Bureau of Reclamation, may pave the way for a new future for lands which otherwise would remain desert. Possibly this article will stimulate interest in a new frontier of the West.

IN SOUTHERN ARIZONA where there seldom is enough water to go around, recent research has brought to light a new plant which may be an answer to the need for conserving soil moisture.

Known as the jojoba (*pronounced* hō-*hō*-bay), the plant thrives on much less water than is required by most other crops. The jojoba is a native of southern Arizona and northern Sonora, Mexico, and grows between the altitudes of sea level and 3,600 feet. Botanically, it is classified as *Simmondsia chinensis.*

The plant is striking in appearance, growing about 10 feet tall in the more favorable locations. It has gray-green, somewhat leathery, persistent foliage and in the fall of the year the female bushes bear a crop of brown nutlike berries. These berries contain about 50 percent of a readily extractable oily liquid. The residue after extraction of the oil is nutritious, being similar to cottonseed meal.

Primitive Indian tribes used the berries as food after roasting them to destroy the tannins that give the unroasted berry a bitter taste.

After the Spanish conquest and settlement, jojoba berries became an article of trade. The Spanish Dons found that the oil from these berries made an ideal hair dressing for their beards and mustaches, and they were the first jojoba oil extractors.

About 1929 Fred Gibson of the Boyce Thompson Arboretum at Superior, Ariz., and the author, ground up a few pounds of these berries and extracted the oil. This small sample of oil was sent to the University of Arizona for analysis and testing for possible uses. The sample was the forerunner of hundreds of samples that were later sent to public and private institutions and individuals for study.

The more intensive the studies became, the more valuable the product appeared, and numerous patents now have been issued to individuals and corporations on processes and products of the mustache wax.

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◀ Left to right: Jojoba nuts after hulling; jojoba meal; jojoba wax; jojoba wax united with sulphur; and hydrogenated jojoba.

As history has it, this is the way the jojoba bean's usefulness was first discovered by the white man. Drawing by Shirley Briggs. ▶

Briefly, this research showed that the oily extract of the jojoba seed is a liquid wax. It is stable and, therefore, will not become rancid; it is odorless and will remain so. Oddly enough, the wax is indigestible in the human alimentary tract. The wax will unite with sulphur to produce an intermediary of many uses. It will hydrogenate to produce a wax product that is exceeded in hardness only by the hardest natural wax, carnauba, and it can be used for almost all purposes for which carnauba is used or needed. It or its intermediate products can be added to other products to improve their desirable qualities.

A patent was granted to an oil company for the product made by adding a small amount of sulfonated jojoba wax to high pressure gear lubricant. This improved grease sustained the highest pressure recordable on the S. A. E. (Society of Automotive Engineers) pressure lubricant testing machine. The paint and varnish industry, the food industry (reducing diets), and many others have taken the jojoba nut to their research laboratories with gratifying results. The "catch" is that they cannot obtain the berries in sufficient quantities to put their new or improved products on the market.

To date the only jojoba berries that reach the trade are those that are collected from the wild plants. The Apache Indians of Arizona, the Papago and Yaqui of Sonora, collect a small tonnage each year for the market, but the demand, for research purposes alone, far exceeds the supply even at the current price of 20 cents per pound to the pickers.

The solution to this problem lies in the establishment of the plant under cultivation. Plantings would contain about 1,200 plants per acre which field tests indicate would yield about 1,200 pounds of fruit. At the current price of 20 cents per pound they would give a return on the investment exceeding that obtained from citrus or cotton at their present prices.

Test plantings have been made, the oldest at Riverside, Calif. Limited experience shows that best results have been obtained by planting the bushes in solid hedge rows with the rows about 12 feet apart. However, plantings to date can be considered only as pre-experimental. Commercial production economics, market outlets, long time price possibilities and other factors are obscure, and no land has yet been taken out of higher water requirement crops for planting to jojoba.

Water requirements are unusually low. From 1 to 2 acre-feet per year applied in good irrigations during the growing season are ample to produce a heavy crop. Experience also shows that better results are obtained if the seed for the planting comes from a more severe climate than the one in which the plantation is located. Only one insect pest is known to affect the crop—it is a micro-lepidoptera that feeds on the newly fertilized seed. However, this pest seems to be confined to elevation exceeding 2,500 feet.

Yes, the jojoba may offer new hope to southern Arizona which for the past several years has been turning land back to the desert as there is not enough water to go around. END

Letters to the Editor *(Continued from page 2 of cover)*

February issue, "Impressions of China," by Constantin P. Cristopoulos was not only very interesting and readable, but I think his "thinking and philosophy" are most worthy and should be spread around the world, and practiced. I would like his address so that I might write him.

Thanking you very much, I am

Sincerely yours,

RALPH E. JOHNSTON.

¶ Many thanks to writer ("Arizona—Great Outdoor Greenhouse" October 1947 RECLAMATION ERA) and reader Johnston. For the benefit of many other readers who were impressed with Dr. Christopoulos' articles, his address is: Dr. Constantin Christopoulos, 80 Pipinou, Athens, Greece. A recent letter from him indicated that he would greatly appreciate hearing from his friends.—Ed.

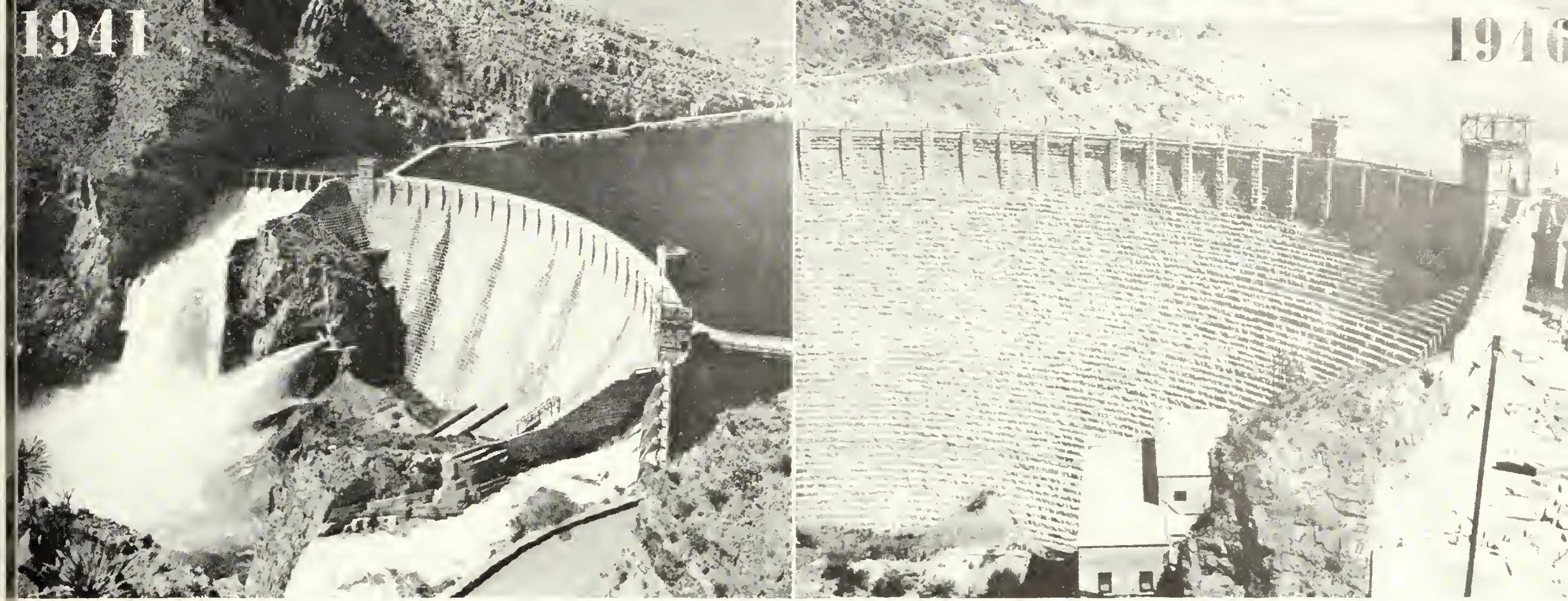
Bloody But Unbowed

TULELAKE, CALIFORNIA,
January 17, 1948.

DEAR EDITOR: I wish to make a correction on your January 1948 issue of the RECLAMATION ERA magazine. On the back cover (outside) you have printed two pictures of a well-known landmark of this community. One, an early picture of the lake as it appeared on June 9, 1905, the other, taken quite recently. The pictures were fine but the information misleading. You referred to the location as Tulelake, Oreg., this is wrong, Tulelake is in California, some 6 miles. The location of those pictures is some 14 miles south of the Oregon border.

Also you referred to the landmark in the background as "Bloody

(More letters on page 124)



The spillways of the Roosevelt Dam on the Salt River in Arizona roared with the overflow in the spring of 1941, before the Southwest had to face a water shortage. The same dam at right, in the fall of 1946, shows the tremendous difference in the water supply available to the Phoenix area's irrigation system.

ARE WE SHORT OF WATER? *(Part One)*

By LESTER VELIE

Reprinted from the May 15, 1948, issue of COLLIER'S through the courtesy of the editors and the special permission of the author. Associate Editor Lester Velie.

The water shortage is spreading like a creeping paralysis. We are using up our underground supply faster than nature can replenish it. The Middle West and industrial East are feeling the pinch but in the semiarid Southwest the trouble is coming to a head.

RICHARD HAMAN, A RANCHER, walked out of the Nevada State engineer's office recently with a legal claim to "full possession and rights thereof" of water in the clouds over his ranch. Moisture is scarce and he intends to milk the clouds whenever they appear, by dropping ice pellets into them, and he wants no ornery neighbor miles down the road getting possessive with the Haman air lake.

At Los Angeles, County Supervisor Raymond V. Darby asks the California legislature to put up $1,000,000 for ideas on how to get sweet water from the sea, cheap. The legislature appropriates no money, but ideas pour in from drought-conscious citizens anyway. One of them: Hoist the Palomar Observatory's $6,000,000 Big Eye out over the Pacific and harness the sun's rays for the heating and distillation of ocean water.

These characteristic American shenanigans provide the lighter side to a grim predicament. Large chunks of our country are running out of water. Drought is creating havoc in the Southwest. But drought is only partly to blame.

At Sacramento, Calif., a newspaper puts a black border on its weather news, in mourning over the situation. The item says, "No rain for 42 days. No rain today or tomorrow."

Townsfolk in Santa Barbara, forced to ration water, rename their city Sahara Barbara. The well-to-do import water by tank truck to save their lawns, and pay $40 per 2-hour wetting. A committee of vigilantes checks water meters for water hogging.

In California's fruitful Central Valley dairy farmers slaughter their cows, and cattlemen send steers out of the State by the thousand. No pasture. Beekeepers ship out their bees. No flowers.

But drought, even as war and pestilence, must pass. The kind of water shortage many communities face has nothing to do with drought. Far from passing, the shortage is, as one alarmed geologist described it, "spreading like a creeping paralysis." We are using up our underground water faster than nature can replenish it. Stored by years of rainfall it has become in some areas an exhausted resource. Chalk it up to overpumping. We are also running out of surface water—our rivers and lakes. Blame overpopulation.

791700—48——2

In the Southwest some experts are already reckoning the day when the last newcomer will cross the Rockies heading west, because there will no longer be enough water for all. Some engineers in Los Angeles have even set the dead line—1968. This is only 20 years away.

"As cities count time," one engineer said, "that's practically tomorrow."

In Arizona, and in California's Imperial Valley, the dead line has arrived.

Confronted with this nightmare of failing water California and Arizona are waging their own cold war over the Southwest's last big water hole, the Colorado River.

Surprised that water can be an exhausted resource? You shouldn't be. In the Texas Panhandle, as in California and Arizona, in the Dakota plains, and even in such eastern communities as Cincinnati, Louisville, and Brooklyn, men are learning a sobering lesson. Like oil and coal you can take water out of the ground faster than nature can put it back.

At Phoenix and Tucson in Arizona, and the irrigated lands around and about, men don't talk about war with Russia or the coming Presidential election. They've something more urgent on their minds—vanishing water. Irrigation is to dry Arizona's economy what lifeblood is to a human being. Two-thirds of this lifeblood comes from below the ground and a third from rains and rivers. So swiftly is Arizona's underground supply being drained away in some places by overpumping that A.N. Sayre, the Government's top expert in this field, says the State's plight will be desperate unless remedial measures are taken immediately. S. F. Turner, United States engineer at Tucson, said: "The situation is so critical it can no longer be solved solely by drilling new wells."

No wonder. In the Eloy area of Arizona's Pinal County, water is being mined 11 times faster than it can, naturally, be put back. In Maricopa County it is being taken out 18 times as fast, and for Arizona, as a whole, twice as fast. The result, Government geologists found in southern Arizona, has been that in several areas water levels have dropped 55 feet in 6 years.

The water table is not getting a chance to come back. As farm produce continues to bring premium prices, Arizona farmers get more land under irrigation and dig more wells. Some land has already returned to desert because of lack of water. Three hundred and fifty thousand acres, or about a third of all that State's arable land, face the same fate.

Said a frightened Arizonan:

"Unless the State finds new water sources, we won't only be shipping out bees and cattle like California. We'll be shipping out people."

Arizona's case is not unique.

In the Panhandle's high plains area, at Lubbock, Tex., farmers swamped local merchants this spring with demands for pumps, gobbling them up at the rate of 50 a day. It costs about \$6,700 to dig a well in the outlying dry country, but with wheat bringing more than \$2 a bushel farmers figured it was worth it. The result was that where only 1,100 wells tapped the underground pools of the Panhandle in the 1930's, 7,200 drain it now.

Yes, drain. Every year nature recharges, or stores, enough water in the area to cover 50,000 acres with a foot of water (50,000 acre-feet). But last year alone Panhandle farmers withdrew 750,000 acre-feet. That's 15 times as much as nature could put in! Down and down goes the water, and deeper and deeper go the wells. In 14 years, overpumping has lowered the water table 40 feet.

Some Texans have learned what prodigality of this sort leads to. When ground water gave out at Aspermont, an oil town 100 miles west of Fort Worth, a barrel of good drinking water brought in from neighboring towns could fetch more than a barrel of oil.

Other Americans are learning to import water, too . . .

(To be concluded next month)

More Letters *(Continued from p. 122)*

Point." This is also wrong, the name of this hill is "The Peninsula" and is so called by the people of this community, the local newspapers, and reclamation maps.

Yours truly,

Bill Jones,
Senior, Tulelake High School.

¶To alert high school student Jones, reluctant praise. A regrettable error, indeed, placing Tulelake in Oregon instead of California. Klamath project, in which is located the Tule Lake (two words, mind you, to make it more complicated) division, crosses the border—but the Klamath peninsula, well-known landmark, is about 8.5 airline miles inside the California border. Bloody Point, referred to in the caption, is the black jut of land in the bottom photo which can be barely discerned in the top photo due to the improvement of the land. Our experts say, "Ah erosion, ah, Soil Conservation Service . . ."—Ed.

Advice to the Land Lorn

8026 Lambert Avenue,
Detroit 13, Mich.,
February 1, 1948.

Dear Editor: I should like to have you discuss in an early issue the following problem. How can a city-bred fellow start a career on the land? All of my life I have wanted to get out of the city. Living in a Metropolitan area, I have had little access to rural life. I can't even begin to meet the requirements for obtaining reclaimed land, i. e., I have had no experience in agricultural work. Although I have had college training, I did not study any agricultural sciences. My soul craves the life I have never known. My health is excellent. Please tell me the most logical step to take!

Very truly yours,

Richard Lipa.

¶ We understand and sympathize with Reader Lipa in his desire to own a farm of his own, a natural and deep-seated desire of many people. However, as he points out, he is not now eligible for participation in the Bureau of Reclamation's settlement program due to his total lack of farming experience. Irrigation farming, being a specialized type of agriculture, requires a background of experience and knowledge if a farmer is to make a living. This has been proved by scientfic studies of those who have worked and lived on irrigation farms and the standards which are maintained for qualifying for a public land opening are for the protection of the potential reclamation farmer as well as for the protection of the investment of the United States Government in the reclamation program which makes possible the opening of reclaimed lands. We know of no substitute for farm experience other than actual work on a farm. Many young men have sought and obtained employment on farms to gain such experience, while they saved and planned for a farm of their own. Others have worked during their vacations, particularly college students, who added to their incomes as well as their knowledge of agriculture in this manner. However, Reader Lipa's problem is really outside the province of the Bureau of Reclamation and we referred his communication to the United States Department of Agriculture for more detailed information.—Ed.

NIOBRARA—the "Forgotten River"

Photo by R. A. Kneeshaw, region VII.

by CLYDE E. BURDICK, Area Engineer, Ainsworth, Nebr., Region VII

THE NIOBRARA RIVER has often been referred to as the forgotten river in Nebraska. It extends from Niobrara, Nebr., to Lusk, Wyo., and flows through much of the sand-hills region nationally famous for its production of beef cattle.

Development of water—the State's greatest resource—in this area has lagged behind that of other basins in the State for various reasons. Historical records indicate that perhaps the first white men in this basin arrived about 1789, and traded with the Ponca Indians near the confluence of the Niobrara and Missouri Rivers. Sheldon's History of Nebraska speaks of a James Mackey, who reached the region of the sand-hill lakes in Cherry County in 1795–96, and continued north to the Niobrara River, which he followed down to the place where it joins the Missouri River. Mackey made a map of the area he had explored, which was published in Paris in 1802. On this map, in the vicinity of Long Pine Creek, is this inscription: *Mountains of sand, underlain by subterranean and invisible streams in the midst of which is a great canyon 250 feet across and 150 feet deep formed by the washing of the mountains.*

These early explorers were followed by men in search of new homes, who lived by hunting and trapping wild animals for food and furs. These were taken back to the settlements and traded, bringing good profits to the hunters. It took only a few years of systematic hunting to kill off the immense herds of buffalo, destroying the major food supply of the Indians, but making way for the large herds of cattle that were to come with the settlement of the country.

After the War between the States, herds of Longhorns came from Texas, traveling over the Chisholm trail and other routes to a new range, which has been described as *a great expanse of prairie, slightly rolling, spread out on every side as far as the eye could reach, most of it covered with a rich growth of grass.* Here and there were streams which were hidden in canyons or ravines where trees and shrubs were found, but until the edge of the canyon was reached, the entire country appeared to be a "Sea of Grass." Here the cattleman was King. Eventually the sand hills were opened for homesteading, and a claim shanty or soddy appeared on almost every square mile of the sand hills, but much of the land was of very little value except for grazing, and cattle-raising remained the major industry within the sand hills as it is today.

In the 1870's the Fremont, Elkhorn & Missouri Valley Railroad began building westward and large companies of settlers soon came to the eastern part of the basin, where land suitable for farming was available. This immigration continued throughout the 1880's until there was a claim shanty on almost every 160 acres of tillable land within the Basin. Rainfall was sufficient for a few short years, then in 1893, 1894, and 1895, drought came to Nebraska. Corn and small grain did well until July, then burned up. People left the basin by wagon loads. A good cow wouldn't bring $15, and shoats sold for 50 cents to $1. Not a great deal of stock was lost due to the droughts, as there had been moisture in the spring, and hay could be found in the sand-hill valleys, but the settlers endured many hardships.

In time, those who stayed were glad they had done so. As normal rainfall conditions returned, the labor of the farmer was rewarded by fair crops. Very slowly prosperity returned, but only through the strictest economy and most diligent labor were the debt-ridden people able to meet their obligations.

The railroad was completed and highways were built affording transportation for crops and livestock to their markets.

Farming became a general practice on the tillable lands north of the sand hills, and farmers, remembering the drought years of the 1890's, and the prolonged dry periods that occur almost annually during July and August, recognized the need for irrigation. Many small irrigation and power projects were developed, but most were abandoned after a few years of operation because of faulty construction, high operational costs, or other reasons. Water rights were granted and, even though some of the projects have been abandoned for years, their water rights still appear in the records.

The Mirage Flats project in western Nebraska was built by a group of farmers in the 1890's, but was abandoned after a few years when their wooden canal structures were lost by fire and windstorm, leaving the farmers unable to finance reconstruction. Another project was started to irrigate land in the vicinity of Johnstown and Ainsworth, but construction was never completed because of financial difficulties. These pioneers recognized the need for water to produce good crops, but were limited by their inability to raise funds. In addition, their projects were designed from sometimes inadequate surveys. No historical records of stream flow or weather were available; topographic maps did not exist. Soil surveys of those areas had not yet been made, and they did not have the benefit of the irrigation experience we have today.

In 1940, the Bureau of Reclamation was authorized to construct the Mirage Flats project to irrigate about 13,000 acres south of Hay Springs. That project is now completed and is in operation. In 1946, the Bureau was directed to make a comprehensive investigation of the entire Niobrara Basin to determine the possibilities of irrigation, power, flood control and other related features.

The first step in this investigation was to make an inventory of the potential projects within the Basin, assembling whatever data were immediately available to determine the feasibility of further detailed studies.

Soil survey maps of most of the basin, and weather reports were available. There were no topographic maps, and records of stream flows were limited to miscellaneous readings on tributaries and reports of a few recording stations maintained for short periods on the main stream.

Geological survey maps were limited, secondary roads were few, and at times the surveyors would have welcomed the use of the map made by Mr. Mackey back in 1795. However, additional information has been collected and a plan for the development of the potential projects is beginning to unfold.

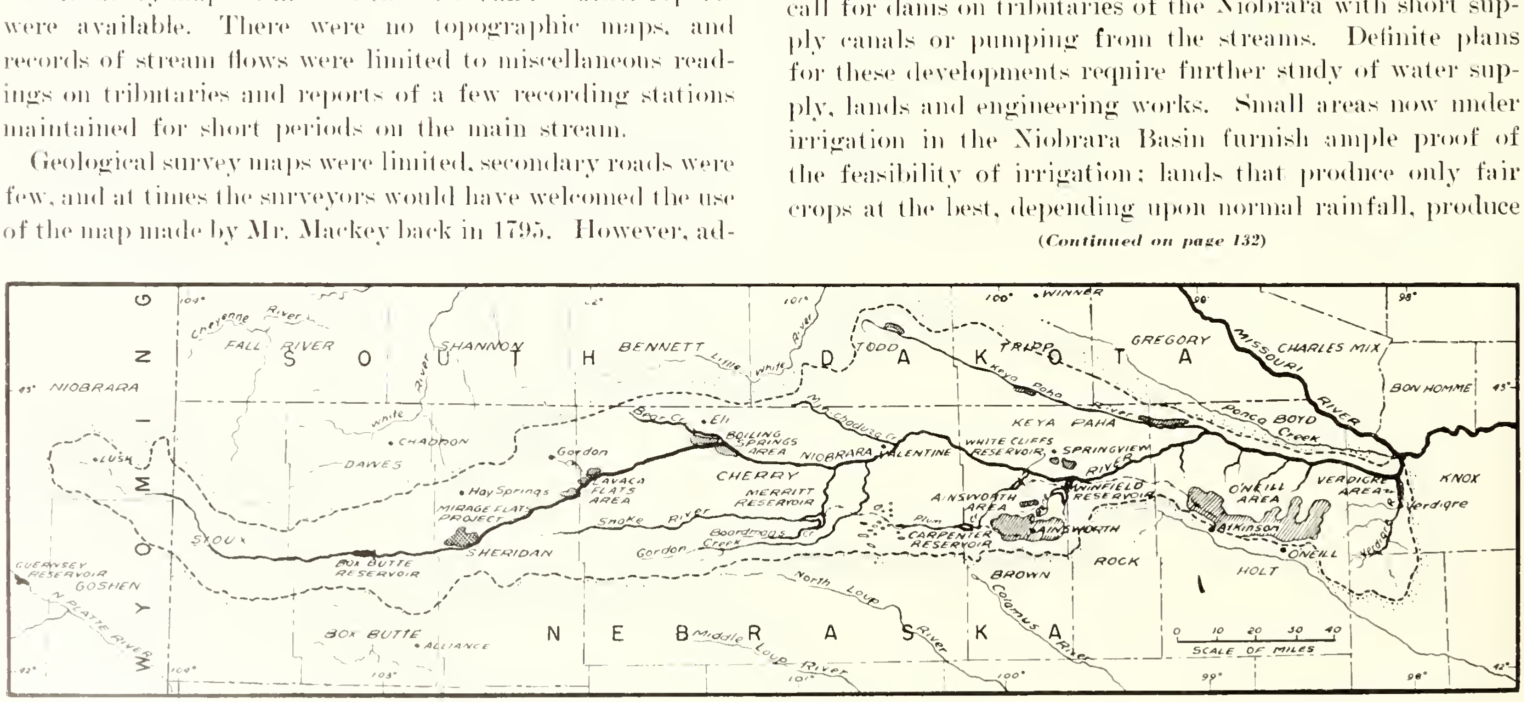
Preliminary appraisal or inventory of projects indicated that there are about 140,000 acres of land where soil topography, and drainage characteristics appeared to be favorable to irrigation and seemed worthy of further detailed studies. These are scattered areas and are mostly table lands which, in most cases, lie high above the Niobrara River and are bordered on one side by the sand hills.

From west to east, the projects under consideration are La Vaca Flats, south of Gordon, Nebr., Boiling Springs, south of Cody, Nebr., the Ainsworth table between Johnstown and Long Pine, Nebr., the O'Neill table extending from near Atkinson to O'Neill, Nebr., and scattered small areas along the Kaya Paha and Verdigre Rivers, and the Springview table near the town of Springview, Nebr.

The Ainsworth and O'Neill areas are the largest areas of potentially irrigable land within the basin, with approximately 45,000 acres at Ainsworth and 67,000 at O'Neill. Plans for the development of these areas call for the construction of a dam on the Snake River southwest of Valentine, which will divert water to a canal system through natural valleys to a point southwest of Johnstown, where a second dam would provide storage and regulations for the Ainsworth service area. Dams on Plum and Pine Creeks would capture the return flow, canal losses, and any water surplus to the needs of the Ainsworth area, and hold it for use on the O'Neill area. Preliminary studies indicate that the water supply available for these two areas is approximately 300,000 acre-feet per year. This does not include ground water supply which may be used to develop a portion of the areas, but for which sufficient information is not available at this time to estimate the amount that may be available.

Tentative plans for development of the smaller areas call for dams on tributaries of the Niobrara with short supply canals or pumping from the streams. Definite plans for these developments require further study of water supply, lands and engineering works. Small areas now under irrigation in the Niobrara Basin furnish ample proof of the feasibility of irrigation; lands that produce only fair crops at the best, depending upon normal rainfall, produce

(*Continued on page 132*)



Niobrara River Basin

LEGEND
AREAS UNDER IRRIGATION
AREAS UNDER INVESTIGATION
EXISTING RESERVOIRS
POTENTIAL RESERVOIRS
POTENTIAL CANAL ROUTES

First Water Reaches Columbia Basin Project

Left: Residents of Pasco and Pacific Northwest cities greet arrival of first water on Pasco unit of million-acre Columbia Basin project. Right: Three generations of the Gillum family are represented as the grandfather (William) right background, and his son (O. C.), at left, handle the first irrigation water to reach their privately owned Pasco lands, while 3-year-old Billy learns how it is done.

by GENE NICOLAI, Coulee Dam, Wash., Region I

In 1904, a virtually new organization then known as the United States Reclamation Service, made its first investigations of the possibilities of irrigating the Columbia Basin of eastern Washington with waters of the Columbia River.

On the morning of May 15, 1948, or just 44 years later, the vision of seeing the first Bureau of Reclamation water flowing to the dry lands in the Columbia Basin project became a reality.

The scene was near the banks of the mighty Columbia, about 15 miles northwest of the city of Pasco, and there was tightness in many a throat as a pump powered by Grand Coulee Dam electricity began pushing Columbia River water through a glistening discharge pipe, over a hill, and into the main lateral serving the 5,550-acre Pasco unit.

Men, women, children pushed anxiously to the canal's edge to get a first glimpse of the first water. Then, as it surged forth, its noise blended with the spontaneous roar created by the shouts and applause from the scores who crowded the canal banks.

Some of the oldsters who saw that first water knew of the delays, the dreams that had preceded the event they had assembled to celebrate at the invitation of the Pasco Chamber of Commerce and the South Columbia Basin irrigation district. They had lived through those years of indecision with unfaltering hope, but now they were too old to work the land.

But standing with them were younger men like O. C. Gillum, Howard Hales, Bill Lovercheck—veterans of World War II who will have farms in irrigation block No. 1, Columbia Basin project.

Fifty minutes after the first Pasco unit pump had started May 15, the water reached a turnout on Gillum's farm, about 2 miles away. Gillum and his family—and the crowd of well-wishers who had bounced along sagebrush-lined roads in their cars—were ready for it. Superior Court Judge B. B. Horrigan of Pasco, who earlier had given the all clear sign to Boy Scouts, who signaled the pumping station to begin operating, watched with others as Frank M. Lowden of Walla Walla opened the headgate.

These long-time project boosters, along with the new settlers, Pasco Chamber of Commerce representatives, the Columbia Basin Commission, and delegations from towns and cities of the Pacific Northwest, grinned elatedly as Gillum, a former Navy officer, grabbed his shovel and followed the water down his farm distribution basin.

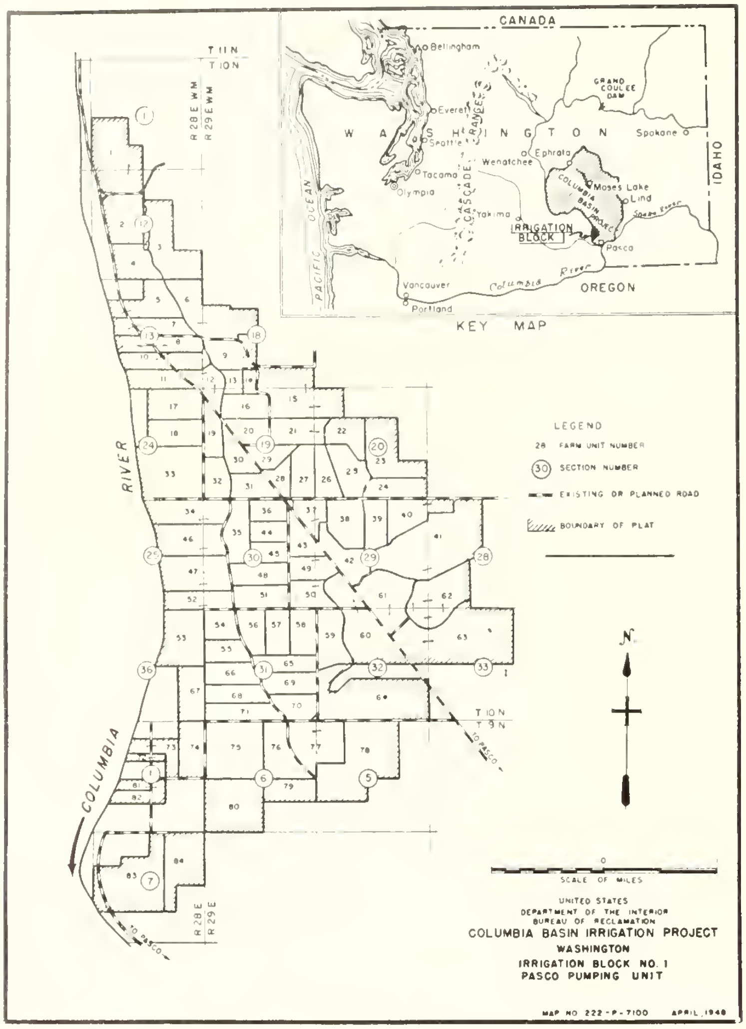
Three-year-old Billy Gillum, son of the veteran, was in the picture, too. His mother and his grandparents, Mr. and Mrs. W. F. Gillum, took off his shoes and stockings, rolled up his pants, and laughed as he waded in the water.

The crowd broke up and the Gillums began to get their first real taste of the responsibilities of irrigation farming.

"She's cutting through!" shouted a bystander.

O. C. Gillum, the one-time Indiana farm boy, and his father ran to stop leaks that were developing alongside the discarded railroad air hoses being used for spiles.

Gillum's 83-acre tract, which he will use chiefly to grow feed for his turkeys, is one of the 84 family-size farms which will be served by the Pasco pumping plant of the Bureau of Reclamation. Several fellow veterans also have holdings in the unit, but there are countless other veterans who would like to own farms, but who are employed at the nearby atomic-energy installations of the Hanford Works, marking time until larger acreages in the Basin are opened for settlement a few years hence.



This map shows how the 5,550-acre Pasco Unit of the Columbia Basin project has been divided into 84 farms averaging 64 acres each.

Bureau of Reclamation representatives and others who attended the Pasco event, pointed out that the opening of the 5,550-acre unit "is only the beginning."

Since nearly all the Pasco unit farms are in private ownership, the opportunity for acquiring a farm there is remote. The Bureau will have from 12 to 15 Pasco farms for sale, probably later this year. Veterans of World War II will receive preference when drawings are held. The Northern Pacific Railway will have about 30 farm units. It also will observe veteran preference, says P. D. Edgell, western land agent of the Northern Pacific, who has offices at 812 Smith Tower, Seattle.

But when selections finally are made by the Bureau and the railway, many hundreds of veterans in all parts of the United States still will remain on the waiting list.

The hope of these waiting veterans and others who seek farms in the million-acre project lies farther to the north, where a gigantic irrigation system is marching southward. The Bureau plans to have canals, siphons, tunnels, and other structures sufficiently advanced by 1951 so water will be available for 216,000 acres in 1952. Construction plans are geared to this goal.

In these first 216,000 acres will be many family-size farms, owned by the Government, which World War II veterans will have priority in acquiring. This is not homestead land—there is none in the entire project—but excess land bought by the Bureau and being held in readiness for veterans. It will not be sold to veterans for some years yet; not until delivery of water is assured for the block in which the property lies.

This land, like the hundreds of thousands of other acres that comprise the big Columbia Basin project, becomes highly productive under irrigation.

The irrigation system taking shape in the northerly part of the project ultimately will spread its canals to all parts of the million-acre expanse, making possible the creation of about 13,000 family-size farms.

When the water-distribution system is completed it will extend from the Grand Coulee Dam 140 miles southward to the vicinity of Pasco. It is because of this great distance that the Pasco unit was built first by the Bureau. When Columbia River water, pumped from Lake Roosevelt at Grand Coulee Dam, reaches the vicinity of Pasco, then the Pasco pumping plant probably will be dismantled and the lateral system served by water that has traveled more than 100 miles.

Development of the entire Basin has been the vision of many farsighted men like Judge Horrigan, who counseled the Pasco unit enthusiasts May 15 with these words:

"In many ways it is more important to dream than to fight against being mastered by dreams. The dream must come before the reality." END

National Conference on Land Use Policy

At a recent meeting in Omaha, Nebr., approximately 200 members of business and industry, representing 33 States, convened to sponsor a national coordinated policy for soil, water, forest, range, and wildlife.

E. J. Condon presided as chairman of the meeting, and among the outstanding speakers on the program were Fairfield Osborn, president of the Conservation Foundation and the New York Zoological Society; Kent Leavitt, president of the National Association of Soil Conservation Districts; Channing Cope, editor of the Atlanta Constitution; Zachary Taylor, editor of the Country Gentleman; Dr. H. A. Lyon, Detroit Board of Commerce and Agricultural Industrial Foundation, and many others.

The group consisted of persons associated with banks, public utilities, farm implement, life insurance, oil and metal products companies. In addition to these, various Government agencies were represented, including a small delegation from the Bureau of Reclamation.

As a result of the meeting the following conclusions were drawn:

- Business and industry are definitely concerned over the possibilities that the land resources of the Nation are being dissipated far too rapidly—and in the minds of these interests there exists a fear that unless the process of deterioration can be stopped industry and business will suffer great losses.
- That business and industry have awakened to the need, in this country, for a national land policy covering all levels of Government and community life.

Killing Weeds with 2,4-D

A spraying machine in operation along one of the canals of the Black Canyon Division of the Boise project near Notus, Idaho, using a 2,4-D mixture of weed killer. *Photo by Philip Merritt, Region I.*

In the 3 years since its sensational introduction in 1944, the strange growth-regulating substance 2,4-D (the commonly accepted abbreviation of 2,4-dichlorophenoxyacetic acid) has become not only the most widely used chemical weed-killer in the United States, but the source of wholly new concepts of weed control that may markedly affect future American farm practice. This seems to be true even though all the facts about 2,4-D are not yet well known. 2,4-D is not a poison, in the ordinary sense, but a hormone-like material that causes serious disturbances in plants. Minute quantities in the plant tissues cause marked changed in the plant's form and functions. Some of these effects are beneficial, such as causing apples to cling to the bough until ripe. Others are highly detrimental or even lethal. In weed control the object is to use 2,4-D in such a way that it is lethal to weeds but harmless to other plants. Obviously this is a delicate operation and one that cannot be used carelessly or with a heavy hand. 2,4-D is a powerful weapon and must be used as such.

The Nature of 2,4-D

The action of 2,4-D on plants is much slower than that of other herbicides. First effects may not be apparent until a week after treatment and the plants may not die until 2 or 3 weeks, or more, thereafter. The most evident visible effects are bending and twisting of the stems, thickening and curling of the leaves, gradual change in color, usually to a yellow and finally a brown and eventually the death of the aboveground portion of the plant.

2,4-D acid itself is a white powder that does not dissolve easily in water. It is, therefore, usually changed to a salt or "ester," in which forms it can be dispersed in water and applied as a spray. Commercial 2,4-D weed-killers are soluble derivatives made with a stated percentage of pure 2,4-D acid.

Types of Commercial 2,4-D Weed Killers

Numerous preparations of 2,4-D are now on the market. These products, which vary in content of 2,4-D from about 10 to about 85 percent, are of three general types: (1) sodium and ammonium salts, (2) amine salts, and (3) esters. Although usually prepared as sprays they may be obtained in a form suitable for application as dust. In general, the relative effectiveness of the commercial preparations is directly proportional to the amount of 2,4-D contained. There are, however, certain differences in the rate of action of different types of 2,4-D, and in their final effects on various kinds of weed and crop plants.

OBSERVE THESE PRECAUTIONS

1. **Protect sensitive plants from 2,4-D spray, dust, and fumes.**
2. **Use only minimum amount chemical needed for the job—don't overdose.**
3. **Check equipment carefully—faulty application is costly.**
4. **Have separate sprayer for 2,4-D, or cleanse carefully after use.**
5. **Use wisely and according to directions—2,4-D is not a cure-all.**

Methods of Applying 2,4-D and Equipment Needed

The 2,4-D is applied most commonly as a very dilute spray solution in water, using a pressure sprayer. Satisfactory application can be made with a variety of spraying equipment ranging from small household and knapsack sprayers to large power-spraying units, and even airplanes for special cases. The best kind and size of sprayer depends largely upon the size of area to be sprayed. The essential requirement of spraying equipment is uniform coverage on the leaves of the plant with a minimum of run-off or wind drift. Spraying pressures between 30 and 100 pounds per square inch give best results for weed control. High pressures are unnecessary and wasteful and greatly increase the danger from drifting.

Especially adapted weed-spraying nozzles that deliver a fan-shaped spray give more uniform distribution of the material and usually better results than cone-shaped sprays. Several types of "fan" nozzles are available and can be obtained for nearly all sprayers.

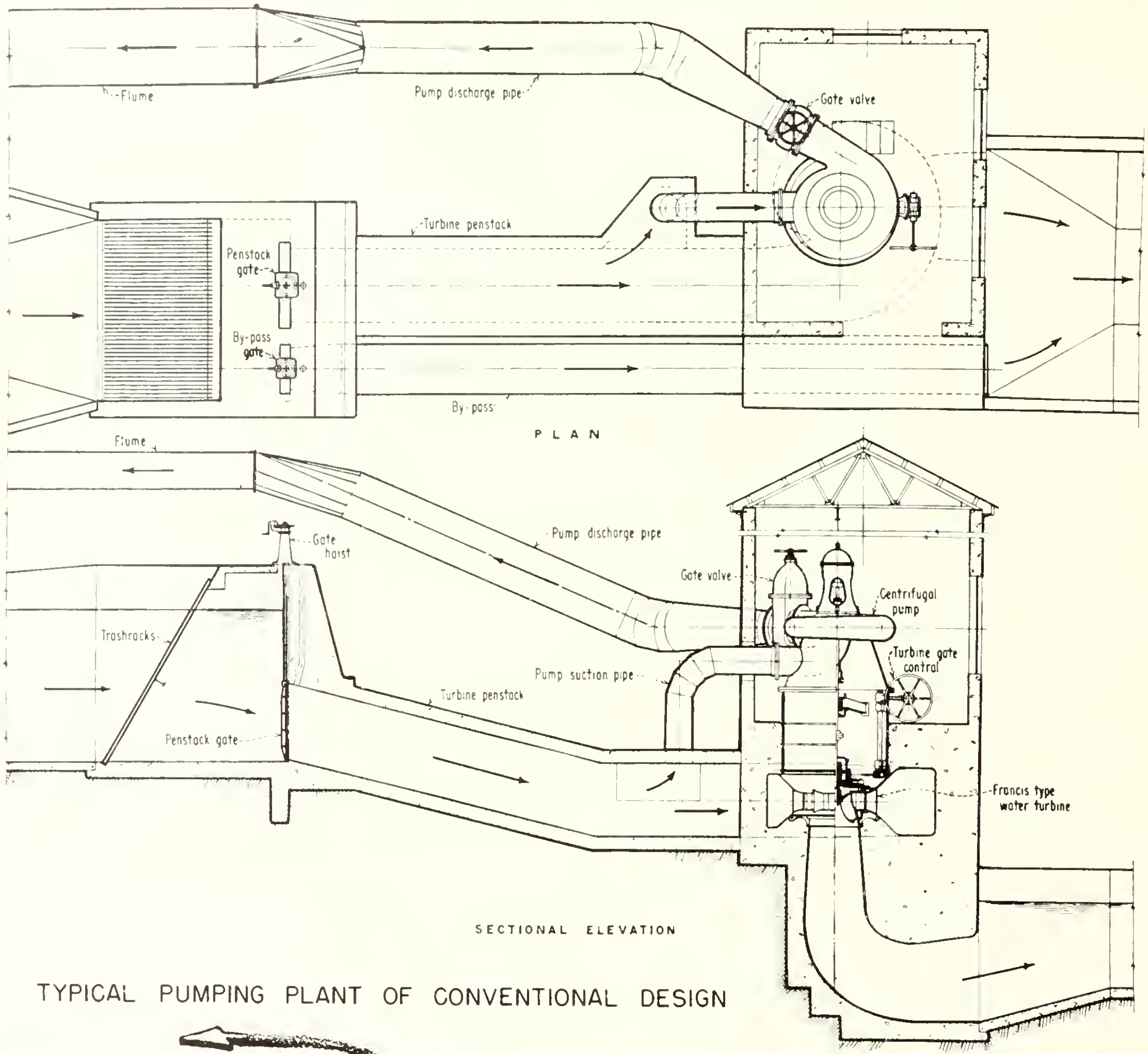
Time of Applying 2,4-D

Time of application is determined largely by the stage of growth of the weed and, in the case of selective sprays, by the stage of growth of the crop plants. In general, 2,4-D treatments have been most effective if applied when weeds are succulent, or at least in an active stage of growth.

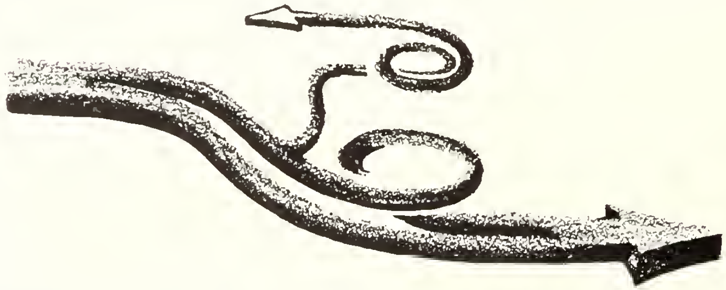
Rate of Applying 2,4-D

Thre are two ways of expressing rate of application of 2,4-D—(1) in pounds of 2,4-D acid per acre and (2) in gallons of a certain percent solution per square rod. For large areas the "pounds of 2,4-D per acre" is usually more satisfactory. For small areas the other system is preferred.

(*Continued on page 132*)



TYPICAL PUMPING PLANT OF CONVENTIONAL DESIGN



How To Irriga

Turbine-Driven Pu

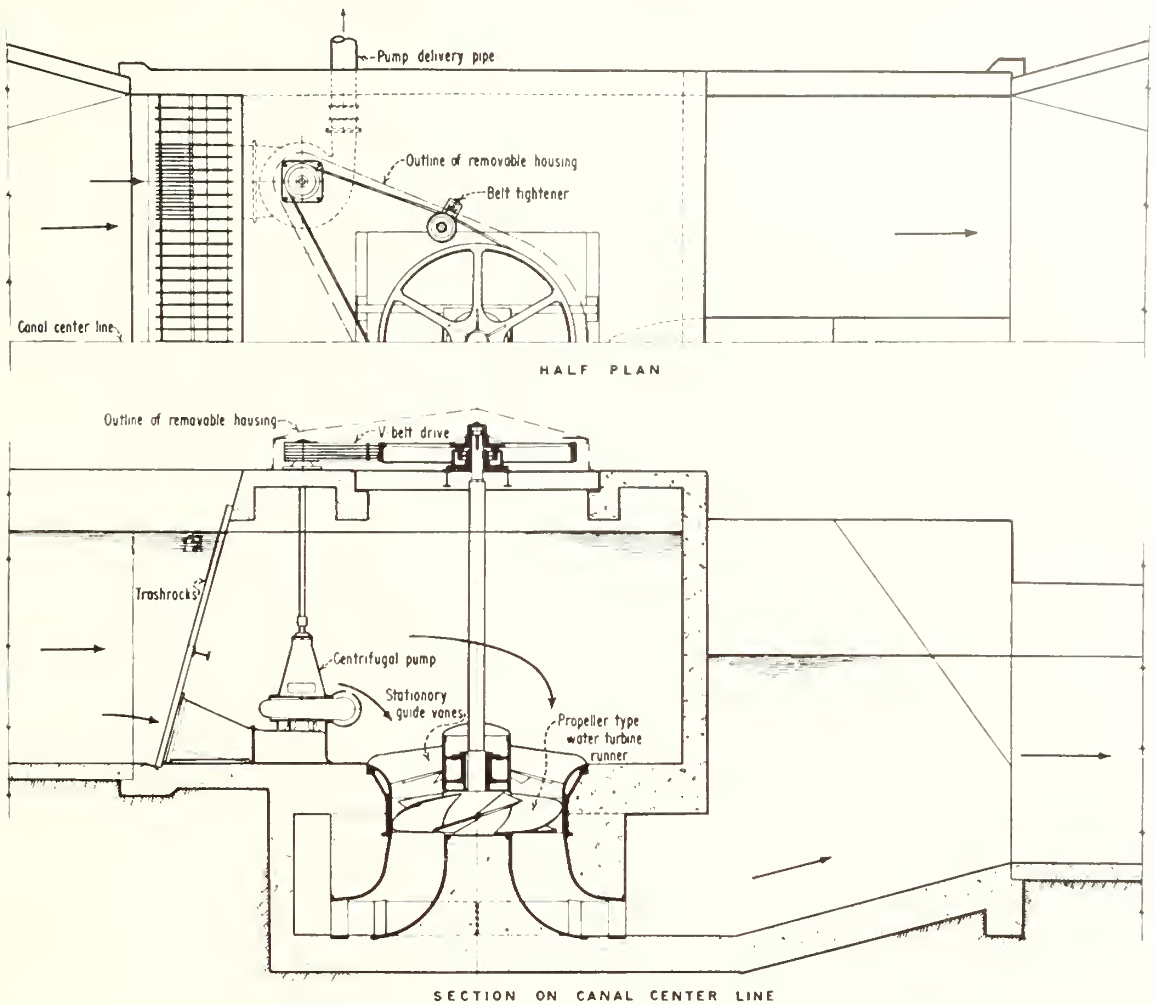
by HENRY H. PLUMB, Chief, Electrical Engineerin

FROM the ancient man-powered waterwheel of Egypt to the modern pumping plant is a long series of steps in engineering evolution. However, each step was one in the right direction—toward successive improvement. Each proven design was an incentive for fresh study which brought forth even better devices with broader applications and increased efficiency.

So it was with the conventional type pumping installations which harness waterpower at drops in irrigation canals for the purpose of lifting water from the canal to farmlands not accessible for watering by direct gravity flow. Such installations have proved to be both dependable and economical. However, other drops at sites near potentially irrigable land which lies above a canal have remained undeveloped. In this situation was a challenge for further improvement. The problem centered on the fact that the hydraulic head for the turbine was not considered high enough for practical development, or the initial cost of the installation would be too great.

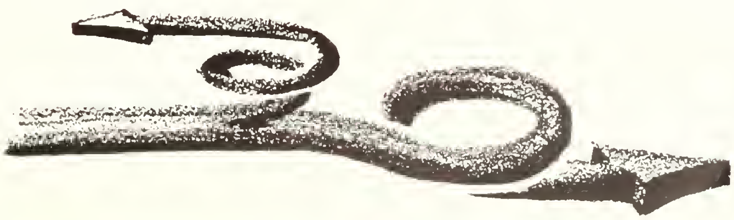
For some of these neglected power drops, a new type pumping unit may make it possible for the first time to irrigate small isolated areas. Moreover, the proposed installation provides a number of advantages not possessed by the typical pumping units now in operation.

The new unit would utilize a V-belt drive arrangement between a centrifugal pump and hydraulic turbine, rather than the conventional direct-connected units. The turbine would be a high-speed propeller type rather than the conventional Francis or reaction type generally used. The propeller-type turbine is practical for heads as low as 10 feet, and pumping heads up to 100 feet or more could be used with a high-speed, single-stage pump. Thus a ratio



PROPOSED CANAL-DROP PUMPING PLANT

Higher Lands



rovide the Answer

, Branch of Design and Construction, Denver, Colo.

of 10 to 1 would be attainable between pumping lift and power drop.

The accompanying sketches compare the conventional direct-connected unit, with the proposed V-belted unit pumping plant. The proposed pump would be mounted in a submerged position in close proximity to the hydraulic turbine. The vertical shafts of the pump and turbine would be equipped with a grooved pulley on their upper ends. The two pulleys would be connected by multiple V-belts. The design shown would permit elimination of a superstructure with a substantial decrease in first cost resulting. A small steel housing over the pulleys would furnish adequate protection for the belts.

The V-belt drive permits both the hydraulic turbine and the centrifugal pump to be operated at their most efficient speeds. Further, the V-belt drive may make possible the higher pumping lifts of the water, by use of a high-speed, single-stage pump rather than a more expensive direct-connected multistage pump.

With the direct-connected type of unit, the turbine and pump designers are handicapped by the fact that the turbine and pump must rotate at the same speed, and consequently the selection of the turbine or pump, or both, has to be a poor compromise. Such a limitation results in higher initial costs, and also some sacrifice in efficiency. A gain of 5 or 6 percent may be realized in the efficiency of the belt-connected unit over the conventional direct-connected unit, if full advantage can be taken of the belted unit.

Multi-V-belts of standard manufacture are capable of transmitting up to 200 horsepower, and a 7 to 1 ratio in speed increase from turbine to pump can be utilized. For still greater horsepower, a gear drive may be used. The

Jesse W. Myer Retires After Serving Longest Term as Bureau Employee

Jesse W. Myer, oldest employee of the Bureau of Reclamation from the standpoint of service, retired optionally on June 30.

A farewell dinner honoring Mr. Myer was conducted by Regional Director K. F. Vernon and members of the region VI staff in Billings on May 12.

A graduate of Washington College of Law in Washington, D. C., Mr. Myer first became employed by the Department of the Interior in 1903. His initial assignment was with the Geological Survey, under which the Reclamation Service first operated. In 1905, after the Reclamation Service started operations as a separate unit of the Department of the Interior, Mr. Myer was transferred to serve with the agency. After being assigned for three years as a messenger, he was appointed to a clerk's position in 1907. After numerous promotions, he advanced to "senior clerk" in 1924 and to "principal clerk" the following year.

In 1945, he was made chief of the Office Services Division and later that year was designated a management analyst. In April 1947, he was transferred to region VI to act as organizations and methods examiner.

How to irrigate higher lands

(Continued from page 131)

cost of replacement for the V-belt is relatively small where overloading is avoided, as the normal operating life of this type belt is quite long. The belt efficiency is high. The new type unit would be capable of long operating periods without attention, except for necessary removal of trash. As the pump is submerged, it would be self-priming. Both the pump and turbine could be provided with water-lubricated guide bearings and the thrust bearings supporting the weight of the runners would be oil lubricated.

Not all of the desirable factors of available power, water, and head, together with irrigable bench lands reasonably close to the power site will be available in the maximum degree at every pumping plant site. Each development is an individual problem. Conventional, direct-connected pumping units will still be the logical choice for large-capacity plants where the pump can be operated at sufficient speed to lift the water to the desired elevation with acceptable efficiency and reasonable cost of construction. End

Killing Weeds with 2,4D

(Continued from page 129)

Actually the amount of solution per acre is important only in obtaining uniform coverage of the vegetation. It varies with the type and size of vegetation and the spray equipment used. The new "low-gallonage" equipment used to spray weeds in grain fields uses 5 gallons or less per acre of a concentrated solution. High-pressure equipment used for tall dense vegetation and woody plants may apply as much as 400 gallons per acre of low concentration. When using hand-operated sprayers, the rule is to apply sufficient solution to wet the leaves. The dosage can be adjusted by varying the concentration of 2,4–D in the spray solution to give the amount of acid desired. In low-volume spraying, dosage is varied by changing the nozzle size and the rate of forward travel of the spray equipment.

The complete bulletin from which the preceding information was extracted contains a more complete description of the types of commercial 2,4–D weed killers, the effect of 2,4–D on various plants, the rate of applying 2,4–D, lists of various weeds and crop plants, with their "susceptibility" ratings, and other valuable information regarding this material.

For the complete version, ask for "Killing Weeds with 2,4–D" by L. W. Kephart and L. S. Evans, publication No. 97CC, January 1948, and send your request to: United States Department of Agriculture, Agricultural Research Administration, Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Cereal Crops and Diseases, Plant Industry Station, Beltsville, Maryland.

NIOBRARA—the "Forgotten River"

(Continued from page 126)

very favorably under irrigation. Under present conditions, the average yield of corn within the Basin is 14 bushels per acre, oats 20 bushels, barley 17 bushels, and alfalfa 1.3 tons per acre. With irrigation, substantial increases may be expected.

The total area of the Niobrara Basin is about 15,000 square miles. Of this, 1,394 square miles, or about 12 percent, is cultivated land. The balance is range land unsuited to general farming, but excellent for the production of livestock. Increased production due to irrigation would permit feeding of livestock in or near the area where they are raised. The population would increase to meet the new demands, better schools, churches, marketing and shipping facilities would come, and the economy of the entire Basin would be affected by the developments.

The Bureau's studies to date have dealt very briefly with the development of hydroelectric power. There are five small plants now operating, two on the main streams and three on tributaries.

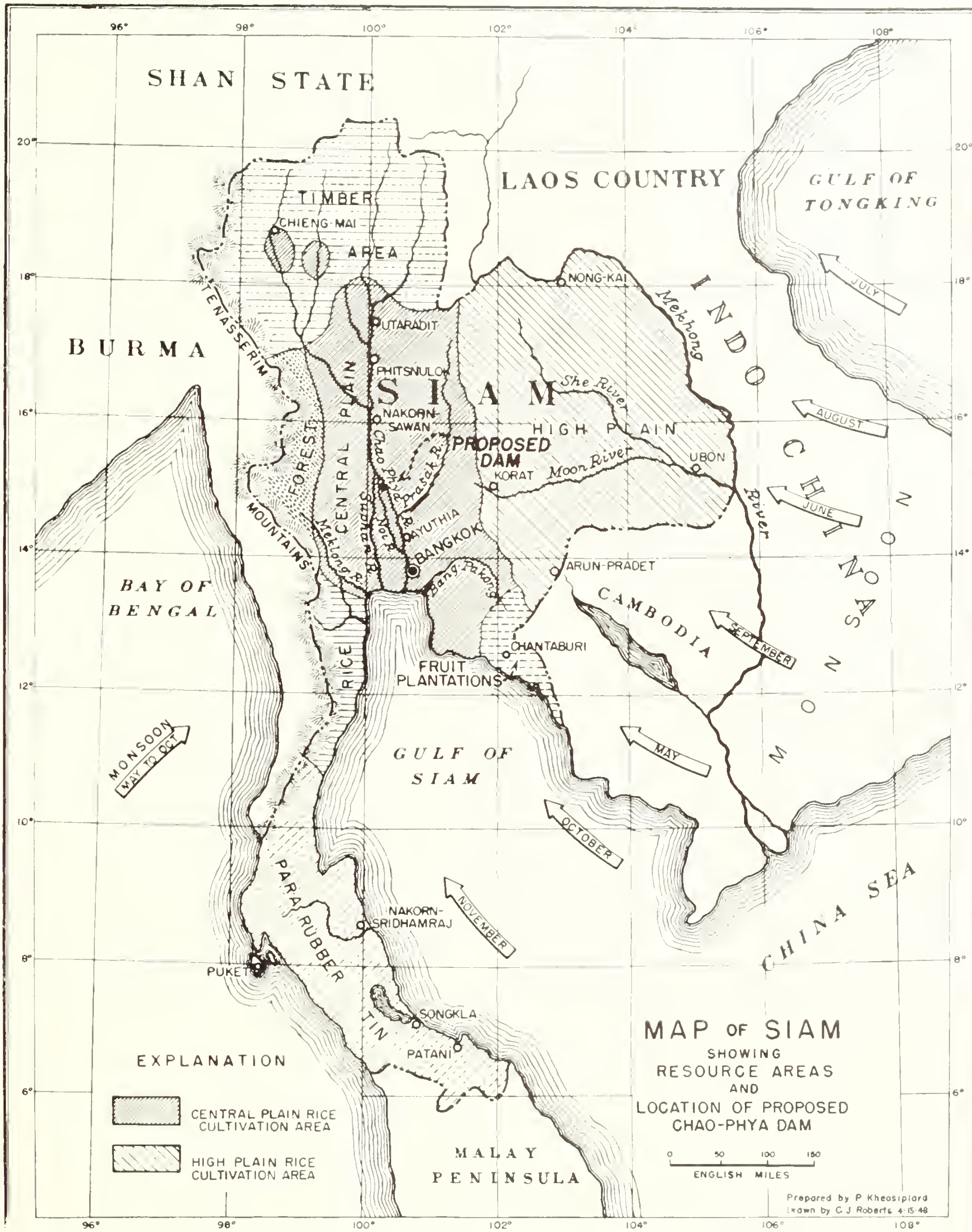
The demand for power has increased, and the existing plants are inadequate to meet the increasing demands. There are many locations on the Niobrara River where additional power may be developed, and these are being given full consideration in the investigation.

With the development of the resources of the Niobrara Basin, this basin could take its place with other basins within the State in the production of food and would enjoy an economy and prosperity never before realized. End

This article was adapted from a statement to the Nebraska Reclamation Association, at Kearney, Nebr., January 16, 1948, by Cylde E. Burdick.

Siam—and Her Irrigation Works

Pard Kheosiplard



AUTHOR'S NOTE.—May 1947, 29 Siamese gineers arrived in the ited States to study irration construction and ter distribution meths under direction of the reau of Reclamation. ree members of the ty, Rung Khantong, arin Atthayodhin, and self, were assigned to rk in the Bureau's gion V. During my ped of study in the renal office at Amarillo, x., I was asked to write ut the irrigation works Siam. Unfortunately, acked exact data or figs for the subject rered for carrying out s assignment at hand. I had to make everyng out of my own mory. Since the article based on memory of the ject material, I hope reader will bear in d that should discrepcies appear in the manuipt I shall welcome ticism, for it is my intion to give the most urate report possible ler existing circumnces.—*Pard Kheosipd.*

SIAM, an independent kingdom, is in southeastern Asia, far above the equator; approximately north 6° and north latitudes and between east 98° and east 106° longies. (See map above.)

The country has an area of about 220,000 square miles ly 47,000 square miles less than the State of Texas) and population of approximately 18 million. Bangkok, the ital, has a population of about 650,000.

Geographically, the country may be divided in four natl regions. The northern section includes the drainage area of four rivers which unite at Nakorn Sawan (Pak Num Po) to form Chao Phya River. The four rivers are turbulent and shallow in the upper reaches, but slow moving and deep where they near the points of concurrence. This northern section is comprised of a series of parallel ranges, lying north and south, and rising from gently sloping acclivities in the south, to precipitous masses in the north. The areas watered by the rivers in the lower reaches are fertile and heavily populated. Villages are scattered along the banks of the rivers in the uplands. Much of the northern section is covered with hardwood timber, including teak wood, one of the most famous species of the Far East. The average elevation of this section is about 1,050 feet above sea level, and the area is approximately 60,000 square miles.

The eastern section of Siam extends over approximately 70,000 square miles, including the drainage area of the Moon and She Rivers and their tributaries. It is generally a huge basin with a broad, high plain, about 200 to 300 feet above sea level, forming the bottom. The hill ranges partly surrounding this basin rise to between 1,000 and 2,000 feet above sea level. The plain is sandy and practically barren. It is subject to floods in the rainy season and to severe drought in the dry season, although it is an important rice growing and pasture area.

The central portion of Siam, including the drainage area of the Chao Phya, Suphan, Bang Pakong, Meklong and Prasak Rivers, extends over an estimated 50,000 square miles. This is the heart of the kingdom. It is a broad, low plain, rising from 10 to 60 feet above sea level. It is an alluvial area flanked by high mountains on the west, sloping to the sea in the south and around the inner Gulf of Siam. Most of Siam's population and wealth are in this central area.

The southern section, which includes the ax-handle part of the country extending into Malay Peninsula, includes an area of about 20,000 square miles. Para rubber and tin are the principal products. Elsewhere, in various parts of the kingdom, are minor sections occupied by fruit plantations, rice farms and forests. These isolated sections comprise another 20,000 square miles.

Siam has three seasons—cool, hot and rainy. Generally it is a monsoon climate. The cool season, beginning about the middle of October, is characterized by dry, cool north winds which continue to about the middle of February. Temperatures range from about 50° to 75° F. The hot season follows the cool season and continues to about the middle of May, during which time temperatures range from 80° to 100° F.

The rainy season extends from May to October. Because it is the most important season for Siam's agriculture, a brief explanation of it may be of interest. The southwest monsoon from the Bay of Bengal and the southeast monsoon from the China Sea, both moisture-laden, begin blowing into the country about May. The southwest monsoon, however, does not bring much precipitation to Siam, as its full force is broken by the Tenasserim Range on the west. The extent of the interference by the mountains is evidenced by the heavy rainfall in neighboring Burma, beyond the mountains, of more than 200 inches annually compared to that of about 50 inches at Bangkok and about 42 inches at Chieng-Mai (in the northern section).

The southeast monsoon from the China Sea is the most vital factor in Siam's agriculture. It approaches the southern part of the country in May, gradually shifts northward and passes over northernmost Siam in July. Then, in August, it shifts southward and again blows across the country until November. In this manner it spills its moisture over the entire area. Temperatures in the rainy season range from 65° at night to 80° F. in the daytime. Average rainfall during the growing season is about 41 inches.

Although rice is the principal food, Siam produces great quantities and varieties of food and fiber, including cotton, castor beans, soy beans and vegetables. The plains area produces rice, pepper, sugar cane, coconuts, bananas, mangoes, pineapples and similar crops.

As previously stated, Siam is supplied with considerable rainfall during the growing season—May to November. Rice, the country's staple crop and principal food supply, requires greater quantities of water than supplied by natural rainfall and greater still compared to other kinds of crops. Rainfall often is insufficient or it does not come at the time most needed for rice production. Droughts during the growing season are not uncommon.

Prior to the construction of modern irrigation works, rice culture, especially in the Central Plain area, depended on two natural means of water supply—rainfall and inundation of fields when the rivers overflowed their banks. Satisfactory crops were produced only when the following conditions prevailed:

- Satisfactory rainfall at the beginning of the season for preliminary agricultural operations.
- Sufficient rainfall to sprout the seed and mature it to a stage where it would not be harmed by inundation.
- Inundation by river overflow, but not so much that it would swamp the growing crops.
- Inundation to last the length of time necessary to bring the crop to full bearing.
- Decline of the rivers inundation in time to harvest the ripened crops.

When these conditions varied in any degree, the crops suffered in direct proportion. Seldom were all factors ideal for peak production. This was the situation that led to the construction of modern irrigation works.

About the turn of the present century, the Siamese Government negotiated with the Indian Government to acquire a specialist to explore the possibilities of irrigation in Siam. The Indian Government assigned Sir Thomas Ward to the job. Sir Thomas later submitted a report of his studies, including a general plan of projects, but because of an economic depression at the time, actual work on the system was delayed.

In 1913 the Siamese Government arranged with the Netherland Government for J. Homan Vanderheide, a Dutch irrigation specialist, then in Java, to make additional investigations and design certain projects. Mr. Vanderheide's conclusions followed the general pattern of those previously formulated by Sir Thomas. Construction of the first irrigation project was started in 1915, under direction of the newly formed Royal Irrigation Department. All irrigation systems in the country are designed for gravity flow. Pumping is not yet practical because of excessive power costs.

In order to conserve space, a description of Siam's irrigation works will be confined only to those in the Central Plain. Several irrigation projects are located on both sides of the Chao Phya and Suphan Rivers in the Central Plain area. These projects can be operated in conjunction with each other by a system of structures and canals. Part of the water requirements during the growing season is supplied by rainfall supplemented by irrigation.

The water elevation in the Chao Phya River during the growing season usually is sufficiently high to allow the river water to flow into the diversion canals of all projects. However, except during the growing season, the elevation is low, although there always is a minimum flow in the river. For example, at a point about three miles above the proposed dam site on the Chao Phya River (see map) the average maximum flow is approximately 211,000 cubic feet per second, and the average minimum flow is about 1,760 cubic feet per second. If the proposed diversion dam is constructed, an upstream reach of the river—approximately 75 miles—will serve as a reservoir. Moreover, the elevation of the water will be raised sufficiently to allow at least the minimum flow necessary for irrigation to be diverted into the irrigation projects during the dry season. Studies show that the increased water supply will permit production of two rice crops annually in favorable seasons. In any event, it will support and increase a diversified agriculture, with the production of other crops on rice land following the rice harvest.

Principal irrigation structures usually are of the diversion dam type (barrage or regulator) which serves to raise the water level sufficiently high to flow into head gates of diversion canals, and regulates the flow of the river. These structures usually are constructed in the low plain projects, and are concrete piers and abutments with steel sectional gates operated by winches mounted on steel or reinforced concrete superstructures. The average size of these is about 262 feet in length and about 26 feet high. The one proposed for construction on the Chao Phya River will be approximately 984 feet long, including log chute, navigation lock and fish ladder, and about 39 feet high.

In the high plain area, main structures usually are of overflow dam type (weir) made of timber of concrete core wall and filled with impervious material such as clay, covered with rubble masonry.

Siam's farmers have grown rice successfully for generations on the same land without fertilizing the soil or rotating crops. This has been possible because each year the river water that was used to inundate the fields carried a great deal of silt. This silt fertilized the soil year by year, thus the soil could retain its fertility. Whether or not the use of modern irrigation works will upset this method of fertilization and require the use of commercial fertilizer is not yet clearly known.

However, about 20 years ago, the Siamese Government established experimental farms in various parts of the country to demonstrate the benefit of fertilizer as well as the diversified farming system. But the farmers, not unlike farmers in other parts of the world, are not easily nor quickly turned from their former practices, hence widespread use of fertilizers will come slowly, even in areas where it is needed greatly.

There are approximately 8,800,000 acres devoted to rice culture in Siam at present. After construction of the proposed Chao Rhya Dam, the acreage is expected to increase to more than 10,000,000 acres.

All costs of irrigation structures are financed by the Siamese Government. The fund is supplied from the country's general treasury. The operation and maintenance costs of the project are borne by the government from the same fund, which is maintained by all taxes, such as national, land, income, export, import and so forth. The fund

Aerial view and artist's conception of the proposed Chao Phya Dam site and Peace City on the Chao Phya River, approximately 100 miles upstream from Siam's capital city of Bangkok. Peace City, a proposed community, was so named because construction of the irrigation works would make the farmers of the area prosperous and happy.

also is used to finance all other developments throughout the country. There is no system for direct reimbursement at the present time.

The land tax is the same on all lands either in or outside irrigation projects. This is based on the theory that all developments in Siam are performed by the government for the benefit of the entire nation, and that developments which benefit any particular group of people will benefit all other groups either directly or indirectly. The irrigation policy of the government may be summarized as follows:

- Stabilization of the annual rice production.
- Improvement of inland trade.
- Increment of national prosperity through enhancement of land values.
- Increasing the ability of the farmers in paying land revenue.

The standard land unit of the country is 40 meters square or 1,600 square meters in area. This unit is called "rai." Approximately 2.5 rais are equal to one acre. Siamese in any part of the country may clear and develop vacant or undeveloped pieces of agricultural land and may possess this land which they acquire in this manner, according to legal requirements, such as successful development of the land within a certain period of time. All lands, except those owned by individuals, are considered as national lands and the government supervises them. Some lands are held for particular purposes such as forest reserves. There is no limitation on the amount of land that an individual may own regardless of whether the land is or is not irrigated. The average Siamese farmer owns from 12 to 20 acres.

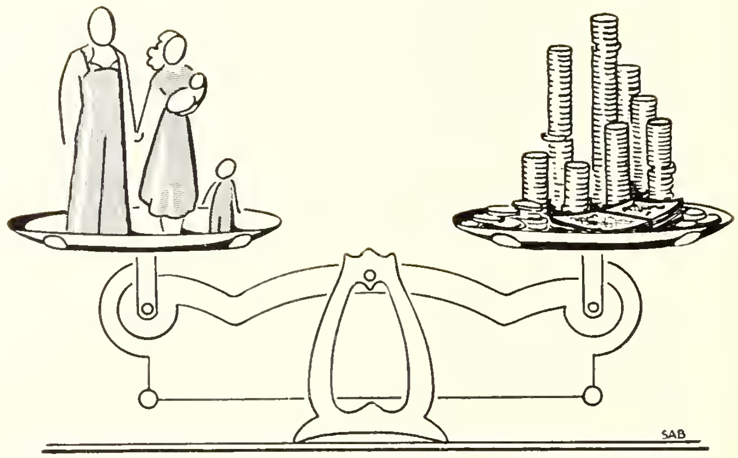
I hope that I have been able to give to the readers a general picture of my country and her irrigation problems.

At this opportunity, I would like to express for all my countrymen our sincere appreciation to the Bureau of Reclamation in particular and American citizens generally for the generosity, courtesy and kindness extended to us during our stay in the United States. I also am personally grateful to the Bureau's officials and employees in region V for all the trouble they have taken in teaching me modern American irrigation methods. END

VALUE for VALOR

Or . . . An analysis of the new wealth for Park County, Wyoming, in the persons of thirty-one veteran settlers

by JOHN K. BLACK, Engineer, Heart Mountain Division, Shoshone Project, Cody, Wyoming, Region VI



LIFE INSURANCE COMPANIES go to great lengths in determining the life expectancy of human beings. They have developed cold statistics showing how much time we can expect to have in this world and how much we can expect to earn in American dollars. The Bureau of Reclamation has devised impressive tables and other data to show how much wealth is brought to the West in the form of concrete, steel, electric energy, and man-hours of labor. It occurs to me that too little emphasis is placed on the value of the lives of the new settlers who are attracted to the irrigation projects which come into existence through Bureau of Reclamation development.

To begin such a study, it is of interest to consider some of the facts pertaining to the 31 young men who selected homesteads on the Heart Mountain Division of the Shoshone project in the State of Wyoming. These men by no means came here without "Purse or Script." Adding up the net worth figures for the 31 I find they total $256,870 for an average of $8,286.13. The highest amount shown is $33,000; the lowest $2,700. Only $2,500 was required by the examining board to meet the minimum requirement so far as capital is concerned. All of this wealth was brought here, together with a good name which each could use to borrow at least $3,500 from the Farm Home Administration, or a total of $98,500. Adding the sum of their net worths to the amount they could borrow makes $354,370 available for the lucky first 31 for first-year investments in modern farm homes, barns, farm shops, fences, machinery, and land improvements. Park County, Wyo., struck a gold mine in this drawing.

It is thrilling to read the letters of recommendations sent in from references used by these applicants. Most of them can be summed up in the words of one farmer who said this about the veteran whom he was recommending. "A very fine balanced young man, wife, and family. They will be an asset to any community, and we will miss them." Here is value this project and the surrounding towns will gain which cannot be measured in dollars and cents.

Three of the young men are college graduates and three others have had over three years of college training. The men brought an average of 10 years' farming experience. It is a known fact that life provides no substitute for experience when it measures out success. All of this training and experience is offered our communities on this project. Who knows but that the group includes future Congressmen, Senators, and it is certain that county commissioners, and community leaders in all fields of politics and society will be numbered among them.

These men bring another vital quality which many of us feel is slipping away and that is youth. The average age is 29½ years. The oldest is 45 years of age and the youngest is 21. It has been truly said that homesteading requires youth and determination first of all. These qualities abound among this group and great accomplishments can be expected from them.

They offer new experiences and possibly new enterprises for the communities. One veteran produced and sold 3,000 turkeys last year on a rented farm in Nebraska. He wants to investigate prospects for this business in Park County. Another produced ten tons of broom corn in eastern Nebraska worth $400 per ton. He wants to know whether it can be grown here. Two men are well established in the bee business and are looking for new fields of blossoms where the busy insects can find nectar which is now worth around 20 cents a pound. One has $48,000 worth of land-moving equipment and wants to do land leveling on a commercial basis. It is truly stated that "Nothing ventured, nothing gained," so we can look to the future with great anticipation of new developments from this year's homesteaders.

Perhaps the most valuable contribution these young men will make to our communities is the loyalty and love of the flag which they bring. Twenty-two of these veterans served their country in World War II in the Army; eight in the Navy, and one in the Marines. Four of these men were officers and 27 were enlisted men. Four were awarded the Purple Heart for wounds received in combat. One has the Distinguished Flying Cross and the Air Medal with Seven Oak Leaf Clusters.

When we consider this wealth concentrated at Heart Mountain we feel assured that this is truly a wonderful work. It should be a source of satisfaction to every person working for the Bureau of Reclamation to know that he is contributing to the success of this program. At the same time it is our solemn duty to do the best job possible of giving assistance and encouragement to these worthy veterans. END

A VETERAN'S VIEW

by RAY C. KING, Settler on Heart Mountain Division, Shoshone Project, Cody, Wyo., Region VI

Mr. and Mrs. Ray King, of Heart Mountain unit No. 31, planting and preparing ground for tiny plum trees which they hope some day will develop into a good-sized orchard. Note Mrs. King tying burlap covering around new tree to protect it from the rabbits who would otherwise enjoy it for an evening meal. ***Photo by T. R. Broderick, Region VI.***

WE ARE A FORTUNATE FEW.

Upon discharge from the armed services we were afraid to peer too far into the future. We were ambitious but our problems seemed to multiply and multiply. Good jobs at high salaries were plentiful but most of us, having been born and reared on farms, could think of the future only in terms of owning a productive tract of land. However, after considering the current price of real estate, machinery and livestock, our savings of a few hundred dollars appeared very small indeed; and our prospects of owning our own farms, without burdening ourselves with an almost overwhelming debt, were far from encouraging.

Upon notification by the United States Bureau of Reclamation that 83 farm units in the Heart Mountain Division of the Shoshone project near Powell and Cody, Wyo., were open for homesteading, we filed application for one of them immediately. We hardly dared hope to meet the Bureau of Reclamation qualifications in all respects, draw a lucky priority number at a public drawing held in Powell and pass the scrutiny of a local board consisting of the late L. J. Windle, project superintendent, and two prominent local men.

When things had gone successfully this far, we at last began to realize that we weren't dreaming and that all we had to do to own a farm of our own, was to comply with the liberal homestead requirements.

We were farther surprised and pleased at being allotted two barracks and much useful equipment from a nearby former Jap internment camp.

A year has flashed by and we are far from prosperous. In fact, ours is probably the poorest community in the State of Wyoming.

Our first year's crops were failures. Cattle from the open range wandered on to many of the farm units and aided the homesteaders in harvesting their meager crops, since few of the units were properly fenced due to the scarcity of fencing material and lack of time.

Our crops this year are flourishing and our future appears brighter, despite the fact that those ever-hungry range cattle again trod our fence lines testing for weak spots. Already we are gaining, to a certain degree, that sense of security and independence which comes only to those who till the soil.

Most of us are living in our partly reconverted barracks which are far from modern and are lighting them by means of kerosene lamps or gasoline lanterns. Pack-rats from the desert often slink in to share our modest abodes and their rowdy romping in our attics at night causes many a sleepless hour.

A few of the settlers have been fortunate enough to obtain water by drilling but it is suitable for livestock only, due to the mineral content, and our water for domestic use is hauled for miles in cream-cans, barrels, tanks and whatever containers we may have.

Despite our many disappointing experiences of the past year, we are not discouraged. We know that ours is a workable, responsive soil and that nature, due to the existing desert conditions in the valley, has been unable to grow the vegetation necessary for building up organic matter in the soil. We are determined to give nature a helping hand by plowing under legumes and other green-manure crops. Thus, in a few years, we expect to accomplish the work at which she, unaided, has so miserably failed.

We like the people of Wyoming. They are friendly, frank and unassuming, traits of a truly agricultural community.

We now feel that we are full-fledged citizens of Wyoming and as such expect to take active interest in all community, county and State affairs. We expect to conduct ourselves in such a manner that we shall be considered a credit to the community and not mere riff-raff that has drifted in from other States.

We are men of vision. When we gaze across these barren, desert tracts, studded with sage and homesteaders shacks, we are looking far into the future, and visualize waving fields of grain and alfalfa, green pastures and modern homes of a prosperous and happy farm folk.

Yes, with our feet planted firmly on Wyoming soil, we throw back our shoulders, breathe deeply of her invigorating air, gaze at her beautiful mountains and are thankful to the depths of our hearts that we live in the greatest, most generous democracy in all the world. END

History of the Bureau of Reclamation's Regular Annual Appropriation Act, 1949 *(Exclusive of Trust Funds)*

State	Project	Allowed by the Bureau of the Budget	As reported by comm. (Rpt. No. 2038) & passed by House (H. R. 6705, 5-27-48)	As reported by Senate committee (Rpt. No. 1609) and passed by Senate	As recommended by conference committee	Appropriation Act 1949 [1]
Reclamation fund, special fund:						
Salaries and expenses		$5,000,000	$3,161,472	$4,000,000	$3,600,000	
General investigations		5,350,000	3,000,000	4,000,000	3,500,000	
Construction:						
California	Santa Barbara-Cachuma Unit	3,000,000	1,000,000	2,700,000	1,000,000	
Colorado	Paonia	471,000	471,000	471,000	471,000	
Idaho	Boise:					
	Payette Division	1,700,000	1,400,000	1,650,000	1,525,000	
	Anderson Ranch	5,800,000	5,100,000	5,100,000	5,100,000	
	Lewiston Orchards	1,136,000	1,136,000	1,136,000	1,136,000	
Montana	Sun River	45,000	45,000	45,000	45,000	
New Mexico	Tucumcari	1,540,000	1,200,000	1,386,000	1,293,000	
New Mexico-Texas	Rio Grande	100,000	25,970	90,000	57,985	
Oklahoma	W. C. Austin	320,000	320,000	320,000	320,000	
Oregon	Deschutes	230,000	580,000	580,000	580,000	
	Owyhee	150,000	150,000	150,000	150,000	
Utah	Ogden River	34,000	34,000	34,000	34,000	
	Provo River	2,200,000	1,800,000	1,980,000	1,980,000	
Washington	Yakima—Roza Division	1,197,000	1,250,000	1,347,300	1,290,650	
Wyoming	Kendrick					
	Riverton	2,011,500	1,750,000	1,810,350	1,780,175	
	Shoshone	430,000	430,000	430,000	430,000	
Subtotal, Reclamation Fund, Construction		20,664,500	16,691,970	19,229,650	17,200,810	
Operation and Maintenance:						
Arizona-California	Parker Dam Power—Power Revenues	2,750,000	2,312,880	2,645,380	2,645,380	
	Yuma:					
	Direct Appropriation	130,000	116,000	116,000	116,000	
	Power Revenues	32,000	32,000	32,000	32,000	
	Yuma (Improvements and Betterments) Power Revenues	78,000	78,000	78,000	78,000	
California	Central Valley:					
	Direct Appropriation	300,000	210,875	250,000	230,437	
	Power Revenues	500,000	768,800	860,000	814,400	
Colorado	Colorado-Big Thompson—Power Revenues	167,500	150,000	150,000	150,000	
Idaho	Boise—Direct Appropriation	250,000	210,000	230,000	220,000	
	Minidoka:					
	Direct Appropriation	38,000	30,000	30,000	30,000	
	Power Revenues	619,000	395,000	500,000	447,500	
Nebraska-Wyoming	North Platte—Power Revenues	206,000	165,000	186,000	175,500	
New Mexico-Texas	Rio Grande—Power Revenues	355,000	235,000	235,000	235,000	
Oregon	Deschutes—Direct Appropriation	150,000	85,000	117,500	101,250	
	Owyhee—Direct Appropriation	325,000	285,000	300,000	292,500	
Oregon-California	Klamath—Direct Appropriation	238,000	210,000	224,000	217,000	
Washington	Columbia Basin—Power Revenues	1,780,000	1,600,000	1,690,000	1,645,000	
	Yakima:					
	Direct Appropriation	360,000	330,000	345,000	337,500	
	Power Revenues	25,000	25,000	25,000	25,000	
Wyoming	Kendrick Power Revenues	225,000	200,000	212,500	206,250	
	Riverton:					
	Direct Appropriation	98,800	92,000	95,400	93,700	
	Power Revenues	60,850	56,000	58,425	57,212	
	Shoshone:					
	Direct Appropriation	97,700	69,700	84,700	77,200	
	Power Revenues	133,300	95,300	114,300	104,800	
Subtotal, operation and maintenance—direct appropriation (irrigation)		1,987,500	1,638,575	1,792,600	1,715,587	
Subtotal, operation and maintenance—power revenues		7,191,650	6,112,980	6,786,605	6,616,042	
Total, operating and maintenance		9,179,150	7,751,555	8,579,205	8,331,629	
Rehabilitation and betterments of existing projects						
Arizona	Salt River	556,500				
	Yuma	500,000				
California	Orland	50,000				
Montana	Bitterroot	40,000				
	Milk River	103,500				
Nebraska	North Platte	750,000				
Nevada	Humboldt	225,000				
New Mexico	Carlsbad	400,000				
Utah	Hyrum	48,000				
Washington	Yakima	151,000				
Subtotal, rehabilitation and betterments of existing projects		2,824,000		1,500,000	1,500,000	
Total, reclamation funds, special fund (includes appropriations from power revenues)		43,017,650	30,604,997	37,308,855	34,132,439	
General fund.						
Construction:						
Arizona	Gila	3,000,000	2,240,000	2,700,000	2,470,000	
	Yuma—Reservation Division					
Arizona-Nevada	Davis Dam	25,427,000	18,000,000	22,884,300	22,125,000	
Arizona-California	Parker Dam Power	260,000	196,000	234,000	212,000	
California	Central Valley	47,186,000	40,000,400	42,467,400	41,358,900	
	Kern River	50,000	40,000	45,000	42,500	
Colorado	Colorado-Big Thompson	23,000,000	19,750,000	20,700,000	20,225,000	
Montana	Hungry Horse	9,850,000	8,100,000	15,115,500	14,611,650	
Washington	Columbia Basin	50,000,000	45,312,000	45,312,000	45,312,000	
Subtotal		158,773,000	133,632,400	149,458,200	146,357,050	

[1] No change.

State	Project	Allowed by the Bureau of the Budget	As reported by comm. (Rpt. No. 2038) & passed by House (H. R. 6705, 5-27-48)	As reported by Senate committee (Rpt. No. 1609) and passed by Senate	As recommended by conference committee	Appropriation Act 1949 [1]
Geueral fund—Continued						
Special Acts:						
Montana	Fort Peck	$2, 200, 000	$990, 000	$1, 980, 000	$990, 000	
Various	Missouri River Basin	63, 900, 000	52, 767, 500	56, 275, 800	54, 786, 650	
	Advances to Colorado River Dam Fund:					
Arizona-Nevada	Boulder Canyon	1, 920, 000	1, 600, 000	1, 728, 000	1, 700, 000	
California	All-American Canal	4, 484, 000	4, 000, 000	4, 242, 000	4, 000, 000	
Arizona-California	Colorado River Front Work and Levee System	1, 160, 000	1, 050, 000	1, 050, 000	1, 050, 000	
Total, general fund, construction		232, 437, 000	194, 039, 900	214, 734, 000	208, 883, 700	
Alaskan investigations		150, 000	150, 000		150 000	
Operation and maintenance: California	All-American Canal	216, 000				
Protection and maintenance of transferred property						
Other special funds:						
Colorado River development fund		500, 000	500, 000	900, 000	900, 000	
Colorado River Dam fund:						
Arizona-Nevada	Boulder Canyon, O. & M.	1, 637, 000	1, 500, 000	1, 500, 000	1, 500, 000	
Subtotal		2, 137, 000	2, 000, 000	2, 400, 000	2, 400, 000	
Total, general and special funds (includes appropriation from power revenues)		277, 957, 650	226, 794, 897	254, 442, 855	245, 566, 139	
Permanent appropriations:						
Repayment of advances from the Treasury (All-American Canal project)		125, 000	125, 000	125, 000	125, 000	
Fort Peck continuing fund		250, 000	250, 000	250, 000	250, 000	
Payments to States of Arizona and Nevada		600, 000	600, 000	600, 000	600, 000	
Repayment of advances from the Treasury, with interest (Boulder Canyon project)		5, 000, 000	5, 000, 000	5, 000, 000	5, 000, 000	
Total, permanent appropriations		5, 975, 000	5, 975, 000	5, 975, 000	5, 975, 000	
Grand total, all accounts (includes appropriation from power revenues)		283, 932, 650	232, 769, 897	260, 417, 855	251, 451, 139	

[1] No change.

Congressional Action on Funds—Fiscal Year 1949

For the fiscal year 1949 which begins July 1, 1948, and extends to June 30, 1949, the President of the United States transmitted to the Congress for its consideration appropriation estimates for the Bureau of Reclamation totaling $277,957,650; of this amount $255,925,500 was for continuation of construction of various projects in the 17 Western States and the remaining amount of $22,032,150 was for general supervision, investigations of future projects, and operation and maintenance of all completed projects not turned over to the water users.

Extensive hearings were held by the Subcommittee for Interior of the Committee on Appropriations for the House of Representatives. These hearings began on March 25 and extended through April 30 for a total of 36 sessions. Every phase of the Reclamation activities was explored in detail in the printed hearings embodying 1,911 pages. On May 26 the full Appropriation Committee reported the Interior Department appropriation bill to the House and included $226,794,897 for the Bureau of Reclamation of which $210,731,870 was for construction.

The House committee in reporting out the bill provided funds for all projects included in the President's budget, and the amounts averaged 18.5 percent less than the amount of the estimate. In addition to the dollar appropriations, the House bill included a number of language provisions.

The bill passed the House on May 27 and hearings began before the Senate Subcommittee on Interior Appropriations the following week. The Bureau of Reclamation appeared on June 3 and 4, night hearings being held on both nights. The Senate bill was reported on June 12 and was passed by the Senate on June 14. As passed by the Senate the bill included $254,442,855 for the Bureau of Reclamation, of which $235,463,650 was for construction of projects. The bill as passed by the Senate was without most of the language provisions that had been included in the House bill.

Conferees on the bill met beginning Tuesday, June 15, and reported the results of their efforts to compromise between the House and the Senate on June 17th. The bill as finally reported by the conferees and accepted by both Houses which will become law for the fiscal year 1949 contains $245,566,139 for the Bureau of Reclamation of which $277,584,510 is for construction. The final bill modified language provisions that had been originally included in the House bill.

The bill as finally passed requires the Commissioner, Assistant Commissioners, and all Regional Directors to have at least 5 years of engineering and administrative experience after January 31, 1949. This affects the tenure of office of Commissioner Michael W. Straus and Regional Director Richard L. Boke of Sacramento, Calif.

The bill also includes restrictions on personnel, but modified somewhat from the original House action; requires the absorption of construction contract holdbacks payable in future years; permits the use of force account employees at a cost not exceeding 8 percent of the construction appropriation for any project; provides for investigation work in Alaska as a basis for legislation; provides for payments to school districts for instruction of dependents of employees of the Bureau and contractors engaged on construction of projects; authorizes work on rehabilitation and betterment of existing projects totaling $150,000,000; and provides for transfers to the Bureau of Reclamation of miscellaneous Government projects now in the custody of the War Assets Administration.

The measure also authorized $126,000 of available funds to complete the Buford Trenton projects in North Dakota.

The Second Deficiency Act for 1948, passed in the closing hours of Congress, includes $1,113,000 for the Bureau of Reclamation for the Boulder Canyon, Preston Bench, and Fort Sumner projects, as well as $2,000,000 for the Department of the Interior to overcome damage to Department property occasioned by floods in the Columbia Basin area.

News Round-Up

International Congress on Large Dams Meets

The third International Congress on Large Dams met at Stockholm, Sweden, June 10–17 with Gail A. Hathaway, Special Assistant to the Chief of Engineers, Corps of Engineers, Department of the Army, presiding as Chairman.

Walker R. Young, retiring Chief Engineer of the Bureau of Reclamation and Joel D. Justin, consulting engineer of Cornell University, served as Vice Chairman. Other distinguished members of the delegation included:

E. Robert de Luccia, Chief, Bureau of Power, Federal Power Commission.

B. F. Jakobsen, Chief, Plans and Specifications Section, South Pacific Division, Corps of Engineers, Department of the Army.

T. A. Middlebrooks, Chief, Soils Branch, Office of Chief of Engineers, Corps of Engineers, Department of the Army.

Clarence Rawhouser, Engineer, Dams Division, Bureau of Reclamation, Department of the Interior.

Dr. Karl Terzaghi, consulting engineer, Graduate School, Harvard University.

Carl P. Vetter, Chief, Office of River Control of the Colorado River, Bureau of Reclamation, Department of the Interior.

As a report on the Conference was not available at the time this issue went to press, a resumé of the proceedings will be published in our next issue.

Kansas Dedicates Its First Big Multiple-Purpose Dam and Reservoir

The huge Kanopolis Dam on the Smoky Hill River, located 25 miles southwest of Salina, Kans., has been completed and was dedicated on May 31, 1948. This is the first dam of the comprehensive Missouri River Basin plan of development to be completed in the lower Missouri River Basin, and it is the first major multiple-purpose dam constructed in the entire State of Kansas.

During the dedication ceremonies, Gov. Frank Carlson of Kansas accepted the physical structure in behalf of the "people of Kansas" from Maj. Gen. Lewis A. Pick, Missouri River Division Engineer. General Pick is coauthor of the Pick-Sloan plan for development of water resources in the Missouri River Basin which extends from the mountains in Montana to St. Louis, Mo., including all or parts of 10 States.

The Kansas State Highway Commission reported that about 35,000 people attended the big celebration at Kanopolis Dam. A State-wide radio broadcast was made of the ceremonies, and there were boat races on the reservoir. Region VII Director, A. A. Batson, District Engineer H. E. Robinson of the Kansas Basin District, and Engineer A. C. Brady of the Bureau of Reclamation attended the gala celebration.

The 3-mile long Kanopolis Dam, constructed by the Corps of Engineers of the Department of the Army, is 131 feet high, and provides a maximum storage of 450,000 acre-feet. It is a multiple-purpose reservoir for flood control and water conservation, and offers attractive possibilities for recreational use, such as boating, fishing, swimming, and other outdoor sports.

There is a possibility of irrigating some 40,000 acres of valley land between Kanopolis Dam and Salina, Kans., by use of waters regulated at the reservoir which has been authorized by the Congress as part of the plan for development of the Missouri River Basin.

Railroad Men Meet at Billings

Representatives of the various railroads operating in Region VI met with Bureau officials recently in Billings, Mont., in order to gain better understanding of the immediate Missouri Basin project.

Among those present were John W. Haw and L. A. MacDonald of the Northern Pacific Railway; L. H. Robbins and G. A. Dyke of the Chicago, Milwaukee, St. Paul & Pacific Railroad; E. M. Gregory and C. E. Jarrett of the Great Northern Railway; A. P. Simon and D. C. McLeod of the Soo Line; and Val Kuska of the Chicago, Burlington & Quincy Railroad.

The railroad men stressed the need for speeding up construction of the Missouri Basin to show the people of the Missouri Basin States that the Bureau is actively engaged in the construction of the project. Too many persons, it was asserted, erroneously believe that the development is still in the "paper plan" stage, to be built sometime in the far distant future. The railroad representatives asked that the people of the country be informed of the benefits to be derived throughout the country from the project and urged the lessening of repayment obligation to the water users in recognition of the national importance of irrigation during a period when food and fibre supplies are short.

Three Die in Tucumcari Cave-In

Construction Engineer William Q. Reeves, Field Engineer George R. Fulton, and Dragline Operator Carl Berg, of the Bureau of Reclamation's Tucumcari project in New Mexico, lost their lives following a cave-in of earth overlying the Conchas Dam irrigation tunnel No. 5 at the south edge of Tucumcari on April 30.

The men were investigating a cave-in which had occurred the week preceeding. The earlier cave-in had been the subject of continuous probing by Bureau engineers and geologists to determine its cause up to the time of the fatal accident.

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NOTES FOR CONTRACTORS

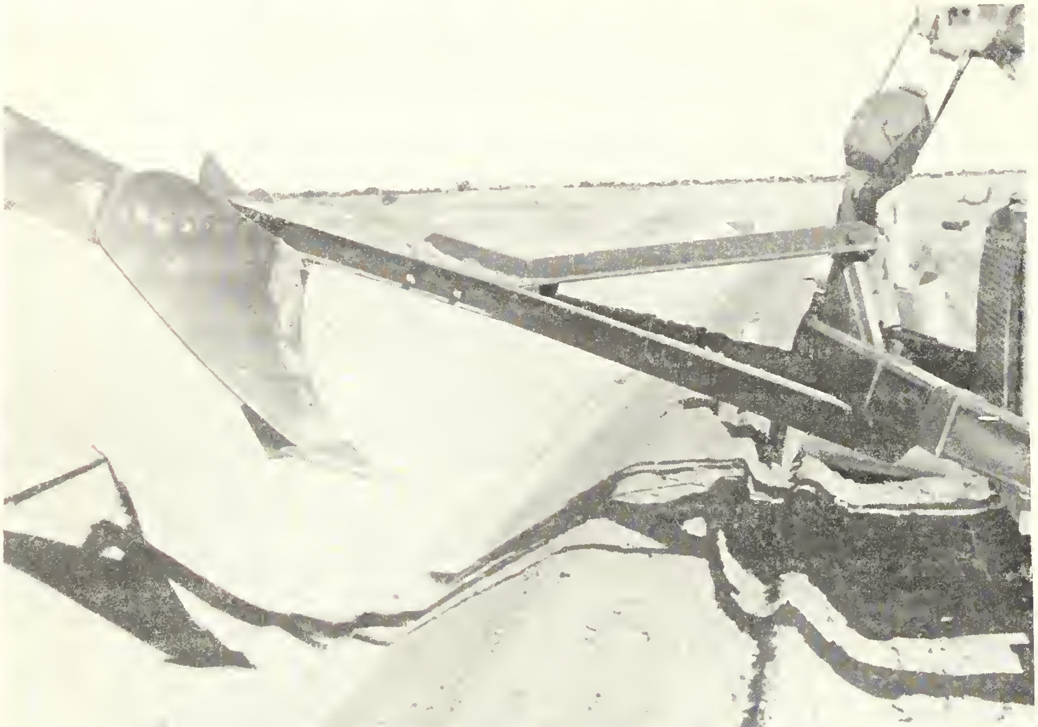
Contracts Awarded During May 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2063	Colorado-Big Thompson, Colo.	May 13	Switchboards for Estes power plant, schedule 1	Westinghouse Electric Corp., Denver, Colo.	$77,021
2063	do	May 7	Distribution switchboards and battery chargers for Estes power plant, schedule 2.	Wolfe and Mann Manufacturing Co., Baltimore, Md	34,940
2101	Columbia Basin, Wash	May 24	Three circuit breakers and 6 current transformers for Grand Coulee switchyards, schedules 1A and 3A.	General Electric Co., Denver, Colo	463,560
2108	Hungry Horse, Mont	May 28	Furnishing and installing four 75,000 kilovolt-ampere generators for Hungry Horse power plant.	do	4,414,000
2113	do	May 19	Four 105,000-horsepower hydraulic turbines for Hungry Horse power plant, schedule 1.	Allis-Chalmers Manufacturing Co., Denver, Colo	2,150,000
2114	Fort Peck, Mont	May 14	Control board for Williston substation, schedule 1	Westinghouse Electric Corp., Denver, Colo.	20,918
2121	Davis Dam, Ariz. Nev.	May 5	Current transformers for Cochise terminal facilities, Tucson substation, schedule 3.	do	10,456
2132	Missouri Basin, Wyo	May 11	Transformers and resistor units for Kortes power plant	do	22,700
2137	Missouri Basin, Nebr.	May 5	Six 50- by 30-foot radial gates for Enders Dam	American Bridge Co., Denver, Colo	298,068
2138	Missouri Basin, S. Dak	May 21	Furnishing and erecting 20 prefabricated residences for Shadehill Government camp, schedule 1.	Fogg and Holzworth Construction Co., Miles City, Mont.	179,999
2138	do	do	Furnishing and erecting 20 prefabricated residences for Bixby Government camp, schedule 2.	Brezina Construction Co., Rapid City, S. Dak., and Homeola Corp., Chicago, Ill.	183,950
2138	Hungry Horse, Mont	May 18	Furnishing and erecting 46 prefabricated residences for Hungry Horse Government camp, schedule 6.	H. & L Building Service, Missoula, Mont.	424,461
2138	Missouri Basin, Wyo	May 11	Furnishing and erecting 16 prefabricated residences for Kortes housing at at Mills, Wyo., schedule 7.	Robertson and Dean, Casper, Wyo.	143,820
2141	Columbia Basin, Wash	May 28	Dispatcher's board and desk for left powerhouse, Grand Coulee power plant.	Control Corp., Minneapolis, Minn.	21,302
2146	Colorado-Big Thompson, Colo	May 11	Outlet pipe for Soldier Canyon Dam, Horsetooth reservoir	Basalt Rock Co., Inc., Napa, Calif.	12,092
2153	do	May 21	Supervisory control equipment for control of West Portal and Shadow Mountain spillway from Granby pumping plant.	Control Corp., Minneapolis, Minn.	12,960
2158	Missouri Basin, Nebr	May 7	Construction of earthwork, canal lining, and structures for Cambridge Canal and earthwork and structures for drains.	J. A. Terteling & Sons, Inc., Boise, Idaho.	937,139
2159	Klamath-Tule Lake, Oreg.-Calif	May 21	Construction of earthwork and structures for laterals and drains in area A; and wasteway and culvert for J canal.	Ramsey Construction Co., Corvallis, Oreg.	91,655
2165	Davis Dam, Ariz.-Nev.	May 26	Steel towers for Davis Dam-Hoover Dam, Davis-Dam-Prescott, and Prescott-Phoenix 230-kilovolt transmission lines.	American Bridge Co., Denver, Colo.	1,958,416
2167	do	May 13	6 oil storage tanks for Davis power plant	Pacific Coast Engineering Co., Alameda, Calif	12,610
2168	Columbia Basin, Wash	May 14	Coupling capacitors and carrier-current line traps for right switchyard at Grand Coulee power plant.	Westinghouse Electric Corp., Denver, Colo.	34,868
2173	Missouri Basin-Boysen, Wyo	May 21	One traveling crane for Boysen power plant	Judson Pacific-Murphy Corp., Emeryville, Calif.	37,914
2174	Davis Dam, Ariz.-Nev.	May 26	Constructing foundations and erecting steel towers for 230-kilovolt Davis-Parker transmission line.	Charles J. Dorfman, Los Angeles, Calif.	128,139
2177	Colorado-Big Thompson, Colo	May 14	Discharge pipe bends and 1 junction branch for Granby pumping plant	Pacific Coast Engineering Co., Alameda, Calif.	34,600
2180	Shoshone, Wyo	May 28	Construction of earthwork and concrete chute for Willwood Canal	Sharrock and Pursel, Casper, Wyo	46,735
2181	Boulder Canyon All-American Canal, Ariz.-Calif.-Nev.	do	Construction of earthwork, pipe lines, and structures for units 2, 3, and 4, laterals 99.8 to 119.6 and sublaterals, Coachella Valley distribution system.	R. V. Lloyd & Co., Russellville, Ark	2,203,993
2196	Columbia Basin, Wash	May 6	Fabricated structural steel for bus structure for right switchyard and Grand Coulee power plant.	Bethlehem Steel Co., Bethlehem, Pa	162,385
2208	Colorado-Big Thompson, Colo	May 28	5 radial gates and hoists for spillway at Olympus Dam	Pacific Coast Engineering Co., Alameda, Calif.	30,430
R5-2	Rio Grande, N. Mex.-Tex	May 19	Construction of 115-kilovolt terminal facilities at Elephant Butte power plant.	Reynolds Electrical & Engineering Co., El Paso, Tex.	20,971
R6-Bis-6	Missouri Basin, N. Dak	May 6	Furnishing and erecting 16 prefabricated residences for Government Camp at Glen Ullin.	Hohn Construction Co., Glendive, Mont.	149,899
R7-8	Missouri Basin, Kans.	May 7	Sewerage and water distribution systems for Government housing at St. Francis, Kans.	Dobson Brothers Construction Co., Lincoln, Nebr.	11,292

Construction and Supplies for Which Bids Will Be Requested By September 1948

Project	Description of work or material
Boise, Idaho	Construction of laterals, earthwork, and concrete structures, Fourth Lateral unit, Canyon County, Idaho.
Do	Moving of cemetery in Anderson Ranch Dam reservoir area near Pine, Idaho.
Boulder Canyon-All American Canal, Calif.	Construction of culvert under highway and railroad near Yuma, Ariz.
Do	Pumping units for Coachella Valley distribution system.
Boulder Canyon, Ariz.-Nev	Butterfly valves, units A3 and A4, for Hoover power plant.
Central Valley, Calif	Construction of earthwork, lining, and structures for 27 miles of Friant-Kern Canal near Porterville, Calif.
Do	Construction of earthwork and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Radial gates and hoists for Friant-Kern Canal.
Do	Radial gates and hoists for Delta-Mendota Canal.
Colorado-Big Thompson, Colo	Construction of earthwork, lining, and structures for 10 miles of Horsetooth Feeder Canal, including a diversion dam on the Big Thompson River, 1 mile of tunnel, 12 concrete siphons, 1 steel siphon, and other structures, near Loveland, Colo.
Do	Construction of 32 miles of wood pole and 6 miles of steel tower 115-kilovolt transmission line from Granby pumping plant to Estes power plant.
Do	Elevators for Granby Dam.
Do	Radial gates and hoists for Granby Dam.
Columbia Basin, Wash	Construction of earthwork and structures for about 15.3 miles of the West Canal near Ephrata, Wash.
Do	Construction of earthwork and structures for about 8.3 miles of Potholes East Canal near Norden, Wash.
Do	Completion of Grand Coulee pumping plant, warehouses A and B, installation of pump discharge pipes, crest railings and lighting; construction of Feeder Canal headworks to station 3+12.12, machine shop and central heating plant, addition to right training wall, and water storage reservoir for Mason Addition, streets, sidewalks; assembly of face caisson; and rock excavation for Feeder Canal between headworks and station 35+00.
Do	Structural steel framing for Grand Coulee pumping plant.
Do	Freight and passenger elevators for Grand Coulee pumping plant.
Do	Elevators for right control bay at Grand Coulee Dam and power plant.
Deschutes, Oreg	Rehabilitation of buildings, including alteration, repair, painting and decorating at Madras Air Base, Jefferson County, Oreg.
Hungry Horse, Mont	96 inch ring follower gates for Hungry Horse Dam.
Do	96 inch hollow jet valves for Hungry Horse Dam.
Kendrick, Wyo	Erecting foundation and 115- and 57-kilovolt bus structures for Casper, Wyo., substation.
Klamath, Calif.-Oreg	Rehabilitation and extension of laterals and drains near Tule Lake, Calif.
Mirage Flats, Nebr	Erection of office building, 3 prefabricated residences, warehouse, utility buildings, well pumphouse, and elevated tank, and installation of utilities on State Highway No. 87 about 12 miles south of Hay Springs, Nebr.
Missouri Basin, Mont	Construction of Canyon Ferry Dam and power plant, a concrete structure about 15 miles northeast of Helena, Mont.
Do	Construction of concrete pumping plant and appurtenant structures on the Yellowstone River near Savage, Mont.
Do	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Moorhead Government camp, about 5 miles southwest of Moorhead, Mont.
Missouri Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot long concrete overflow structure, on the Republican River near Guide Rock, Nebr.
Missouri Basin, S. Dak	Construction of office building, garage and shop, warehouse, laboratory, mess hall, streets and walks, and installation of water and sewerage systems and other facilities at Shadehill Government camp, about 20 miles south of Lemmon, S. Dak.
Do	Construction of office building, garage and shop, laboratory, bunkhouse, streets and walks, and installation of water and sewerage systems and other facilities at Bixby Government camp, about 40 miles northwest of Faith, S. Dak.
Do	Construction of about 3 miles of access road at Bixby Dam, Perkins County, S. Dak.
Missouri Basin, Wyo	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Keyhole Government camp, about 18 miles northeast of Moorcroft, Wyo.
Missouri Basin, Wyo.-Nebr	Construction of about 170 miles of 115-kilovolt wood pole transmission line from Casper, Wyo., to Gering, Nebr.
Provo River, Utah	Construction of about 1 mile of 69-inch diameter steel or concrete cylinder pipe line for the Big Cottonwood secton of the Salt Lake aqueduct near Salt Lake City, Utah.

Special Excavator for Ditch Turn-Outs



ENGINEER L. M. ARMSTRONG of the Bureau's Gila project on the Lower Colorado River designed the "brain child" shown in the photograph at the left which provides economical excavation of turnouts from farm ditches. The equipment consists of a ditcher plow mounted on the trunnion bar of a D–7 caterpillar tractor and, at the right immediately below, it is shown in action. This efficient equipment excavates ditches at a rate of 24 cents per turnout as compared with $1.125 per turnout when a half-yard dragline was used. This device is practical for farm ditch excavation on various irrigation projects.

Above, after turn-out is excavated, concrete pipe is placed prior to backfilling which is done with the aid of a tractor with attached dozer blade shown at right. Cost of building excavator was $220. Armstrong's idea speeded installation of approximately 11,680 farm turn-outs on Yuma Mesa Division of the Gila Project in Arizona.

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AUGUST

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In This Issue:

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ONEER PIPELINE

by C. E. Mohler

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y Everett A. Pesonen

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"BONIFICA" in Italy

George E. Tomlinson

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THE Reclamation ERA

Reclamation Place Names in This Issue

United States Department of the Interior

J. A. Krug, Secretary

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Assistant Commissioner — Kenneth Markwell
Assistant Commissioner — Wesley R. Nelson
Assistant to the Commissioner—Engineering — T. W. Mermel
Assistant to the Commissioner—Management — G. S. Ellsworth
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REGION III: E. A. Moritz, Regional Director, Administration Building, Boulder City, Nev.
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REGION V: H. E. Robbins, Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.
REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Letters to the Editor

Sentiments from Siam

BUREAU OF RECLAMATION,
Region 5, Amarillo, Tex., May 30, 1948.

DEAR EDITOR: I would like to notify you of changing my address, because I am beginning to make the inspection trip in the western part of the United States in Reclamation work and after that return to Siam.

I am highly appreciative of your kindness for sending the RECLAMATION ERA to me during my training work with the Bureau of Reclamation. I am very glad to inform you I have found the ERA useful and informative, every article is very interesting and profitable to me, and it is going to give me a great deal of pleasure to make use of these publications in studying how to practice irrigation work and

(*Continued on page 148*)

Reclamation ERA

August 1948 **Vol. 34, No. 8**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, *Editor*

OUR FRONT COVER

A reclamationist on his own is young Jackie Robinett, son of a Kendrick project, Wyoming, irrigation farmer. Here he takes time out to paddle his canoe in an irrigation ditch. He made the improvised vessel from tin roofing. Note the nail holes sealed with cloth. This photo was taken by Norton T. Novitt of Region VII.

OUR BACK COVER

We are indebted to photographer George O. Bonawit of Region III for this excellent shot of Castle Peak in the Buckskin Mountains of Arizona. This unsolicited photo was taken from the California bank of the Colorado River near Parker Dam, Calif. ERA readers will remember Mr. Bonawit for his prize-winning photo of the Arizona Canal which appeared in the January 1947 issue of our magazine when he placed third in the professional class in the Bureau's photo contest held in the fall of 1946.

PIONEER PIPELINE

MAN-MADE RAIN IS FEATURED ON THE WEST UNIT OF THE DALLES—FIRST ALL-SPRINKLER IRRIGATION PROJECT TO BE CONSTRUCTED BY THE BUREAU OF RECLAMATION

by C. E. Mohler, Engineer,
Salem, Oreg., Office,
Region I

A SHORT DISTANCE BELOW CELILO FALLS, where the mighty Columbia River cascades into the quiet backwaters of Bonneville Dam, lies the city of The Dalles, Oregon. Surrounding the community in this scenic locality are 4,530 acres of crop land comprising the West Unit of The Dalles project.

It is there that an advancement in Federal Reclamation will be pioneered. Water is to be lifted more than twice as high as in any pumping plants previously built by the Bureau of Reclamation, and the project is the first to be approved on the recommendation that sprinkling facilities be provided for all irrigable lands.

An Area of Hillside Orchards

Water is to be pumped from the Columbia River to hillside orchards as much as 800 feet above river level under the irrigation plan recommended and approved by Secretary of the Interior J. A. Krug in March 1948.

Various plans for irrigation of orchards in the vicinity of The Dalles were rejected in the past because of insufficient water supply or excessive costs. In fact, without two important and rather recent technological developments, irrigation of the total area would still be infeasible. The first of these two is the abundance of seasonal power from the large-scale hydroelectric plants at Bonneville and Grand Coulee Dams. It is this power, available at low cost, that will lift the water to levels previously unattainable economically.

The second development is creditable to the manufacturers of pipes, sprinklers, and auxiliary equipment. Without these devices for applying irrigation water in the form of artificial rain, it is doubtful that the steep hillsides of the area would ever be irrigated successfully. Such terrain is definitely not adapted to the traditional method of delivering water through canals and farm ditches.

Many of the lands to be irrigated lie on high, rolling hills with occasional steep, rock slopes and deep drainageways. The fairly level bottom lands along the creeks are bordered by terraces with moderate slopes. Steep and strongly rolling uplands lie above the terraces.

Soils of the area are derived from weathered rock and shale underlying the hills. They are light brown in color with surface textures ranging from very fine sandy loam to silt loam. Except for insufficient moisture, the area is ideally adapted to orchard crops. Soils are sufficiently deep and of good texture. The steep slopes prevent accumulation of cold air with attendant frost damage. A dry, sunny ripening and harvesting period can be expected in almost all years. Fruit orchards as a result occupy most of the tillable acreage. Cherries, peaches, and apricots are the major fruit crops. The acreage in cherries has remained nearly constant in recent years at 57 percent of the project area, but peaches have increased in acreage while apricots have decreased. Other fruit crops are of slight and diminishing importance.

Orchard operators and others in the area have long recognized that rainfall is inadequate for full production. Available water supplies have been adequate for irrigation of only a small acreage, however. In 1946 only some 1,500 acres received any irrigation water.

At left: Lush orchards are the result of irrigation practices in The Dalles, Oreg., area. Above: Columbia River water supply which is used to irrigate Dalles project lands. ***Left photo by Stanley Rasmussen, above by B. K. Thomas, both of Region I.***

Although temperatures and the deep soils are favorable for orchards, low rainfall permits only wide spacing of trees and practically prohibits the use of fertilizers and cover crops. The orchards are clean cultivated to conserve moisture; as a result, much soil is lost through erosion on the steep slopes. Some of the steeper drains are mulched with straw to prevent gullying. Cherries must be pruned heavily at present, as there is much dead wood and little new growth without adequate moisture. Apricots and peaches are pruned severely in order to obtain fruit of adequate size. With such severe pruning, yields of all three fruits are necessarily lower than they need be if water were available.

Benefits of the Project

Irrigation of the area should reverse the recent downward trend in crop yields and assure continued fruit production. Low yields resulting from extreme water shortages would be eliminated.

The most immediate and noticeable local benefit of project irrigation would be the increase in annual gross crop value over nonirrigated conditions. This benefit is estimated at $831,000, or an average of $183 for each of the 4,530 acres. Increased net farm income is estimated at $318,200 per year, or $70.24 per acre before deductions for value of the operators' labor, water charges, and interest on additional investment.

Much of the increased production and resulting increase in income would be derived from the use of cover crops, for which past moisture supplies have been inadequate. Cover cropping prevents gullying and sheet erosion which remove valuable top soil from the orchards. Cover-crop residues increase organic content of the soil and improve its workability. The use of commercial fertilizers, which are desirable and profitable with high-value orchard crops, could be adopted.

The erosion hazard, partly overcome by covercropping, and the necessity of pumping the water supply through pipes over the rough terrain lead to adoption of the sprinkler method of irrigation.

Recommended Sprinkling Plan

The system has been designed to supply one cubic foot per second continuous flow for each 108 irrigable acres. This capacity is sufficient to apply 4 inches of water to all project lands during the peak demand period between July 1 and 20.

The method of operation on individual farms will be, of course, left to the choice of the farm operator. A very satisfactory arrangement now practiced in the area, however, is to move lateral pipes with their sprinklers twice a day, in the morning and in the evening. Both moves can then be made by daylight, irrigation is continuous, and there is ample time for other farm work through the day.

From his service outlet, generally at the low point of the farm, the operator would arrange his own system for applying water to the fields. Farm mains should usually be run down slopes with the sprinkler laterals as level as practicable. In orchards, the sprinkler heads are mounted in the area between adjacent trees on risers short enough to throw water under the low-lying branches. The sprinkler which the growers will probably purchase has a capacity of 5 to 7½ gallons per minute, and requires a minimum operating pressure equivalent to 70 feet depth of water. Designs provide for an additional 15 feet of pressure to overcome friction losses in the farm system. Each service outlet would be supplied with a meter for measuring deliveries and with a pressure-reducing valve to provide the most advantageous sprinkler pressures up to the maximum available in the system.

Welded steel pipe has been chosen as the most economical pipe for the project distribution system. The high pressures necessary (up to almost 950 feet head) exclude most other types. Besides having low first cost, steel pipe is installed easily and requires little maintenance.

All pipe, except the small standard weights, is to be coated and wrapped on the outside. Pipe over 10 inches in diameter will also be coated with coal-tar enamel inside. As the soils in the area are neither alkaline nor acid, this treatment is estimated to provide a useful life of the pipe in excess of 50 years. All field pipe connections are to be welded, except for sleeve type couplings, installed at about 760-foot intervals to allow for pipe expansion and ease of installation and maintenance.

The first mile and a half of pipe line from the pumps to an equalizing reservoir, would be 36-inches in diameter with a wall thickness of eleven-sixteenths and a carrying capacity of 42 cubic feet per second. The next section would be of 30″ pipe with ½″ wall and continue to the reservoir without reduction in diameter but with wall thickness gradually decreasing to 7 gage. The pipe lines would be buried wherever possible with a minimum of two feet to cover.

Pipe Delivery System

The pump-reservoir and main distribution lines are to be sectionalized by gate valves so that a line can be repaired without shutting down the entire system. To reduce high stresses caused by a sudden halting of the flow of water, these valves would be of a slow-closing type. Combination air-release and vacuum valves would be placed at all high points of the line, at all abrupt breaks in slope, and immediately below gate valves to permit escape of entrapped air when the system is operating and to eliminate collapsing stresses when it is emptied suddenly. Blow-off valves would be installed at all low points and just above sectionalizing gate valves to drain the line for repairs or to protect it from freezing after the end of the irrigation season.

Lateral pipe lines are laid out to serve as large an area as possible and thus reduce the size of the main line beyond the lateral connection. The laterals would follow the ground profile and be buried at least two feet. Service connections would be made to the laterals at the lowest point of the farm to be irrigated. Each farm would receive one or more service outlets, except for areas of less than one acre, which would share an outlet. Blow-offs, air and vacuum valves, and shut-off valves would be installed wherever required in the laterals.

An equalizing reservoir lined with concrete would be provided to maintain more uniform pressures and aid in operating the pumps. The reservoir would have a capacity of 1.5 acre-feet (about 490,000 gallons). Water surface of the

(Continued on page 154)

Sacramento Salmon Resettled

New "Nursery" for salmon propagation established below Shasta Dam

by Everett A. Pesonen
Recreation Specialist, Region II, Sacramento, Calif.

The familiar magazine cover picture of a big buck salmon rocketing up a waterfall against gravity and the plunge of the stream, truly shows you not only the great size and strength of this magnificent fish, but also the tremendous driving power of the instinct which sends him back from the furthest ocean to spawn in the river that bore him.

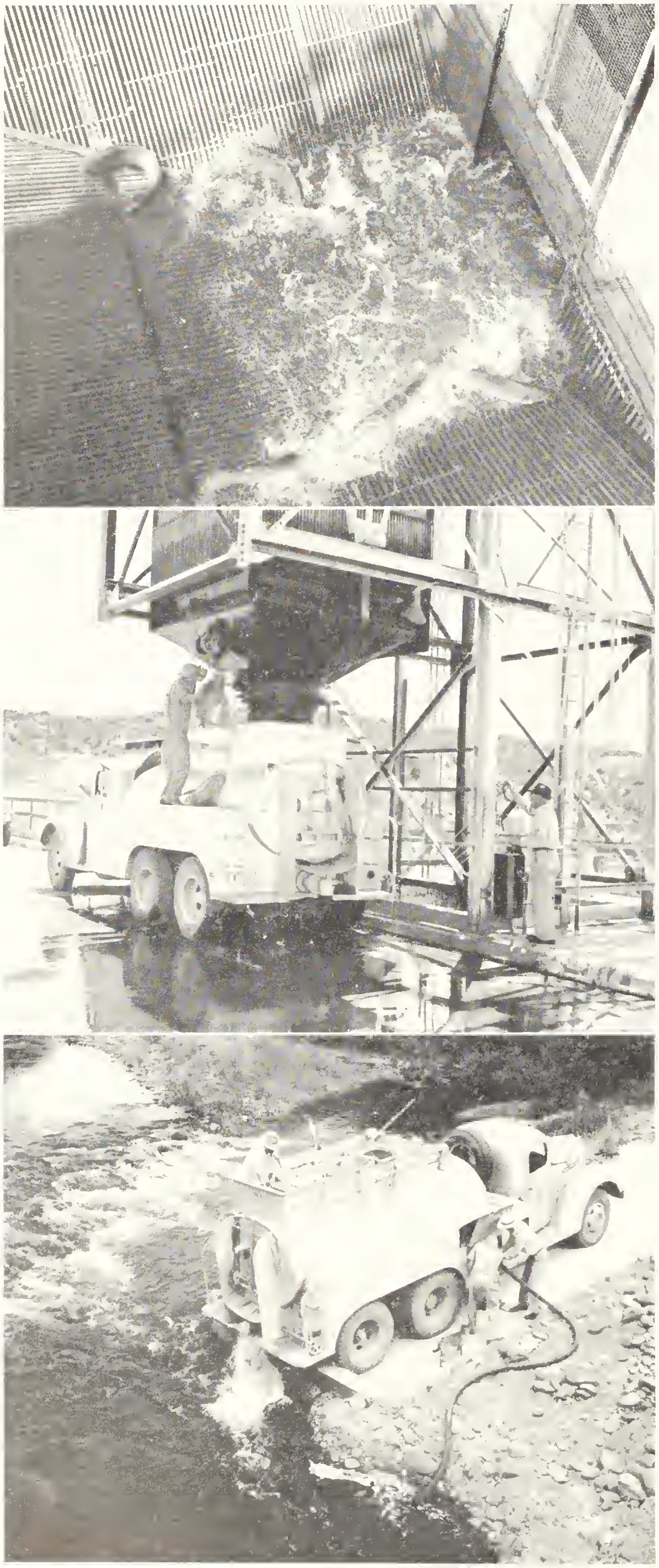
The salmon's urge to complete his existence in his own home stream makes possible the multimillion-dollar fishery of the Pacific Coast. And it also makes concern for the salmon's welfare a major consideration in building dams across West Coast waterways. Exhibiting this concern, one of the largest "salmon salvage" programs on any Pacific Coast river has been undertaken by the Bureau of Reclamation at Shasta Dam, key unit in California's Central Valley project, a 600-foot-high concrete barrier below the junction of the four principal streams that form the main stream of the Sacramento.

When Walker R. Young, Construction Engineer, arrived in 1935 to set in motion the machinery for building Shasta Dam, he found that salmon had been forgotten in the concern for water conservation. No provision, he found, had been made in project plans to compensate for ancestral spawning grounds which the dam would cut off. The salmon's plight was called to Mr. Young's attention by the California Division of Fish and Game and the United States Bureau of Fisheries (now a part of the Fish and Wildlife Service). There was no information on which to base a conservation program; apparently everyone had taken the presence and persistence of the salmon for granted. So Mr. Young saw to it that funds were allocated from the Bureau's appropriation and enlisted the aid of the fish conservation agencies in working out means to relocate the runs below the dam.

In 1938 a platoon of biologists and engineers, under the direction of Dr. Paul R. Needham of the Bureau of Fisheries set to work on the problem. They were to determine the numbers of salmon involved, to survey downstream areas where they might be relocated and to devise artificial measures to compensate for the stretch of river to be cut off—if alternative streams and spawning areas could not be found.

A counting station was set up at the Anderson-Cottonwood

Top right: Closeup of large female salmon. Note teeth and undershot jaw of male lying on slats outside box. Immediate right: Fish scales are used to determine salmon food consumption. Lower left: Removing salmon from Battle Creek for artificial spawning: Below: Fish truck discharging salmon into holding basin at Coleman Hatchery. *Photos by W. W. Nell and J. E. Fluharty, Region II.*



MR. FISH takes a trip. In top photo, about 10 large chinook salmon battle the fish trap at Keswick Dam. But it's a losing fight and they are gradually forced into the gate and elevated to the top of the Dam where they are deposited in Fish and Wildlife refrigerated truck (center) for trip to Deer Creek. In bottom photo, water is pumped into the truck from the future propagation stream to acclimate the imprisoned salmon to their new home. ***Photos by J. E. Fluharty, Reg. II.***

irrigation district dam at Redding, to keep a tally of every salmon leaping the narrow weir through which the runs were funneled. The cobbled gravel riffles of the Sacramento, McCloud, and Pit Rivers and their tributary creeks were surveyed. Forty square feet was allowed for each salmon nest in calculating spawning areas cut off and estimating the adequacy of the substitute grounds.

Time pressed the investigators. The minimum period for counting the size of the runs is 4 years, the usual life cycle of the chinook salmon. But both the investigations and the plans for "salvage" had to be completed within 2 years. To assure the best possible solution, the Bureau selected a "Board of Consultants"* to evaluate the findings and recommendations of the investigators and to recommend a plan from the various alternatives proposed.

The Board finally selected a scheme advanced by Fred J. Foster, Director of Fish Culture in the Bureau of Fisheries. His plan was based on the gloomy promise that Shasta would cut off a good 60 percent of the spawning in the entire Upper Sacramento River system.

The Foster plan provided for taking care of 25,000 fish, the number estimated to spawn above Shasta Dam, by transferring 3,000 of the spring run 60 miles south, to Deer Creek, and 3,000 more to holding ponds to be established 30 miles downstream, in Battle Creek. The purpose of the transfer was to escape high water temperatures anticipated to prevail in the river. In addition, 4,000 fall-run fish, expected to arrive before the water cooled, were to be trapped and transferred to Battle Creek for holding and artificial spawning during the period that the dam was under construction. All fall-run fish were to be left to spawn naturally in the river after the dam was in operation.

By 1943, Bureau designers, working with Fish and Wildlife Service experts, were ready to carry out the Foster plan with a unique fish trap in Keswick Dam, an afterbay structure 9 miles below Shasta Dam. In this trap the fish, lured by a series of weirs resembling low waterfalls, end up in a flytrap entrance into a hopper-shaped elevator. The elevator rises up through the dam to a derrick perched on the crest. Here the fish are dumped into special tank trucks, which are equipped with refrigeration and aeration pumps, and are hauled 30 miles to Coleman Hatchery, another major unit of the salvage plan.

At the hatchery, racks or barriers are provided in Battle Creek to hold the fish until "ripening" in September, October, and November. Eggs are removed from "ripe" females, fertilized with milt from the males and placed in hatching trays, where they are kept in running water until they hatch, about 60 days later. In four to eight weeks after hatching, the yolk-sac of the egg, which remains attached to the fry (or parr), as the young fish are called, is absorbed and the "fingerlings" are ready to feed. Soon after, they may be released to start their 300-mile journey to the Golden Gate and the open sea.

For four years, up to and including 1946, spring-run salmon were hauled to Battle Creek and Deer Creek according

(Continued on page 160)

*The three members of the Board were R. C. Calkins, now Dean of the College of Commerce, Columbia University; W. F. Durand, Professor (Emeritus) of Mechanical Engineering, Stanford University; and Willis H. Rich, Professor of Biology, Stanford University.

EDITOR'S NOTE: This is the second and concluding part of an article reprinted from the May 15, 1948, issue of COLLIER'S through the courtesy of its editors and the special permission of Associate Editor Lester Velie, the author.

ARE WE SHORT OF WATER?

By LESTER VELIE

(Part Two)

Other Americans are learning to import water, too. At Coalinga, Calif., drinking water must be hauled in by tank cars from 45 miles away. The town's wells finally had gone so deep they hit salt beds which made the water unfit to drink.

Long Beach, Calif., scene of vast aircraft production during the war, isn't importing drinking water yet, but galloping salt encroachment from the sea is giving the town a bad fright. Thirsty war factories and a mushrooming community gulped so much water from underground pools that water levels, once above the sea, are now as much as 75 feet below sea level. As the fresh water retreats, the ocean seeps into the water-bearing beds and puts wells out of business. Already in possession of a 2-mile beachhead, the salt water invader is pushing forward several hundred feet every year, and townsfolk talk of building a sort of underground Maginot line of concrete to contain it.

But the trouble lies not only in the Southwest. The Middle West, and East, too, generally unperturbed about water, are drawing down their underground supplies. Water levels under the downtown district of Louisville, Ky., have dropped 40 feet in 10 years, and in the town's outskirts, distillers and synthetic-rubber producers hoard their water like misers to forestall their warborn dread—vanishing water. At Indianapolis the water table below the center of town is down as much as 50 feet. Air-conditioning systems, the newest arrivals at the water trough, have been gulping giant draughts of the city's water and are posing this hard question for the rest of America, too: What to do about it?

Baltimore had to reduce pumping at the beginning of the war when wells became contaminated with salt. Philadelphia's water has been tasting more like Epsom salts every year. Brooklyn's water used to arouse as much comment as the Dodgers because overpumping pulled it down 35 feet below sea level and gave it a rank, musty taste.

"The way we've used up our ground water without regard to the way nature puts it back is scandalous," said government geologist Sayre.

A limiting factor now on industry and agriculture in some areas, the scarcity of water will dry up our future growth unless we know how much water is available and then use it wisely, he added. We can only go as far as our water will go.

Here's why: It takes 65,000 gallons of water to produce a ton of steel (water is used chiefly for cooling). It takes 7 to 10 gallons of water to produce 1 gallon of gasoline. It takes fifteen gallons of water to make 1 gallon of beer. It takes 800,000 gallons to irrigate 1 acre of oranges. And when we get around to making synthetic fuel from coal or shale it will take as much as 50,000,000 gallons of water per plant per day. Where's the water coming from? Much of it will have to come from wells, for more than half of our daily water—or 20,000,000,000 gallons—comes from underground.

The industrial East has its water troubles cut out for it. The problem is growing, but things are coming to a head in the arid and semiarid Southwest. In California there are two kinds of weather: "perfect" (which means all sunshine) and "unusual." San Diego calls itself "heaven on earth" because it rains only nine days in a year. Rain is rare in southern California and in the Southwest from May through September. The fertile land there is largely a reclaimed semidesert area that by the grace of water taken from underground or rivers is blooming with oranges, dates, cotton, grapes, and alfalfa. As one California farmer put

At left: Good wells are hard to find. Only a dribble comes from this one at Fairfield, Calif. At right: This parched orchard, near Friant-Kern Canal (under construction) was abandoned when water gave out. ***Left photo by J. E. Fluharty; right by B. D. Glaha, both of Region II.***

it: "You're just a slave to your well, or to your irrigation ditch."

It's not his name, but call him Elmer Clay. Clay has his grove in lush San Joaquin Valley. Nightly he would be lulled to sleep by the double-beat, sighing rhythm of his well pump.

With each stroke, the rod and plunger would shoot 400 feet into the earth and force up the gushing water. Down, up, down, up, chough, chough, chough, went the pump, playing a lullaby. That meant to Clay that all was well with his world; that his 20 acres of oranges would bloom, that tiny Valencias would come and grow steadily through the rainless summer and fall. Then one night he sat up suddenly in bed, awakened as rudely as if a bell had clanged in his ear. But he hadn't been aroused by a sudden noise. He had been awakened by a sudden silence.

It was the pump. The even beat had ceased, and now after a moment there came an uneven hammering. The next morning Clay knew the worst. His well was dry. His pump was sucking air and rattling itself to pieces. A new well and pump would cost at least $4,000. Already mortgaged beyond his means, Clay bitterly turned away from his grove.

"Banker, come and get her," he said.

From Poor Richard

"When the Well's dry, they know the worth of Water."
—Benjamin Franklin's Almanac

Clay had cause to be bitter. He had bought his grove just two years before, paying $2,000 an acre for it. A fantastic price? You might as well have tried to convince an old forty-niner the investment in his gold diggings was too steep. For gold is coming to California's 500-mile-long Central Valley—liquid gold in the form of river water. The Government's Bureau of Reclamation will spend more than $3,000,000,000 in the next decade to alter the courses of 2 rivers, build 20 reservoirs and cut a dozen canals to open up land for 50,000 new farms. (*This is in the planning stage—Ed.*)

But the new canals are still some years off, and Elmer Clay's well gave out before Government water could come to the rescue. Other wells throughout the valley are giving out too. The reason is that, lured by the promise of ample water, farmers and speculators have started a land rush, opening up arid lands, sinking more wells and sinking them deeper, and draining off the underground water.

"Let me show you what's going on in this valley," Richard Stark, a prosperous orange grower at Lindsay, Calif., urged. "You've got to see it from the air to appreciate it."

We climbed into a four-seater Fairchild and were soon bumping along high over the southern San Joaquin Valley, with its geometric pattern of orange groves, cotton and vegetable farms and white towns. From an altitude of 1,500 feet, evidence of the great drought could be seen everywhere. To the west, the peaks of the Sierra Nevada wore tiny caps of white, and through the afternoon haze the foothills showed a uniform, dusty brown.

"What a pitiful sight!" Stark exclaimed. "At this time of the year (early March) the mountains are usually white with snow halfway down their sides and the foothills are a deep green. Those grazing lands," he continued, pointing to a bare gray waste of land, "should be ablaze with poppies and lupins. This year there's nothing."

The grazing lands were as bare of cattle as they were of flowers. Some 100,000 head of steers had been shipped to Idaho and Colorado and whatever other States could provide pasture.

"Now watch this," Stark said, as we passed over the parched bed of the Tule River and swung south toward Bakersfield, the southern terminus of the Central Valley. Below there appeared signs of vast activity which even a newcomer to the area couldn't mistake.

We could see, interspersed among the green patches of old cultivated land, thousands of acres of raw land being newly rolled and leveled in preparation for planting. With their straight-cut furrows the newly broken lands stretched away as far as the eye could see, like so many pieces of precisely ruled graph paper.

High prices for cotton and onions and carrots and lettuce and spinach were luring hopeful farmers to break the raw lands. So was the prospect of ample, new irrigating water. Both attractions may lead the farmers into a tragic trap.

"Every one of those thousands of newly broken acres down there will have to be irrigated with water from wells," my guide said. "We have no other water yet. That means we'll need one and a half to three additional acre-feet of well water for every new acre. Now, where's the water coming from?"

Because there's a power shortage in California as well as a drought, Central Valley farmers may not be able to keep their pumps going the required 24 hours a day, and so they face disaster this summer. But even if there were no power shortage, the arithmetic of the water situation just doesn't add up.

The point is that a canal, now under construction, the Friant-Kern, will bring 800,000 acre-feet of water annually into an area that now needs about 2,000,000 acre-feet. That leaves a deficit of 1,200,000 acre-feet to be made up by pumps ing. But nature doesn't put that much water underground each year into the southern San Joaquin area, and the water must inevitably give out unless ways can be found to recharge it artificially.

The exhausting of the water supply has gone a long way. At Delano, which lies in the heart of the newly developed country, underground water levels have dropped 220 feet in 20 years, and wells now reach 1,200 feet into the bowels of the earth. Other districts all over the San Joaquin Valley are losing their water at alarming rates. Someday soon California must cut its farming to fit the water supply.

If the water situation in the San Joaquin Valley keeps farmers awake nights trying to figure some way out, the problems in addition and subtraction posed by the Colorado River are still more of a nightmare to the whole Southwest. Once a savage torrent that terrorized the desert country with its floods, the river has been tamed by three monumental dams and loaded down with a water-supply burden too much even for its great resources. It furnishes power and water to *seven* States.

Man proposes great plans for southern California, Nevada,

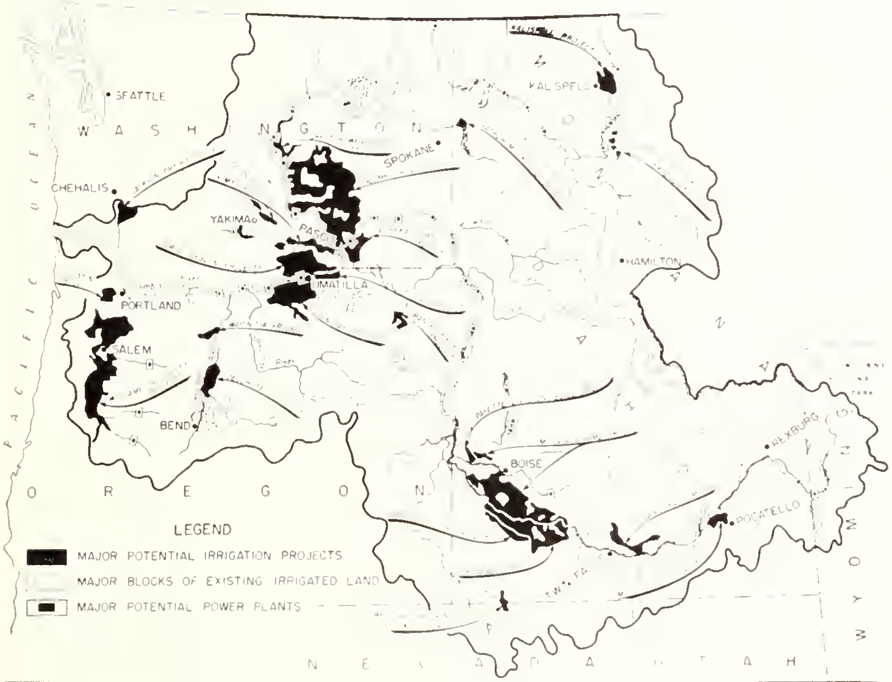
(*Continued on page 148*)

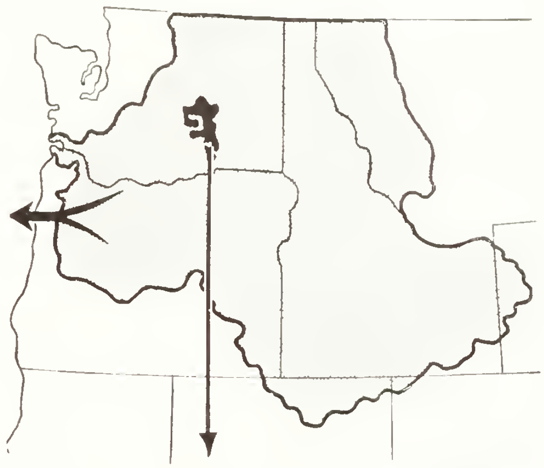
FLOOD DAMAGE in the COLUMBIA BASIN

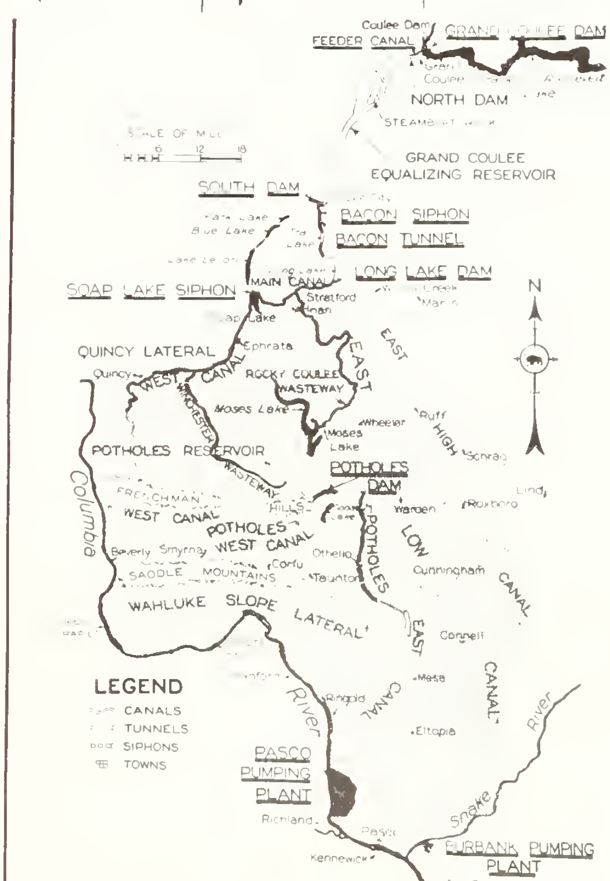
Front page news featured the 1948 flood in the Pacific Northwest where several major Reclamation developments are located. Among those to feel the fury of the flood most seriously was Grand Coulee Dam. Here the high water washed away considerable sections of the heavy protective blanket of rock on the river banks immediately below the dam. Three shifts of emergency crews swung into action and carried on protective maintenance throughout the floods holding the damage at a minimum and taking necessary action in the event of possible slides. Emergency electric service facilities were installed in the Government hospital at Grand Coulee because the power circuit serving the portion of the town of Coulee Dam on the east side of the river was severely threatened. The power output at Grand Coulee Dam was reduced from the overload peak of 125,000 kilowatts per generator to the nameplate capacity of 108,000 kilowatts. There are nine of these huge generators in operation at the plant.

Emergency calls for men and equipment available at Grand Coulee Dam were received from various points in the Okanogan and Wenatchee Valleys as well as the hard hit Portland-Vanport zone. Every possible assistance was rendered to these stricken areas as well as occupants of a number of houses near the right bank of river below Grand Coulee Dam.

Columbia River Basin Plan







Columbia Basin Project

SEE THE DIFFERENCE?

Strange as it may seem, we have had inquiries which showed that people are beginning to confuse the Columbia River Basin Plan with the Columbia Basin project. Although the names are similar, there is a big difference as you can see. Directly above is a map of the Columbia River Basin Plan, while at the immediate right is a map of the Columbia Basin project, now under construction. In the upper right hand corner an outline drawing shows the over-all Columbia River Basin Plan in gray with the Columbia Basin project identified by the small black area.

The River Basin Plan would provide for the development of natural resources in five States, namely Idaho, Montana, Oregon, Washington, and Wyoming, while the Columbia Basin project provides for such development in the State of Washington only. This project with almost half of its power facilities completed and work well under way on the irrigation system which will ultimately irrigate approximately one million acres of rich farm land actually would form a nucleus for the River Basin Plan.

Are We Short of Water?

(*Continued from page 146*)

and Arizona. But the Colorado River disposes. One of these days it will serve an ultimatum: The feverish growth of the Southwest must stop! The seven dependent States have made claims on the Colorado that add up to more water than it can furnish them. Someone someday will have to decide which areas shall stop growing.

The two States most determined to grow and live in the manner to which the war accustomed them are California and Arizona. More people have moved to California during the last several years than there are in the whole State of Virginia. About 2,000 migrant families pour in every week. On a smaller scale, Arizona has enjoyed a similar expansion. The consequent cries for water have the desperation of a thirsting camel driver.

All this proves that the energies of westerners, as well as easterners, are likely to be directed toward opening up new supplies of water or battling over old ones. Little effort has as yet gone toward conserving water, the only alternative.

Underground Water Laws

Only 8 of the 48 States have laws governing the use of underground water. In the others a man is free to punch a hole down into the earth until he strikes water. If he drains off a neighbor's supplies there's nothing that the neighbor can do about it. Or if an office-building owner wants to use his town's underground resources for air cooling, there's nothing to stop him, either, from letting it run down the drain after he is through with it.

Most of the eight States that conserve their underground water passed their laws under compulsion of bitter necessity. The Roswell Basin in New Mexico used to boast huge flowing wells that yielded 9,000,000 gallons daily. By 1925, many wells had stopped flowing. The artesian water levels were sinking. As the water table went down, money interest rates in the area went up. Bankers would take no chances on farm land whose water was failing. The State called in the water experts of the United States Geological Survey. They found the wells were losing water through holes in the casings and that, anyway, the water was being overpumped.

A State control law, passed in 1930, requires permits for drilling wells and empowers the State engineer to require that leaking wells be plugged. This has been a successful conservation program. Forty-five thousand acres were being irrigated in the area in 1930. Now the figure is 100,000 acres. And interest rates are down again.

A New York State law requires that for every well sunk to provide air conditioning in the four Long Island counties, which include Brooklyn, another must be used to return the water to the ground.

The average American requires more than 100 gallons of water each day. Only part of it is used for drinking or washing. Most of it is needed by the industries or farms that support his community. Europeans use only a quarter of this—a key to the difference in the standards of living. Like the car and the radio, ample water is part of our way of life. It is even part of our national defense. During the last war some 300 proposed war-plant sites had to be discarded because of water scarcity. Should another war come, geologists warn us, it would be more difficult to locate plants than ever before. The situation, geologists insist, is by no means hopeless. But as in the case of our mineral and other resources, it is time we take stock of how much water we have and learn how to use it without using it up.

One hundred and forty-five millions of us can't live on this continent of ours without drawing on its water. We found we could use wood and still conserve trees. We can do the same with water. It looks as if we'll have to stop letting our most basic resource flow down the drain. THE END

RIVERTON MAP

A new Riverton Project map has just been received from the printer.

Map No. 48-4, in 4 colors, red, blue, green and black, size $10\frac{1}{2}$ x 17 inches, price 15 cents.

Same map, size 21 by 34 inches and numbered 48-4A, price 25 cents.

Copies of these maps can be obtained by sending check or money order payable to Treasurer of the United States, to Director, Region 6, Bureau of Reclamation, P. O. Box 2130, Billings, Mont. Stamps are not acceptable.

Dam Named for O'Sullivan

James O'Sullivan, popularly known as the "Grand Old Man of Grand Coulee Dam" (See November 1946 Era) was recently honored for his efforts to make the Columbia Basin project a reality, when President Truman signed Senate Joint Resolution 202 which changed the name of the Potholes Dam in the Columbia Basin project to the O'Sullivan Dam.

Letters to the Editor (*Continued from page 2 of cover*)

everything in engineering, which I appreciate very much. I believe the RECLAMATION ERA will be very interesting to Siamese engineers when I return to Siam.

Very sincerely yours,

CHAIN ATTHAYODHIM,
Siamese Engineer.

Words to Remember

Merriman Bros. Inc., manufacturers of marine hardware, blocks and rigging, self-lubricating bearings, powder metallurgy products, megaphones, of 185, Amory Street, Boston 30, Mass., sent us a letter which contained the following heartwarming sentiment:

"* * * we do not wish our subscription to your publication to ever run out, and will certainly see to it that it is paid up well in advance."

"Bonifica" in Italy

*The Italian word for reclamation. Loosely
anslated it means "for the good of the land."*

by George E. Tomlinson,

*Assistant Director of Branch of Project Planning,
Bureau of Reclamation*

Dr. M. A. McCall, Assistant Chief of Bureau of Plant Industry, Department of Agriculture, Counsel Aldo Loni of the Foreign Office, and George E. Tomlinson, Assistant Director of Project Planning, Bureau of Reclamation, discuss calcium deposit as part of fight on foot and mouth disease at Arborea.

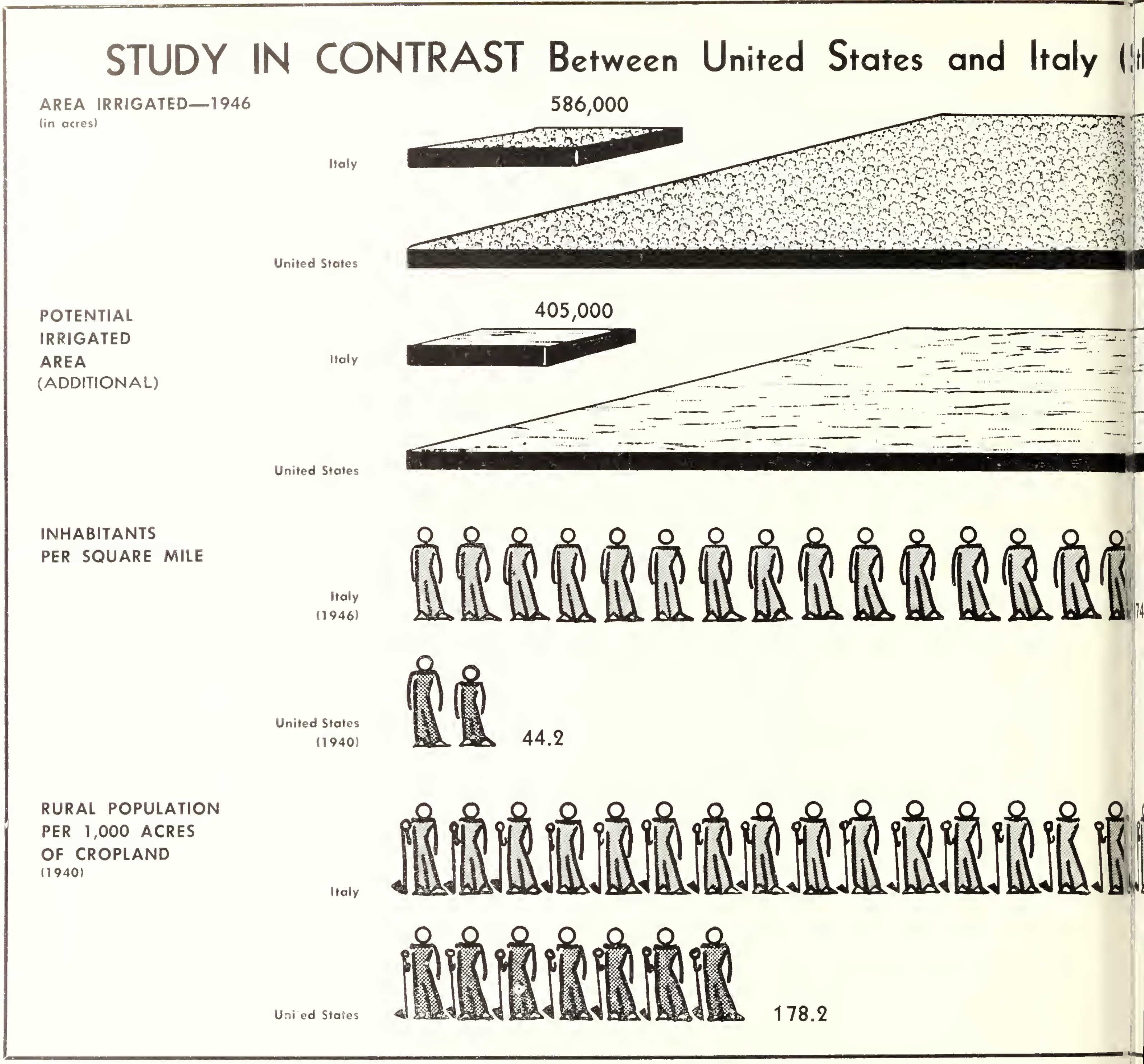
"WHAT ITALY NEEDS IS RECLAMATION!" This is what farm leaders everywhere told us on our recent tour rough the ancient lands of the Romans.

The United States State Department, at the request of the lian Government, sent a Technical Mission to Italy to sur- the possibilities of further development of irrigation, ricultural and hydroelectric resources in Southern Italy, cily, and Sardinia. This mission, composed of Dr. M. A. Call, Assistant Chief of the Bureau of Plant Industry, partment of Agriculture and the author, traveled extenely by airplane, automobile, train and on foot, in the 6 eks devoted to this survey.

We were joined by outstanding Italian engineers, agri- lturists and economists to form a joint Italian-American mmittee. On our tour of the several areas we observed isting and proposed projects in the irrigation, drainage, droelectric and general agricultural fields and became quainted with problems and opportunities in the area as vhole. The areas covered by the survey are generally recnized as being the areas with the most serious problems in Italy.

The Italian farmers, like some of our own farmers here in e United States, are handicapped by too little rain or too ch rain at the wrong time. The annual rainfall is usually inches or less, and frequently less than 10 inches. To make atters worse, the distribution of the precipitation is very poor, resulting in maximum stream flow in winter and early spring, with less flow or none at all at other times. Most of the streams were dry when we visited there in April and May, although there was considerable evidence of serious flood damage earlier in the year.

The Italian topography ranges from flat coastal plains, through rolling country, to mountainous areas. Unfortunately, the percentage of level land is small with the result that too large a percentage of land on the steeper slopes is used for grains and other crops. This land has been farmed

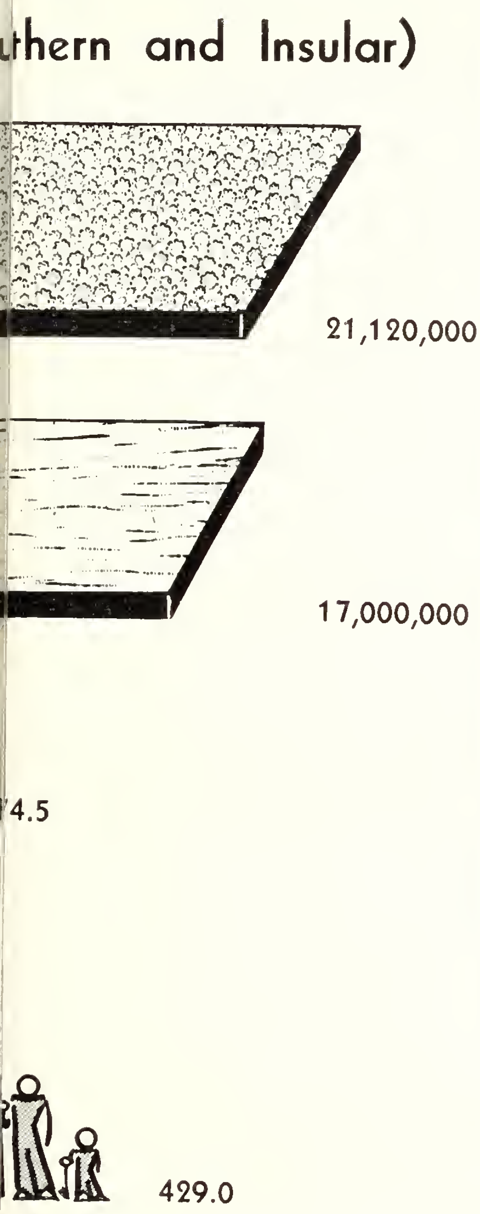


for many centuries. The "age" of the country is a matter of public pride. We saw the partially restored city of Pompeii which was destroyed by Vesuvius in 79 A. D.; cathedrals, such as the "relatively new" one at Lucera which was built in the 13th century, and the still-intact fortresses, called Nuraghas, in Sardinia which are estimated to have been built about 5,000 B. C.

I was especially interested in an ancient dam, the Grotticelli in Sicily. This aged structure, though overburdened with the weight of years of silt, is still in use today. You'll notice in the picture the old and "new" sections. The lower part was built by the Arabs in the 12th century; the dam was remodeled and raised in 1563; and it was remodeled again in 1926.

Speaking of age in Italy, one of their great problems is the long and continued use of the land. In Sicily and South Italy in particular, and to a lesser degree in Sardinia, population pressure is so great that the amount of presently available good land is insufficient under the present systems of intensified use. This unhappy combination makes it necessary to force lands into cultivation which either should not be farmed or should be cultivated only by the most careful methods to prevent erosion and serious deterioration. The situation is critical not only because it seriously lowers living standards of peasants on such lands, but also because it is a menace to soil resources in extensive areas.

The long and continued use, and *over* use of the land has taken its toll in the form of heavy erosion in the upper reaches



Basic Statistics

	Southern Italy (continental)	Sicilia	Sardinia	Total (southern and insular)	United States
Total area (1,000 acres):	18, 102	6, 350	5, 952	30, 401	[1] 1, 903, 000
Nonagricultural, nonforest use	(2)	(2)	(2)	(2)	[1] 53, 000
Nonbeneficial use	743	323	212	1, 278	[1] 77, 000
Agricultural and forest use	17, 359	6, 027	5, 743	29, 129	1, 773, 000
Land use of agricultural and forest area (1,000 acres):					
Area in pastures, forests and woodland	6, 483	1, 150	4, 132	11, 765	[1] 1, 315, 000
Cropland harvested	10, 692	4, 862	1, 611	17, 165	[1] 359, 000
Other cropland and farm use	[3] 184	[3] 15	[3] 0	[3] 199	[1] 99, 000
Percentage distribution of land use:					
Pastures, forests and woodland	37. 3	19. 1	71. 9	40. 4	74. 2
Cropland harvested	61. 6	80. 7	28. 1	58. 9	20. 2
Other cropland and farm use	1. 1	0. 2	0. 0	0. 7	5. 6
Area irrigated (1,000 acres):					
1946	339	215	32	586	21, 120
Potential (additional)	269	74	62	405	17, 000
Population (1,000):					
Italy:					
1911	8, 548	3, 672	852	13, 072	
1936	10, 652	4, 000	1, 034	15, 686	
1946	11, 489	4, 356	1, 196	17, 041	
United States:					
1910					[4] 91, 972
1930					[4] 122, 775
1940					[4] 131, 669
Rural population (1,000):					
Italy, 1936	5, 093	1, 784	525	7, 402	
United States, 1940					[4] 57, 246
Percent of total	47. 8	41. 6	50. 8	47. 2	43. 5
Inhabitants per square mile:					
Italy:					
1911	311. 9	390. 1	95. 1	290. 6	
1936	392. 6	424. 8	115. 3	344. 5	
1946	423. 5	451. 7	133. 4	374. 5	
United States:					
1910					30. 9
1930					41. 2
1940					44. 2
Rural population per 1,000 acres of crop land	477. 5	364. 2	323. 8	429. 0	[5] 178. 2
Power (kilowatts) 1946:					
Hydroelectric installed	761, 666	70, 124	45, 506	877, 296	[6] 14, 848, 491
Hydroelectric potential	412, 836	180, 831	96, 980	690, 647	[6] 77, 130, 000
Other installed	51, 847	38, 195	33, 570	123, 612	[6] 35, 468, 130
Total installed power (kilowatts) per 1,000 inhabitants	70. 8	24. 9	66. 1	58. 7	382. 1

[1] Data for 1930 from National Resources Board's Report of Dec. 1, 1934.
[2] Not reported.
[3] Not reported. Computed as difference between total area in agricultural and forest use and the sum of cropland harvested and pasture, forest and woodland area.
[4] Source—U. S. Census.
[5] Rural population 1940 (57,246,000) and cropland harvested in 1940 (321,242,000 acres).
[6] Source— U. S. Federal Power Commission.

of the river basins and the inevitable byproduct—heavy deposits of the eroded soil, gravel, and boulders in the low lands near the coast line.

It was not difficult to recall the legend concerning King Alaric of the Visigoths, who died at Cosenza in the sixth century after conquering Rome. The Goths, incidently, gave us our gothic style of architecture. The legend relates that his followers buried the king next to the Busento River and then diverted the flow over his grave for a short while. After the silt deposits had completely hidden the grave, the dikes were mended and the river returned to its regular channel. Although the accuracy of such a story is subject to some question, it does support the belief that for many, many years, these streams have been carrying tremendous loads of soil and other materials, eroded from the upstream areas.

In the coastal low lands the river has brought down such heavy loads of eroded material that efforts to confine it to its banks by levees and keep it off the adjacent lands have resulted in a gradual raising of the river bed. Restrained only by concrete side walls, the river, now in effect a huge "aqueduct," several hundred feet wide, flows through the valley at an elevation of more than 10 feet above the surrounding country.

The resourceful Italians make the best of the unfortunate distribution of their meager rainfall which comes at such inopportune times. For example, in the coastal area between Foggia and Bari, engineers have diverted the floods of the local rivers into diked-off marsh areas. Over the past 100 years they have been able to reclaim about 12,000 acres, by filling to a depth of six feet or more with the sedimentation thus "milked" from the flood water. This is a slow, gradual process, but one which is being prosecuted continuously with the reported objective of eventually reclaiming a total of about 25,000 acres in that area.

Enterprising peasants who have settled in the marsh country in nearby areas have built their tiny farmsteads by laboriously using baskets, or in some cases carts, to carry precious soil to these small tracts of low land that they have acquired by exercising "squatters' rights." These little farms have been enlarged over several decades until most of them now contain a couple of acres or more. Nature has not favored these people any too well. Although they are relatively safe from the ravages of water erosion, they have to take back-breaking measures against wind erosion. Figure 2 shows how a farmer has carefully placed straw between the rows to anchor his "farm."

Italian farmers in a number of coastal areas are faced with still another land problem—that of salinity, if they pump too heavily from the high ground water table.

We observed a different form of land reclamation in an area near Foggia where relatively flat land was underlain with a stratum of limestone rock 12–18 inches thick and lying so close to the surface of the ground (15–20 inches) as to make farming impracticable. Because of the scarcity of land, the owners of this property were removing this ledge of rock by hand labor. This is a costly, slow process of reclamation. Because of recent changes in the exchange rate between the Italian lira and the American dollar, money values are meaningless to the average reader; however, it is estimated that in the neighborhood of 400 man-days of labor are required per acre for this method of acquiring more land to cultivate.

To understand Italy's reclamation needs we should look at a few figures on acreage, population, and extent of power development. The lack of kilowatts for farm and industry will be discussed in a separate article. Italian members of the study group supplied the basic Italian information for the table on page 150. For comparison purposes, corresponding data concerning the United States are given.

These figures show that Italy needs more good land under cultivation to feed her increasing people. The population in over-all Italy is growing at the rate of about 400,000 persons a year, or at a net annual increase of about 0.85 percent. The increase in Southern and Insular Italy is higher than the national average. Consequently, it appears that the already overpopulated areas are becoming more crowded.

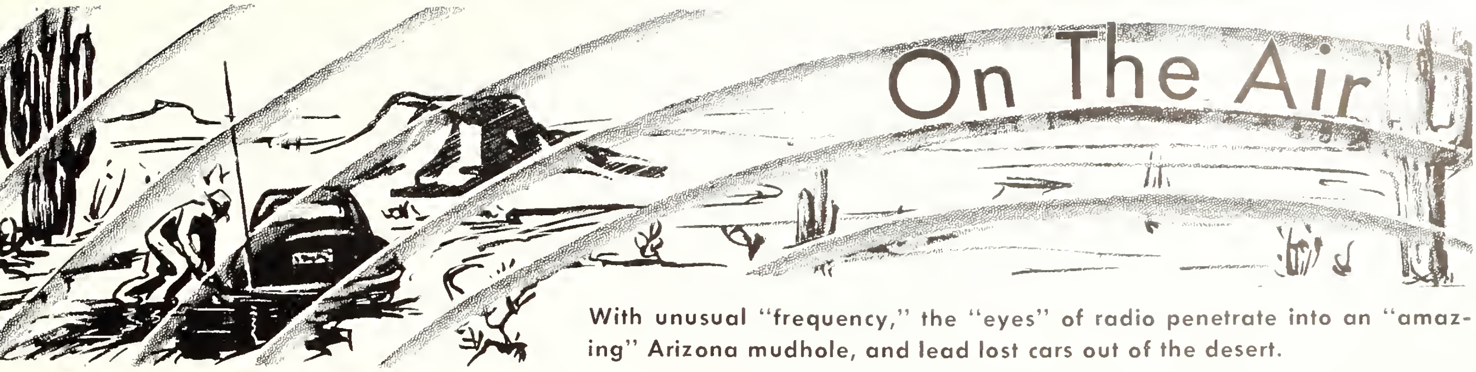
There are plenty of persons available for work throughout Southern and Insular Italy; many of them are both hungry and unemployed. Estimates of presently unemployed Italians range in the neighborhood of 2,000,000. These persons are mostly unskilled, untrained, uneducated, and illiterate. However, they are reported to be good workers, and from the evidence which we observed, they do well with tools they know how to use. In Italy they build by hand as much as possible, to take advantage of the available supply of labor and also to avoid the limitations imposed by a severe shortage of practically all building materials other than stone masonry. Most of the construction designs call for structures using the minimum amount of lumber, steel, and other materials, even though the amount of hand labor exceeds by far the proportionate amounts which would be considered good practice in this country. But to get back to the subject of the farmer, the tenant situation has contributed to Italy's acreage problem.

It is very difficult, if not impossible, to draw definite conclusions on land reclamation in Italy based on such a brief reconnaissance. The following observations are presented merely to point out a few of the many interlocking problems that need to be resolved.

Land in Italy is generally controlled by large land owners. These holdings are frequently rented to a tenant who pays an annual rent and in turn has the land divided into small areas, each of which is farmed by one or more peasants on a sharecrop basis. This practice frequently results in the tenant attempting to earn as much as he can from the land without returning much of his profits to the soil, to farm facilities, or into permanent improvements. Consequently, in many instances, the land has deteriorated over the years to a point

(Continued on page 156)

Below left: Grotticelli Dam, Sicily. Lower part built by the Arabs in the 12th Century; remodeled and raised in 1563; remodeled in 1926; silted up but still useful for irrigation diversion. Below right: Small bunches of straw used to prevent wind erosion, east of Zapponita.



On The Air

With unusual "frequency," the "eyes" of radio penetrate into an "amazing" Arizona mudhole, and lead lost cars out of the desert.

by M. M. McINTIRE, Chief, Power Operation and Maintenance Division, Region III, Boulder City, Nevada

C. McCormick and O. K. Mangum, Parker Dam wer Project, display portable transmitter used for rol and maintenance crews on line system. *Photo by M. M. McIntire, Region III.*

IT JUST COULDN'T HAPPEN—BUT IT DID.

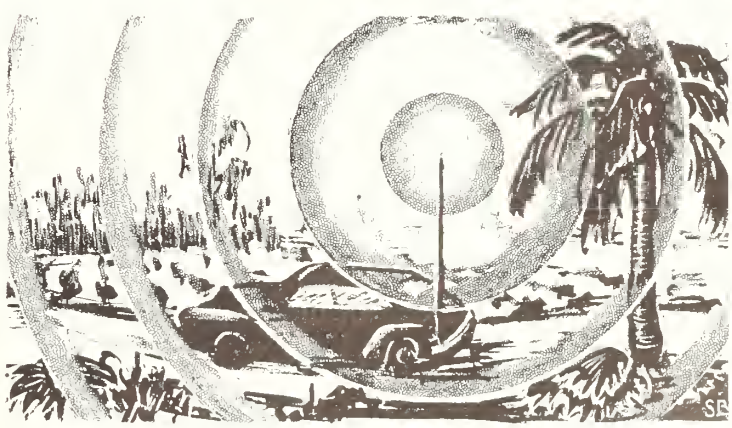
Florida and California may have many differences over ather and may be rivals for the tourist dollar but it is dent that there is a very friendly spirit of cooperation been Florida and Arizona—at least between the Soil Convation Service in Florida and the Parker Dam Power oject of the Bureau of Reclamation in Arizona.

Recently O. K. Mangum, engineer in charge of operation l maintenance of the Parker power system in Central izona, and just now actively engaged in establishing a lio communication system for direction of the patrol and intenance crews on the transmission system, got stuck in nudhole a few miles south of Phoenix. He was testing a rtable, two-way radio set over which he notified the operor at the fixed station that he would have to sign off long ough to get out of the mud. Much to his amazement, when was again rolling, the operators of the Soil Conservation rvice station located just north of Tampa, Florida, conted him directly through his portable set in the car. They d him that they had been listening to his trouble and had od by to send out a power wagon to help him out of the le. But they added, what amazed them was that there was ficient water in Arizona to develop enough mud to stall ar. They said they were used to mud and had specially iipped "power wagons" to lend aid to bogged-down equipnt.

Since meeting in the mudhole, the Bureau of Reclamation l the Florida crews have established direct communican between the two radio systems on several other occasions, h between fixed stations and between cars operating in two States. At one time contact was lost between the reau's fixed station and a radio car testing between Yuma, Arizona, and El Centro, California. The car was "lost" behind the southeastern California sand hills known in this area as "The Hollywood Sahara." The directing station called Florida and the operator there contacted the test car and told it to return to Yuma.

It appears that the Soil Conservation Service in Florida has been assigned an operating frequency of 36.02 megacycles for dispatching its cars and the same frequency has been assigned to the Bureau for test purposes west of the one-hundredth meridian. While this short wave radio communication is considered satisfactory only when the receiving aerial is in sight of the transmitting aerial, actually the phenomenon of reflected waves frequently renders it effective over much greater distances. One of the Soil Conservation men commented that the Service had been sold the equipment with the understanding that it was "line-of-sight." There must be a straight tunnel between Tampa and Phoenix.

Operating under the understanding that such radio equipment is most effective and reliable when both the transmitting and receiving aerials are within sight of one another, the Bureau of Reclamation is planning to place automatic relay stations on strategic elevations and expects to obtain complete coverage of its far-flung Parker-Davis power transmission system so that patrol and maintenance crews will be constantly in contact with headquarters. In the wide open spaces of Arizona, where wire telephone communication is frequently non-existant, the use of two-way radio will reduce the time of power shut-down due to accident or emergency, promote safety for the maintenance men, and save far more than the cost of installation of the system. THE END



(*Continued from page 142*)

reservoir when full would be 886 feet above the average river level at the pumping plant. Automatic float-control valves at the reservoir would start and stop the pumps by means of a 28,500-foot electric control line. An independent automatic signaling system would further provide against overflow.

The Pumping Plant

Preliminary studies have shown that two pumping plants should be provided, a deep-well turbine plant to lift water from the river and a multistage centrifugal pumping plant to force the water to the high-lying project lands. Each pumping plant would be separately housed.

The river pumping plant is designed for the wide fluctuations in river elevations. The plant would consist of three 6,300-gallons per minute, 45-foot head, motor-driven, deep-well turbine pumps with 20″ discharge pipes, screened at the intake to protect fish life.

The main pumping plant would contain three 14-cubic feet per second, 900-foot head, horizontal, multistage, centrifugal pumps with bases and couplings. Prime movers would be three 2,000-horsepower, 1,800 revolutions per minute synchronous motors with exciters. Mechanical equipment would be 20″ discharge pipes with 4-way fittings, three 14″, 400-pound, gear operated, gate valves; three 14″, 400-pound, tilting-disk, check valves; and one 14″ Pelton surge suppressor.

Power for pumping would be obtained from the Bonneville Power administration. Project requirements coincide with the peak power production months when total power demand is at a seasonal low. Ample power is available during this period, and the law grants preference to power needs of public bodies. The Bonneville Power Administration has agreed in principle, contingent upon available funds and materials, to construct the necessary transmission line from their substation west of The Dalles to the pumping plant. The Administration would also provide the necessary substation for reducing voltage at the pumping plants .

Costs of the Project

Construction cost of The Dalles project, West Unit, has been estimated at $2,300,000. Operation and maintenance costs, including power costs and a reserve fund for replacements, are estimated at about $66,000 per year. Average annual costs over the 40-year repayment period without interest are about $123,500 or $27.30 per acre on the 4,530 acres. Payment of this cost for water out of $70 average per acre increased net farm income leaves $42.70, about half of which would provide a return of 5 percent of the increased farm investment. The other half would give farm operators a relatively high wage for the additional labor required with irrigation. The irrigators should therefore have no difficulty in repaying construction costs, if a flexible repayment contract based on crop income is adopted to insure against undue hardship in low income years. THE END

MEASURING

A MEASUREMENT, whether it measure space, force, time, or any other physical quantity involved in the engineering control of nature, can be no more accurate than the standard by which the measuring instrument is checked and adjusted.

As instruments used for routine measurements undergo normal wear and tear during their use, other instruments of extreme accuracy must be kept as primary standards for periodic check-ups and calibration of "tools of the job."

Laboratory data used by the Bureau of Reclamation must be reliable and accurate at all times. This is most important as the effective diagnosis and practicable solution of many of the Bureau's varied engineering problems depend upon intensive laboratory tests and studies. Thus the accuracy of laboratory gages and calibrating standards comes to the forefront when it is necessary to determine correctly, before construction starts, and before designs can be drawn, what quality of concrete should be used in a dam or canal, how to assure the efficient operation of gates and valves, and what would be the most economic design of other structures and operating equipment.

FOR ACCURACY

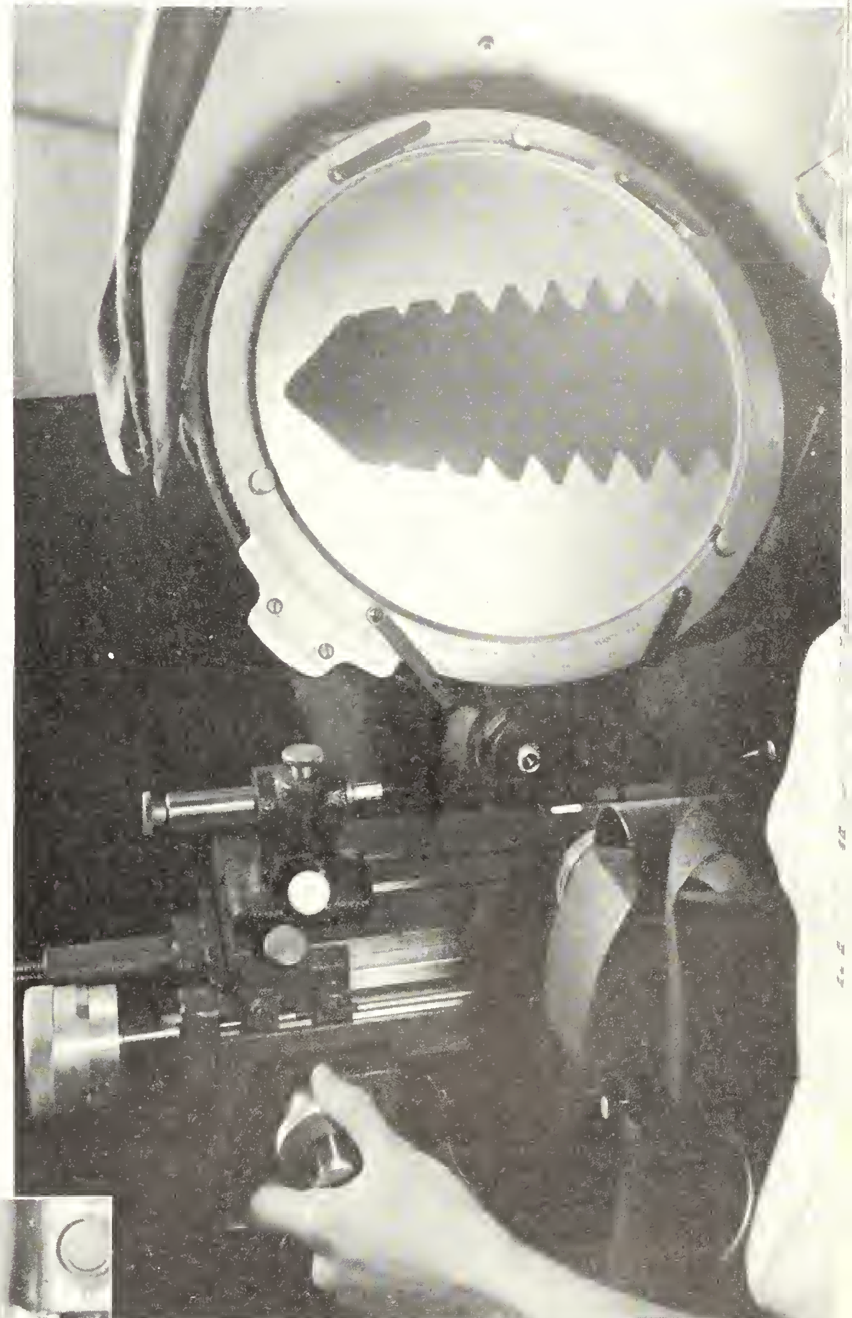
By LESTER D. ERB,
Engineer,
Branch of Design and Construction,
Denver, Colorado

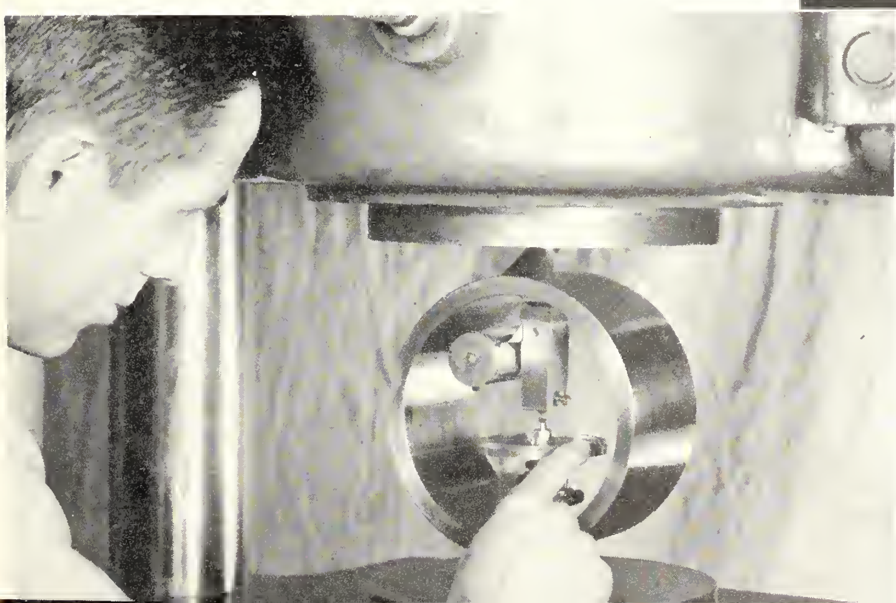
Typical of the varied types of calibrations is the periodic check of the compression testing machines. These machines are used to measure the compressive strength of concrete. It is possible for them to determine the strength and elasticity of a concrete mix for design studies and control the strength and uniform quality of concrete during construction. The testing machines are calibrated by the use of specially designed proving rings, each of which is accurately calibrated by the U. S. Bureau of Standards to give the ultimate in accuracy in pressure measuring instruments.

The Materials Laboratories are well supplied with equipment for measuring physical dimensions, such as the optical comparator which projects on a ground-glass screen a highly enlarged image or "close-up" of the article being measured. This device is very useful for measuring such irregular objects as thread gages, taps, screen gages, and other parts where micrometer measurement is insufficiently accurate, impractical, or impossible.

Where extreme measuring accuracy is required, such as for the calibration of micrometer calipers, micrometer operated instruments, dial indicators, determination of the flatness of surfaces, etc., the gage blocks and optical comparator are used. These primary standards have accuracies within four millionths of an inch of the specified dimension.

A wide variety of miscellaneous laboratory equipment is also calibrated in the laboratory, such as concrete elasticity testing fixtures, compaction machines, hydraulic presses, hydraulic and pneumatic pressure gages, and jacks, as well as instruments to measure the hardness of metals, rubber, and plastics, gas volumes and velocities, light intensities, and high temperatures. Thus a check, double-check, and even triple check is assured of all the complicated and vitally essential materials which go into the structures built by the Bureau for the reclamation of western lands. THE END





Extreme left: Accuracy of testing apparatus is determined by testing hardness of steel with that of other specimens of known hardness. Immediate left: Technicians measure deformation of proving rings under a wide range of loads to enable them to calibrate the compression testing machines to a fine degree of accuracy. Above: Angles of the cutting faces of the 1/4-inch tap (center) are accurately measured on the enlarged image projected on the ground glass screen of the optical comparator.

"Bonifica" in Italy

(Continued from page 152)

where it is yielding much less than it should produce. In other cases, the large land owner farms the land himself either with day labor or by use of peasant share croppers. In this case the peasant probably does not fare much better than in the previous case, but there does exist more incentive to build up the land and farm facilities. In a number of cases, peasants have secured by purchase, by homesteading in undesirable, marshy or mountainous areas, or by other means, tiny areas on which they erect homes and eke out a bare living through an intensive type of agriculture. It is not unusual to see three "layers" of crops on the same land—

- small row crops
- olive trees or fruit trees, and
- grape vines, which are carried above or between the trees.

Such an intensive system creates a tremendous strain on the resources of the soil. Despite such intensive agriculture, the smallness of the typical peasant's farm usually makes it necessary for him to seek additional compensation by hiring out as day labor when he is not required to tend his own tiny holding. Because of the critical land shortage the peasant cannot leave the only land he owns and because he cannot earn a living on that small tract, he is in a very unsatisfactory bargaining position with the large owners with whom he seeks supplemental employment.

A solution to the land holding problem is very complex and would require a considerable amount of time to effect. I sincerely believe that the present government is very desirous of effecting land reforms. In fact, the Government has recently appointed a special Vice Premier who will spend the major portion of his time in working toward the solution of the agricultural problems in these areas. His task will be far from easy. Any plan of helping Italy necessarily includes the bringing into cultivation of large quantities of new land. Italian farm leaders look to reclamation as a way to adjust economic difficulties.

With the possible exception of Sardinia, as shown in the table on page 150, the entire areas are seriously over populated. In Sardinia the natives have been shepherds for years and changes in their mode of life must be gradual. Consequently, it is not expected that this country, which is very rugged in topography and not suited to intensive cultivation, will be changed very much in the immediate future, although efforts are being made to utilize every possible agriculture area to its fullest extent and to improve the type of agriculture being pursued. Before land reform, including the making available of family size farm units to the peasant, can be made fully operative, a program will have to be put into effect for improving the educational level of the peasants. Only thus can they learn to use modern farm equipment efficiently, and on their own initiative. Elementary education is also a necessary step in helping them to learn to do much of their own farm planning and marketing. Most of this work is now being done for them by the tenants or large land owners. Someone—perhaps someone corresponding to our county agent—is needed to lend a hand by serving as a readily available and continuous source of sound, practical advice to the farmer. When the Italian farmer learns to think for himself and to use modern machinery effectively he can add to his income by participating in small off-the-farm industry thereby raising his standard of living.

There has been much discussion about emigration to help the over-populated situation. There is no doubt but what a large amount of immediate emigration would ease the critical crowded conditions, but such relief would be short-lived under present conditions. A better program for long-range planning would be to improve as much as possible the educational level of the individual peasant so that he can solve for himself many of the problems he faces. Continued emigration usually results in a loss to the country of those individuals who possess large amounts of vision, courage, resourcefulness and industry. No country can afford continually to lose people with these qualifications. It is like a farmer selling his seed corn because it draws a premium, and keeping his inferior corn to plant. No country can prosper long under such a practice.

There is no doubt but what drastic, immediate relief is necessary, but in obtaining this stop-gap aid, the longer over-all program should be kept in mind. THE EN[D]

From the Diplomatic Pouch

Termed "one of the most complimentary papers to be received through State Department channels" here are excerpts from an incoming telegram regarding the Italian mission in which American Ambassador to Italy James C. Dunn transmitted this unsolicited letter from Count Carlo Sforza, Minister of Foreign Affairs, De Gasperi Government of Italy:

My dear Ambassador:

With the departure of Messrs. McCall and Tomlinson, the first phase of Italian-American technical cooperation on the problems of South Italy is finished. Together we have laid the foundation for this cooperation and watched over its early development.

I wish first to express to the U. S. Government and to you personally, the hearty appreciation of the Italian Government for the arrival of these scientists. In addition, I must tell you that the choice couldn't have been better; Messrs. McCall and Tomlinson not only proved their known ability and experience in technical agricultural and hydroelectro problems, but also achieved a most satisfactory degree of cooperation with our technicians, upon whom they made an excellent impression in every way.

The report, presented at the end of their trip is really constructive and interesting. This report is now being carefully studied by the interested governmental bodies in the hope that a cooperative effort so well begun may take more definite form as soon as possible.

I need not repeat my conviction that the solution of our southern problems will contribute in no small way to definite politico-economic balance in Italy, something which I am sure, will be a solid guarantee for social stability in this vital Mediterranean sector.

As soon as I have the opinion of the various other branches of the government I shall discuss this question again with you in order that we may achieve the goals which we have discussed for some time.

Please accept every expression of my warmest regards,

Sforza.

RATS ARE ROBBERS

by DORR D. GREEN,

Chief, Branch of Predator and Rodent Control, U. S. Fish and Wildlife Service, United States Department of the Interior

Rats are rubbing their paws with greedy delight—the harvest which is being stored away in the Nation's barns this fall will provide an easy feast for them. If humans are as careless as they have been in the past, the rats can count on gorging on two-hundred million bushels of grain this year, almost half the grain needed to send to starving Europe.

The 150,000,000 rats in the United States shouldn't brag too soon about the coming harvest for them. This year, all over the country, the farmer and the city-dweller are mobilized in the National Rat Control Campaign to stop the $2,000,000,000 anual thievery of these expensive pests. The Fish and Wildlife Service of the U. S. Department of the Interior, and the Department of Agriculture are working together to save every morsel of food from the rats to help feed the hungry world. This campaign, part of the President's emergency food conservation program, is sparked by the National Committee for Rat Control, whose chairman is Hamilton M. Warren, vice president of the National Carbon Company, New York City.

Getting rid of rats may seem like a hopeless job to many farmers. There are so many sources of food, so many places for rats to make their homes. Where does one start? Actually, a rat-proofed farm is not necessarily one where every kernel of corn has a day and night guard against rats. A rat-proof farm however, must provide such uncomfortable living conditions for rats that they will move to greener pastures or can be easily destroyed by the farmer.

Surprisingly, the most basic step in getting rid of rats on the farm is simply good housekeeping. Keep the farm neat, and it will not only look like a farm journal picture, but it will have few rats.

Don't let any of the refuse from the house lie around, for it will attract rats. Provide incinerators for burnable trash and garbage, deep covered pits with trap doors for tin cans, and a garbage can with a tight lid, if table scraps are not fed directly to poultry or hogs.

On the rest of the farm, make sure that there are no piles of materials which supply "Home with Eating Facilities" to rats. Lumber or other usable materials piled on sawhorses or on platforms 18 inches above the ground will be unattractive to a home-hunting rat. While rats like to live in piles of cut stove wood, manure or hay within walking distance of food, they are easily discouraged if you move these home-sites to some distance from the granary, house or other building where food is handled.

Stone walls and ditches also are often a source of rat in-

At left: Stack of lumber carelessly piled on the ground provides an ideal "rats' retreat." At right: This creature and its kinfolk cost the U. S. about two billion dollars a year. ***Both photos courtesy U. S. Fish and Wildlife Service, by John C. Jones.***

festation, and unlike the previously-named harborages, cannot be easily moved away from food. The inviting openings in stone walls however can be closed easily with cement. Destroying the protective vegetation on the ditch banks near buildings will give the sensitive rat a good healthy fear, but it must be repeated often.

After the entire farm is tidied up so no rats are living comfortably outside, it is time to look at the buildings. A good, solidly built building is usually a good rat-proof building. For example, rats seldom burrow deeper than 2 feet in the ground, so a building whose foundation extends well into the ground below the frost line automatically keeps the rats from digging under the floor. Concrete foundations should also extend a foot or more above the ground to keep the rats from sneaking up behind a bush to gnaw through the wood siding.

Old buildings with dirt floors and without concrete foundations may be ratproofed by adding a two foot concrete curtain wall and a concrete floor or by raising the building on concrete posts to a height of at least 2½ feet off the ground. No matter what method is used, precautions must also be taken not to pile materials around or under the building and thus provide stepladders to help the rats over the ratproofing.

Ratproofing all the buildings with concrete, sheet metal or hardware cloth is the only sure way of permanently excluding rats. It may seem like too large an expenditure, but compared with the $20 each rat on his farm costs the farmer annually, it is cheap. In one year, the cost of ratproofing the buildings will be completely repaid by the amount of foodstuffs saved, the United States Fish and Wildlife Service rat control experts estimate.

Remember the Corn Crib

Of all the buildings on the average farm, the corncrib needs the greatest amount of work to protect the harvest from rats. Surveys of farmers' losses of corn stored through the winter have found as high as one-fourth of the corn eaten or destroyed by rats. The amount of this loss would have been sufficient to pay for ratproofing the crib several times over.

While the most satisfactory way to ratproof a crib is to cover entirely the walls, ceilings, and floors with woven wire mesh, three meshes to the inch, there is a cheaper way. The same wire mesh can be used to cover the floor and walls to a height of two feet where the mesh can be fastened with a strip of galvanized iron 8 inches wide. Because the rats cannot gain a footing on the smooth metal to climb over it, the wire mesh need not be used above the iron strip. In any case, the wire mesh should be smoothly and firmly fastened and must be carried around both sides of doors and door jambs. Doors should be provided with closing springs or weights to make sure that after a thorough ratproofing job, the rats don't simply walk through the open door!

The granary is equally important in ratproofing the farm. Small wooden or portable granaries should be protected with wire mesh in the same way the corn crib was made ratproof. In the larger granaries with concrete foundations and floors, check to make sure that the ventilators are screened and that rats cannot come in through the elevator pit.

It is seldom possible to shut rats completely out of the barn or wherever livestock is fed. However, if rats' nests and runs are eliminated and the food is not handled carelessly, the rat population will start looking for a better home.

Besides stopping rats outside with concrete floors and ratproof foundations, the farmer must also check his barn walls. A hollow wall is nothing more than a safe retreat and a convenient runway leading to the haymow and home. Hollow walls should either be ripped out or filled to a height of 10 inches above the sill with cement. If the wall runways are eliminated, and all other rat harbors destroyed, the haymow will lose its attraction for rats.

The grain bin should be completely lined or covered with metal and should have metal-lined lids. Any open spaces behind or under the bins should be tightly closed with metal. Concrete feeding floors, troughs, water tanks, hog wallows and similar structures should be constructed with a curtain wall extending 2 feet or more into the ground to keep rats from burrowing under the slab.

The poultry house is another building difficult to ratproof, yet a place where the farmer can suffer a huge loss to rats. One poultry man reported that rats caused the loss of 80 dozen eggs within a week. Here, too, is another building which must have a ratproof foundation and no hollow walls. If warmth is necessary, sheathing and siding with a layer of building paper between, and tar paper sandwiched by double flooring will do the trick without encouraging rats. Nests should be raised 2 feet above the floor and feed and grit hoppers at least 1 foot. Drinking vessels for water and skim milk should be supported on a platform 1 to 1½ feet above the floors. Because rats feeding on poultry often have their homes as far away as 100 feet, nearby buildings must also be ratproofed.

After the farm is thoroughly ratproofed, the farmer can then turn to methods of killing off the rats. It is the least important method of rat control, however, for without ratproofing the rats will return twice as strong within 6 months. If it is decided to use poison, the only safe poison to use around livestock is red squill. However, it should be carefully controlled and each bait uneaten by the rats should be picked up the next morning.

A good rat dog can keep a rat-proofed farm free from rats. Other natural enemies of the rat which should be encouraged by the farmer are hawks and owls. The killing of these birds should be limited to those actually caught preying upon the poultry, and the others, should be left to their work of reducing the number of rats.

The rat control job on an individual farm of necessity extends beyond the property line. Because rats are no respectors of fences or "No Trespassing" signs, they will keep invading a rat-proofed farm as long as its neighbors maintain a growing rat population. Get together with your neighbor in a concerted anti-rat drive.

Fighting rats is a year-around, continuous job, but at no time is it more important than at harvest time. What counts is the amount of grain sold or used during the winter not the amount originally stored and then ruined by rats. The ratproofed farms in each county in the United States invariably are the more prosperous farms. A rat-proofed farm is proof that the farmer isn't going to let any possible profit be stolen away from him. Rat control is good farming and a good investment.

THE END

News Round-Up

Water from Mexico Aids American Farmers

Mexico has proved a good neighbor to the Rio Grande Valley again by releasing an additional 500 cubic feet a second of water from Marte R. Gomez Reservoir, President A. L. Cramer of the Valley Water Conservation Assn. said recently.

Mexico is providing more than half of the Valley's water supply by releasing it from her reservoir storage, he said. River flow at Rio Grande City is about 900 second-feet and the Mexican release is about 1,000.

"Demand for irrigation water in the Valley is a little more than 2,000 cubic feet a second," he added. "If it were not for the generosity of our neighbors, we would be in a critical situation."

Davis Dam Power Allocated

Secretary of the Interior J. A. Krug has authorized the Bureau of Reclamation to negotiate contracts for selling Davis Dam power in accordance with allocations which will supply the most urgent needs for power first. The three States which will benefit are the power-short areas of Arizona, California, and Nevada.

Applications for more than four times the capacity of the Davis Dam power plant have already been received. The basic allocations, which take into consideration fulfillment of commitments in presently existing Parker Dam power contracts will provide about 50 percent of the 180,000 kilowatt capacity for use in Arizona, and 25 percent for California and Nevada each.

Applications for more than 600,000 kilowatts were received from four States, with Arizona requesting most—approximately 322,000 kilowatts. As previously stated, allocations were based first on fulfilling Parker Dam power and other Colorado River commitments. Next, power allocations were made to Federal Agencies in the Department of the Interior and other Federal Agencies. Next in line for consideration were certain small contractors having preference under Reclamation Law now supplied power from Parker Dam, and finally other applicants having preference under Reclamation Law.

1947 Reclamation Crops Mark New High

Four and one-half million acres of farm lands, in cultivation last year on Federal Reclamation projects utilizing either full or partial water supplies from Bureau of Reclamation, constructed facilities, produced a gross crop value of $555,420,804, for a new record high.

The 1947 crop value was $24,796,859 greater than in 1946, when Federal Reclamation projects also surpassed the half-billion-dollar mark in production of food for the Nation.

The average return per acre in 1947 was $121.95, compared with $120.69 in 1946.

Commenting on the new record, Reclamation Commissioner Michael W. Straus said:

"Soundness of reclamation development of the Western arid lands cannot be better demonstrated, I believe, than by this annual gain in national well-being that is made possible by bringing irrigation water to the dry, fertile soils of the West. In the three years of 1945, 1946, and 1947, the gross crop values realized on federally served irrigated lands was greater than the total reclamation expenditures by the Federal Government since 1902, when the Reclamation Act was passed. Since 1906, when the first record of crop production on a Federal project was reported, more than 5½ billion dollars worth of crops have been produced on the lands these projects serve. And under the reclamation laws, which are designed to create family farming opportunities for the people, the cost of irrigation and hydroelectric power construction is being repaid to the Federal Treasury by the water users and from power-sale revenues."

The irrigable acreage in 1947 was 5,166,789, an increase of 15,952 over 1946. This is the total area for which the Bureau of Reclamation was prepared to supply irrigation water.

Of the 37 projects which received a full water supply from Federal works, the Okanogan project in the State of Washington reported a 1947 per acre gross crop return of $398.18. On the Yakima project in the same State, the Tieton Division had a crop return of $509.87 per acre. Both of these areas are devoted largely to apple production.

Report on International Commission

The purpose of the Third International Congress on Large Dams, which met at Stockholm, Sweden, June 10–17 this year (see July 1948 ERA) was to discuss recent developments in the building of large dams. Invitations were issued to the twenty governments which are members of the International Commission on Large Dams with approximately 300 engineers in attendance.

Dams higher than the Hoover (Boulder) Dam, the highest in the world, are now being planned in both Europe and India. The Congress will contribute materially in the development of techniques which will make the construction of such dams practical. The Congress also discussed experiences arising from the testing and the actual use of special cements for large dams. Other topics considered related to uplift pressures and stresses arising therefrom, research methods and instruments for the measure of stresses and deformation in earth and concrete dams, and the most recent measures taken to avoid piping through dams.

The first two days of the Congress were devoted to the presentation of reports and to discussions, while the following 5 days, were spent on a study tour of a number of dams and hydro-electric power plants, and of one of Sweden's large industries. Some of these dams functioned north of the

Arctic Circle, and former Chief Engineer Walker R. Young, carried on his inspection at midnight, in the full daylight of the Midnight Sun.

The First Congress was held at Stockholm in 1933, simultaneously with the Sectional Meeting of the World Power Conference. The Second Congress was held at Washington, D. C., in 1936, simultaneously with the Plenary Meeting of the World Power Conference.

The International Commission on Large Dams, which arranges for the Congresses, was constituted in 1928 for the purpose of promoting research in matters connected with large dams and of collecting experiences in regard to their design, construction, maintenance, and operation. The member nations of the Commission function through national committees. The United States Committee on Large Dams is headed by Michael W. Straus, Commissioner, Bureau of Reclamation, Department of the Interior, whose paper "Global Hydro-Economics—A World Survey" was presented at the Congress.

Sacramento Salmon Resettled

(*Continued from page 144*)

to the Foster plan. But by 1945, it appeared that many fish preferred to stay and spawn in the Sacramento River, where temperatures were lower than in the creeks. By 1947, it was clear that water temperatures in the Sacramento, which both Mr. Foster and the consultants had believed would be too high to hold fish over summer, were practically ideal.

To utilize the river for spawning, plans were changed. In 1947, upstream migration was stopped at the Anderson-Cotton-wood Irrigation Dam in Redding. Thus blocked, the fish just drifted downstream to await the time of their bilogic mission in the large cool pools supplied by water from Shasta lake, apparently well contented with their new "home." As a result, the Sacramento River, from Redding 50 miles south to Red Bluff, now serves as a huge salmon nursery. A nursery capable of accommodating the entire run, even though the estimated number of fish is now 100,000, four times the number contemplated in the Foster plan. (The increased estimate is due not to an increase in the number of fish, but to improved counts made possible by the Balls Ferry "rack" and the Keswick fish trap.)

The original pessimism that water temperature below Shasta Dam would be too high for salmon has, for years of normal water supply at least, been dispelled. Trapping and hauling of fish has been discontinued. With only four years of operation, the life cycle of but one salmon run, optimism regarding the success of the program in its altered form must still be tempered with some qualifications. But there is good cause for optimism.

Even the 1942 run, whose migration was hampered by construction at Shasta Dam, but not aided by the salvage plan, must have spawned successfully. For the 1946 commercial catch—progeny of the 1942 run—of 6,462,050 lbs. in the Sacramento-San Joaquin Rivers was the largest in 21 years of record.

The 1947 catch of 2,323,926 lbs. was just about average. Although, to date, the Upper Sacramento River Salmon Maintenance Program appears to have compensated for the lost spawning areas, a cycle of dry years must be experienced, and the full operation of Shasta Dam achieved, before the success of the program can be fully evaluated.

Meanwhile, the modifications in operation of the plan which have been made because of low stream temperatures, will make the program much less costly. Mainly, by eliminating the need to transfer the spring run from the main river to Battle Creek and Deer Creek, thus making operation of the Keswick and Balls Ferry fish traps unnecessary. These traps must, however, be held in standby condition for future use. For a very dry year with high water temperature might make it necessary to move the fish. Or Mother Nature might pose some new problem which no one has foreseen. Operation of Coleman Hatchery will probably have to be continued, to propagate the fish relocated in Battle Creek from 1943–46.

Under cooperative arrangement with the Bureau of Reclamation, the Fish and Wildlife Service is continuing to observe water temperatures, and to estimate fish population and success of natural spawning. Important lessons regarding fishery management are being learned, lessons which should be of great value in building future water-control projects on Pacific Coast streams.

Meanwhile, the modifications in plan have not only resulted in reduced operating cost of the program, but if natural spawning is more efficient than artificial propagation, more fish have been produced. And, if salmon can be induced without much trouble to change their ancestral spawning grounds, the problem of reconciling the fish industry with farming—an area of bitter conflict—will have been changed to one of whole-hearted cooperation in the best development and use of the limited Western water resources. THE END

____
(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior,
Washington 25, D. C.

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NOTES FOR CONTRACTORS

Contracts Awarded During June 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2101	Columbia Basin, Wash	June 7	10 disconnecting switches for Grand Coulee switchyards, schedule 2A.	Schwager-Wood Corporation, Portland, Oreg	$71,129
2113	Hungry Horse, Mont	June 16	Four governors for Hungry Horse power plant, schedule 2	Woodward Governor Co., Rockford, Ill	121,600
2116	Davis Dam, Ariz.-Nev	do	Construction of 34.5 kilovolt transmission lines for Yuma area	J and J Construction Co., Oklahoma City, Okla.	65,132
2127	Boise, Idaho	June 2	Construction of relocated reservoir road at Anderson Ranch Dam	Hoops Construction Co., Twin Falls, Idaho	341,133
2131	Columbia Basin, Wash	June 8	Electric heaters for Grand Coulee right power plant	Coates Electric Manufacturing Co., Seattle, Wash.	41,599
2138	Missouri Basin, Mont	June 4	Furnishing and erecting 14 prefabricated residences for Moorhead government camp, schedule 5.	Lewis Construction Co., Billings, Mont	148,574
2144	Davis Dam, Ariz.-Nev	June 7	Steel structures for Parker switchyard extensions	Allison Steel Mfg. Co., Phoenix, Ariz	56,513
2147	Boise, Idaho	June 4	Clearing Anderson Ranch reservoir site	W. D. Zavalas, Oroville, Calif	115,328
2155	Klamath-Tule Lake, Oreg.-Calif	June 17	Two pumping units for pumping plant D	Worthington Pump & Machinery Corporation, Harrison, New Jersey	49,433
2166	Central Valley, Calif	June 15	Construction of 69 kilovolt transmission line from Contra Costa substation to Clayton and Ygnacio pumping plants.	George Pollock Co., Sacramento, Calif	136,728
2176	Davis Dam, Ariz.-Nev	June 29	Carrier-current telephone apparatus, coupling capacitor potential devices, and carrier-current line traps for Davis Dam and Parker Dam power systems.	General Electric Co., Denver, Colo	222,000
2182	Columbia Basin, Wash	June 8	Control boards for units R4, R5, and R6, Grand Coulee power plant; and 230 kilovolt Columbia lines 3 and 4, and Snohomish Line No. 1.	Westinghouse Electric Corp., Denver, Colo	60,312
2187	Davis Dam, Ariz.-Nev	June 15	Two air break switches for Davis tap to Hoover-Basic Magnesium line.	Pacific Electric Manufacturing Corporation, San Francisco, Calif.	16,375
2191	Klamath-Tule Lake, Oreg.-Calif	June 25	Construction of earthwork and structures for Lost River Channel improvement, Poe Valley.	J. A. Terteling & Sons, Inc., Boise, Idaho	91,730
2192	Columbia Basin, Wash	June 16	Nine 230,000 volt lightning arrestors for Grand Coulee 230 kilovolt right switchyard.	Westinghouse Electric Corporation, Denver, Colo.	24,195
2197	Central Valley, Calif	June 30	Construction of earthwork, concrete lining, and structures for Delta-Mendota Canal.	Morrison-Knudsen Co., Inc., and M. H. Hasler, Los Angeles, Calif.	4,418,811
2201	Missouri Basin, S. Dak	June 8	Construction of earthwork, structures, and surfacing for access road at Shadehill Dam.	Fogg and Holzworth Construction Co., Miles City, Mont	10,741
2206	Provo River, Utah	June 28	Construction of tunnels 1, 2, and 3, Salt Lake aqueduct	United Concrete Pipe Corporation, Baldwin Park, Calif.	439,330
2210	Hungry Horse, Mont	June 16	Two traveling cranes for Hungry Horse Dam and power plant	Moffett Mfg. Co., Albany, Calif.	42,215
2211	W. C. Austin, Okla	June 16	Installing radial gates and spillway bridge at Altus Dam	Stebbins-Frost Construction Co., Tulsa, Okla	70,935
2212	Columbia Basin, Wash	June 2	60,000 barrels of bulk portland cement for construction work in vicinity of Coulee Dam and Odair, Wash.	Superior Portland Cement Inc., Seattle, Wash	161,400
2212	Columbia Basin, Wash	June 2	40,000 barrels of bulk portland cement for construction work in vicinity of Coulee Dam and Odair, Wash.	Permanente Cement Co., Oakland, Calif	122,000
2214	Missouri Basin, S. Dak	June 30	Clearing part of Angostura reservoir site	Schutt Construction Co., Inc., Genoa, Wis	24,551
2217	Tucumcari, N. Mex	June 28	Construction of earthwork and structures for Conchas Canal, lateral unit 6; and construction of bridge at Conchas Canal.	J. A. Terteling & Sons, Inc., Boise, Idaho	918,029
2219	Hungry Horse, Mont	June 25	Construction of dormitory, office annex, ten-car garage, and 20 residences for Hungry Horse government camp, schedule 1.	Askevold Construction Co., Inc., Missoula, Mont.	468,270
2225	Columbia Basin, Wash	June 16	Six 12-by-18-foot radial gates for Main Canal headworks at South Coulee Dam.	American Bridge Co., Denver, Colo	55,563
2243	Hungry Horse, Mont	June 15	1,250,000 barrels of bulk portland cement for construction of Hungry Horse Dam.	Lehigh Portland Cement Co., Chicago, Ill	4,000,000
2243	do	do	625,000 barrels of bulk portland cement for construction of Hungry Horse Dam.	Spokane Portland Cement Co., Spokane, Wash.	1,812,500
2243	do	do	do	Ideal Cement Co., Denver, Colo	2,062,500
2246	Missouri Basin, Wyo	June 23	Furnishing and erecting 10 prefabricated residences for Keyhole government camp.	Brezina Construction Co., Rapid City, S. Dak	94,300
2258	Colorado-Big Thompson, Colo	June 29	Materials for steel warehouse at Wild's Spur (Loveland), Colo	American Bridge Co., Denver, Colo	31,411
2284	Missouri Basin, S. Dak	June 25	132,500 barrels of bulk portland cement for construction of Angostura Dam	Universal Atlas Cement Co., Chicago, Ill	324,625
2300	Davis Dam, Ariz.-Nev	June 29	Three 30,000 kilovolt-ampere transformers for Phoenix substation	Allis-Chalmers Mfg. Co., Denver, Colo	445,000
R1-15	Boise, Idaho	June 18	Construction of pumping plant and pipe line for Cascade, Idaho	Intermountain Plumbing Co., Boise, Idaho	12,482
R5-3A	Rio Grande, N. Mex.-Tex	June 24	Paving camp roads at Elephant Butte Dam.	D. D. Skousen, Albuquerque, N. Mex	31,678
B11D-50-B	Missouri Basin, Wyoming	June 7	66,250 barrels cement for Boysen Dam	Monolith-Portland Midwest Co., Denver, Colo.	406,881
R6 RP-12	Riverton, Wyo	June 15	Preparation of concrete aggregates at Krump deposit	Gilpatrick Construction Co., Riverton, Wyo	94,580

Construction and Supplies for Which Bids Will Be Requested by October 1948

Project	Description of work or material
Boulder Canyon, Ariz.-Nev	Generators and power transformers for units A3 and A4 at Hoover power plant.
Colorado-Big Thompson, Colo	Construction of 1,500 kilovolt-ampere Fleming substation near Fleming, Colo.
Do	Construction of 500 kilovolt-ampere Haxtun substation near Haxtun, Colo.
Do	Construction of 115 kilovolt transmission lines from Estes power plant to Marys Lake power plant and from Estes power plant to Granby pumping plant.
Do	Construction of earthwork, lining, and structures for 8 miles of Horsetooth Feeder Canal, including 11 concrete siphons, one steel siphon, and other structures near Loveland, Colo.
Columbia Basin, Wash	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 8 miles of Winchester wasteway near Winchester, Wash.
Do	Generators for units R7, R8, and R9, Grand Coulee power plant.
Do	Transformers for units R7, R8, and R9, Grand Coulee power plant.
Do	Generator for station service unit LS-3, Grand Coulee power plant.
Do	Transformers for station service unit LS-3, Grand Coulee power plant.
Do	Wire, insulators, copper tubing, oil circuit breakers, and disconnecting switches, for station service unit LS-3 tie circuit, Grand Coulee power plant.
Do	Additions to 6,900 volt switchgear XLS, Grand Coulee power plant.
Do	Construction of North Dam, an earthfill structure which is to form the north barrier of the Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 14.5 miles of East Low Canal; construction of about 6.5 miles of Rocky Coulee wasteway; in vicinity of Moses Lake, Wash.
Davis Dam, Ariz.-Nev	CO_2 fire protection equipment for Davis power plant.
Kendrick, Wyo	Control board for Hanna substation.
Klamath, Calif.-Oreg	Rehabilitation and extension of laterals and drains near Tule Lake, Calif.
Do	Radial gates and hoists for Lost River diversion channel.
Lewiston Orchards, Idaho	Construction of earthwork, structures, and pipe lines for domestic and irrigation water distribution system.
Missouri Basin, Colo	Construction of Bonny Dam, an earthfill structure, on the South Fork of the Republican River near Hale, Colo.
Missouri Basin, Kans	Construction of Cedar Bluff Dam, an earthfill structure, about 136 feet high and 12,570 feet long, on the Smoky Hill River, near Ellis, Kans.
Missouri Basin, Nebr	Radial-gate hoists for Enders Dam.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior, Nebr.
Missouri Basin, S. Dak	84-inch outlet pipe for Shadehill Dam.
Do	Construction of Shadehill Dam, an earthfill structure, on the Grand River about 20 miles south of Lemmon, S. Dak.
Missouri Basin, Wyo	Power circuit breakers and disconnecting switches for Boysen switchyard.
Do	Construction of office building, garage, shop, laboratory, streets and walks, and installation of water and sewerage systems and other facilities at Keyhole government camp about 18 miles northeast of Moorcroft, Wyo.
Do	Construction of about one mile of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Paonia, Colo	Enlargement of about 4 miles of Fire Mountain Canal, from its present capacity of 70 cubic feet per second to a capacity of 200 cubic feet per second, located near Somerset, Colo.
Provo River, Utah	Construction of Duchesne tunnel from station 5+10 to station 199+48, and construction of a diversion dam on the North Fork of the Duchesne River about 24 miles east of Heber, Utah.
Do	Construction of Murdock Diversion Dam, Canal, and tunnel lining at the head of the Provo Reservoir Canal near Provo, Utah.
Parker Dam Power, Davis, Dam, and Boulder Canyon, Ariz.-Calif.-Nev.	Telemetering and supervisory control equipment.


The Colorado River

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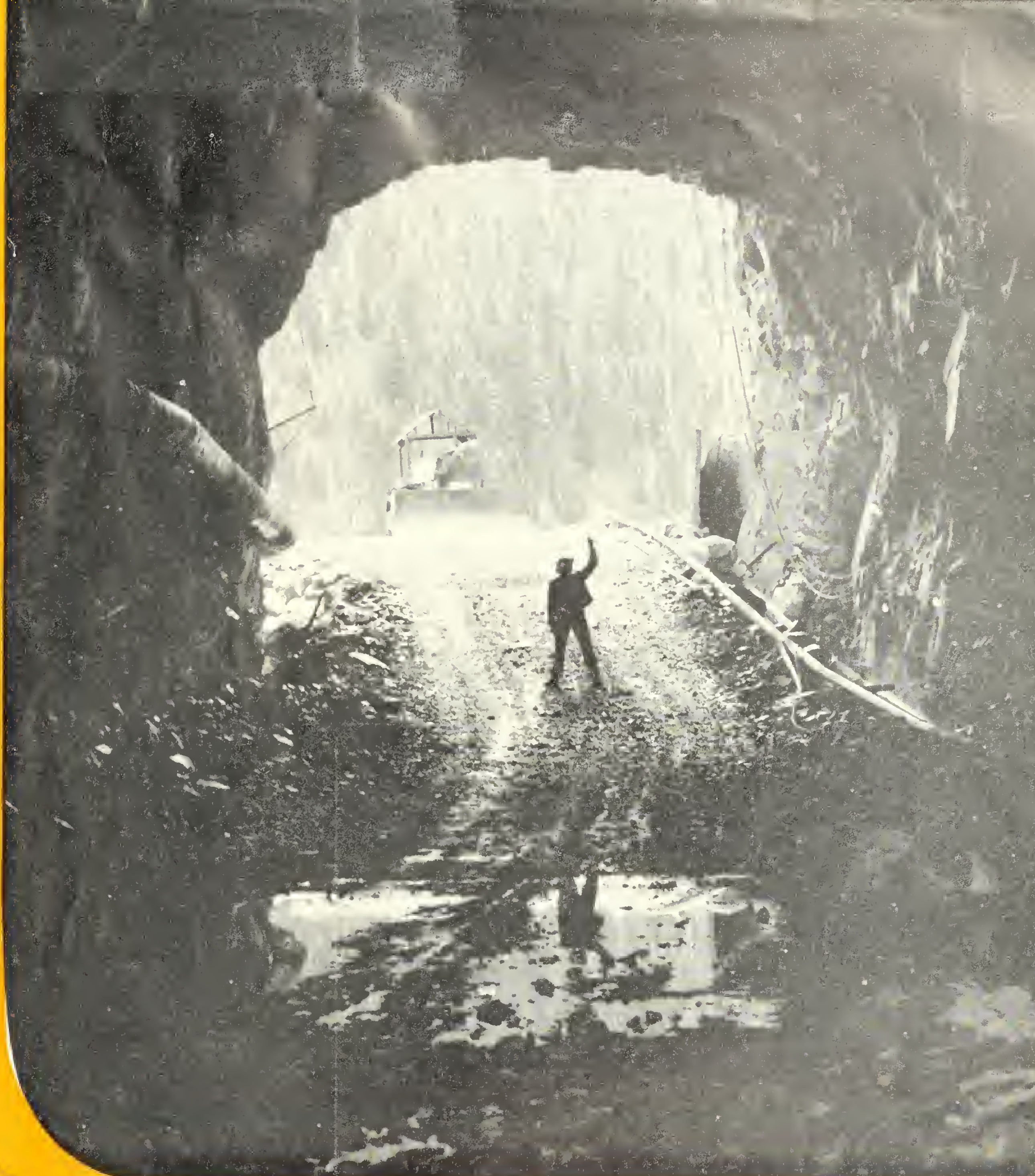

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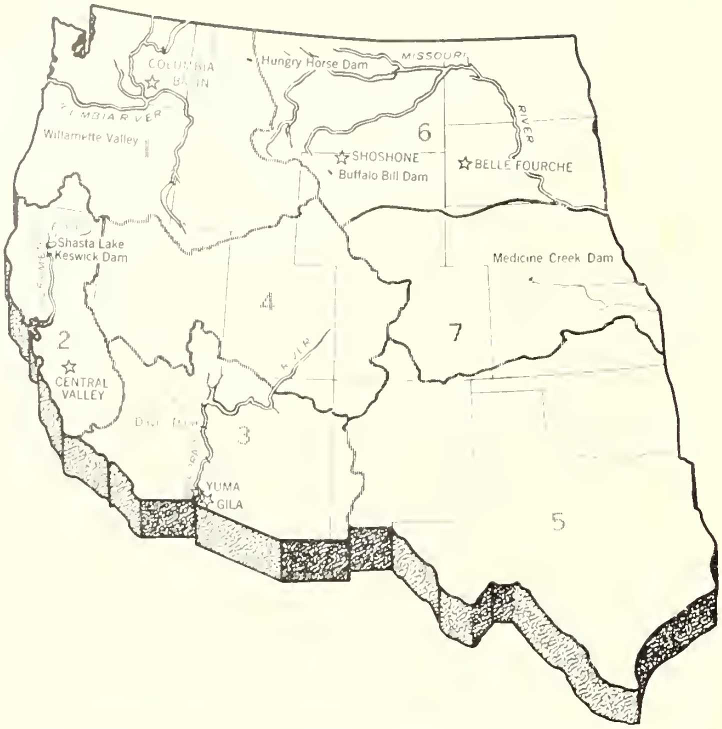

Reclamation Place Names in This Issue

Want a Waterweed Killer License?

Many commercial firms have requested information on preparing and dispensing a chemical formulation discovered to be of value in controlling waterweeds by personnel of the Bureau's Chemical Engineering Section of the Chief Engineer's office in Denver and the Bureau of Plant Industry, Soils and Agricultural Engineering. An article entitled "A New Killer for Waterweeds," by W. T. Moran and J. M. Shaw, discussing the use of the chemical compound, which is a solvent naphtha, appeared in the May issue of the Reclamation Era.

The Department of the Interior has applied for a patent on the material for use as an aquatic herbicide.

Those interested in obtaining a license for the use of patents held by the Department should file directly with the Solicitor of the Department of the Interior, Washington 25, D. C., an application stating:

(1) the name, address, and citizenship of the applicant;
(2) the nature of his business;
(3) the patent or invention upon which he desires a license;
(4) the purpose for which he desires a license;
(5) his experience in the field of the desired license;
(6) any patents, licenses, or other patent rights which he may have in the field of the desired license; and
(7) the benefits, if any, which the applicant expects the public to derive from his proposed use of the invention.

Reclamation ERA

September 1948 **Vol. 34, No. 9**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, Editor

OUR FRONT COVER

"Glory Road" at Hungry Horse

Downstream view of the 1,100-foot-long diversion tunnel now being drilled through the right abutment at Hungry Horse, Mont. During construction of the Hungry Horse Dam the entire flow of the South Fork of the Flathead River in northwestern Montana will be diverted through this tunnel. The portion of the tunnel shown here will eventually become part of the discharge end of the "glory hole" spillway. This photo taken by Stanley Rasmussen, Region 1, Boise, Idaho.

The Urban Benefits of Reclamation

The people of the town of Yuma, Ariz., show how town and country benefit from reclamation development, and raise the question, "Should the farmer foot the entire bill for irrigation projects?"

by NED O. THOMPSON
Branch of Operation and Maintenance, Region III, Boulder City, Nev.

SILVER DOLLARS ON THE HORIZON—Canals like this interlace the Yuma project so that desert soils may drink and produce. As in hundreds of other irrigated areas, the Yuma project has created a lasting economy for surrounding towns and has benefited industry throughout the Nation. ***Photo by Harry W. Myers, Region III.***

THE STRANGER EMERGED FROM A TRACKLESS DESERT of sagebrush and cacti and entered a lush green valley of growing crops. Men with tractors were at work planting some fields, harvesting others. Livestock grazed in alfalfa. Highways were crowded with trucks hauling produce to market. Farther along was a modern city of paved streets, beautiful homes, and buildings. Sidewalks were thronged with people going in and out of stores and banks.

The dollar was having a busy day.

"What is responsible for all this industrial activity?" the stranger asked a passerby. "Irrigation," was the reply.

From the beginning of time, civilization in the arid regions of the world has flourished around the water holes. The same is true today in the dry West where more than 4 million acres of land now being irrigated by Bureau of Reclamation facilities have created wealth locally and throughout the Nation.

For irrigation benefits go much beyond the farm. They are shared by merchants, transportation systems, manufacturers, laborers, and all business people, particularly in irrigated areas. However, the farmer generally foots the Reclamation bill except when part of the costs are borne by hydroelectric power revenues, or charged off to flood control and other such benefits.

As a general rule projects that have major power or flood control features are not difficult to justify under existing Reclamation law. On the other hand, projects without a helping hand from power or flood control experience difficulty in demonstrating reimbursability of funds advanced for their construction. This is particularly true in this day and age when most of the easy projects already have been constructed.

But how about the benefits which accrue as a whole to the Nation, from an irrigation project? Expenditures for construction provide employment and profit to individuals and business firms located in various parts of the country. Likewise, an expansion in irrigation extends the market for farm machinery, fertilizers, and other supplies used by farmers which may be manufactured at considerable distance from the project area. Other Nation-wide benefits include lower food prices that may result from the development, especially in periods of scarcity; additional quantities of food, the need for which is evident particularly in wartime and other periods of national emergency; and more stable food production with less likelihood of crop failures from droughts, which have a disrupting effect on the Nation's economy.

It also can be demonstrated that the Federal Government over a period of years receives a return on its investment in irrigation projects through increased revenues in the form of taxes that may exceed by many times the original cost of construction. In passing the original Reclamation Law of 1902, the Congress recognized the benefits accruing to the Nation as a whole from irrigation development by requiring repayment of construction costs without interest and later providing for a development period of up to 10 years prior to initiating repayment. At present interest rates charged for borrowed capital, it may be shown that the Government, by providing interest free money and deferring repayment of capital costs for 10 years, is contributing 35 to 40 percent of the total investment in irrigation works.

In recognition of the fairly direct benefits of Reclamation to business concerns in nearby towns, the House Appropriations Committee, Eightieth Congress, first session, requested the Bureau of Reclamation to compile information on the relation between irrigation development and growth in project towns and related business activity. The Yuma project, located in the southwest corner of Arizona and the southeast corner of California, was selected as one of several projects to illustrate the urban development associated with irrigation farming. An examination of the growth in population and

Workers harvesting cantaloupes in the Yuma Valley for markets throughout the Nation. Last year this crop brought over $2½ million to project growers. ***Photo by Harry W. Myers, Region III.***

Livestock exhibit in downtown Yuma, Ariz., draws large crowd. Sales of livestock for the project during the last year amounted to approximately $2¾ million. ***Photo by Samuel B. Watkins, Region III.***

business in the Yuma area will serve to illustrate the propriety of shifting a portion of the irrigation repayment to local nonfarm interests.

Without irrigation, farming would be impossible in the Yuma area, since rainfall averages only 3 to 4 inches annually. There is little mining or other basic industry providing employment or trade in that vicinity. Except for some tourist business the entire urban economy is dependent on irrigation farming.

The Yuma project comprises only 69,000 acres of irrigable land. Some irrigation was being practiced by direct diversion from the Colorado River prior to the construction of the project in 1905–10 by the Bureau of Reclamation. At present the water is diverted from the west side of the Colorado River at Imperial Dam, with the water required for lands located on the Arizona side of the river siphoned under the Colorado at the city of Yuma. Irrigation is by gravity except for about 2,000 acres which require a pump lift of 70 feet. The main crops grown are alfalfa, flax, feed grains, lettuce, cantaloupes, carrots, other winter vegetables, and citrus fruits. Yuma, Ariz., is the main town located on the project; other small towns are Somerton and Gadsden in Arizona, and Bard and Winterhaven in California. The net cost of constructing the project, not including interest on Treasury funds, amounted to about $9,700,000.

In 1910, there were 9,000 acres cropped on the Yuma project. This was the first year that gravity water was available from the project system. The acreage irrigated increased year by year until about 56,000 acres received water in 1925. About the same acreage is being farmed currently. The year-round growing season permits the raising of more than one crop on some of the lands. Often lettuce and cantaloupe crops are harvested from the same acreage in one year.

The crop production value on the project since water was first available in 1910 amounted to 145 million dollars, or 15 times the original cost of construction. In the early years from 1910 to 1914, crop returns ranged from $445,000 to $709,000. In recent years, they ranged from $8 million to a record of nearly $14 million in 1947. It is estimated that the value of livestock and livestock products sales from the project have amounted to a total of over $20 million during the last 37 years, or over twice the original cost of the system.

Reports show that 1,500 people were residing on farms on the project in 1912. The number increased to over 5,000 in 1920, but is now about 3,000. This decrease in farm population in recent years corresponds with an increase in the size of farm units resulting primarily from mechanization of farming. Especially in recent years, with the shift to vegetable production, a large number of agricultural workers are employed on a seasonal basis and not reported in the above figures. Also many agricultural workers live in town.

The number of people in the towns of Yuma, Somerton, and Gadsen, Ariz., and Winterhaven and Bard, Calif., increased from 3,150 in 1912, to about 30,000 at the present time. Nearly one-third of the urban population lives outside the city limits of incorporated towns, on subdivision tracts of land. In 1912, there were 2 people living in town for each person living on farms; now there are 10 people in town for each person residing on farms. Most of the people living in Yuma and other towns in the area obtain a living directly or indirectly from the agricultural development.

The trend in carload shipments of farm commodities from the project and shipments of all commodities to the project area are indicative of the growth in business activity for railroads, packing firms, and retail trade. Prior to 1917, less than 300 carloads of farm produce were shipped from the area. In 1946 and 1947, over 17,000 carloads of farm produce were shipped. Shipments of all commodities to the Yuma area increased from about 800 carloads annually in the early years to over 3,100 carloads at the present time.

Economists estimate that the farmer's dollar changes hands seven times before it comes to rest in the Federal treasury or is invested in capital goods. If this is true, nearly one-half of the business activity resulting from farm production may accrue to the local towns, judging from a comparison of farm and business income in the Yuma area. Business gross income has averaged about $21 million annually during the period 1939–46 as compared with a value of crop production of 6.5 million dollars annually. Of course, not all of the business income originated from the farmers' dollars. On the other hand, the 21-million-dollar figure which is that reported for sales tax purposes, is not all-inclusive. Income for personal services, such as doctor and lawyer fees, transportation, and communication is not included.

The trend in post-office receipts, which in recent years were 300 to 600 percent of what they were in 1921, furnished another reliable measure of the growth in the Yuma area business activity. This was an increase of from $22,000 in 1921 to the high of $161,000 in 1943, and $91,000 in the latest year reported, 1946. Record receipt in 1943 to 1945 reflect wartime activity associated with operation of the Yuma Army Base and other military installations near Yuma which have not been a factor since 1945.

Expansion in the use of modern conveniences in Yuma indicates the establishment of business concerns and residences. Since 1929, telephones in service have increased 160 percent, gas connections 116 percent, water connections 107 percent, and electrical connections 62 percent.

Millions in Taxes Returned to Government

One concept of the national benefit of Reclamation projects is the extent to which the Federal Government obtains a return from the development in the form of Federal tax revenues. Federal taxes paid directly or indirectly from Yuma County are estimated to have totaled 37 million dollars for the 14-year period 1934 to 1947. This amounts to an average annual payment of $2,660,000.

A similar expansion in urban development to that of the Yuma area can be shown for most irrigation projects. Although it is not always readily apparent that the development has been dependent upon irrigation farming, at least local businessmen, often the most outspoken proponents of Reclamation, recognize the fact that they benefit from Reclamation development.

In view of these known benefits accruing from irrigation farming to nearby towns, and the dwindling number of projects which can be constructed and paid for by reclamation farmers, the question naturally arises, "Should not those who benefit from irrigation development share part of the costs?"

This is not a new idea. Urban beneficiaries have participated in repayment plans for a number of Reclamation projects. For example, the northern Colorado water conservancy district was organized to help repay the cost of the irrigation features of the Colorado-Big Thompson project, located in the State of Colorado. The district became the contracting agency with the Government, under legislation passed by the Colorado Legislature in 1937, and was authorized to levy an ad valorem tax on all real and personal property within the district boundaries. The rate of this tax on the property was not to exceed one-half mill during construction, nor one mill after construction is completed. Of the $600,000 annual payments for irrigation features expected at the time the contract was written, the district planned to raise $150,000 or 25 percent of the cost through a tax on both farm and nonfarm property. The remaining $450,000 to be paid annually would be collected from the water users.

The State of Nevada, by special legislation, authorized Washoe County to issue bonds in the amount of $500,000 which were to be used to pay one-half of the cost of Boca Dam and Reservoir, the reimbursable cost of which, in the amount of $1,000,000 was assumed by the Washoe County water conservation district. Under this arrangement, property not assessable by the district is taxed by Washoe County to repay the bond issue as an aid in paying the project cost.

The Carbon water conservancy district, having the same limits as Carbon County in the State of Utah, was formed for the purpose of contracting with the United States to repay the reimbursable costs of the Scofield project. All property within the conservancy district, including the principal towns of Helper and Price in Carbon County, is subject to ad valorem tax to the extent of one mill to repay the obligation which the district assumed in its contract with the United States. The cost of operating and maintaining the project is borne by the irrigators.

In New Mexico, the Middle Rio Grande conservancy district was organized to construct irrigation, flood control and drainage facilities. Under an assessment plan devised by the district, 43 percent of the construction costs are levied on agricultural property and 57 percent levied on nonagricultural property. Nonfarm participation is based largely on flood protection provided by levees. The district is comprised of lands below the main canals, and properties at higher elevations do not contribute to project costs.

Under the plan to rehabilitate the Middle Rio Grande area recommended by the Bureau, the conservancy district would become the contracting agent to repay project costs and the present division of costs between agricultural and nonagricultural property would be continued. This plan recognizes the fact that indirect benefits of irrigation, as well as flood protection, justify a contribution by urban property.

Other instances where town people have willingly participated in paying for reclamation could be cited, such as the Paonia project, Colorado; San Luis project, Colorado; Tucumcari project, New Mexico; and the Mancos project, Colorado.

THE END

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Shasta Dam and Power Plant.

THE LAND

by BEN W. CREIM
Regional Power Manager, Region II, Sacramento, California

BEFORE IT WAS OVER, the record-breaking spring drought of 1948 in the great interior valley of California had become a record-breaking early summer rainfall, and major disaster was averted. But during the despairing months of January, February, and March, every farmer in the Central Valley had learned a number of bitter, paradoxical lessons. It had been a strange kind of drought—strange and instructive. There was some water, but the power to move it was lacking.

In the valley's years-long race against the threat of drought, emphasis has naturally been placed on development of water itself, as the desirable end-product. While thousands of new wells have been sunk throughout the Sacramento and San Joaquin Valleys to tap the already dwindling underground water supplies, vigorous support has been given to rushing completion of the reservoirs and canals of the Central Valley project. Most of the farmers have taken little or no interest in the power development, despite the fact that here, as elsewhere, power is irrigation's "paying partner," and power revenues will repay a large share of irrigation's construction costs.

This year, however, the farmers realized with a start that a large preponderance of the Central Valley's irrigation supply is entirely dependent on electricity, and that they had been unwise to take power supply for granted.

Probably less than a third of the irrigated lands throughout the valley have a partial or complete gravity supply. All the rest use pumped water—either pumped directly from the underground, or pumped from streams into gravity canals. The pumps, in all but a few old-time installations, are powered by electricity. Suddenly, power was scarcer than water, and without power the water supply was useless. How this came about is a story fascinating in itself—the story of an upside-down year.

The growing period in the San Joaquin and Sacramento Valleys is divided into two seasons, the rainy season from November through March, and the season of irrigation from April into September, when little or no rain falls. The rainy season, of course, is all-important to the later irrigation season, carrying trees and vines through the budding period, preparing the soil for late-spring planting of irrigated crops and sufficing entirely for nonirrigated grains, pasture and a few tree crops. At this time the mountain reservoirs fill to provide simultaneous irrigation and power-production later in the summer, and the snow-pack is formed which will determine the amount of stream-flow diversion possible later on from snowmelt. Power use in the area is normally low during the rainy period, allowing the hydro-reservoirs to fill.

But the irrigation pumping load in the Central Valley is in itself a very large factor in the electrical economy and accounts for the area's annual peak, which usually occurs either in July or August. Clustered throughout the valley are no less than 40,000 individual wells tapping the underground water channels and nearly all powered by electric motors. The water level in most of the wells has been dropping steadily since 1930 because of overdraft, so the wells have had to be progressively deepened. Consequently, the amount of energy consumed in lifting water from even greater depths has increased rapidly. The wells vary in depth from 30 feet to over 2,500 and the motors to operate the pumps range in capacity from 10 to 1,500 horsepower. During the war, thousands of new pumps were installed, increasing the pumping load directly and, by further lowering the water levels, indirectly as well. The following table of agricultural power sold by the private company serving most of the area demonstrates the size and growth of the pumping load very graphically:

Year	Total kilowatt hours	Revenue	Average cost per kilowatt hour
1942	666, 662, 095	$8, 891, 421	$0. 0133
1943	706, 124, 875	9, 377, 155	. 0133
1944	842, 484, 789	10, 868, 013	. 0129
1945	889, 167, 857	11, 460, 550	. 0129
1946	1, 098, 843, 661	13, 100, 265	. 0119
1947	1, 376, 508, 304	15, 264, 700	. 01108

Even these figures, which show that power sold at agricultural rates has doubled in amount since 1942, do not completely indicate the scope of the pumping load. In addition, large irrigation districts and water companies, particularly along the Sacramento River, buy pumping power under other than agricultural schedules in order to pump surface water from the streams or to lift canal water to high lands. In the San Joaquin Valley, over 75 percent of all irrigation is from groundwater. Thus, except for the few fortunate areas where gravity diversion is possible, the entire irrigation supply of the Central Valley requires large amounts of electric

of the SKY-BLUE POWER

In the Central Valley of California, *Power is Water*—as Valley farmers learned this year, when the switches were pulled

energy, and in midsummer the area's electric facilities must meet their yearly peak demand—in contrast to the situation throughout most of the United States where, in midsummer, electric use is lower than in any other part of the year. When sufficient power capacity is available, this irrigation peak has a hand-in-glove efficiency, since the water which produces hydroelectric energy for the pumping load provides at the same time, farther downstream, the necessary flow for surface irrigation diversions.

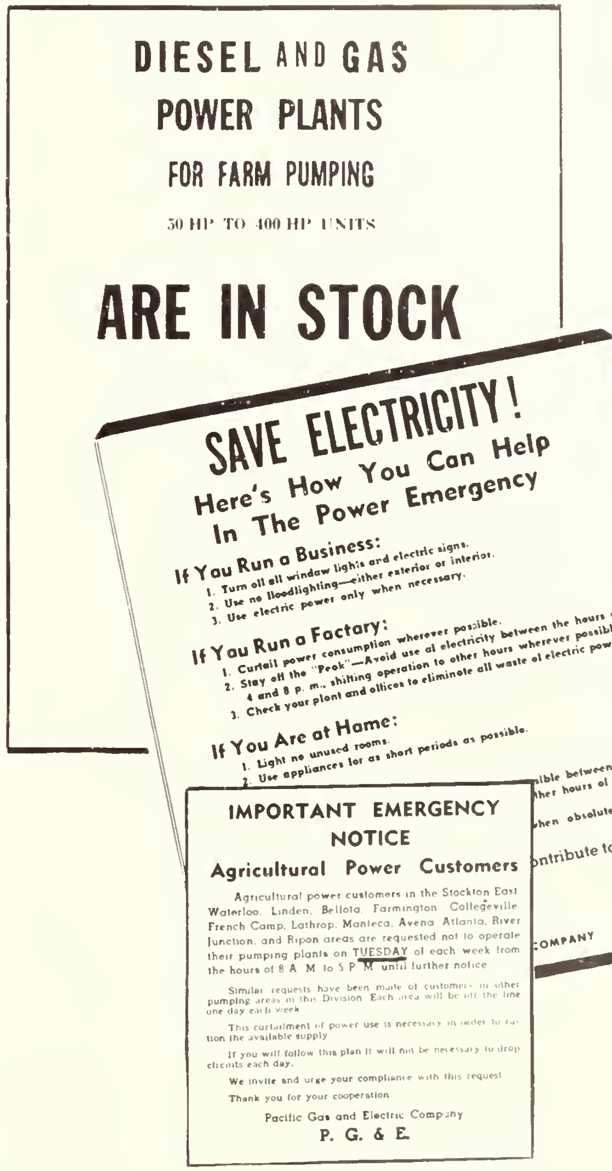
In 1948, two things went wrong with this admirable arrangement:

- There was far less than enough power capacity to meet the normal situation; and
- The two seasons simply reversed themselves.

Here is how it happened.

During the war, every part of the area electric load had increased similarly to the pumping load, without any increase in installed power capacity. Steam plants, normally used only in dry years or for a few weeks during the year, had to be used more and more to meet normal load, on a 24-hour basis. By the peak summer season of 1947, the steam capacity was in constant full production and yet the area ran out of power. But the farmers were still not vitally concerned, because the only load which the company had to drop was its industrial contracts which could be interrupted, such as those with chemical plants. It was clear that trouble lay ahead during 1948. For just the natural growth of electric use in the area alone would exceed the small amount of new plants to be installed. Something more than the chemical plants would have to be dropped in 1948, while voltage and frequency were certain to fall below standard during the peaks. By January 1, demand had risen alarmingly and was riding close to the previous August peak. The electrical picture darkened day by day. Then the weather did its flip-up.

Rainfall had been about normal throughout October and November in most of the valley. December, however, was considerably less than normal. In most places, January began rainless and stayed that way. In the Sacramento Valley, it was the driest January since 1878, while on January 24 the San Joaquin Valley passed its previous record of 35 days without rain during the normally rainy season, a record set in 1912. On February 5, when less than half an inch fell, the drought broke at Friant Dam after 46 rainless days. But in all of February, the rainfall at Friant was less than 1 inch. It looked like the worst drought in history. Throughout California, prayers for rain were a prominent feature of every church service.



Appeal to the public!

Irrigation had begun by the second week of January, mostly by orchardists and vineyardists who had to irrigate to save their trees and vines. Grain crops had been written off and stock was being shipped out, slaughtered or turned into the short-standing grain fields. A few specialty growers did some preirrigating, but most considered that any investment in planting was too great a gamble, since the outlook was that no vegetable crop would mature. By the beginning of February, the irrigation pumping load was rising rapidly, just as normally it would rise between mid-**April** and the first of **May. The irrigation season was in full swing, in the middle of what should have been the rainy season.** It was then the farmers learned that power is water in the Central Valley.

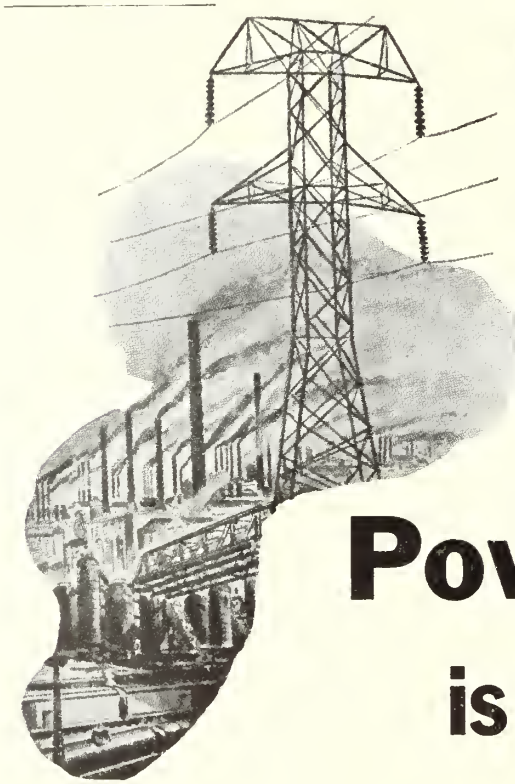
The partial pumping load, coming out of season and on top of the already tight power situation, precipitated an almost immediate crisis in power supply. The first signal was a drop in frequency, which caused electric clocks to slow down. Radio programs throughout northern California fumbled for a few days and in the cities everybody was late for work. The area was still experiencing winter conditions, which meant that the daily peak was occurring in the evening, so the power company appealed to the public to conserve electricity between the hours of 4 to 8 p. m. Business establishments were asked to black out display lighting, farmers were asked not to pump during peak hours and householders to cut down their use of electricity wherever possible.

Public response to this appeal was generally helpful, but the peak rose too rapidly in February for such voluntary restrictions to be very effective. On February 25 the State public utility commission stepped into the picture and imposed a 10 percent reduction on all uses of electricity, with a penalty of disconnection attached to violation. But the irrigation pumping continued to rise, and the utility companies began pulling switches on rural areas. This was more effective, since it struck at the central problem. The power was cut off for only an instant, but once deprived of power, the pumps had to be started by hand again. And, since they were at the other end of the farm, a moment's switch-off would serve to reduce the load for more than an hour—enough to get over the peak. Householders experienced only a momentary inconvenience, but the effect on irrigators was drastic. The only trouble with this technique was that it made the farmers hopping mad, and it did not get the fields and orchards irrigated.

The next step was a rotation-system for agricultural power shut-off—in short, to achieve on voluntary schedule what the switch-off method had effected involuntarily as emergency arose. Throughout the valley, announcements were printed in the newspapers, informing farmers on which day of the week they were not to operate their pumps between 8 a. m. and 5 p. m.

(*Continued on page 172*)

Shafter Press 8
FRIDAY, MARCH 12, 1948



Each Kilowatt of Electricity

WE CAN HELP SAVE

Means More Power For Agriculture

in the Shafter District

AND THROUGHOUT CENTRAL CALIFORNIA

Power Conservation

is YOUR JOB and MINE

Here Are Some Simple Rules:

1. Turn Out All Unnecessary Lights at All Times.

MERCHANTS OF THE TOWN OF SHAFTER IN CALIFORNIA'S CENTRAL VALLEY KNOW THAT THEIR LIVELIHOOD DEPENDS UPON THE WELFARE OF THEIR FARMER-CUSTOMERS. THIS SPRING THEY CAMPAIGNED FOR POWER CONSERVATION TO HELP SAVE THE CROPS BY MAKING MORE POWER AVAILABLE TO THE FARMERS.

Layout of this article by George V. Gideon

Deep Sea Diving in the West

Atop Belle Fourche Dam, Jim H. Thompson makes last-minute check-up on diving gear before his brother John starts another shift on valve repair work. ▶ Belle Fourche Reservoir appears in background.
Photo by T. R. Broderick, Region VI.

A mention of deep sea diving usually brings to mind an underwater scene wherein the hero, clad in the Man-From-Mars-like costume of a deep sea diver, fights with pirates, an octopus or other denizen of the deep, perhaps in a search for hidden treasure, and emerges exhausted but victorious—sometimes after having lost communication with those "on top" or cutting his life-line of oxygen.

Colorful, dramatic scenes like these have often been enacted inland. At present (See front cover, July 1948 issue) deep sea divers are searching for the clue to pirates of another sort—silt particles in Lake Mead which rob the West of life-giving water.

At Buffalo Bill and Belle Fourche dams in Region VI, deep sea divers were called in to help release the energy of a power plant, and free irrigation water blocked by a leaking valve.

The most hazardous of all diving jobs in Region VI was done in April of this year during four days on the Belle Fourche Reclamation project in northwestern South Dakota.

At the Belle Fourche project, water from Belle Fourche river is diverted by a 1½-mile-long diversion dam and carried 6½ miles through an inlet or supply canal to the Belle Fourche Dam on Owl Creek, a tributary of the Belle Fourche River.

Belle Fourche Dam, once one of the largest earthfill dams in the world, has a structural height of 112 feet and a crest length of 6,262 feet. Water is distributed from the reservoir to most of the project lands by means of the north and south canals.

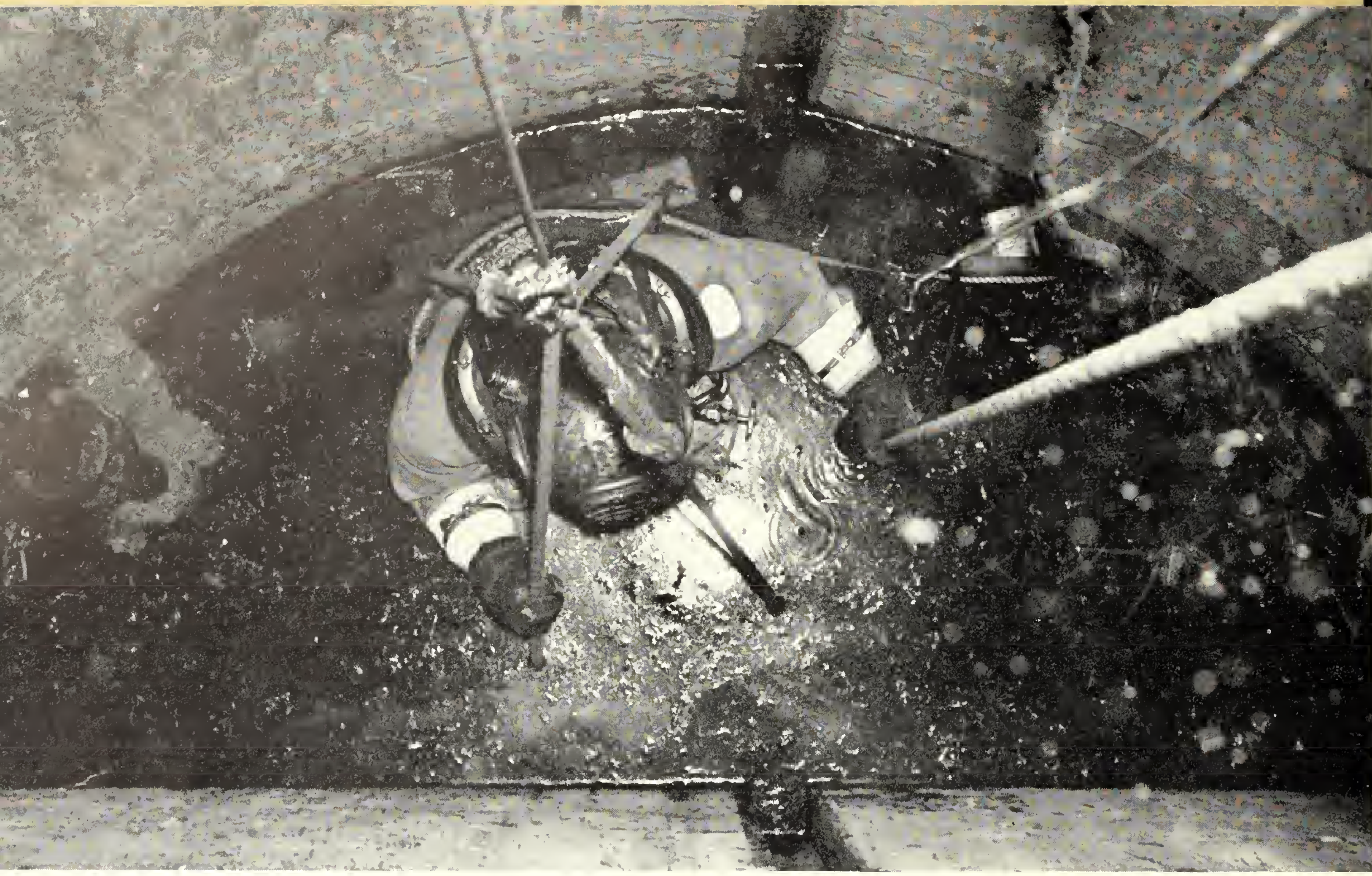
Near the end of the 1947 irrigation season, the gatetender at Belle Fourche Dam discovered that the Ensign balanced valve, controlling the reservoir release into the north canal, had become unmanageable. The only way to regulate the flow of water through the valve was to run the control pump at high speed. This indicated there was a leak in the hydraulic system controlling the valve.

It became obvious that someone had to go down into the tunnel to see what was wrong. Accordingly, the valve was partially closed and an inspection was made. The cause of the trouble was discovered—a jet of water spurting from the face of the valve, indicating that the internal pressure necessary to control the valve was being lost at that point. Since it was not possible to keep the valve closed, the emergency gates were lowered. One of the gates was then used to control the reservoir release for the remainder of the irrigation season. The emergency gates, however, were not intended to regulate a flow which would meet the demands at the peak of the irrigation season. Therefore the valve which had failed had to be repaired, at least to the point where it would close—and stay closed. Water could then be regulated by its twin which is located beside it at the end of a fork in the tunnel. As these valves are to be replaced within the next 2 years the officials believed this stop-gap measure would take care of the situation temporarily.

As soon as the emergency gates were closed, the outlet tunnel and gate shaft filled with water to the level of the reservoir water surface. Obviously, only a deep sea diver would be able to repair the face of the valve. Invitations for bids for this work, issued by the Missouri-Oahe district office, resulted in the arrival of Capt. H. H. Thompson & Sons of Duluth, Minn.

The divers considered the type of operation necessary to be unusually hazardous. And, no wonder! The diver's only access to the leaking valve was by descending the gate shaft 70 feet to the floor of the tunnel and then walking about 200 feet up the tunnel to the valve. In an emergency, the diver would have to walk the 200 feet back to the shaft before he could possibly get out.

A hand winch was rigged to raise and lower a trapezelike platform to let the diver down the shaft until he was in the water and to bring him from the water to the top of the shaft on his ascent. While in the water the diver controlled his buoyancy through his air-relief valve. An air compressor, with a stand-by unit and ample receiver capacity, was lo-



GOING DOWN—Diver John F. Thompson is lowered into flooded gate shaft at crest of Belle Fourche Dam. Following a descent through 55 feet of water in the shaft, he will proceed 200 feet through the North Canal outlet to work on valve. ***Photo by T. R. Broderick, Region VI.***

cated on top of the dam at the gate house to make sure the diver had an unfailing air supply.

The first time down, the diver made a thorough inspection of the face of the valve and discovered two holes—one at the top which had been observed before the emergency gates were closed, and another at the bottom of the face. The holes appeared to be the result of cavitation, or surface erosion of the metal as a result of the vacuum created by the rapid movement of water over the face of the valve. When the valve had been inspected before the 1947 irrigation season began, cavitation damage had not appeared to be serious.

By working with hand tools and a small air-powered grinder, the diver reamed the holes so that they could be patched. When reamed, the holes were a little more than an inch in diameter. The upper hole was patched by placing a metal plate, with a rubber gasket cemented to it, through the hole and drawing it against the inside surface of the valve face with a bolt through a plate on the outside. The lower hole was in a rather inaccessible place and the best remedy that could be devised was to ream the hole and drive in a turned wooden plug.

After the patches were in place, the hydraulic control pump

Left: View from top of Belle Fourche Dam, looking south (reservoir at right). Gate house with shaft which diver Thompson entered can be seen at left. Below: Diagram of OPERATIONS BELLE FOURCHE.

was put in operation to close the valve. But the valve had become jammed in the open position, and about twice the normal operating pressure was applied before it finally moved shut.

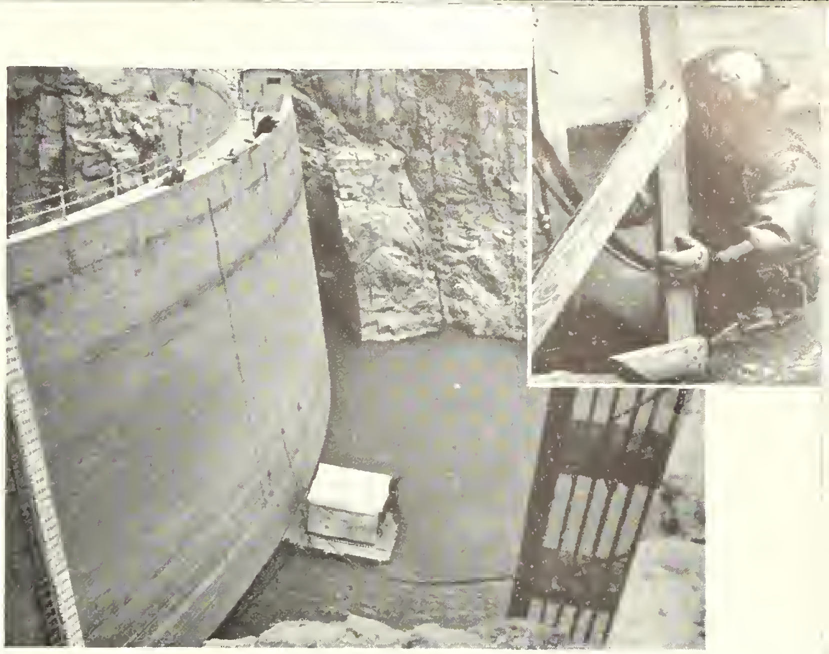
With the valve closed, the emergency gate was raised and the shaft and tunnel unwatered. Now the patching job could be inspected. There was a little leakage around the bolted patch, but caulking with lead wool put a quick stop to that. The inspectors reported the wooden plug was holding very well. The diver's work was accomplished in six diving operations performed in 4 days, with the diver working under water as long as 3 hours at a time. The temperature of the water was between freezing and 40° Fahrenheit. Fortunately, there were no mishaps and the work was accomplished without serious complications.

S. T. Larsen, Belle Fourche superintendent, stated, "While this is the first time it has been necessary to engage the services of a deep-sea diver on the Belle Fourche project, the work was accomplished in a very adequate manner and at less expense than was anticipated."

Back in March 1941, Shoshone project officials hired Walter McCray, a deep-sea diver from Seattle, Wash., to inspect trashracks at the inlet end of the pipes through Buffalo Bill Dam which lead to the power penstock. This was part of a routine inspection to remove any debris which may have been caught by the trashracks, which had last been cleaned out in the fall of 1932. Project officials installed a three-drum hoist so that they could use a one-half to three-fourths cubic-yard orange peel bucket for removing accumulated trash in front of the trashracks. McCray started diving on March 28, and reported his findings which were checked against the drawings of the trashracks and trashrack structure.

The conditions found by the diver checked with the drawings and the next day he went down to double-check. He found that both racks were obstructed with tumble weeds, sagebrush, driftwood and mud, piled higher than the tops of the pipes through the dam. He also discovered that the trashracks were not in proper position. This cleared up the mystery of why rocks and driftwood had been found in the power penstock pipes in 1940, but made it impossible to lift the trashracks until the debris had been removed. This took a greater part of a month, during which time McCray continued making inspections of the trashracks and reporting as well as possible the underwater conditions, telling the dredgers where debris was located so they could go to work with the bucket. He was unable to see anything below the surface of the water, which was about as clear as it ever gets, and had to depend entirely on touch and measurements when he made his inspections. However, the trash, consisting mostly of waterlogged sticks, tree stumps with roots attached, some rocks, silt and automobile parts, was cleaned out—several hundred cubic yards of it—and the racks removed, inspected and replaced.

Chester Womack of San Francisco, and his men, "Deepwater" Smith and Bill Swart arrived at Cody, Wyo., May 13, 1945, to investigate the condition of the trashracks at the Buffalo Bill Dam which had allowed debris to enter the penstocks since a rock slide the previous November. Several shutdowns had been required to remove this debris and it appeared that the penstock inlets were partially blocked.



Above: Diving operations conducted from a barge to clear inlets to power penstock caused by rock slide at Buffalo Bill Reservoir. Diver can be discerned by disturbance in water created by air escaping from his helmet. Note part of trashrack, at right, "on the way up" for inspection. Inset Diver "Deepwater" Smith leaving barge for 200-foot trip below water to continue probe. ***Above photo by Ed Witz, Region VI. Inset photo by C. T. Hinze, Region VI.***

Project officials had assumed that the trashracks had been damaged and that top grillage should be installed on the racks. Master Mechanic William J. Montgomery started dredging operations on December 4th, continuing for almost 3 weeks, until bad weather, complete with ice, set in. By that time the dredgers had dragged up 300 cubic yards of assorted trash, plus an automobile with 1937 license plates. [The mystery of the automobile has never been solved.—Ed.]

With the coming of spring, and the deep-sea divers, the water in the reservoir was lowered, and the original cause of the power shutdowns came into view—a place in the north cliff where a large quantity of rock had evidently "let loose" and which the power officials believed to be the origin of the slide which occurred on November 24.

This time the divers worked from an improvised barge, making two dives each day, with shifts "on the bottom" varying from several minutes to 23 minutes per dive. As in all diving operations under Bureau supervision, time spent working "on the bottom," decompression time and the number of dives per 8-hour-shift were governed by United States Navy Regulations. The job was another "feel and see" operation, as the divers' boots stirred up silt, making it impossible for them to see their hands before their helmets. In spite of these handicaps the divers located huge rocks (one averaging about 6 feet square and 18 inches thick) and other debris, and attached wire rope slings to them. The mechanics made their hauls via cableway between diving operations. Working from 161 to 196 feet below the surface, the divers continued their job of helping to clear the inlet, raise and replace trashracks, and make underwater inspections until the job was completed. The penstock was flushed out after the dredging and diving work had been finished and an inspection was made. A small quantity of debris was removed from the manifold trashracks and no more trouble was ex-

(Continued on page 177)

Taking a Poke at Poison Oak

Shasta Lake area may be freed of West's worst pest

by J. W. Koehler

Sacramento Valley District, Region II

Sacramento, California

The State of California, as any fair-minded geography student will freely admit, excels in every possible way. Everything is bigger and better in this more than normally excellent section of the country. Therefore the public school botany textbooks can afford to admit that: "Poison oak is the most widely distributed shrub in the State."

Poison oak is our Western counterpart of the East's poison ivy. Western poison oak found growing most often in the three West Coast States is not an oak but is a species of the same genus (*Rhus*) as is poison ivy. Another common species of this poisonous group is oakleaf poison ivy found mostly in the Southeast. Poison sumac, which is a true sumac, also belongs to this genus and is usually associated with bogs in the eastern part of the country.

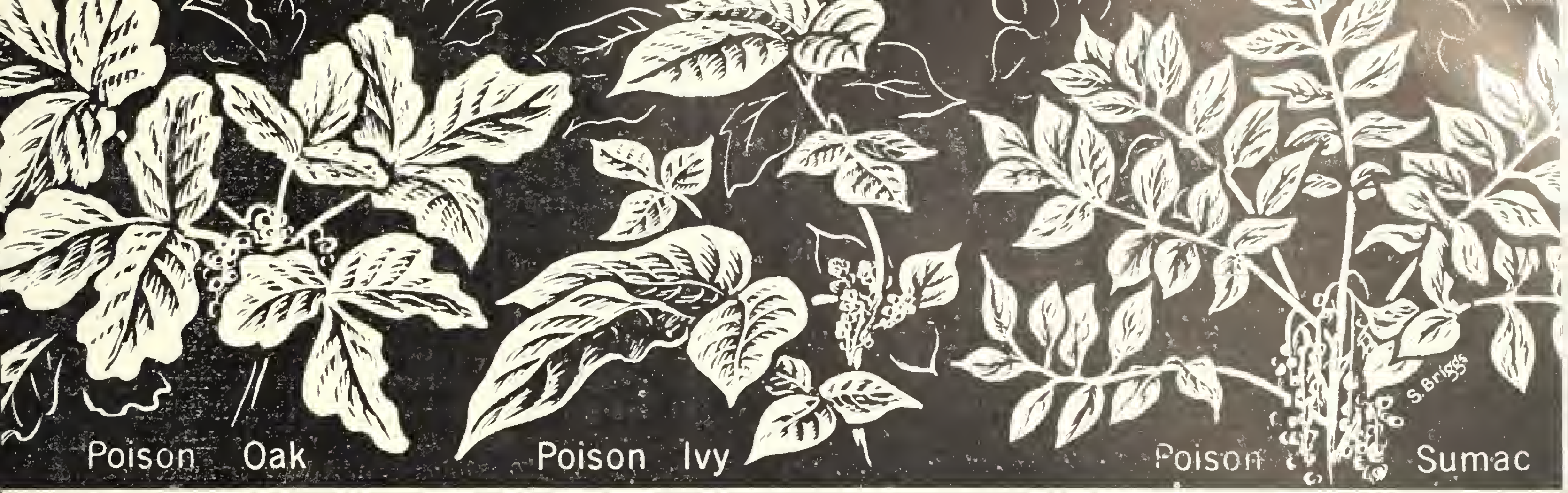
The western poison oak is not to be dismissed lightly, as Webster does, with: "Any poison ivy of bushy habit." It resembles poison ivy the way an atom bomb resembles a firecracker. Its habits may sometimes be bushy; they are always beastly.

Robert Louis Stevenson in *The Silverado Squatters* recognizes the true character of this pest by stating: "In all our woods and by every wayside there prospers an abominable shrub or weed called poison oak, whose very neighborhood is venomous to some and whose actual touch is avoided by the most impervious." Stevenson well knew that having oak poisoning is like being seasick. You don't die of it. You just wish you were dead. And you can't avoid getting it like you can avoid seasickness or poison ivy. You do not *have* to take an ocean voyage. Of course, you *can* avoid poison ivy by staying out of the countryside, but California, with its 10,000,000 happy inhabitants, is still almost *all* countryside. People by the scores of thousands have to work in it. Every vacationer has to go through miles of it to get to the nearest luxurious, homelike vacation spot.

"The abominable shrub" first came under the Bureau of Reclamation's scrutiny when Shasta Dam was thrown across a canyon chocked with it. Countless thousands of man-hours were lost among construction workers who brushed against the plant, or handled tools which had come in contact with it. The problem continues in the area today, with the plant

Upper left: District Weed Specialist J. W. Koehler, spraying poison oak with a mixture of 2, 4–D and diesel oil in Shasta Lake area. Immediate left: Loading spray equipment on Bureau barge for poison oak elimination tests in Boy Scout Camp area, Shasta Lake, Calif. *Photos by R. A. Midthum, Region II.*

At top of page, photo by A. E. McCloud, Region II, drawings by Shirley Briggs.



creeping right up to the back doors of the houses sheltering the fairly large permanent colony of Shasta Dam and power plant employees. And with the projected opening of a recreational area along Shasta Lake's hundreds of miles of shore line, some way of cheaply eliminating the weed became a large-scale necessity last year. Advice from State, county, and University of California weed specialists was sought. These experts all agreed that the new "wonder weed control chemical," 2,4-D, should be used for a large-scale trial application against the poison oak menace.

The first place chosen for the trial was the main council area of the new 600-acre camp of the Boy Scouts of America on Shasta Lake. Cooperating in this volunteer program with the Bureau of Reclamation specialists were the Boy Scouts, always ready to do a good turn, the National Park Service, The State of California Division of Forestry, The State Bureau of Rodent and Weed Control, the botany division of the University of California, the Shasta County Agricultural Department and the Shasta County Agricultural Extension Service; a total of 33 men and boys.

Sunday, May 4, 1947, was picked as POE (Poison Oak Elimination) Day.

At dawn a Bureau barge, laden with men and equipment, stole across the misty lake to a 10-acre beachhead on the steep foreshore.

The assault forces sprayed over 4 acres with a low-volume concentration of the butyl esters of 2,4–D mixed with diesel oil. The remainder got a dose of ammonium sulfamate, a more expensive but useful chemical which has been used for poison oak control for several years. Since the terrain was sloping and steep, only those areas accessible by road could be treated with the power-spray machines: a 65-gallon sprayer loaned by a chemical company for the 2,4–D, delivered at 20 pounds pressure; and Shasta County's sprayer sending forth ammonium sulfamate at 250 pounds. Inaccessible areas got ammonium sulfamate spot control from knapsack pumps strapped to the backs of the fighters. Weather conditions were favorable—maximum temperature 86° F. with a slight southeast breeze. Tired, unhappy and afire with blistering itch, the gallant band sloshed gallons of calamine lotion on each other as they retreated across the lake at sunset.

Walter S. Ball, Chief of the State Bureau of Rodent and Weed Control; W. A. Harvey of the University of California College of Agriculture; C. J. Graham, regional weed specialist, and the writer, returned to the scene of the battle just a year later. We found considerable light regrowth of about equal density in both the 2,4-D and ammonium sulfamate-treated areas. This regrowth was no worse than expected. Retreatment of the area should eliminate nearly all of the plants for good.

The most important results of the test was proof that at least under these particular conditions, 2,4-D, only a fifth as costly, is just as effective as ammonium sulfamate. (Cost of original 2,4-D spray and final respray amounted to $15 per acre as against approximately $70 for ammonium sulfamate.) The new chemical will have the additional benefit of being easier to handle—using lighter equipment than ammonium sulfamate takes—because low-volume spraying with it has proven successful. And of course, as already known, 2,4-D will not corrode the spray equipment.

Subsequently, trial applications of 2,4-D sprays were made on poison oak in and around the Bureau of Reclamation construction camp near Shasta Dam. These trials show partial control, with some regrowth, and spot-spraying should keep the camp area relatively free of the pest.

The Bureau's report indicated that the assault troops had established a successful counter offensive against the enemy which should result in holding casualties to a minimum. In the future it is hoped that fewer and fewer workers and vacationers will be harassed by "this skin irritant which often causes intense and extremely painful dermatitis." These cooperative tests give us hope of bringing under control at a price any Government unit, contractor or resort operator can stand, an ailment that doesn't kill or cripple for life, but can put a substantial portion of a working force out of commission or, like an outbreak of bubonic plague, drive tourists away from a desirable vacation area. The End

The Land of the Sky-Blue Power

(*Continued from page 166*)

At about this time the Pacific Gas & Electric Co., which serves almost the entire area, was placing large ads in the local papers entitled "Facts About Power Curtailment," and informing, in a headline, that "Power Saved is Water Saved." A statement in the Shafter Press of March 12, paid for by 56 commercial firms in the town of Shafter, hit the nail on the head by beginning its full-page announcement with:

EACH KILOWATT OF ELECTRICITY WE CAN HELP SAVE MEANS MORE POWER FOR AGRICULTURE IN THE SHAFTER DISTRICT AND THROUGHOUT CENTRAL CALIFORNIA.

By the middle of March, the State commission had appointed an emergency power administrator, who promptly ordered a 20 percent curtailment in all electric use. This superseded the rotation plan and left farmers with the threat of having their electricity disconnected if they did not reduce their pumping by a full 20 percent.

At this point, desperate farmers began buying diesel-electric plants. Every Valley newspaper carried advertisements like one in the Oakdale Leader for April 1, which read:

Diesel and gas power plants for farm pumping are in stock—Reserved exclusively for ranchers. See us at once as the supply is limited.

The Farm, a San Francisco publication, reported on April 2 as follows:

Sale of diesel power plants is booming in the San Joaquin Valley. Big and little farm operators are scrambling for a source of energy that is not subject to restrictions, except those involved in price and availability.

Fresno dealers estimate "several hundred" diesel power plants have gone into service, or been ordered, in Fresno County and part or all of Madera, Kings, and Tulare, since the power shortage pinch. There are no exact figures but a fair guess would be nearer 1,000 than 500.

In April, the rains began, tentatively, then in volume, continuing through May—when normally the irrigation season would be getting into full swing. By May 1st, with 200,000 kilowatts of power being imported from southern California and the pumping load reduced by rainfall, all restrictions on power use were temporarily removed. Prospects were that Californians would get through the season without further mishaps.

To most northern California farmers, the true role of the Central Valley project as **a water project** had been considerably clarified, and they had learned a new respect for the power facilities at Shasta and Keswick Dams. During the critical months, however, Shasta Reservoir was storing for what threatened to be an historic dry cycle and the generators could not be operated at full capacity around the clock without seriously endangering the water storage. Nevertheless, in the 4 months from January through April, the project delivered better than 250 percent of its contract commitments (377 million kilowatt-hours instead of the 150 million required by contract) and at the same time achieved a full reservoir at Shasta. This achievement represented an all-but-perfect job in water management for a multipurpose reservoir. It was marred only by the fact that the totally unhoped-for mid-April rains made it necessary to release water for a few days to keep the reservoir from spilling uncontrolled over the flashboards that block the drum gate gap, and carrying away falsework for a bridge downstream. At the same time Shasta was storing precious water in anticipation of *future* drought, it was able to produce desperately needed electric energy to relieve the *present* water crisis brought about by power shortage.

The thousands of farmers in the Central Valley project service-area who do their own pumping were grateful for the CVP power this spring, when it was providing 10 percent of all the energy in northern California and saving them from much more drastic curtailment in their irrigation. In a land where power is water, the Central Valley project is throughout **a water project**—not in spite of its power features, but because of them.

THE END

"Seepage Losses from Irrigation Channels" Now Available

The Colorado Agricultural Experiment Station, Colorado A&M College has announced the availability of Technical Bulletin 38 entitled "Seepage Losses from Irrigation Channels." The publication may be obtained by writing the Office of Information, Colorado A&M College, Fort Collins, Colo. The price is 50 cents per copy.

(Date)

THE COMMISSIONER,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

SIR: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ______________ for a __________ year subscription to the RECLAMATION ERA.

Sincerely,

Check (√) if member of water users association ☐

(Name)

(Address)

(Name and address of association)

(Include zone number, if any)

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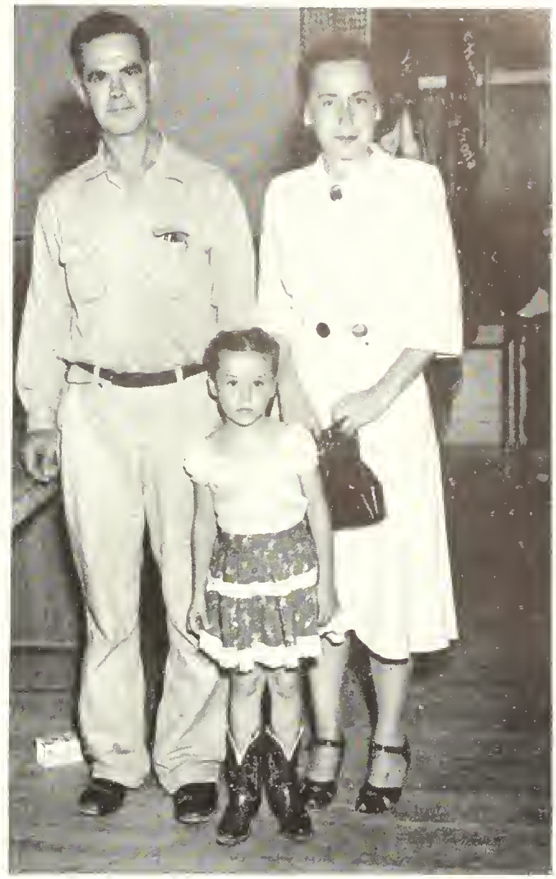
Gila Homesteaders Take Over

by IAN A. BRIGGS

Branch of Operation and Maintenance, Region III, Boulder City, Nevada



Yuma veteran Francis Henry Martin, his daughter, and Mrs. Martin were on hand to hear his name called on the 15th draw for one of the homesteads. ▶
Photo by Samuel B. Watkins, Region III.

On the sun-parched Yuma Mesa of the Gila project in southwestern Arizona 54 homesteaders are making irrigation history.

Colorado River water, sunshine, fertilizer, experience and hard work—these are the main ingredients that are going into some 5,000 acres of predeveloped public land now being settled by veterans from New Jersey to California and Oregon to Alabama. The newcomers to the mesa were selected by lot at a public drawing in Yuma, Ariz., last June 29. Most of them had not seen their homesteads until they went to Yuma after being notified their names were drawn.

"That alfalfa looks mighty good to me," homesteader William Ford Montgomery remarked in his best Alabama accent as he stood in the middle of one of the predeveloped plots on the mesa.

Homesteading on land with alfalfa kneehigh is something new in the settlement procedure. Unlike their forefathers who carved homesteads from raw land, the Yuma Mesa settlers are moving onto farms already under cultivation and producing crops.

But, one can hardly call the settlement program on the predeveloped farms of the Yuma Mesa an experiment. It is far more than that. It is an attempt of the Federal Government to make it possible for veterans, who otherwise would not have the opportunity, to have farms of their own.

During the war, the Bureau of Reclamation was authorized to level the mesa land, construct farm ditches, fertilize and seed the soil to a nurse crop and to alfalfa for the dual purpose of dust abatement and land preparation for settlement. This predevelopment has eliminated the gap between the entrance onto the land and the harvesting of the first crop. That gap has defeated homesteaders on other projects who did not have the financial resources to "last." It is a long hard struggle for the settler who must level his own land, construct his own farm ditches, plant his crops and wait for the harvest, particularly on the Yuma Mesa where land preparation is extremely exacting, and correspondingly expensive. All this has been saved the Yuma Mesa settler whose alfalfa crop provides cash and a good start in his battle to conquer a desert soil which for many centuries had lain dormant.

Despite the apparent advantages of the predeveloped farms, the picture on the Yuma Mesa is not as rosy as some may imagine. Farming on the southwest desert is never a "cinch" even under the most favorable of circumstances. This fact was expressed aptly by Regional Director E. A. Moritz of the Bureau of Reclamation in his speech at the drawing for the Gila homesteads.

"Some years ago there was a sign in a midwestern railroad depot advertising land in Mexico," Moritz recalled. "The advertisement bore the legend 'the hand that shuns the thorn will not pluck the rose.' This legend may well be applied to the mesa homesteaders even though the desert thorns have been replaced by lush alfalfa. Their homes must be built on firm foundations of ability, the will to work, and the real determination to succeed in a new land. The mesa settlers will not have easy going. They must have patience. They must learn new ways in the science and art of agriculture. There will be compensations for those who possess those attributes. We sincerely believe that the mesa farms offer success to those who go after it."

Here are a few of the facts concerning the mesa homesteads: The porous sandy mesa soils have no humus and require large quantities of irrigation water. Fortunately, water costs, although high, are not as high as many irrigation farmers now pay. Deficient in phosphorous and other nutrients, the soils require large quantities of fertilizer. The kinds of crops that can be grown are limited. Special methods of farming are required for the mesa soils and even those homesteaders who are experienced irrigation farmers may have to forget their old ways and learn again.

The homesteader will be required to repay the predevelopment and construction costs on his land over a period of 70 years. Therefore, probably not in his lifetime will he own his land free of incumbrance. The predevelopment costs repayable by the homesteader, are estimated to amount to

$150 and the construction charges will average about $200 an acre—ranging from $260 per acre on class 2 land, which is the best on the division, to a minimum of $120 on class 3 land. The settler is not required to begin paying the construction charges until 10 years after entry onto his land. These payments will extend over a 60-year period. However, he must begin repaying predevelopment costs immediately. These payments as currently proposed will extend over a 30-year period with the annual payments of $8 an acre for the first 10 years and $2.50 per acre during the following 20 years. In addition to the predevelopment and construction charges, the settler must pay operation and maintenance charges which will average $7.70 per acre for delivery of 10 acre-feet of water, under the current public notice. Hence, the total annual cost during the first 10 years, which is considered the development period, is expected to approximate $15.70 per acre.

Although costs are high—averaging $350 an acre—the homesteader has the advantage of using interest-free money which was advanced by the Government to predevelop the farms and construct an irrigation system. What the homesteader pays for construction and predevelopment on class 2 land on the mesa without interest is about the same as he would invest in private land of equal productivity at $139 an acre, assuming 5 percent interest on his loan.

To date, alfalfa is the leading crop on the mesa. Some of the Southwest's finest grapefruit is grown on several hundred acres of privately owned land on the lower end of the mesa, in what is known as the Yuma Auxiliary project. Potatoes, tomatoes, and peas, planted on small acreages on the mesa have shown some promise of becoming profitable crops. Commercial plantings of table grapes indicate that promising results may be anticipated with that crop.

Work with many crops is still in the experimental stage. The Bureau of Reclamation, the Bureau of Plant Industry, and the University of Arizona are engaged in a three-way cooperative project on the mesa to explore new crops, fertilizer treatment, methods of irrigation and other factors. These agencies will continue to work with the mesa settlers and advise them in establishing sound farming practices with recommendations correlated by the county agricultural agent. And the settlers, to be sure, will have many worth-while ideas of their own. The land is theirs to do with as they wish. They are free to plant any crop or crops of their choice without dictation from any agency or organization.

The best land on the mesa has yielded as high as 8 tons of alfalfa hay to the acre. Five tons per acre is considered a good yield for the mesa soils. With alfalfa selling this year at around $28 a ton the outlook for that crop is most encouraging to the mesa homesteader.

The Yuma Mesa receives a dependable water supply from the Colorado River for a 12-month growing season. Construction of the Gila Canal headworks at Imperial Dam, 18 miles northeast of Yuma, began in December 1935. Three pumps lift the water 52 feet from the main canal onto the mesa where it flows through a distribution system to the fields.

Work on the mesa development was virtually halted during the war. However, under special authorization, the Bureau of Reclamation was permitted to develop several hundred acres adjacent to the Yuma Army Air Field and plant it to alfalfa as a dust control measure. Work was resumed on a full scale immediately after VJ-day. The land now being settled includes 4,940 acres divided into 54 farms ranging in size from 40 to 160 acres, the smaller farms being most suitable for production of specialty crops such as citrus. Each of the homesteaders was privileged to indicate his selection of the type and size of farm he desired.

The land was opened to homestead entry last December 30 and during the following 3-month period veterans of World Wars I and II, the Spanish-American War and the Philippine Insurrection had preference in filing. Nine hundred and twelve applications were received and of this total 609 were approved by the settlement board for the drawing. Subject to final approval by the examining board, California had 21 successful homestead applicants, Arizona, 8; Oregon, 4; Texas and Colorado, 3 each; Iowa, New Mexico, Oklahoma, and Illinois, 2 each; Alabama, Kansas, New Jersey, Wyoming, Utah, Missouri, and Ohio, 1 each.

Since most of the applicants were out-of-State, few were present for the drawing and only four of these heard their names called for one of the 54 farms. They were: Francis H. Martin, Dan E. O'Connell, and John R. Scarbrough, Jr., all of Yuma, and Baldwin W. Foote, of San Diego, Calif.

Martin, a salesman with an implement firm in Yuma, came to Yuma 2 years ago from California. He formerly was a wheat farmer at Banning and Tulare, Calif. During the first World War he served with the Ninth Trench Mortar Battalion.

The Yuma Mesa homestead will give him a chance he has always wanted—a chance to be in business for himself. "I'm tired of working for the other fellow," he declared. "I want to build something for myself." He thinks he may try his hand at growing winter vegetables on his mesa soil. Martin is 49, is married and has a 5-year-old daughter.

Winning one of the homesteads has helped Foote to realize a lifelond ambition to become a farmer. During the first World War he was a captain with the 4th Division, in France and Germany. In the second World War he was stationed in the Hawaiian Islands as a lieutenant colonel. He is married and has a 4-year-old daughter.

O'Connell hails from Nampa, Idaho, and plans to leave his land in alfalfa for a while and go into livestock raising. During the first World War he was with the Three Hundred and Forty-fifth Field Artillery in Germany.

Twenty-six-year-old Scarbrough wears the Purple Heart for his service with the Two Hundred and Ninth Combat Engineers in northern Burma during World War II. Prior to winning the mesa homestead he was a custom farmer and did land leveling jobs in the Yuma area. He plans to leave his land in alfalfa until he can determine the most suitable crops. The experimental crop of grapes being grown on the mesa especially interest him. Scarbrough, a native Oklahoman, went to Yuma soon after his discharge from the army early in 1946. He is married and has a 17-month-old daughter.

Martin, Foote, O'Connell, and Scarbrough, are representative of the high caliber of men who are homesteading on the Yuma Mesa—men who are being rewarded with a fraction of the soil they fought to protect. THE END

Drainage and Irrigation in the Willamette Valley

by LEE McALLISTER

Planning Engineer, Region I, Salem, Oregon

This giant rhubarb grown on Neal Thompson's place near Canby, Oregon, is only one of the many irrigation products of the Willamette Valley. ***Photo by F. B. Pomeroy, Region I.***

Regions with contrasts more intriguing than those of the Willamette Valley in northwest Oregon are uncommon. Such a combination of humid winters and arid summers is unparalleled farther east. This rich agricultural valley produces an amazing variety of specialty crops, while being dependent primarily upon diversified farming. Although it is one of the oldest Anglo-Saxon farming communities west of the Mississippi, it is still an area of young expanding economy. It is so young, in fact, that virgin natural resources are still being developed, and population is increasing rapidly under the impetus of war-established industries. Perhaps the outstanding contrast in agriculture, however, is the existing need for both drainage and irrigation.

To the pioneer settler, the Willamette Valley must have seemed a Garden of Eden after the desolate wastes crossed by the old Old Oregon Trail. Here he found in abundance wood, water, and fertile land, the three essentials of successful pioneering. These three are still the basic natural resources, conservation of which will assure a firm foundation for a continuing high standard of living. The valley when first settled was covered with fir forests interspersed with open treeless prairies. Lands adjacent to the rivers were settled first. Earliest farming was of the subsistence type, though for a short period cattle ranching was important. However, the settlers soon turned to grain production, and for a long period the principal export was wheat transported out over the navigable rivers. Gradually, as markets and transportation facilities expanded, farming became more diversified until the present wide variety of products was reached.

The importance of general farming in the Willamette Valley is often obscured by the spectacular nature of its many specialty crops. The 1940 census shows that in the nine valley counties $22,500,000 worth of field crops, dairy products, and livestock were sold or traded in 1939. The value of fruit, truck, and miscellaneous crops sold or traded was $10,000,000. More than 65 percent of the total crop land produced forage, grain, and seed. A deficiency in forage is met by importation of hay and increasing pasture yield by irrigation.

In the production of specialty crops, irrigation is of further importance. Small fruits, canning vegetables, some seeds, bulbs, and peppermint are all irrigated to some extent. The entire acreage of some canning vegetables is irrigated. The wide range of high value crops results largely from the favorable climate.

Climate in the Willamette Valley is mild. Destructive winds, hail, and thunderstorms are rare. Freezing periods are infrequent, and summer temperatures are, in general, moderate. The frost-free period varies but averages about 200 days, though hardy crops grow much longer. Often the shorter season east of the Cascades has more effective heat and matures crops earlier.

The floor of the basin, partially in the rain shadow of the coastal upland, has the least precipitation, averaging 38 inches per year. However, rainfall is inadequate for shallow rooted, late maturing crops, as only 15 percent of the annual precipitation falls in the five summer months. In June, July, and August, the rainfall averages only about 2 inches and is often less than 1, or about equal to that in the semiarid districts east of the Cascades. It is generally conceded that at least ½ inch of rain in 20 consecutive days is required for dry-land crops.

While the periods of deficient rainfall are prolonged and severe, excessive precipitation in winter is also a problem. December is the wettest month when more than 10 inches of rainfall in 3 days has been recorded at Portland. Stream

Snap beans thrive on sprinkler irrigation system in the Willamette Valley

Higher Valley lands are adaptable to the lower cost of gravity irrigation.

flow follows the same cycle as precipitation. The need for flood storage is evident as is also the necessity of summer storage releases if any but a minor portion of the Basin's water resource is to be utilized.

Mention of the green Willamette Valley is commonplace. For three seasons of the year it is green indeed, but in late summer large portions support no growth following the harvest of early maturing crops. Such widespread fallow areas, when temperature conditions and soil fertility would allow continuing production, does not indicate full use of land and water resources. Crops which are established over a high water table are left with only a shallow feeding zone when ground water recedes in late summer. Drainage and irrigation are thus parallel needs. Neither in itself is a complete solution to the problem, for both are needed to maintain a proper soil-moisture balance.

Farmers in the Willamette Valley recognized limitations of the climate at an early date. Selection of crops adapted to the climate was such an effective solution for this limitation that the supplementary solutions of drainage and irrigation are not always evident. Some crops, for example, hops and fiber flax, owe their remarkable success to the assured dry harvest season. The continuing expansion of irrigated and drained areas however, demonstrates the recognized value of water conservation.

Five drainage enterprises serving 16,000 acres were reported in the valley in 1940. There are many other cooperative and private ditches serving small areas. The need for drainage on a small scale has been satisfied fairly adequately. There are larger areas having more difficult financing problems which still need drainage construction.

The 1940 census reports 27,205 acres irrigated in the valley in 1939. Informed sources estimate present irrigated acreages at twice to three times this amount. A pumping plant, serving a portion of one farm through a sprinkler system, is typical irrigation development. Irrigation of this type is confined largely to the river bottoms where water is readily available, the surface is too rough for gravity distribution, and the soil is adapted to high value crops. On the higher valley lands away from the streams, the land is smoother and adaptable to the lower cost gravity irrigation, but most wells have a low yield. These higher lands therefore are more suited to development by project.

Four non-Federal irrigation projects now operate in the Willamette Valley. Two of them, the McKenzie and Muddy Creeks projects, irrigate main valley lands rather than river bottoms. Both are non-profit cooperative organizations with a simple diversion plan. They demonstrate the possibility of large scale irrigation, but are not typical of potential future development because of their low costs and simple financing. Additional projects may be more difficult to develop where diversion and distribution are more complex and reservoirs are needed for sustaining summer flows.

The Corps of Engineers began investigation of the Willamette River after approval of the River and Harbor Act of 1927. During the next 10 years examinations and surveys following various directives from Congress, chiefly with regard to flood control and navigational features, culminated in a project report submitted March 12, 1938. On June 28, 1938, Congress authorized the Willamette Valley project. The present project plan includes 13 primary flood control reservoirs. Two of these reservoirs are completed, and operating and construction has begun on two others. Reservoir space for flood control in the 13 reservoirs is to be filled gradually in early spring after destructive floods are no longer expected. This plan would provide 566,000 acre-feet of water per year for irrigation.

The Bureau of Reclamation began irrigation studies of the Willamette Basin in 1940. It was immediately apparent that any extensive irrigation must depend upon reservoir storage because of over-appropriation of summer flows and limited extent of ground-water supplies. In these first studies, releases from only the primary flood-control reservoirs were contemplated for irrigation. Later studies were extended to other fertile tributary valleys not included in the primary flood-control plan. In all, the 21 potential irrigation projects summarized in the table on page 177 have been selected for investigation. The annual irrigated acreage under all these projects would be 414,700 acres, which is 80 percent of the irrigable area.

The Bureau of Reclamation has completed land classification surveys of the Cottage Grove, East Long Tom, West Long Tom, Salem, Yamhill, Canby, and Tualatin projects. Considerable other project studies have been made, including preliminary surveys, preparation of preliminary plans and estimates, cooperation with the Corps of Engineers on plans for storage and flood control, and aerial mapping. Dam and reservoir surveys including core drilling have been completed for the Yamhill and Tualatin projects, and diversion dam and pumping site surveys have been completed for the West Long Tom, Canby, and Cottage Grove projects. Surveys of the main canals and inspections of the drainage requirements were made for all seven projects except West Long Tom. Field draft reports on many phases of the seven projects have been completed. Field work has not begun on the other 14 potential projects. Complete reports on the Canby and East Long Tom projects are scheduled for release to cooperating agencies in the near future. THE END

POTENTIAL IRRIGATION PROJECTS—WILLAMETTE BASIN, OREGON

No.	Project	Acres [1]	Source of supply
	PROJECTS UNDER PRIMARY FLOOD CONTROL RESERVOIRS		
1	Cottage Grove	5, 300	Row R. and Coast Fork.
2	Pleasant Hill	1, 000	Middle Fork.
3	Eugene	8, 600	Willamette River.
4	Springfield	7, 000	McKenzie River.
5	Coburg	28, 000	Do.
6	East Long Tom	8, 400	Long Tom River.
7	West Long Tom	5, 000	Do.
8	Albany	20, 000	South Santiam River.
9	Scio	15, 600	Do.
10	Stayton	11, 200	North Santiam River.
11	Salem	74, 400	Do.
12	Willamette Flood Plain	76, 800	Willamette River.
	Subtotal	261, 300	
	PROJECTS UNDER AUXILIARY RESERVOIRS		
13	Brownsville	3, 400	Calapooya River.
14	Calapooya	12, 300	Do.
15	Independence	8, 300	Luckiamute River.
16	Yamhill (3 units):		
	Amity and McMinnville	43, 400	South Yamhill River.
	Carlton	9, 200	North Yamhill River.
17	Molalla	32, 500	Molalla River.
18	Canby	1, 700	Do.
19	Clackamas	2, 200	Clackamas River.
20	Tualatin (3 units):		
	West and South	21, 000	Gales Creek.
	East	15, 900	East Dairy Creek.
21	Marys River	3, 500	Marys River.
	Subtotal	153, 400	
	Total	414, 700	

[1] 80 percent of irrigable area.

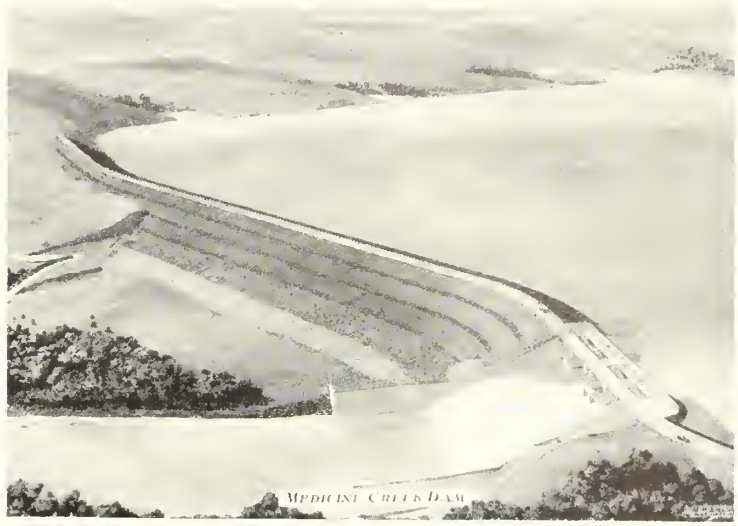
Deep Sea Diving in the West

(Continued from page 169)

perienced. According to the project officials, "The divers were very conscientious and they made a special effort to do a thorough job. They cooperated with Bureau employees at all times and assisted with work that was not directly connected with diving operations." THE END

The foregoing article was based on material submitted by Region VI officials, including a sketch by S. T. Larsen, superintendent of Belle Fourche project, from which the drawing appearing on page 168 was prepared.

Medicine Creek Dam Dedication



Artist M. H. Wilson's conception of Medicine Creek Dam.

On August 10 approximately 15,000 persons attended a celebration at Cambridge, Nebr., for Medicine Creek Dam, second large structure to be dedicated in the Republican River basin-wide program.

Mr. H. L. Mousel was chairman of the Cambridge Citizens Committee in charge of celebration. Among the distinguished speakers present for the occasion were Senators Hugh Butler and Kenneth S. Wherry of Nebraska, Hon. Carl T. Curtis, Nebraska, Governor Val Peterson of Nebraska, General Lewis A. Pick, Corps of Engineers, Department of the Army, Harry D. Strunk, President of the Republican Valley Conservation Association, and Assistant Commissioner Kenneth Markwell, Director of Operation and Maintenance Lineweaver, and Floyd E. Dominy representing the Bureau of Reclamation and the Department of the Interior.

A large early morning parade preceded the dedication at the damsite which was followed by a huge free barbecue donated by the Cambridge citizens in the afternoon. The festivities were concluded with a community banquet and street dance in the evening.

NEXT MONTH—How scientists are salvaging the keys to North America's history buried at the Medicine Creek site. Read "Saving a Segment of History" by Dr. Jesse D. Jennings, Archeologist, Region Two, National Park Service.

A Build-Up From "Down Under"

The Americans have published some very fine books and papers, and one in particular, Control of Weeds on Irrigation Systems, by the Reclamation Bureau of Department of Interior, deals with the subject very fully.

(Extracted from March 1948 issue of SPILLWAY, OFFICIAL SUPPLEMENT TO STAFF MAGAZINE, State Rivers and Water Supply Commission, Victoria, Australia.)

Reclamation's 1948-1949 Construction Program

At the annual programing conference held in July at Grand Lake, Colorado, Reclamation administrators and engineers from the 17 Western States drew up a plan for orderly construction on reclamation projects during the 1949 fiscal year.

The all-time record appropriation of $250,000,000 will provide for bringing reclamation water to over 125,000 more acres and making available over 260,000 additional kilowatts of hydroelectric generating capacity during the coming year.

A break-down of the work by regions as now planned follows:

REGION I (Headquarters, Boise, Idaho)

Idaho

Palisades, $1,725,000; Continuation preconstruction work and pending consummation of water savings agreements, required by law, if agreements are made by March 1, 1949, provision is made for the start of construction of the storage dam.

Rathdrum Prairie (Hayden Lake Unit): $107,000; Completion of overhaul pumping facilities; replacement 8,600 feet steel and concrete discharge pipe lines.

Anderson Ranch Dam (Boise Project): $5,600,000; Complete dam, continue construction of spillway outlet works, powerhouse; manufacture of turbines, generators and equipment.

Payette Division (Boise Project): $1,500,000; Complete construction of Cascade Dam outlet works, main canal system, railroad relocation; clearing reservoir; construction on highway construction, water pipe line for town of Cascade and on pumping plant; completion by 1950.

Lewiston Orchards: $1,215,000; Complete construction Sweetwater siphon; work on irrigation pipe lines, Clearwater reservoir and domestic water distribution system.

Minidoka: $131,000; Complete canal and lateral systems of Gooding Division; continue project development activities; investigations of feasibility of supplying irrigation water to proposed Northside pumping division.

Montana

Hungry Horse Dam (near Kalispell): $14,600,000; Construction work on major concrete dam; start work on powerplant and on manufacture of turbines, generators and equipment. Completion expected by 1954.

Bitter Root (Rehabilitation): $40,000; Repair of gates at Lake Como Dam; reconstruction of existing wooden irrigation flume.

Oregon

Owyhee: $191,000; Complete construction of canal, lateral systems, and other features of the project.

Deschutes: $978,000; Complete construction of main canal and Willow Creek siphon; construction of Wickiup Dam, reservoir and lateral system; to be essentially completed.

Ochoco Dam (near Prineville): $350,000; Surveys, studies and rehabilitation work. Completion by 1950.

Washington

Yakima (Roza Division): $1,837,000; Complete eighteen small pumping plants, pump, laterals, transmission lines to supply pumping power; continuation construction of shops, warehouses, and operators living quarters.

Yakima (Rehabilitation): $100,000; Construction of pipe line, Prosser Irrigation District; repairs to spillway channel at Keechelus Reservoir; repair outlet channel Kachees Reservoir; repair outlet gate, spillway Bumping Reservoir.

Columbia Basin: $45,000,000; Continue presently contracted construction work; award contract for construction of primary pumping plant at Grand Coulee Dam to house 12 of the worlds' largest motors and pumps; start work on Soap Lake siphon and additional portions of primary canals to advance availability of irrigation water to project lands by 1952; continue electrical installations to enable early completion of another block of badly needed power.

REGION II (Headquarters, Sacramento, Calif.)

California

Central Valley: $43,000,000; Installing drum gates of Shasta Dam to increase storage capacity; complete installation of last two 75,000 kw generators at Shasta; temporary connecting transmission lines to Shasta Substation; continue work on East Side transmission line from Shasta Dam to Tracy Pumping Plant, including switchyards at each end; continue work on Delta Mendota and Friant Kern canals and Tracy Pumping Plant pointing to beginning water deliveries in 1951; completion Contra Costa canal; starting work on irrigation distribution systems for two and possibly a third irrigation district.

Santa Barbara: $1,000,000; Start work on Tecolote Tunnel and Goleta Conduit.

Orland (Rehabilitation): $50,000; Start repairing head gates at Stony Gorge and repairing flumes.

REGION II (*continued*)

Oregon-California

Klamath: $2,200,000; Continue work on diversion channel between Lost River and the Klamath River and channel work in Poe and Langell Valleys; work to provide increased flood protection for leased lands and new veterans' homesteads.

REGION III (Headquarters, Boulder City, Nev.)

Arizona

Gila: $2,640,000; includes $2,000,000 to start work on Wellton-Mohawk division, embracing construction of canal and three pumping plants; installation of supplemental sprinkler irrigation system.

SALT RIVER (Rehabilitation): $275,000; start replacement of worn-out irrigation structures; reshaping and lining certain parts of canal system.

Yuma (Rehabilitation): $264,000; (including $14,000 advanced by water users). Start replacement of worn-out irrigation structures; rebuilding and lining certain parts of canal system; continuation of investigations.

Arizona-California

Parker Dam Power: $480,000; construction housing, streets and utilities for new machine shop building; general improvements for new equipment to powerhouse and switchyards.

Arizona-Nevada

Boulder Canyon: $2,790,000; start manufacture two additional generating units to be installed at Hoover Dam to produce power for the State of Arizona; additions and improvements to the Boulder City water and electric systems; construction additional housing facilities; start construction of high school building in Boulder City; miscellaneous improvements to powerhouse and dam and reservoir area.

Davis Dam: $23,325,000; continue construction of the dam, reservoir and power plant; construction tunnel facilities at switchyard; continuation construction Davis Dam backbone transmission grid; completion second 115-kv line Phoenix-Tucson.

Arizona-Nevada-California

Colorado River Front Work and Levee System: $1,170,000; complete purchase of river dredge; dredging operations in the Needles, California, area; river control investigations, channel and levee maintenance and drainage for protective works.

California

All American Canal: $7,726,000; start construction of lateral distribution system on Coachella Division; complete work on flood dikes and wasteway; continue minor work on Coachella Canal.

REGION IV (Headquarters, Salt Lake City, Utah)

Colorado

Grand Valley: $4,600; Surveys of Garfield pumping division.

Mancos: $1,021,000; Contemplates completion work now under way including Jackson Gulch Dam and inlet and outlet canals.

Paonia: $1,005,000; Start construction on Spring Creek Dam and Fire Mountain Canal Enlargement.

Idaho

Preston Bench: $425,000; Contemplates completion of work 15.6 miles of new canal and a 1,280 ft. tunnel to replace present Munk Creek Canal.

Nevada

Humbolt (Rehabilitation): $110,000; Start rehabilitation and improvement of existing project.

Utah

Hyrum (Rehabilitation): $48,000; Start rehabilitation and improvement of existing project.

Newton: $127,000; Completion of dam and reservoir.

Ogden River: $117,000; Continuation of canal and distribution system.

Provo River: $2,719,000; Continuing work on last 7.8 mile section Salt Lake Aqueduct in Salt Lake County; Jordan Narrows Siphon and Pumping Plant; start work on remaining excavation for Duchesne

(*Continued on page 180*)

News Round-Up

Upper Basin States Reach Agreement On Division of Colorado River Water

Representing the United States at Vernal, Utah, Chairman Harry W. Bashore, of the Upper Colorado River Basin Compact Commission, has reported that agreement has been reached by the Upper Basin States (Colorado, New Mexico, Utah, Wyoming, and Arizona) with regard to the apportionment of the use of water allotted to them by the Colorado River Compact.

This agreement comes more than 25 years after the seven-State Colorado River Compact headed by Chairman Herbert Hoover was initialed in 1922 at Santa Fe, N. Mex. The purpose of the compact was to agree upon a division of the waters between the Upper and Lower Basin States.

The tentative Upper Basin States Agreement is a forward step in the development of the Colorado River which is the primary resource of the region. If completed in detail, executed, and approved by the legislatures of the respective States and by the Congress, it will clear the way for the Secretary of the Interior, through the Bureau of Reclamaiton, to proceed to the actual development of main stream reservoirs of the upper basin, thus providing power and irrigation water and storage to assure fulfillment of the Upper Basin's obligations under the Colorado River Compact and the Mexican Treaty, notwithstanding future developments in the Upper Basin.

Bashore reported that the agreement for allocating Colorado River water was based on the following apportionment of water among the Upper Basin States:

50,000 acre feet allocated to Arizona and balance percentagewise * * * 51.75 percent to Colorado, 11.25 percent to New Mexico, 23 percent to Utah, and 14 percent to Wyoming.

The tentative agreement has been reduced to writing and it is hoped it will be completed and executed by the Commissioners at a meeting in October at Bishop's Lodge, Santa Fe, site of the original Colorado Compact.

Reclamation Activities in Alaska

The Bureau of Reclamation has established an investigations office at Juneau, Alaska, headed by electrical engineer Joseph M. Morgan who will explore the water power possibilities of the Territory with a view to future expansion of settlement and industrial development.

These studies were made possible by an appropriation of $150,000 granted to the Bureau for the work during the fiscal year 1949. Reclamation's survey of the water resources will round out a program already under way by other Interior agencies on mineral, geologic, fisheries, wildlife, and other resources designed to enrich the multiple-purpose development in Alaska.

The existing shortage of electric power makes these investigations necessary for industrial expansion and settlement. One of the most pressing problems to be considered will be development of a power supply at Eklutna Lake to provide adequate resources for the city of Anchorage, for the electric cooperatives in Matanauska Valley, for the Alaskan Railway, and for Indian Service installations.

Other studies will include Juneau, Sitka, and Ketchikan. Development of a suitable power supply at Ketchikan would be designed to assist materially in creation of a pulp industry to alleviate newsprint shortages faced by the American public today.

Engineer Morgan will be assisted by Richmond C. Johnson, formerly area engineer for the Bureau at Salt Lake City. The staff consists of a hydrologist, geologist, field engineers, and a draftsman. This is the first work that the Bureau of Reclamation has done in Alaska.

Hells Canyon Project Report Under Study

The Hells Canyon project report for the Columbia River Basin was submitted to the Basin States for review and comment after its approval by Secretary of the Interior J. A. Krug.

The report provides for the construction of a concrete dam in the Snake River Canyon between Weiser and Lewiston, Idaho, which would tower approximately 740 feet from bedrock to the top. This would be one of the key features of the Columbia River Basin Plan and, combined with other reservoirs, could help control the flood waters which recently poured into the Columbia River with catastrophic results.

Cooperative Combine to Work in Missouri Basin

Representatives of the Extension Services and Experiment Stations of universities and agricultural colleges of the Missouri Basin States met at Lincoln, Nebr., July 16 and 17 to discuss ways and means for integrating their respective programs with the Missouri Basin Project development of the Bureau of Reclamation and the Corps of Engineers. This was one of the first concerted moves on the part of the State colleges to participate directly in the development phases of the Missouri Basin program and was welcomed by the Bureau of Reclamation which has been perfecting details with the State institutions as the focal point for cooperation with Department of Agriculture and State agencies. By invitation of Director I. B. Johnson, of the South Dakota Experiment Station, and Assistant Director Gould, of the Nebraska Extension Service, O. & M. Director G. W. Lineweaver, Washington, and O. & M. Supervisor John Spencer, Denver, and Ed Landerholm, Billings, were at Lincoln and participated as consultants in developing cooperative programs. Representatives of various agencies of the Department of Agriculture were also present. The results of the Lincoln conference will have far-reaching effects on the cooperative program of the Bureau of Reclamation in the Missouri Basin.

Construction Program (Continued from page 178)

REGION IV (*continued*)

Tunnel; construction one mile of steel pipe Salt Lake Aqueduct, Salt Lake County; work on three short tunnels and the upper 4½ miles of Salt Lake Aqueduct in Provo Canyon.

SCOFIELD: $21,000; Minor work on dam appurtenances and rights-of-way.

REGION V (Headquarters, Amarillo, Texas)

Colorado

SAN LUIS VALLEY. $621,000; anticipated start of clearing reservoir site for Platoro Dam and construction of temporary camp; prepare specifications looking toward starting construction on dam in 1949–50.

New Mexico

CARLSBAD (Rehabilitation): $100,000; start work on rehabilitation and improvement of existing project.

TUCUMCARI: $2,187,000; near-completion of canal and lateral irrigation facilities for Unit No. 6; 50 percent completion of canal and lateral irrigation facilities for Unit No. 7; build major drains.

Oklahoma

W. C. AUSTIN: $724,000; complete all construction of canal and lateral irrigation facilities. Build four main drainage canals.

Texas

VALLEY GRAVITY: $250,000; continuation of examinations and surveys.

Texas-New Mexico

RIO GRANDE: $578,000; complete Elephant Butte-Socoro transmission line; procurement of equipment for Alamogordo, Hollywood, Socoro substations, and Elephant Butte switching facilities; studies and preliminary work for future proposed construction.

REGION VI (Headquarters, Billings, Montana)

Montana

BUFFALO RAPIDS (second division): $48,000; minor construction work.

CANYON FERRY DAM (Missouri River Basin): $3,000,000; subject to review of feasibility under new appropriation language, start work on major storage, river regulating, and power producing dams in Missouri Basin Program.

FORT PECK: $2,944,000; continue construction of major transmission system from Fort Peck to Williston, S. Dak., and from Glendine to Miles City and related substations; continue work on tap lines and substations to serve rural cooperatives and irrigation pumping units; start work on tap lines and substations to serve additional rural cooperatives and pumping units.

LOWER MARIAS UNIT (Missouri River Basin): $775,000; preliminary construction on Tiber Dam. Completion by 1954.

MILK RIVER (Rehabilitation): $73,000; rehabilitation and improvement of early project.

MONTANA PUMPING UNIT (Missouri River Basin): $210,000; start construction on N-Bar-N Subunit, the first irrigation pumping unit adjacent to the Missouri River.

MOORHEAD UNIT (Missouri River Basin): $770,000; construction of camp and access road and start of work on Moorhead Dam in 1949.

SUN RIVER: $72,000; minor construction work on project.

YELLOWSTONE PUMPING UNITS (Missouri River Basin): $565,000; start construction on Savage and Cartwright Units. Completion of both scheduled by 1950.

North Dakota

BUFORD-TRENTON: $59,000; minor construction work on project.

CANNONBALL UNIT (Missouri River Basin): $680,000; complete preconstruction work and begin construction on Cannonball Dam. Start construction of camp and access road. Completion by 1952.

HEART RIVER UNIT (Missouri River Basin): $2,356,000; continue construction Heart Butte Dam on restricted schedule. Completion anticipated by Fiscal Year 1950. Start work on Dickinson Dam. Completion 1951.

TRANSMISSION LINES (Missouri River Basin): $1,482,000; major items in the transmission line program cover continuation of Williston-Garrison line and start of construction on lines to serve Heart River Pumping Plants in North Dakota.

North Dakota-Montana

MISSOURI-SOURIS UNIT (Missouri River Basin): $987,500; continue land classification surveys and other preconstruction work on North Dakota Division; begin work on main diversion dam on Missouri River below Fort Peck.

South Dakota

ANGOSTURA UNIT (Missouri River Basin): $3,180,000; continue construction of Angostura Dam on restricted schedule. Completion late in Fiscal Year 1950.

BELLE FOURCHE (Rehabilitation): $27,000; rehabilitation and improvement of early project.

REGION VI (*continued*)

GRAND RIVER UNIT (Missouri River Basin): $1,647,000; start construction on Shadehill Dam. Completion by 1953.

MOREAU RIVER UNIT (Missouri River Basin): $910,000; construction of Government camp and access road; start work on Bixby Dam.

Wyoming

BOYSEN DAM UNIT (Missouri River Basin): $5,535,000; continue construction on restricted schedule with major activity centering on railroad relocation. Completion 1952.

OWL CREEK UNIT (Missouri River Basin): $200,000; prepare plans and specifications and perform other preconstruction work necessary to start construction of Anchor Dam in 1949.

RIVERTON: $3,031,000; continue work on canals and laterals.

SHOSHONE: $1,639,000; continue work on irrigation and power facilities on Heart Mountain Division; completion of laterals in Ralston Area; substantial completion of Heart Mountain Power Plant and Switchyard and Heart Mountain-Garland transmission line.

Wyoming-South Dakota

BELLE FOURCHE STORAGE UNIT (Missouri River Basin): $550,000; build camp and access road; carry on preconstruction work on Keyhole Dam, with actual construction of dam programed to begin late in fiscal year 1949. Completion early fiscal year 1952.

REGION VII (Headquarters, Denver, Colorado)

Colorado

COLORADO-BIG THOMPSON: $20,000,000; Continue construction on Granby Dam, Pumping Plant and Canal; Horsetooth Reservoir and Feeder Canal; Estes Park Aqueduct and Power System; Olympus Dam; Colorado River Improvement; continuation various surveys.

NARROWS UNIT (Missouri River Basin): $1,650,000; start construction on Narrows Dam and railroad relocation; complete housing.

Kansas

CEDAR BLUFF UNIT (Missouri River Basin): $2,350,000; construction of Cedar Bluff Dam will be started; housing will be completed.

Kansas-Colorado

ST. FRANCIS UNIT (Missouri River Basin); $2,000,000; complete construction of Government camp at St. Francis, Kans.; start construction of Bonny Dam near Hale, Colo.

Colorado-Nebraska-Wyoming-South Dakota

MISSOURI RIVER BASIN TRANSMISSION LINES: $2,500,000; complete construction of Gering-Sidney line (Nebraska), Sterling-Sidney line (Colorado-Nebraska), Gering-Alliance line (Nebraska), Cheyenne-Sterling line (Wyoming-Colorado), Glendo-Lusk line (Wyoming); begin construction Fort Randall-O'Neill line (South Dakota-Nebraska), Sidney Substation (Nebraska), Gering Substation additions (Nebraska), Alliance Substation (Nebraska), Pine Bluff Substation (Wyoming), Casper Substation (Wyoming), Lusk Substation (Wyoming), Sterling Substation (Colorado), Sterling-Ogallala section of Sterling-North Platte line (Colorado-Nebraska).

Nebraska

BOSTWICK UNIT (Missouri River Basin): $2,670,000; assuming that the repayment contracts will be signed, construction on Superior-Courtland Diversion Dam, the Republic Diversion Dam and the Superior and Courtland Canals will begin.

FRENCHMAN-CAMBRIDGE UNIT (Missouri River Basin): $7,500,000; continue construction of Enders Dam and Reservoir, Medicine Creek Dam and Reservoir; complete construction of Cambridge Diversion Dam, first section of Cambridge Canal, Oxford Siphon; start construction of second section of Cambridge Canal, and Culbertson Dam; complete housing at Trenton, Nebr.

MIRAGE FLATS: $194,000; completion of the dam, main canal laterals, drainage system and headquarters building; Cottonwood Creek Siphon will be extended to prevent recurrence of recent flood damage.

Wyoming

GLENDO RESERVOIR (Missouri River Basin): $850,000; subject to agreement between Wyoming and Nebraska required by congressional appropriation language, start construction of project housing; begin construction of Glendo Dam. Completion is expected by 1952.

KENDRICK: $1,150,000; start clearing of Seminoe Reservoir; begin lining of main canal; Medicine Bow-Hanna and the Casper-Kortes-Seminoe transmission lines will be completed; start construction Casper, Medicine Bow, and Cheyenne substations.

KORTES DAM AND POWERPLANT (Missouri River Basin): $4,235,000; construction of dam and powerplant will be continued; construction of permanent improvements including housing, roads, and utilities will be completed. 36,000 kw. power capacity is anticipated for Spring of 1950.

Wyoming-Nebraska

NORTH PLATTE: $350,000; rehabilitation and betterment construction being programed depends upon attitude of Districts to repayment plans. Studies for improvement of project will be continued.

U. S. GOVERNMENT PRINTING OFFICE: 1946

NOTES FOR CONTRACTORS

Contracts Awarded During July 1948

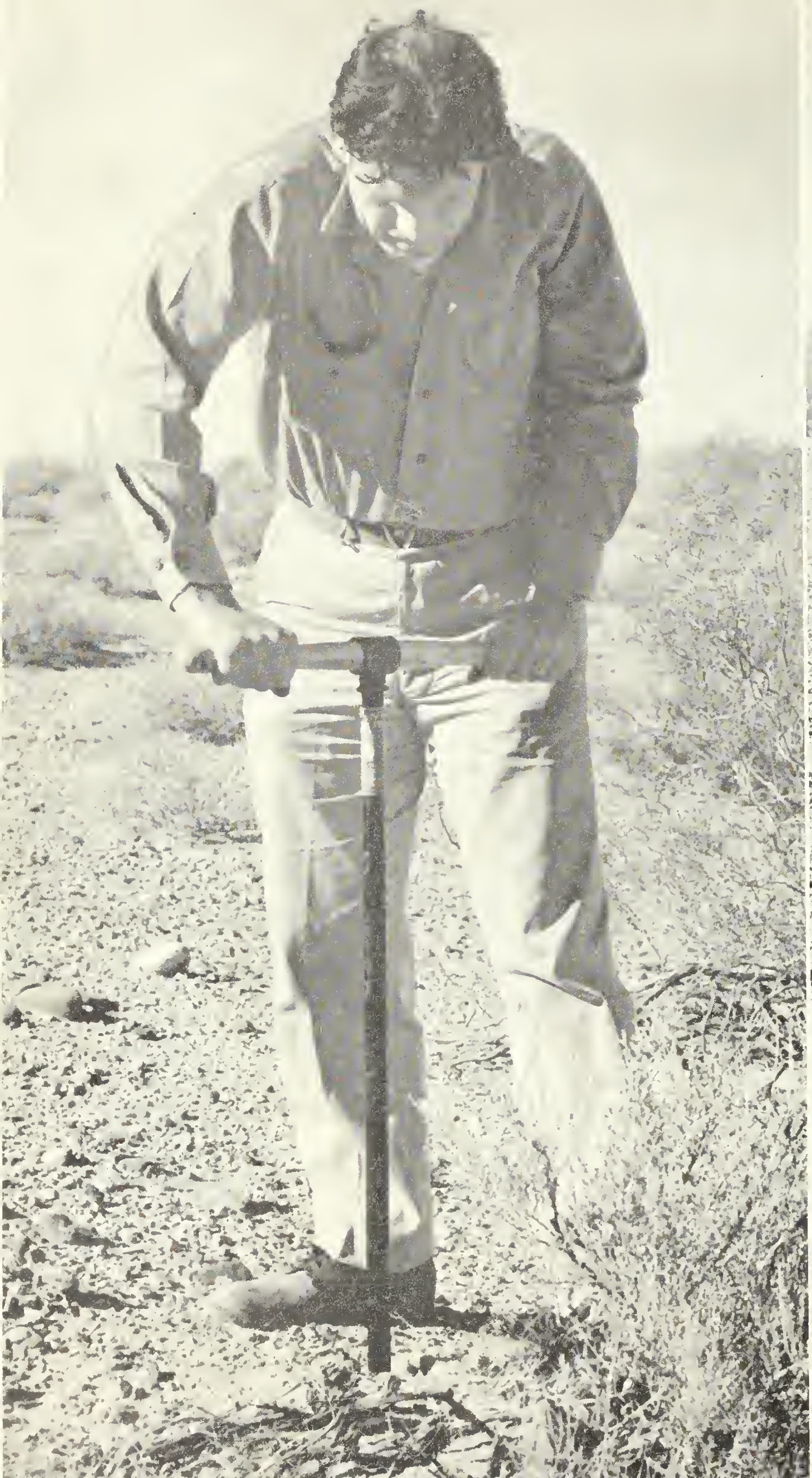
Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2148	Missouri Basin, S. Dak.-Wyo.	July 27	Trashracks for canal outlet and river outlet works at Angostura Dam and main units at Kortes power plant.	Virginia Bridge Co., Denver, Colo	$45,492
2164	Fort Peck and Missouri Basin, Mont.-N. Dak.	July 9	Carrier-current telephone apparatus, coupling capacitor potential devices, and carrier-current line traps for Fort Peck-Williston, Fort Peck-Glendive, Glendive-Miles City, and Williston-Beulah-Garrison transmission lines.	General Electric Co., Denver, Colo	89,677
2175	Central Valley and Davis Dam, Calif.-Ariz.	July 23	Miscellaneous structural steel for Tracy pumping plant and Phoenix substation, schedules 2 and 3.	Golden Gate Iron Works, Inc., San Francisco, Calif.	26,949
2183	Yakima-Roza, Wash	July 15	Constructon of earthwork, pipe lines, and structures for lateral distribution systems, pump areas 2, 5, 6, and 7.	Goodfellow Bros., Inc., Wenatchee, Wash	181,788
2184	do	July 15	Construction of earthwork, pipe lines, and structures for lateral distribution systems, pump areas 9A, 10, and 12.	John Klug & Co., Yakima, Wash	102,367
2203	Provo River, Utah	July 30	Construction of earthwork, canal lining, and structures for Provo reservoir canal enlargement, schedule 3.	Young & Smith Construction Co., Salt Lake City, Utah.	98,035
2216	Kendrick, Wyo	July 14	Construction of Seminoe-Casper 115 kv transmission line	Lewis Construction Co., Billings, Mont	65,447
2219	Hungry Horse, Mont	July 2	Construction of garage and fire station for Hungry Horse government camp, schedule 2.	Modern Construction & Fabrication Co., Seattle, Wash.	28,407
2226	Columbia Basin, Wash	July 12	3 unit substations for Grand Coulee Dam	Standard Transformer Co., Warren, Ohio	11,996
2230	Central Valley, Calif	July 22	1 pump gallery gantry crane for Tracy pumping plant	Judson Pacific-Murphy Corp., Emeryville, Calif.	25,208
2237	do	July 21	One 100-ton traveling crane for Tracy switchyard, item 1	Moffett Mfg. Co., Albany, Calif	38,560
2239	Rio Grande, N. Mex.-Tex	July 16	One 2,300-kilovolt-ampere package type substation for Hollywood substation.	General Electric Co., Denver, Colo	48,744
2242	Columbia Basin, Wash	July 6	Structural steel for railroad bridges at west canal	American Bridge Co., Denver, Colo	19,915
2245	Colorado-Big Thompson, Colo	July 16	One 6,900-volt switchgear assembly for Estes power plant, schedule 1.	General Electric Co., Denver, Colo	45,005
2250	Columbia Basin, Wash	July 13	One 100-ton transfer car for Grand Coulee right power plant	Star Iron & Steel Co., Tacoma, Wash	15,500
2252	Missouri Basin, Mont	July 29	Three 1,250 kilovolt-ampere and one 15 kilovolt-ampere transformers for Forsyth substation, schedules 1 and 2.	Standard Transformer Co., Warren, Ohio	24,305
2253	Columbia Basin, Wash	July 19	One 75-ton traveling crane for machine shop at Grand Coulee Dam	Cyclops Iron Works, San Francisco, Calif	67,943
2256	do	July 22	Three 25-by 25-foot radial gates for main canal, Long Lake headworks, item 1.	Pacific Coast Engineering Co., Alameda, Calif	19,140
2256	do	July 26	Three 60,000-pound radial-gate hoists for main canal, Long Lake headworks, item 2.	Columbia Machine Works, Berkeley, Calif	19,725
2259	Colorado-Big Thompson, Colo	July 13	Clearing part of Granby reservoir site	Trione Contracting Co., Denver, Colo	193,340
2262	Newton, Utah	July 21	Construction of Newton Dam spillways	Thatcher Construction Co., Ogden, Utah	94,960
2291	Boise, Idaho	July 1	40,000 barrels of bulk portland cement for construction of Anderson Ranch Dam and power plant.	Oregon Portland Cement Co., Portland, Oreg	122,000
2303	Kendrick, Wyo	July 30	Constructing new Casper substation	Malcolm G. Long, Billings, Mont	79,762
VII-16	Missouri Basin, Kans	July 16	Constructing sewerage collection, water and gas supply lines, sidewalks, curbs, and earthwork for Government housing at Ellis, Kans.	John H. Keller Construction Co., Longmont, Colo.	12,933
VII-20	Missouri Basin, Kans	July 16	Furnishing and erecting 14 two-bedroom sectionalized, precut, prefabricated, or conventionally built houses for Government housing at Ellis, Kans.	Metcalf Construction Co., Omaha, Nebr	167,994

Construction and Supplies for Which Bids Will Be Requested by November 1948

Project	Description of work or material
Boulder Canyon-All-American Canal, Calif.	Pumping unit for Coachella Valley distribution system.
Central Valley, Calif	Construction of earthwork, lining, and structures for about 27 miles of Friant-Kern Canal near Porterville, Calif.
Do	Construction of earthwork and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Motor protective and grounding equipment for Tracy pumping plant.
Colorado-Big Thompson, Colo	Construction of 1,500 kilovolt-ampere Fleming substation near Fleming, Colo.
Do	Construction of 500 kilovolt-ampere Haxtun substation near Haxtun, Colo.
Columbia Basin, Wash	Generator voltage bus structure for units R7, R8, and R9, Grand Coulee power plant.
Do	Grounding equipment for station service unit LS-3, Grand Coulee power plant.
Do	Spare motor exciter set for Grand Coulee left power plant.
Do	Turbines and governors for Grand Coulee power plant.
Do	Water supply pumps for Grand Coulee Dam.
Do	Air vent siphon breakers for Grand Coulee pumping plant.
Do	Radial gates and hoists for O'Sullivan Dam.
Do	Construction of North Dam, an earthfill structure which is to form the north barrier of Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Davis Dam, Ariz.-Nev.-Calif	Construction of and furnish equipment for 15,000 kilovolt-ampere Blythe substation, located about 12 miles north of Blythe, Calif.
Davis Dam, Ariz.-Nev	Main control boards for Coolidge substation.
Do	Generator bus, protective and neutral grounding equipment for Davis power plant.
Do	Spiral stairways at Davis Dam.
Fort Peck, Mont	Construction of about 4.3 miles of 12.5-kilovolt wood-pole transmission line near Savage, Mont.
Do	Construction of 500-kilovolt-ampere substation which is to furnish power supply to Savage pumping plant.
Gila, Ariz	Pumping units for Wellton-Mohawk pumping plant.
Hungry Horse, Mont	115-kilovolt power transformers for Hungry Horse power plant.
Klamath, Calif.-Oreg	Rehabilitation and extension of laterals and drains near Tulelake, Calif.
Missouri Basin, Colo	4- by 4-foot high pressure gates for Bonny Dam.
Missouri Basin, Kans	Construction of Cedar Bluff Dam, an earthfill structure, about 136 feet high and 12,570 feet long, on the Smoky Hill River near Ellis, Kans.
Missouri Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior Nebr.
Missouri Basin, N. Dak	Construction of 1,500-kilovolt-ampere Watford City substation located near Watford City, N. Dak.
Missouri Basin, Nebr.-S. Dak	Construction of 50 miles of 115-kilovolt wood-pole transmission line from O'Neill, Nebr., to Fort Randall, S. Dak.
Missouri Basin, Wyo	Construction of about 1.5 miles of access road at Keyhole Dam about 18 miles northeast of Moorcroft, Wyo.
Missouri Basin, Wyo.-Nebr	Construction of about 170 miles of 115-kilovolt wood-pole transmission line from Casper, Wyo., to Gering Nebr.
Paonia, Colo	Enlargement of about 4 miles of Fire Mountain Canal, from present capacity of 70 cubic feet per second to a capacity of 200 cubic feet per second, located near Somerset, Colo.
Riverton, Wyo	Radial gates and hoists for Wyoming Canal.
Yakima, Wash	Construction of 63 miles of 34.5 kilovolt, 2.6 miles of 13.8 kilovolt, and 2.4 miles of 2.4 kilovolt wood-pole transmission lines.

NEXT MONTH—What the food processing business has done to boost irrigation farming and what irrigation farming has meant to the canning, processing, and freezing industries in Oregon. Written by Professor Ernest H. Wiegand, head of the Department of Food Technology, Oregon State College.

NEXT MONTH—The story of the Pacific Northwest Power Pool and how this huge cooperative venture has proved to be the "partner of irrigation" in the fast-growing Northwest section of the Nation. Written by Don Campbell, Regional Power Manager, Region I, Boise, Idaho.



SOIL SLEUTHING! Above we see the Iwan Type auger with 3" bit being brought into play for soil testing. The advantage of this type auger is that the soil removed is retained for examination in the "bucket" or opening immediately above the cutting edges. Many different types of augers are used, but all have one purpose—to examine the subsoil and find out what lies below the surface. While better data could be obtained by digging a pit with a shovel, this method would consume much more time and require the expenditure of much hard labor. Upper right: View of "bucket" containing gravely soil. Lower right: First-hand examination is made of sandy gravely soil contained in "bucket." *All photos by Wm. S. Russell, Region III, Boulder City, Nev.*

OCTOBER

1948

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THE *Reclamation* ERA

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Letters to the Editor

Re Visitors from Siam and Elsewhere

Assistant Commissioner Nelson kindly forwarded the following letter to our editorial office:

CAMERON COUNTY, BROWNSVILLE, TEX.,
July 9, 1948.

DEAR WESLEY: I read the July number of the RECLAMATION ERA with great interest—especially about the article from Siam.

I am sending a copy of this to the Denver office, and I would appreciate it very much if you would give me at an early date the number and names of the foreign countries that have sent their engineers to the United States to get a practical knowledge of reclamation.

(*Continued on next page*)

Reclamation ERA

October 1948 **Vol. 34, No. 10**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, *Editor*

OUR FRONT COVER

Did you know the Rio Grande Valley is good apple-raising country? This photo proves it. Here we see picker Peggy Jean Jarman in the midst of some choice harvest fruit on the Fort Sumner project, New Mexico. This photo was taken by A. E. McCloud, Region II photographer, when he was stationed at Region V.

OUR BACK COVER

"A THING OF BEAUTY . . ." Although East Park Dam, to complete the quotation, may or may not be "a joy forever" it has served the people of the Orland project in California since its completion in 1910. Teaming up with Stony Gorge Dam, East Park Dam on Little Stony Creek stores 51,000 acre-feet of water for irrigating about 20,000 acres of land. And its appeal is not only utilitarian, as this unusually striking photograph by J. E. Fluharty of Region II amply demonstrates.

LETTERS (*Continued*)

According to my best recollection, you had some 29 foreign countries who applied for permission to send their men here almost before the guns got cold on VJ-day and then they have been sending them all along.

Thanking you and with best wishes, I am,

Yours truly,

OSCAR C. DANCY, *County Judge*.

¶Reader Dancy was informed that a check of our records reveals that since the end of the war the Bureau has had visitors from 56 foreign countries. These visitors were principally eminent engineers employed by the governments of their own countries. Many of them have been government officials interested in conservation of water and natural resources. Others have been professors and educators from colleges and universities, and some have been engineers who have received degrees from American universities and colleges. In addition to the visitors, the Bureau has had trainees from 16 countries. These men, as did the group from Siam, spent from 4 months to 1 year with the Bureau working in the offices, laboratories, and on the job, gaining practical knowledge of the American way of engineering Reclamation projects.

The Bureau of Reclamation has been cooperating with the United States Department of State in aiding foreign countries to better their knowledge of engineering and reclamation so that those countries may enjoy higher economic and social positions through increased industry and food production. The Department of State has provided funds to the Bureau for aiding these visitors and it is hoped that greater assistance may be afforded them in the future.—Ed.

Niobrara—Not-So-Forgotten River

4131 NORTH KEELER AVENUE, CHICAGO 41, ILLINOIS, *August 16, 1948*.

DEAR EDITOR: I was very much interested in reading in your July issue, the story of NIOBRARA—the "Forgotten River."

It happens that I spent many years of my younger life in the area covered by this story. As a young boy I went with my father and mother to Sheridan County, where we located and lived for several years, near Rushville. Later I spent many years at college in Neligh, and from there we often made trips to the Niobrara River.

Naturally, therefore, this story interested me in a personal way and I was very glad indeed to read it. My wife lived for many years at Ainsworth.

Very truly yours,

CARL D. THOMPSON,
Secretary, Public Ownership League of America.

He Came, He Saw, He Was Conquered

113 E. COLLEGE ST., CRAWFORDSVILLE, IND., *July 12, 1948*.

DEAR EDITOR: I am just back from a 1-month trip (3,800 miles) trailer travel survey of Reclamation projects in the West. I have been reading about reclamation for years and this gave me opportunity to see that it is all true.

In these days of doubt and suspicion and name-calling, when everyone is a little doubtful where we are going as a nation, the work of the Reclamation Bureau stands out as something without doubt American—in the true tradition of America—and in that nonpartisan spirit that has kept moving us forward to better the conditions of all, despite partisan politics, sectional jealousies and community arguments.

I have recommended the RECLAMATION ERA be added to the list of magazines for the Public Library, Crawfordsville, Ind., and for the Crawfordsville High School Library, Crawfordsville, Ind. Could you send a sample copy of the RECLAMATION ERA to these two addresses?

I am a G. I. looking for a place to invest in a farm. That was the reason for my trip.

Yours very truly,

L. L. PATTON.

¶ Glad to oblige reader Patton and hope Crawfordsville likes the ERA. We are encouraged by the growing number of subscribers outside the Reclamation area who are becoming more and more interested in the West, and its water resource development problems.—Ed.

California Comment

306 S. Union Avenue, Los Angeles 13, Calif., MAY 24, 1948.

DEAR EDITOR: I have enjoyed the Era very much and find it quite beneficial for those who are farming on irrigated land.

Very truly yours,

MISS JENNIE L. MCGOWAN.

Credit Correction

An error was made in allocating the photo credits on page 141 of the August issue, illustrating "Pioneer Pipeline." The photo of sprinkler-irrigated orchards was by B. K. Thomas, and the one of The Dalles, area by Stanley Rasmussen. Both of these photographers are Region I employees.

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"Invisible"

by F. M. CLINTON
Assistant Regional Planning Engineer
Region I, Boise, Idaho

(All photos by Philip Merritt, Region I)

View of main canal showing checks, turn-outs, and laterals. The water table in field stands at approximately the same level as water surface in main canal.

Simultaneous irrigation and cultivation at Egin Bench. Note the sandbag checks in the control ditch.

When you say "irrigated farm," you generally think of a hard-working farmer standing in mud-covered rubber boots and armed with a long-handled shovel, guiding small streams of water down parallel furrows along which his crops are growing.

But that picture does not fit the 28,000-acre Egin (rhymes with "Legion") Bench in southeastern Idaho. There, strangely enough, irrigators don't use boots or shovels. They employ such an unusual method of irrigation that most people will not believe it until they actually see it done.

Egin Bench is situated on the west side of the Henry's Fork River near the town of St. Anthony in Fremont County, Idaho. The bench is the remainder of an alluvial fan of volcanic sand laid down on the lava plain by the Henry's Fork River when prehistoric glaciers were melting. It has an unusually smooth surface, which slopes uniformly downstream and toward the river. The deposit of volcanic sand tapers from a depth of about 50 feet along the edge of the terrace overlooking the river to a featheredge on the west side where the lava rock is exposed on the surface. This mass of sand is covered by a thin layer of wind-deposited soil similar to that covering the lava beds throughout most of the Snake River Plain, except that here it has been mixed with the underlying sand.

The history of this unusual project dates back to the 1890's when the first settlers built a canal from the Henry's Fork River and attempted to surface-irrigate the land on Egin Bench in the conventional manner. The water percolated into the porous soil and subsoil so fast, however, that it was impossible to get a normal head of water across even a small field. This operational difficulty was disheartening in itself, but discouragement became widespread among the settlers when they found that crops did not grow as they should even where the soil had been kept wet.

Although many tracts were sold for a pittance or abandoned during this trying period, the continued application of water by a few of the more determined settlers resulted in raising the water table to the ground surface in a few places near the main canal. Contrary to expectations, it was found that crops flourished in these "seeped" areas.

Greater efforts were then made to raise the water table to the surface over a larger area by operating the main canal during the winter and increasing the rate of percolation. The latter was accomplished by constructing five more large canals from the river and utilizing every available "ponding" area where a pond of water could accumulate, either by means of a natural depression in the earth or by constructing small levees. The water table was eventually raised to the surface throughout the bench and the cultivated area was stabilized at the present 28,000 acres.

Although the benefits of subirrigation were thus discovered by persistence and accident, this peculiar method of irrigating has now been practiced successfully for almost half a century on Egin Bench. Throughout the years, the farmers on the bench have reverently referred to the water table as the "sub."

The "sub" is allowed to drop about 20 feet below the ground surface in the center of the bench during the winter. Heavy diversions begin in the spring as soon as the ice in the canals has melted, usually about the first of April, and the "sub" is raised to within a few inches of the surface by about the first

Irrigation on Egin Bench

of June. During that period, the percolation of water to the underground reservoir is accelerated by filling all available "ponding" areas and by running water through small ditches across the fields, which are known locally as control ditches. In fact, water is seen almost everywhere **except** in the cultivated fields, farmyards, and roads.

After the "sub" has been raised to the desired level, the flow in the main canals is reduced somewhat and the stage of careful regulation begins. During the remainder of the growing season, the "sub" is held within 6 to 18 inches of the ground surface, depending on the type of crop being grown. During this period, the operation of the control ditches is all-important because they serve as the final adjusting valves which the farmers use to control the "sub" in the fields.

The control ditches are spaced about 35 crop rows apart in the center of the bench, but are as close as 16 crop rows apart near the edge of the bench where the "sub" is more difficult to hold. Only a small amount of water enters the control ditch and the water level is controlled by one or more sandbag checks spaced according to the slope of the field. The ideal manner of operation is to keep the flow at the inlet equal to the percolation along the length of the ditch, so that no water spills over the last sandbag check or out of the end of the ditch. Often a farmer will subirrigate only a part of his field by stopping the flow at a strategically placed sandbag check.

The flow of water in the main canals is regulated by a ditchrider, whose job is radically different from that of his co-worker on a conventional irrigation system. Essentially he is operating a huge ground-water reservoir, the level of which is very sensitive to the slightest changes in the rate of inflow and outflow. The variables in his equation are precipitation, evaporation from the soil, and consumptive use by crops and other vegetation. Errors on one side mean flooded fields, farmyards, and roads, while those in the opposite direction result in wilted crops. Either can happen in a matter of hours.

To maintain the required fine balance, the ditchrider keeps a wary eye on the weather and works closely with the farmers who are constantly watching the "sub." The ditchrider does not allocate, measure, or check the water used in the control ditches. From the main canal headworks to the inlets to the control ditches, there is a noted absence of padlocks on the gates and checks. This is the typical aspect of the community cooperation practiced and respected by the watermaster, ditchriders, and farmers alike.

The farmer on Egin Bench is seldom seen wearing rubber boots or carrying a shovel. His irrigation job is confined almost entirely to regulating the inflow to the control ditches in his field. He cooperates with his neighbors in regulating the inflow to the laterals and "ponding" areas in the vicinity of his farm. About the only manual labor involved in irrigating his field is the removal of weeds and trash which occasionally lodge in the control ditches. Occasionally the water must be turned out of the control ditches so they can be plowed to break the crust along the banks and loosen the bed to increase the rate of percolation.

Irrigation does not interrupt cultivation of fields as is the case where fields are surface-irrigated. Even the row next to the control ditch can be cultivated at any time the farmer chooses. Farm machinery can be operated in the fields at

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any time, even though the water table is standing within a few inches of the ground surface. Barnyard manure is used almost exclusively for fertilizing because it increases the humus in the soil and acts as a binder to keep the sandy soil from blowing when the surface is dry.

The principal crops grown on the bench are, in order of percentage of cropped area, potatoes, alfalfa and clover hay, small grains, sugar beets, and field peas. The cropping program is closely tied to the livestock industry, in which many of the farmers are engaged; and large numbers of range cattle and sheep are fattened and fed during the fall and winter. Egin Bench is now one of the most prosperous farm communities in Idaho. The many modern and well-kept farm homes on the bench furnish ample proof of prosperity.

The process of subirrigation on Egin Bench requires relatively large quantities of water because of the very porous nature of the underlying formations in which the abnormally high water table is maintained. The formation is similar to a leaky tub filled with sand. Approximately 390,000 acre-feet of water is diverted onto the bench from April 1 to December 1, with the peak diversion by all six canals reaching 1,450 second-feet about June 1. A base flow of about 170 second-feet is maintained in the canals during the winter months of December, January, February, and March.

Thus, about 15 acre-feet of water is diverted annually for each acre of cultivated land on the bench. Of the total of 420,000 acre-feet diverted annually, about 11 percent is consumed by crops and about 15 percent returns directly to the Henrys Fork River. The remainder joins the large underground flows moving westward beneath the Snake Plain which are contributed by seepage from the Snake River channel and by streams discharging onto the plain from the mountains on its northern border, and which rejoin the main stream in large part about 180 miles downstream in the famous Thousand Springs of the Snake River Canyon.

The addition to this natural underground movement contributed by irrigation of the Egin Bench, however, has been responsible for the interesting development of another irrigation project on the Snake River Plain around Mud Lake, a natural depression in the lava fields about 25 miles due west of the bench.

Prior to 1900, Mud lake was an intermittent pond that impounded flood waters from Camas Creek in the spring and was often reported dry in the late summer. Ground water stood at more than 100 feet below the lakebed. Soon after subirrigation was practiced widely on Egin Bench, the water table rose to the surface in the Mud Lake area and many springs appeared around the lake. Geologists who have studied the area have attributed this rise to the fact that the underground outlets south of the lake did not have sufficient capacity to carry the additional water arriving from Egin Bench.

This great and progressive increase in the visible supply of water in Mud Lake attracted wide attention and resulted in the promotion and development of several irrigation systems. Unfortunately, the rise in groundwater levels was accompanied by a cycle of above-average rainfall and surface inflow to the lake. As might be expected, the unusual optimism on the part of the promoters resulted in the construction of canal systems to cover a far greater acreage than could be dependably watered during normal climatic conditions.

After the surface inflow to the lake practically ceased during the drought of the 1930's, ground-water pumping was resorted to in order to supplement the water supply available from the lake. Decreed water rights and fear of another drought have since stabilized the irrigated area at about 30,000 acres. About one-fourth of the water supply for this acreage is now drawn directly from the lake and the remainder is pumped from shallow wells around the north shore line with lifts ranging from 10 to 25 feet.

A casual trip over Egin Bench and across the desert to Mud Lake will not reveal the above-described unusual ground-water conditions. If the traveler happens to stop and visit with an old-time farmer on the bench, however, the conversation will soon drift to water and before long, the story of the "sub" and its effect at Mud Lake will be told. A tribute is due those pioneers who developed the bench and mastered the vagaries of ground water in the porous lava plain and put it to work. The present economical use of the ground-water resources moving beneath Mud Lake is due to their experimentation and perseverance. The End

Excavation Work Started on India's Tungabhadra Project

According to a report from the consulate general, Madras, India, dated January 7, 1948, the Tungabhadra Dam project in South India is now out of the planning stage. Rapid progress is being made in the excavation of the dam foundations. Illustrations clipped from the *Madras Information*, an official publication of the Government of Madras, showed an excavated reach of the Tungabhadra canal, the Honorable Minister of Public Works inspecting the dam site and distributing sweets for children of laborers in the Tungabhadra area, blasting and concrete work, and thousands of laborers busily engaged in ground work.

Nearly 5,000 laborers are working at the dam site. According to the captions of several illustrations, many of these are Burma evacuees. The depth of necessary excavation varies from 17 to 70 feet. Rock spoil from the excavations is being partly carried away by rail to be used as railway embankments. Quarters for the engineers, clerks, and laborers engaged have been erected.

According to *Mysore Commerce*, the journal of the Mysore Chamber of Commerce, Bangalore, Mysore State, the whole project will cost $60,000,000 and, according to schedule, will be completed in 1953. The dam proper will cost $21,000,000, the canal system $18,000,000 and the power plant and accessories another $21,000,000.

The project is expected to irrigate 300,000 acres in Madras Province and some 600,000 to 700,000 acres in Hyderabad-Deccan. Only 10 percent of the area covered by the entire project is expected to be devoted to rice and vegetable production. The rest will be utilized for dry crops such as millets, cotton, and peanuts.

It is hoped to grow long-staple cotton in this area to replace cotton presently imported from Africa to supply the Indian textile industry. A variety of such staple cotton suited to this area has already been developed through experimentation. The black cotton soil of this area is expected to yield 1,200 pounds per acre under controlled irrigation.

WOLF POINT —city of destiny

by DONELLA M. RUSH, Clerk-Stenographer

Editor's Note: This article has been written to acquaint the different regions of the Bureau of Reclamation with Wolf Point, Mont., former field headquarters for the Missouri-Souris unit, Montana division. Wolf Point is now the suboffice reporting to the Missouri-Souris' present headquarters located at Minot, N. Dak.

About a mile and a half southwest of the present town of Wolf Point, where Wolf Creek joins the Missouri River, stood the original Assiniboine Indian village of about 3,000 now commonly known as Oldtown. The village was located on a point of land, now eroded away, which formed a convenient landing for boats coming up the Missouri River. This became an important stop as a wood station, a place where the hunters and trappers stacked the hides of the countless gray wolves they killed, so numerous they attracted much attention through successive seasons. One winter these hides froze before they could be loaded to the trading posts and had to be left until the coming of spring. This pile was so high it became a landmark for miles around and was known as "the wolf point."

By 1884, most of the buffalo had been killed and the Indians had established homes in permanent villages. Farming was in its initial stage and most of the work was done by the Indian women.

The Presbyterian Mission Board established a school for the Indians in 1883, teaching them to read and write in their own language or English, and instructing them regularly in Bible knowledge. Up until this time the Indians worshipped the sun god and the thunder bird.

Teaching the Indians was uphill work. However, a free lunch was served at noon, and as it was a period of hard times for the tribe, at least the morning attendance at the school increased.

Gradually, through the children, the mission and teachers reached the parents, instructing them also. Redstone, chief of the tribe, was a kind and peaceful man. Although he could neither read nor write, he encouraged his people to respond to the white man's teachings. The school grew and more money was granted for new buildings. Dormitories were built and the children lived at the school, each family supplying its own children with fuel, food, and clothing. The girls were taught general housework, and the boys cared for the dormitories, schoolrooms, and stock. In 1930, as public schools were established, these mission buildings were either torn down or moved to the present townsite and Indian schools were started at the Agency in Poplar, Mont. The restless Missouri gradually crept closer and closer to Oldtown until the buildings were no longer safe.

Pioneers started settling in 1885. Sherman T. Cogswell established the first trading post in Oldtown. He was joined in 1889 by his sister Alma, who became the first white woman settler. Miss Cogswell, today, is living in California at the age of 90.

Although the Assiniboine Indians were a friendly peace-

loving tribe, the settlers could not easily forget the graves across the Great Plains of immigrants who had come to their death at the hands of hostile Indians. Not many years past the Custer Massacre had taken place. At Fort Keogh, approximately 224 miles south, the Second Infantry fought the Sioux and Cheyennes through the winter of 1876-77. The Nez Perce Indians in northern Idaho were at war, so a heavy stockade was built around the trading post. It is no wonder that women and children shivered with fright when curious Indians would peer through cabin windows.

The coming of the railroad was a great event for the homesteaders. The first track was laid in July 1887, and a heavier, more permanent line was built in 1888. The railroad was built about a mile north of Oldtown and boasted of a boxcar depot and a few log houses. The present town soon developed on this more favorable location.

With the coming of the railroad, large cattle ranches began to develop around Wolf Point. One of the larger was the N-Bar-N Ranch, located south and west of Wolf Point. The range land for the N-Bar-N extended from the Canadian border to the Yellowstone River, a distance of about 180 miles. In 1908, the company owning the N-Bar-N Ranch constructed ditches, still in evidence, for irrigation purposes. Centrifugal pumps of the old, inefficient type, extremely large and cumbersome to handle, were shipped in, and Diesel motors were purchased to power the pumps. Old-timers enjoy telling of the first irrigation effort. As the story goes, the motors were started and water flowed into the canals. Soon they were filled, and the pumps continued to labor. Suddenly there was too much water for the canal to carry. It came back, washing the engine and pump into the river. This ended the irrigation efforts at that time.

From 1912 to 1914, Wolf Point was a boom town. Two banks, three grain elevators, four lumber yards, an electric light plant and a flour mill were built. A newspaper was established. In 1914, the Fort Peck Reservation land drawing was held and by 1917 the reservation was "settled up."

In 1914, all the principal business buildings on the north side of Main Street burned and it was with difficulty that the frame buildings on the south side were saved. A few days after the fire, one of the businessmen whose building was destroyed erected a shack with the sign "Slightly disfigured but still in the ring." In that spirit the businessmen rebuilt larger buildings with fireproof walls.

In 1915, Wolf Point was incorporated and the first town election held.

The second Wolf Point boom started in 1917. The prairie clouds were generous, giving the grain sufficient moisture, and yields were heavy.

In 1919, Roosevelt County was created. Through the perseverance of Wolf Point people their town was selected as county seat. There have been several battles over this issue since then, but Wolf Point has managed to retain its status. In 1940, a new two-story courthouse was built, in which the Bureau of Reclamation has its offices which take up almost the entire court house basement.

Present-day Wolf Point boasts of beautiful residential districts with paved streets, modern stores, and two airports; \$50,000 is being spent for improvements on the town's largest, 117-room hotel. An \$80,000 laundry is being constructed. A temporary 30-bed hospital is being redesigned from Government baracks at a cost of \$50,000 and the finest equipment available has been purchased, while plans are being made for construction of a \$150,000 fireproof hospital building. A \$450,000 public school has been proposed.

A. V. Appelgren, now one of the directors of the Missouri-Souris Projects Association, was one of the first farmers to experiment with irrigation. In 1920 he purchased one of the old 6-inch pumps used by the N-Bar-N Ranch, and a 10-horsepower engine. This made a nice irrigation set-up for strawberries and a garden. The garden was so successful that an attempt was made to irrigate alfalfa. Because of an insufficient water supply, another 6-inch pump was purchased and a tractor was used for power. This seemed ideal until the June raise occurred. A tremendous flow of water came down the river, washing the river bank away,

(Continued on page 200)

Above: Mute evidence of "too much irrigation," at the old N-Bar-N Ranch. At right: Leslie Fourstar, early irrigationist near Owsego, Mont.

Irrigating the Sahara Desert

by A. E. Place, Consulting Mining Engineer

Fantastic? French engineers and officials no longer scoff at Justin Savornin's theory as work goes forward to provide new homes for 1,500,000 people in the oases of the North African desert

One of the largest and least known new irrigation projects is that of the French Colonial Ministry to bring artesian water to extensive tracts of wasteland in the Sahara Desert of North Africa. They plan to create 1,500 new oases in the midst of barren, burning sands; to extend the irrigated areas of present oases and to populate the desert with an additional 1,500,000 inhabitants.

Preliminary work has been started in the Moab Valley, where 200 new oases have been laid out on a strip of land 200 miles long and 5 miles wide. A new town has been built at El Fayan, where selected natives are being trained to supervise and instruct the coming inhabitants in the art of irrigated farming, and in organized peaceful cooperative effort. This will be something new to the restless desert tribes. They have followed ancient patterns of existence from before the days of Abraham and Moses; their customs have involved bloody tribal feuds; raids upon their neighbor's herds of goats and sheep, camels, and horses; the strong took from the weak by force, and peaceful possession of land and home depended upon the favor and protection of some powerful desert sheik.

Each new oasis will have a village. They will all be alike and will provide, to begin with, for 200 families, or about 1,000 inhabitants. There will be a central square which will contain the artesian well or wells, with the pumping plant and distribution system. A mosque, a market, an assembly hall, and a public school, as well as a restaurant and a lodge will care for the community life. An administration building, equipped with post office, telegraph, telephone, and radio facilities will house the Government officials. The villagers will live in prefabricated houses, set up along wide streets. Each family is to receive 1 hectare, or 2½ acres, of irrigated land, upon which the Government will plant 120 date palms of chosen varieties. While the trees are maturing, which takes a number of years, other crops will be sown between the rows. The dates are to become the money crop and be exported. Good roads for automobile traffic will connect the strings of oases and give access and outlet. Railways have been surveyed to central points, and shops and industrial establishments will follow. Where the artesian waters do not reach the surface they expect to put in power plants to generate electricity for operating deep well pumps.

The French, who know the character of the natives, will not make outright grants of lands or dwellings to them. These will be leased, with the understanding that failure to cultivate or maintain a plot or home will cause the holder to forfeit his lease. As all transfers require Government sanction, schemers, who might accumulate more than their share of property, are barred.

Like many other big and useful projects, the plan to irrigate the Sahara Desert, and its inception in the face of great obstacles, was due to the knowledge, foresight and tireless persistence of a single individual, Justin Savornin.

He was a professor of geology, who lived and taught in the city of Algiers, in the French African Province of the same name. His specialty was the geology of the great Atlas range of mountains, which separates the Sahara Desert from the Mediterranean Sea, and his particular hobby was proving the hypothesis that the Sahara Desert was underlain in many regions with water that could be made available for irrigation. He concluded that a great part of the Sahara was covered at one geological period by an immense fresh-water lake, or chain of lakes, similar to the Great Lakes of North America; that these lakes with their shores and beds dried out and were later covered up by eruptive and other formations which now form the floor of the desert basin, and that they were sufficiently porous in texture to hold water which might be tapped for irrigation.

To prove his theory, Savornin spent years in making geological examinations of the rivers and water courses which flow from the snow-covered Atlas Mountains south into the desert, where their waters disappear under the sands of their dry beds. Taking careful measurements, he came to the conclusion—

- that there was a water-bearing formation under much of the desert surface, about 600 feet thick;
- that this stratum held the underflow from the Atlas watershed;
- that water-holding beds extended south to the Sudan, and easterly to Egypt, dipping gently toward the Lybian Desert; and
- that they would be found there at a depth of 4,000 feet.

He claimed—

- that impervious layers below and above the water carrier prevented absorption and evaporation, and that there was no possible outlet or break which might drain it.

He also predicted—

- the existence of many rolls and anticlines that would bring water close enough to the desert surface to yield flowing artesian wells, and finally
- that loss through tapping on a large scale would not diminish the available water supply, as the latter would be annually replaced by the underflow coming from the Atlas Mountains.

Savornin was ridiculed and contradicted by other geologists and engineers. They called him an impractical dreamer. Government officials and private capital refused to aid him in his work. His copious reports and maps were pigeon-holed and forgotten. Years passed.

But when in recent times recurrent droughts in northern Africa began to dry up many of the ancient desert wells and oases, compelling large numbers of natives to abandon their ancestral homes, and crowd into the populous coastal plains of Tunis and Algiers, French colonial officials remembered Savornin's theory. They dug out his old reports and called him into consultation.

About 1931, two hydrographic expeditions were sent into the desert to prove Savornin's conclusions. They were failures. They did not drill deep enough.

Finally, in 1937, a third attempt was made by the colonial government near the town of Ghardaia with better equipment. This time the deep well drills tapped what appears to be an inexhaustible supply of fresh water at a depth of 1,500 feet. Subsequent drilling in other places not only proved the existence of Professor Savornin's underground reservoir, but delineated its vast extent. It was found to exceed in area all of France.

The government granted preliminary funds, and work was begun. They estimated 10 years necessary to finish the project, but war intervened, and everything stood still until recently. Now they are going ahead as fast as they can get the necessary supplies and equipment.

Justin Savornin has seen his theory vindicated and his dream materialized. France will not forget him. THE END

This article is based upon a report printed on page 9 of an independent Swiss weekly, published in Zurich, Switzerland, in German language, bei Sihl A. G., called Die Weltwoche, *of October 24, 1947. It is unsigned, but initialed M. C. Die Weltwoche. The original has been shortened, transposed, and modified by the author, A. E. Place.*

ADOLPH EDWIN PLACE is a consulting mining engineer who lives in Boulder City, Nev., but spends most of his time operating mines in Mexico and Central America. He was born in Hamburg, Germany, of American parents who were residing abroad for business reasons. He received a large part of his education in Germany and Switzerland, but graduated from the Massachusetts Institute of Technology in 1903 in civil engineering. He entered the Hydrographic Division of the United States Geological Survey in 1903, as engineering aid, was transferred to the newly formed Reclamation Service, and put on the staff of Cyrus C. Babb as assistant engineer in the Milk River project of Montana. In 1906 he resigned to take charge of a mine his father owned in Mexico. Here he founded the engineering firm of Place & Elton in the city of Oaxaca, operating mines for absentee owners. Selling out in 1911, Mr. Place took over the management of the Oaxaca state project to supply Oaxaca City with potable water and a complete drainage system. Driven out by the revolution in 1914 he joined the American Army forces invading the port of Veracruz, where he was employed as sanitary engineer and chief sanitary inspector under General Gorgas until the troops left. From 1916 to 1931 he maintained an office in Los Angeles as consulting engineer, and from then on he has operated and examined mines from Alaska to Central America. During the war he was employed by the United States Interior Department, Bureau of Mines, and later as shift superintendent at the manganese ore metallurgical plant in Henderson, Nev. When this was terminated he went back to his mines in the Republic of Mexico. Mr. Place is married to Buenaventura Aispuro of Tamazula, Durango, Mexico. He is a member of the American Institute of Mining and Metallurgy, of the Mexican Geological Society and others.

SHOTCRETE Canal Linings

by THOMAS L. STEELE

Engineer, Branch of Operation and Maintenance, Region III, Boulder City, Nev.

Call it pneumatically applied mortar, shotcrete or gunite, when it comes to canal linings, the Maricopa program presents an interesting study in efficient and economical operations.

During the past several years the Maricopa County municipal water conservation district has faced a problem common to all other irrigated areas in central Arizona—not enough water. The district irrigates its 35,000 acres of land with surface water from Lake Pleasant on the Agua Fria River and also pumps from underground storage. Low run-off into the reservoir, together with excess pumping, led to a serious water shortage that shows little sign of easing up soon. As a result of this situation the district undertook a program of lining about 15 miles of canals and laterals to conserve all the water that would be available.

The Maricopa County municipal water conservation district is located some 25 miles northwest of Phoenix. Its headquarters are at Beardsley on its northern boundary. To the district's southeast is the Salt River project which is the Bureau of Reclamation's oldest development in the Southwest. To the south is the Roosevelt irrigation district.

District forces started work in the spring of last year, under the field supervision of H. S. Raymond, district engineer, and completed the job in the fall. W. W. Lane, the district's chief engineer, directed the program. About half of the lining was done on laterals that had been in use for several years, and the other half was on new construction. The old laterals had to be cleaned and reshaped before placing the lining.

Cleaning and shaping was accomplished by using a pull grader and a bulldozer or by a blade ditcher specially designed and built on the project. The blade ditcher consists of an 8-foot grader blade attached to each side of a crawler tractor. By running the tractor down the canal bank the

(*Continued on page 198*)

▲

Top photo shows blade ditcher designed and built by project forces. An 8-foot blade is attached to side of crawler tractor. Center: Placing 2-inch header board on each side of canal. Thickening each edge of lining to 2 inches gives strength to weak points. Bottom photo shows equipment, including water truck used for wetting ditch ahead of shotcrete placement.

Right: Placing 1-inch shotcrete lining. Nozzleman helper has hood end of spade with which reinforcing can be raised to approximate center of lining. ***All photos on this page by Harry W. Myers, Region III.***

The Pacific Northwest Power Pool

by DON CAMPBELL
Regional Power Manager
Region I, Boise, Idaho

A SUBSIDIARY AND SECONDARY PRODUCT of reclamation, hydroelectric power, sometimes referred to as the "partner of irrigation," has achieved a position of eminence in the fast-growing Northwest section of the Nation.

In this region, 150 electric generating stations are tied together by more than 1,600 miles of electrical transmission lines to meet ever-expanding demands for power for industries, homes, farms, and irrigation pumping.

The interconnected system is known as a "power pool." In simple words, a power pool is a reservoir of power-producing facilities operated on a cooperative basis in much the same manner as a group of farmers might operate a collection of farms for the purpose of obtaining maximum output or crop yield.

The Northwest pool is one of the largest in the country.

At the start of World War II, it became apparent in the Pacific Northwest that, in order to achieve maximum results in bringing the war to an early conclusion, all electrical resources would have to be "pooled" to meet the power demands for production of aluminum, lumber, airplanes, for ship construction, atomic energy research and resulting production, and for normal loads in the area. The Government, acting through the War Production Board, on May 1, 1942, issued what was known as General Limitation Order No. L–94, which required the integration of the operation of interconnected electrical systems. Even prior to the issuance of this order, some work had been done toward that goal.

As a result, all of the major interconnected electric utilities in the States of Washington, Oregon, Idaho, western Montana, and northern Utah, some 12 in number, were tied together electrically. The area served by the Northwest power pool comprises approximately 450,000 square miles, or roughly 15 percent of the total area of the continental United States.

The present total capacity of the utilities making up the pool is approximately 3,725,000 kilowatts, about one-half of which is represented by the Federal plants at Grand Coulee and Bonneville Dams, and five smaller plants of the Bureau of Reclamation. The maximum instantaneous load carried to date by the pool was 3,495,000 kilowatts, which occurred at 5:30 p. m., Pacific standard time, on December 10, 1947.

This huge load exceeded the maximum carried during the war, the area load having increased almost continuously since the pool was placed in operation, with the exception of a short period following VJ-day.

During the month of March 1948, the pool generation amounted to 1,898,688,000 kilowatt-hours, about 52½ percent of which was produced in the two Government plants at Bonneville and Grand Coulee. This output is slightly under 10 percent of the total output of all generating plants in the United States—20,788,000,000 kilowatt-hours.

The fact that the area served lies in two time zones, Pacific and Mountain, has been used to advantage in serving loads. Peak loads occur an hour earlier in the eastern section of the pool area and energy can flow from west to east to help meet this demand. An hour later when the daily peak occurs in the western part of the area, the flow of energy is reversed and resources otherwise unused are made available in the eastern section to help carry coastal loads.

It was necessary to provide temporary interconnections for the purpose of making the combined output of all integrated plants available to serve loads. This made it possible, for example, to use surplus capacity available in Utah to serve new defense loads in the Seattle, Wash., area. In order to make the power pool function properly, it was necessary for each of the interconnected utilities to have contractual arrangements with other utilities which needed the surplus capacity.

The plan worked so well that it has been continued by mutual consent. It now saves large quantities of coal, oil, and water in the day-to-day operations of power producers.

The pool is operated by a small group of operating engineers, generally not to exceed two from each utility. These engineers have adopted a set of rules and regulations which are rather remarkable insofar as simplicity and number are concerned. Shortly after the first of each calendar year, the engineers meet and submit their estimates of the amount of load that their respective systems will be called upon to deliver during the coming year. Likewise, the load-carrying capability of the individual systems is estimated for the same period.

Those readers who are familiar with irrigation will recognize the term "critical water year." This term is also used in preparing the estimates of load-carrying capability since it is the only assured water supply that may be expected. On the basis of a critical water supply, the draft of water from reservoirs is scheduled so as to obtain as much hydro power as possible. Knowing this figure, the difference between the amount of load to be served and the amount of hydro generation expected, it is easy to see how much additional generation is required from other sources, principally steam. During the last few years, it has been necessary to further subdivide the steam requirements into two parts, that obtained from oil-fired plants and that from coal-burning plants. Estimates of the amount of oil available for power production are obtained and then the balance must be furnished from coal-burning facilities.

The pool operators also make allowances for water conditions which are better than "critical" in case that early guesses are too pessimistic, and in so doing are in a position to shift to a type of operation that will get the greatest output from the water available. The schedules which are prepared provide for the discontinuance of fuel-fired facilities in the reverse order of their efficiency, that is, the more costly plants are shut down first.

Another feature of the pool's operation which is of major importance is the "scheduling of maintenance outages." Electrical equipment, dams, penstocks, and other items require periodic maintenance work just as do automobiles if reliable service is to be expected from them. Normally, a utility does this type of work during seasonal periods of light load. It is obvious that if all utilities followed this procedure, it would be impossible to serve the load. Therefore, each pool operator submits a list of the work to be done, the time required, and the amount of the reduction in output involved for his particular system. The equipment outages are then scheduled and adjusted so that their effect on the load-carrying ability of the pool is a minimum. Through this type of advance planning, it is possible that the pool enters its maximum seasonal load period with all generators operating and in the best possible mechanical condition.

Through the efforts of "pool" operation, a more reliable service has been available to consumers in the entire Northwest, the use of critical materials, such as fuel, has been curtailed, and the construction of smaller, less efficient generator installations has been eliminated.

The operation has successfully avoided a "brownout" in the Northwest, such as was recently experienced in the Southwest, where lack of water seriously interfered with normal life of the area. Drastic curtailment of load has been

Lower left: Grand Coulee's control boards play leading role in Northwest power output. Directly below: Interior shot of Coulee power plant, showing governor gallery. Directly under the clock (left) is generator control board.

avoided in the Northwest as have minor inconveniences such as low voltage, slow electrically operated clocks, etc. With average water conditions in the next few years and with new installations of generation being brought in as scheduled, normal load growth should be taken care of. In the last 6 or 7 years, it would have been impossible to accomplish the results without the pool type of operation.

In the Pacific Northwest 487,000,000 kilowatt-hours were used in the production of aluminum in January 1945, the peak of wartime production. By April of 1947 peacetime production of aluminum had reached a level of 429,000,000 kilowatt-hours in the region. Other new industries have absorbed more than the difference between wartime and peacetime production levels.

Another important new load is on the horizon insofar as the Northwest is concerned, that of commercial phosphate fertilizer production needed to rehabilitate depleted and worn-out soils in the Nation. The only way in which this new load, estimated at 134,000 kilowatts in 1955, can be served is by the pooled type of operation described, as it is beyond the capacity of any one system to serve. THE END

CLIPPING FROM "*IN OUR OWN WORLD*"—*News and Comment, Especially 'Round About Central Washington and the Great Northwest.*

In November 1897 just 51 years ago, the Scientific American said, "America leads the world with a total installation of over 70,000 horsepower of electric energy. Switzerland next with 32,000. France 18,000, Germany 17,000 and Great Britain 4,000." Seventy thousand horsepower for the United States! Now we have one dam close to us capable of producing 300 times that amount and the time is not so far distant when the main Columbia will be producing 1,500 times as much as we were in 1897 over the entire United States.

In Chicago's World Fair days electric lights were becoming quite the thing in the cities. In the Chicago World Fair, too, was that Ferris Wheel 475 feet high, another gigantic piece of machinery, the result of man's imagination and ingenuity.

Most every community still has its "romancer" with imaginary ideas which he tells for facts. The old home community had one and the boys loaded up one for him about the Ferris Wheel. They told him the Ferris Wheel would be taken down and taken to Niagara Falls to be used as a giant water wheel for the development of electricity. That gave him a new one to palm off as a fact.

Supplemental Water

"And what is the baby's name," asked the minister softly.

The young father smiled proudly as he hoisted the little fellow upon his arm.

"Chauncey William Robert Montgomery Finley."

Up shot the minister's eyebrows, as he turned to his assistant:

"More water, please."

—*From the ARMY AND NAVY JOURNAL*

SAVING a SEGMENT

by Dr. JESSE D. JENNINGS

Archeologist, Region Two, National Park Service

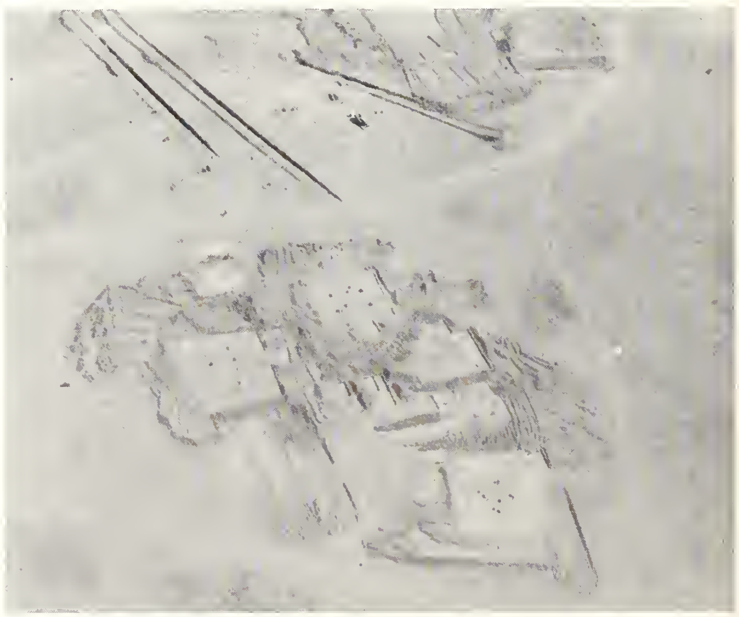
About 80 percent of the clues to North America's buried history is found on the banks and in the flood plains of our watercourses.

Therefore, each dam or reservoir constructed for irrigation, flood control, navigation, or power automatically imperils scientific information about the historic and prehistoric Indians who inhabited this continent before the coming of the white man.

The present era of rapid development of our western water resources is no exception, and unless something is done, important segments of the pre-history of the West will be lost. However, because of the alertness of Government officials and members of the archeological profession, something **is** being done, particularly in the Missouri River Basin.

In the Missouri River Basin, at present, funds are made available to the National Park Service for recreational studies. A part of that recreational study involves an evaluation of archeological, historical, and paleontological materials. By agreement with the National Park Service, the Smithsonian Institution has undertaken the archeological survey of reservoir areas and has been on this job since July 1946 when funds became available. The resources of 50 reservoirs have been assessed. More than 500 sites, some of which are of great importance, have been discovered. These archeological and paleontological findings are being and will be, where appropriate, keyed in with the recreational proposals of the National Park Service.

Survey, however, is but the beginning of the job. Location is not enough. Some sites must be sampled, while some should be thoroughly excavated if adequate representative



Aerial photo showing general view of excavation activity being conducted by Smithsonian Institute on right abutment of Medicine Creek Dam site. *Smithsonian Institute Photo.*

# of HISTORY

data is to be salvaged. Information recovered from reservoirs ahead of inundation enjoys several values. Primarily, of course, it will make important contributions to general knowledge of the prehistoric Indian cultures of the West. One unexpected benefit from archealogical work is a fuller knowledge of prehistoric climate and man's adaptation to climate. Tree ring calendars, and soil analysis, and recent geological phenomena are all specific basic data for climatological inferences.

Although the past 2 years of reconnaissance survey have taught us a great deal about the prehistory of the Plains, this information can be considered little more than suggestive. Excavation of key sites is the next phase of the program and is becoming an acute problem. Funds for the much more expensive work of excavation are difficult to arrange but in one very urgent case at Medicine Creek Reservoir near Cambridge, Nebr., money has been authorized for archeological search.

The valley of Medicine Creek is a treasure house of raw scientific fact. On Line Creek are Pliocene and Pleistocene quarries yielding many new fossil animal forms. At one such fossil site tools made by ancient man were found, together with extinct animal forms, beneath many feet of wind and water-laid soils. At other places in the reservoir, prehistoric villages of the Woodland (A. D. 1000) culture have been discovered. These Indians, although they made pottery, probably did not cultivate food plants but lived upon game and wild plants. There is no evidence that they made permanent houses.

But by A. D. 1300 or 1400 all the Medicine Creek Valley was densely populated by the Upper Republican people. These Indians lived in rectangular lodges built of timber and earth. They knew and practiced agriculture, so were not entirely dependent upon the natural foods. Their economy was rendered more stable by the cultivation of corn, beans, and squash. Their permanent dwellings formed irregular villages on the bluffs and terraces along the creek. Gardening was done in the flood plain of the stream.

After about 1500, the Medicine Creek region, as far as we know, was never again settled by permanent groups.

Close-up of storage pit at Medicine Creek Dam site showing worker uncovering a piece of pottery.

At present, the Smithsonian Institution is conducting full-scale excavations, with the aid of Bureau of Reclamation equipment and hired laborers, at the Medicine Creek Dam site in an effort to salvage representative data from sites in immediate danger of destruction by construction. The routine and continuous use of power equipment for the removal of overburden, handling spoil dirt, etc., constitutes an innovation in archeological excavations, so the dig is doubly important. If the use of such equipment proves feasible at Medicine Creek, we hope that the techniques developed there become routine throughout the Missouri River Basin.

Recent finds at Medicine Creek include numerous earth lodges, burials, fine large samples of long-discarded tools and utensils, and related materials. All these add up to a richer understanding of the life of the early settlers in the Medicine Creek Valley. THE END

At left: General view of floors of Indian homes at Medicine Creek. Note activity in background of excavation on another floor plan. Man in foreground is digging storage pit. Inset: A collection of bones, flint, and shells uncovered on one of the old Indian homes. ***All photos on this page by Don H. Demarest, Region VII.***

Agriculture and Food Processing in Oregon

by ERNEST H. WIEGAND
Head, Department of Food Technology, Oregon State College

Editor's Note: A leading authority on food-processing, Professor Wiegand describes the current status and future outlook of this industry in the State of Oregon. Readers will note that the author looks to expansion of irrigation in the Willamette Valley, Rogue River Valley, Deschutes area, and Umatilla County to pave the way for an extensive growth in the industry. The Bureau of Reclamation is making project and river basin studies in each of these areas. Professor Wiegand lists Owyhee and Vale Federal Reclamation projects as areas which make noteworthy contributions in crop production for processing.

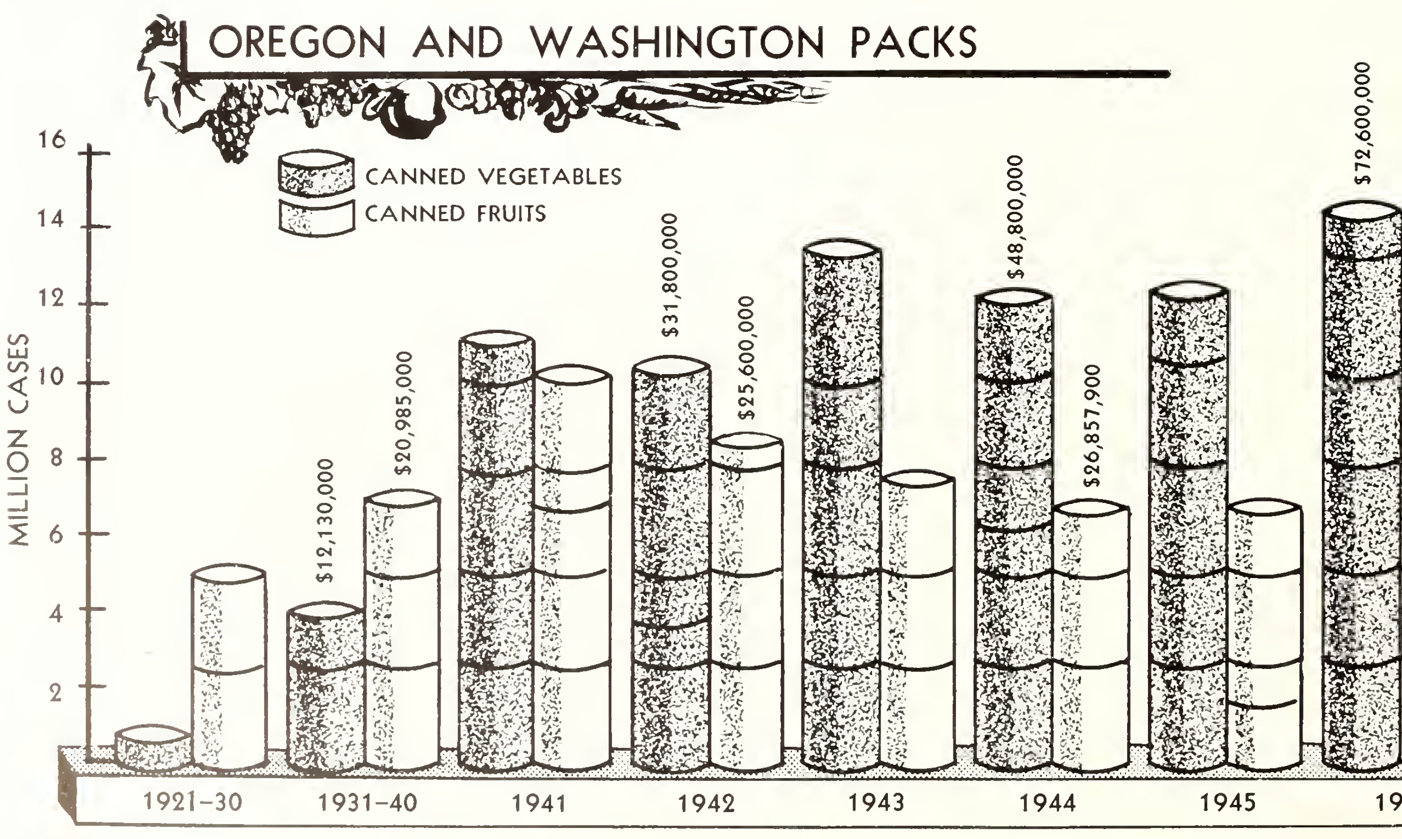
Agriculture has always been a basic industry in Oregon. Since early times the farmland has been important to the economy of Oregon people. Today the 63,125 farms are responsible for a high economic yield; in fact, in 1947 the cash farm income totaled $376,350,000.

There are several reasons for Oregon's success in agricultural pursuits. Her long growing seasons, wide range of soil, topography, and plentiful rainfall make possible many diversified crops. This diversity accounts for 242 different horticultural products grown or manufactured in the State—a record beaten only by California. Oregon growers market such specialty crops as peppermint, hops, flax, and sugar beets, with 12 different types of small fruits, 30 common vegetables, and all the well known deciduous tree fruits, walnuts, and filberts.

The fertile growing areas and the important f essing areas of the State have grown up together, tributing to the other's prosperity. In the lush gar of Oregon, you can find canning, freezing, and del plants in profusion—especially in the valleys we Cascade Mountains. This area supports two-third gon's 1,474,000 population and boasts of never hav crop failure. Here you find the greatest diversifi crops, along with a temperate climate, and plenty o for three seasons of the year.

Oregon's "Garden of Eden" is the Willamette Val extends 150 miles along the Willamette River. The neatly hemmed in by the Cascade Mountains on the the Coast Range on the west. About 70 percent of total population live within this valley. Fifty perc State's farm population live here on 51 percent of t farms. The Valley's rich fruit orchards, berry fa orchards, and truck farms account for the wealth of terials flowing into processing plants each season percent of Oregon's small fruits come from farms in lamette Valley and are processed in canning and plants in the area.

But don't overlook the valleys of southern Orego are similar to the Willamette Valley in length of seasons, soil fertility, and moderate temperatu



Rogue River Valley, nationally famous for its luscious pears, also produces apples, cherries, strawberries, apricots, grapes, nuts and a large variety of vegetables. Prunes rank as the number-one fruit in the Umpqua River Valley, although other tree fruits and vegetable are also grown in abundance here. Fresh marketing of fruits, especially pears from the Rogue River Valley, has become an important business and has helped to spread the fame of southern Oregon's fruit.

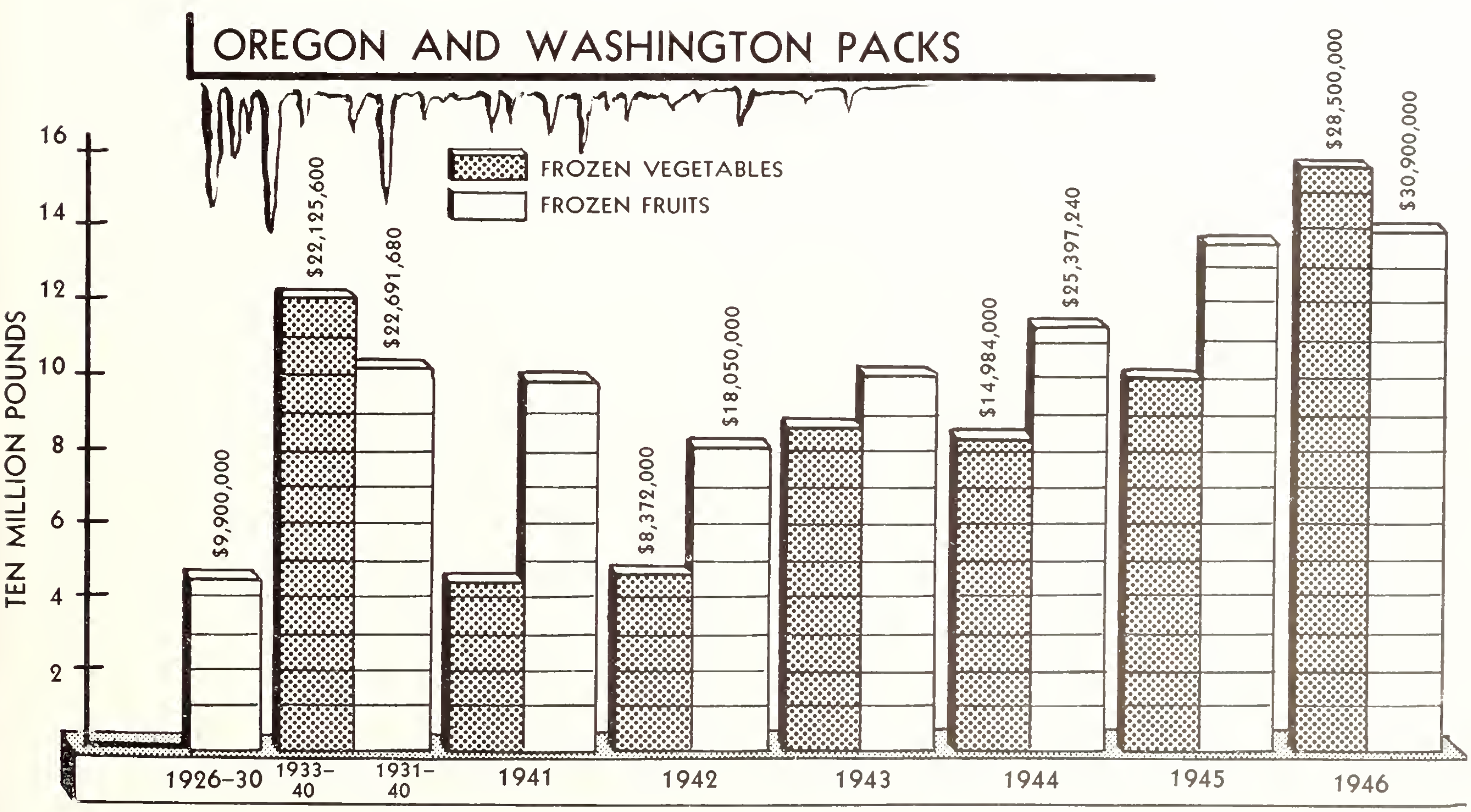
East of the Cascade Mountains stretch miles of semiarid lands and sagebrush where dry-wheat farming and beef-cattle raising predominate. For the most part, irrigation has turned these semiarid lands into growing areas with rich production of tree fruit and vegetable crops. Apples have long accounted for national and international fame for Hood River; however, pears have colored the picture in the past few years with expanding markets and ready sales. Cherries and strawberries come from Hood River farms, too, and go into both processing and fresh market channels. Irrigation in Umatilla County has provided a wide diversity of crops and has been responsible for the growth of large-scale processing operations here. Prunes and peas are processed extensively along with apples, cherries, and corn.

In the Snake River Basin of Oregon there are 185,000 acres of irrigated lands. This irrigation (on the Vale and Owyhee projects) has made possible the production of both tree fruit and vegetable crops on land which was formerly wheat and livestock country. Now apples, prunes, peaches, peas, and corn flow into processing markets for canning and freezing. Alfalfa, potatoes, and onions are also grown in this area.

Irrigation, important to Oregon's agriculture, has been carried on extensively in central Oregon and has made possible the increase of row crops of the region. By 1950 the North Unit of the Deschutes Federal Reclamation project is expected to provide water to 50,000 acres of land. Some of this area is already being served. Projected irrigation of 35,000 acres in Jefferson County, in which the North Unit is situated, will provide additional means to carry on intensive farming in the next few years. As more water becomes available, gradual changes in land use will occur which will greatly influence the agricultural economy of this section.

This quick freezing plant in Ontario, Oreg., is a direct outgrowth of the increased vegetable production in the State during the past twenty years. Here, we see employees processing kernel corn for quick freezing. ***Photo by Phil Merritt, Region I.***

In 1946 there were 60,000 acres of irrigated land in the Willamette Valley, and within the next few years further irrigation is planned for this farm land. Umatilla County



is scheduled for further irrigation developments, too, in the near future.

Oregon's horticultural products rank high among those of the Nation. In fact, Oregon ranks first in the production of winter pears, filberts, loganberries, youngberries, boysenberries, black raspberries, and gooseberries. Second place in the Nation goes to Oregon on strawberries, red raspberries, walnuts, prunes, and sweet cherries.

The most significant change in the acreage devoted to horticultural products—the transition from fresh-market production to production for processing—occurred between 1920 and 1943. As the number of acres destined for processing has grown, so have the national and international markets for the finished processed foods. Statistical studies show close coordination between production and market outlook.

Vegetable acreage, for example, has increased very rapidly during the past 20 years. This growth has been due to the canning and freezing industries, which in turn, have increased throughout the State. The gain in acreage is graphic and startling in implication. In 1930, some 7,630 acres were harvested for fresh market and 3,930 for processing. Ten years later (1940) some 12,740 acres were harvested for marketing, whereas 35,610 were harvested for processing. By 1947, about 16,620 acres were harvested for market—an insignificant figure, compared with the 75,000 acres harvested for processing.

Freedom from Crop Failure

The most dynamic increase has been in vegetable production, although farmers have produced more and more from trees, as well as small fruits. Oregon still leads the Nation in its production of many tree fruits and berries, and processing statistics mirror this lead.

Oregon, recognized as the source of high-quality foods, has long been a key State in the processing industry. True, she has considerable competition with producers closer to the big markets, but that problem is made lighter by several factors. The long growing season plus a wide choice of products, and comparative freedom from crop failures have made it possible for Oregon processors to compete at a lower cost. High-quality products, produced at a lower cost to both grower and processor, have helped maintain Oregon's lead.

The frozen-food industry, born and nurtured in the West, has shown very significant gains since its beginnings in 1918. Although the industry has spread to many parts of the United States, the three Pacific Coast States still account for much of the yearly production. The growth in Oregon and Washington, shown in the number of cases of canned fruits and vegetables and pounds of frozen fruits and vegetables, is depicted graphically in the charts. The dollar values of these processed foods are indicated on the charts, representing wholesale prices which the industry brings to the two northwest States.

With the world food situation as it stands today, there is every indication that the processing industries will grow even more extensively. Dehydration of fruits and vegetables, which boomed in Oregon during the war, has decreased significantly throughout the United States. However, increased production in the other processing fields offsets this change.

The brined-cherry industry in Oregon, not yet 50 years old, represents 7 million dollars to the State. Maraschino cherries, made from brined cherries, are manufactured outside the State, however. An all-time high was reached in 1946, when nearly 248,000 barrels of brined cherries were produced in the United States; of these, approximately 85,000 barrels were produced in Oregon.

The brined-cherry industry furnishes an example of the active interest and participation of the Food Technology Department at Oregon State College in Oregon's food-processing industries. Cherry growers came to the department, part of the agricultural experiment station, in 1925 when they were faced with a bumper crop of cherries—and no market. The growers and staff members of the Food Technology department got together, studied the situation, made their plans, and cooperated in solving the problem. The result of their joint efforts was the cherry-brining industry. The story of the industry in the past 23 years illustrates well the cooperative spirit between Oregon growers and the research staff in the Food Technology Department.

The early experiments in the frozen-food industry were carried on, in part, by the food-technology staff from the experiment station. Some outstanding work on dehydration during World War II was done in the department for the Army's Quartermaster Corps.

Continuous research projects are being carried on to solve new problems in the processing field—for canning, freezing, dehydration, and brining. New methods of food preservation are investigated which will enlarge the markets for Oregon's horticultural products. The project to develop new and better varieties of small fruits for canning, freezing, and preserving carried on in cooperation with the United States Department of Agriculture, has been actively studied for nearly 25 years.

One of the latest projects is to develop new uses for surplus filberts grown in Oregon. Already preliminary experiments have developed filbert butter, oil, flour, and press cake. Another laboratory study involves filbert shells and how they can be put to a profitable, money-making use.

There is a larger project for utilizing the otherwise wasted residue in the processing plants, including a study in which methane gas is produced from pear waste. This project, with all its possible ramifications, may mean a great deal to Oregon pear growers and processors. Utilization of other processing wastes may change the existing situation which canneries, frozen food plants, and cherry briners face each season. If they can make money even from the processing waste material, Oregon manufacturer may be able to compete more easily with eastern processors, as such an additional financial return will certainly influence the price of the finished processed foods.

Agricultural Oregon is a "horn of plenty" with many different crops grown on her farms. She is blessed with mild weather, plentiful rainfall, and long growing seasons. These factors combine with fertile soil to make possible the production of Oregon's quality tree fruits, vegetables, berries, and nuts. Farm production and processing go hand in hand, to make Oregon a leader in agriculture and in food processing. THE END

Hungry Horse Breaks "Fast"

Hungry Horse celebration heralding start of construction July 10, 1948—a dynamite blast set off by Gov. Sam Ford of Montana officially started construction. *Photo by A. E. McCloud, Region II.*

"The Northwest is moving forward. The future is yours. Working together throughout the Columbia River Basin with a single plan in mind, we can make that future bright. For this is a land of destiny."

Spoken by Assistant Secretary of the Interior William E. Warne, simple, meaningful words these were. They expressed better than any other, the real sentiment of the people of Montana on July 10 when they forgot everyday cares and celebrated in rip-roarin' fashion the official start of construction of the multiple-purpose Hungry Horse Dam.

Joined by neighbors from surrounding areas, 6,000 Montanans came from all parts of the State to the dam site on a tributary of the Columbia—the South Fork of the Flathead River—12 miles from the west entrance to Glacier National Park. They had a great time. They were proud of what they had done. They agreed with "Bill," as Montanans called the Assistant Secretary, as he told them and a vast Northwest radio audience:

"The one resource that distinguishes the Pacific Northwest among all our western regions is the wonderful Columbia River. It provides at once both the opportunity and the challenge of this region. The Northwest will prosper, grow, and gain economic and political strength in direct ratio to the development of its great river."

The day was one of fun and good will, with an underlying serious tone that always attends events of historic significance. Everyone agreed, from little Johnny with his big balloon, to topmost officials—and there were many—that Montana did itself proud in celebrating the start of the $100,000,000 project.

Sponsors—the Flathead Valley Citizens Committee—appropriately called the festival "Northwest Progress" in full knowledge of the significance of the dam to the northwest country as a whole. How significant, was explained by both Assistant Secretary Warne and Commissioner of Reclamation Michael W. Straus. In the words of the latter:

"If we protect it, it will be serving the Northwest after everybody in Montana today is dead and gone—a hundred, five hundred, or a thousand years—as long as water runs downhill, perhaps forever."

The structure will be one of the great dams of the earth. It will produce 300,000 kilowatts of power at the site and in addition, will provide, through planned releases of water from its reservoir, additional stream flows which are needed at Grand Coulee, Bonneville, and other dams downstream to firm up the power outputs there.

As Bill Warne put it, "this power, of which there will be 700,000 kilowatts, is just as real, as valuable, and as useful as though it were generated here."

Furthermore, he added "a million acre-feet of water stored here when some future disaster threatens to sweep the valleys below will reduce flood heights all the way down to the Pacific, and when more dams are available, such peak flood storage promises to pacify the river and hold it within bounds. These results flow from unified operation of the system of dams."

Yes sir, July 10 was a day long to be remembered. It began with two bands and a cordial welcoming committee greeting the Bureau plane bringing Interior and Bureau officials, including Messrs. Warne and Straus and Chief Engineer Leslie N. McClellan. In the greeting group were Governor Sam Ford of Montana, Congressman Mike Mansfield, Regional Director R. J. Newell, Construction Engineer Clyde H. Spencer, Al Winkler, president, and Don Treloar, secretary, of the Flathead Valley Citizens Committee.

From the minute of arrival, there followed a rapid-fire succession of events, each designed in its own way to portray the enthusiasm of the Northwest, and particularly Montana, for the new project.

The climax of the day was the setting off of the blast marking the official start of construction in the spectacular and deep canyon of the South Fork by Governor Ford. Equally impressive were such events as the presentation of a historical pageant depicting the history and growth of Montana, a free barbecue for 6,000 people, and an Indian ceremony, during which Messrs. Warne and Straus were made members of the Blackfeet Indian Tribe and named "Medicine Eagle" and "White Beaver" respectively. No less enjoyable were the informal tours of Glacier Park, a buffet luncheon at Columbia Falls, and the dinners at Lake McDonald Hotel.

When the day was over and all the tired kids had been put to bed, many a Montana mother and dad gave a tired sigh that said "It's a swell world, after all." There were others, such as Winkler, Treloar, Leon Phillips, Gray Edmiston, and others of the Flathead organization which did so much to make the dream come true, who leaned back and already were longingly thinking ahead to another day, when they would gather again on the rugged South Fork, this time to celebrate the completion of the 535-foot high barrier. They're not short of vision in Montana.

THE END

Shotcrete Canal Linings

(Continued from page 189)

blade can be manipulated so that it shapes the near bank. The same operation can be performed by the pull grader but more equipment and personnel are required. In addition to these pieces of equipment, laborers with shovels helped out in the final shaping and cleaning operations.

The objective of the entire reshaping operation was to provide a reasonable base for the lining with a minimum of expense. No attempt was made to finish the section to accurate line or grade, or to maintain a regular section. The physical result was a lateral that will satisfactorily perform its required function of carrying irrigation water. The economy is attested to in the final cost of the operation.

The new laterals were built by first preparing an even grade and roadway with a tractor and scraper, and then cutting the ditch with a tractor and blade. It is reported that by laying out the lateral line to avoid heavy cuts and fills, the costs of new construction were very little higher than costs for reshaping the old sections. The average section has a 2-foot bottom width, a 2-foot depth, and 1 to 1 side slopes.

After the canal section had been shaped, 2-inch boards were placed lengthwise along the canal on both sides to form the top of the finished lining. After the boards were in place, 4-inch mesh No. 11 wire was placed in the section, and a thickness of 1 inch of shotcrete was applied to the section for the top 6 inches on each side where the lining was flaired out to a 2-inch thickness at the edge. After the lining was placed, it was cured by spraying with Hunt process compound. The rebound was not troweled.

The entire operation for placing the lining was highly mechanized. A central batching plant, where the sand was placed in an overhead hopper by a crane, was established. From this hopper the sand passed by gravity through shaker screens, then into a small mixer where cement was added and the batch dry-mixed. On being discharged from the mixer, the batch was raised by an elevator into another hopper from which it discharged by gravity into dump trucks which were backed under the hopper. The trucks then carried the mixed batch to the shotcrete machine and dumped it into a skip, with which it was elevated and dumped into a hopper over the shotcrete chamber.

The sand used in the shotcrete was river-run material delivered to the central batching plant by a contractor. After screening, it had a fineness modulus of 3.25. Water was obtained from the nearest ditch and carried to the site in a tank truck. Water was pumped to the nozzle from a 350-gallon water tank on the shotcrete trailer. Nine sacks of cement were used per cubic yard of shotcrete. A crew of six men handled the single-gun-size shotcrete equipment. The operation included water hauling and application of the curing compound on the finished lining, but did not include hauling the mixed material from the central plant. The nozzleman was paid $1.62½ per hour and the other five men were paid at various rates down to $1 per hour.

Following is a tabulation of the final costs for the job:

Materials (sand, cement, wire, curing compound)	per sq. yd.	$0.442
Mixing, hauling, placing wire, shotcrete and cure	do	.366
Subtotal	do	.808
Grading	do	.147
Total	do	.955

The material costs were:

Sand	per cu. yd. delivered	$1.45
Cement	per bbl	3.25
Wire	per square ($0.095 per sq. yd.)	1.06

The cost of placing the wire was $0.089 per square yard. (This includes the cost of delivering the wire to the job and of placing the 2-inch headers.) The total cost of the wire ($0.184) subtracted from the cost of the lining ($0.808) leaves a total unreinforced lining cost of $0.624 per square yard. A total of 78,000 square yards of lining was placed. These are field costs and do not include overhead or depreciation of district-owned equipment. (This cost ordinarily runs about 20 percent. At this rate, the cost, per square yard, of 1-inch paving would be $1.146, which is not unusual for lining of this type.—Ed.)

In addition to the use of pneumatically applied mortar for lining canals and laterals on the project, the district is utilizing its shotcrete equipment in the construction of canal structures. Some drop structures were built up with river rock and then faced with shotcrete. In other cases, checks were built up of concrete block and then faced with shotcrete. Slots for stop logs were formed in the concrete blocks, which were then laid in their proper positions.

In planning similar programs, other irrigation projects may profitably observe Maricopa County's shotcrete canal-lining experience. THE END

Inter-American Conference on Renewable Resources Held

The first Inter-American Conference on Conservation of Renewable Natural Resources was scheduled for September 7–20 in Denver, Colo. The conference was organized by the Pan American Union and the Department of State with the assistance of several other Government agencies, including the Department of the Interior. The conference is designed to discuss problems arising out of deforestation, flood, and increasing water supplies. Plans call for a study by the group of the Bureau of Reclamation's Colorado-Big Thompson project in relation to agriculture, grazing, and forestry practices on the land from which irrigation water is derived. A relief model of the project and other Reclamation exhibits will be included in the large display at convention headquarters.

Reclamation Engineers Going to Ceylon and Venezuela

In compliance with a Department of State request the Bureau of Reclamation is sending two of its engineers to serve as technical advisers on irrigation matters to the governments of Ceylon and Venezuela.

Mr. Paul von der Lippe, of the Denver office, is slated for at least a year's duty in Ceylon, while Mr. John L. Mutz, area planning engineer at Albuquerque, New Mex., is slated for 3 months' service in Venezuela.

News Round-Up

Lindsay-Strathmore Okays Central Valley Water Contract

By an overwhelming vote of 188 to 1 the Lindsay-Strathmore Irrigation District located in the San Joaquin Valley, midway between Fresno and Bakersfield, Calif., recently approved a water-service contract with the Bureau of Reclamation.

Under the contract, water delivery will be made in accordance with the 9 (e) clause of the Reclamation Act of 1939 for a period of 40 years. The rate will not exceed $3.50 per acre-foot for 18,000 to 30,000 acre-feet annually of class 1 (assured supply) water and $1.50 per acre-foot for class 2 water (indeterminate quantity, dependent on available supply and time of occurrence). The Bureau will also transport up to 12,000 acre-feet a year of water at present available to the District under established water rights from Wutchumna Ditch via the Friant-Kern Canal.

The water-service type contract differs from the older water rental contracts in that it provides for payment of annual water-service charges but does not require the water users to retire the construction cost of the water-supply facilities in 40 years.

United Western Investigations Move Along

Ground work for staffing the united western investigations is being laid by the Department of the Interior. This program, primarily a Reclamation activity, is designed to make preliminary explorations and studies of possible routes and means by which water from the Pacific Northwest can be diverted southward through interchanges to reach such southern points as San Diego and the Imperial Valley.

The investigation will coordinate planning work and draw on the investigative resources of the Bureau's Regions at Boise, Idaho, Sacramento, Calif., Boulder City, Nev., and Salt Lake City, Utah. Seven States are expected to benefit directly from the proposed diversion. They are Washington, Oregon, California, Idaho, Nevada, Utah, and Arizona. It is also expected that major indirect benefits will accrue to Colorado and Wyoming.

Department of the Interior Weed Control Committee Formed

More comprehensive studies are being made each year of losses and control costs caused by weed growth. An analysis of these studies has resulted in a greater realization by both the Government and the public of the vital need for creating more interest in weed control and for research to establish more economic methods of combating the weed menace.

Because of this realization a Department of the Interior Weed Control Committee has been formed in Washington, D. C., as a step toward gaining closer cooperation between

"KINK" IN THE RIVER

Engineers literally put a "kink" in the Colorado River when they diverted it at the Davis Dam site. This recent aerial photograph shows the mighty river flowing through its new man-made channel at the dam site following its recent diversion. (See "Detour at Davis" page 105, June 1948 RECLAMATION ERA for a comparison between the above photo and MacGilchrist's drawing of the finished structure.) The lower end of the new channel was excavated through rock to a depth of 200 feet. The river originally flowed through the area at left which now has been pumped almost dry and soon will be excavated, in preparation for placing the earth and rock-fill embankment. The S-shaped structure in the center is the trestleway from which concrete is being placed into the power plant intake and spillway structures. Photo by Harry W. Myers, Region III.

the various agencies in the Department which are interested in weed control and to prevent duplication of activities.

The departmental agencies represented in the committee are: Office of Land Utilization, Fish and Wildlife Service, Office of Indian Affairs, Bureau of Land Management, National Park Service, and Bureau of Reclamation. The committee has chosen Agronomist Robert B. Balcom of the Bureau of Reclamation as its chairman. The committee plans to work closely with the Department of Agriculture's research program conducted by its Bureau of Plant Industry, Soils and Agricultural Engineering.

While it may be determined later that the committee may serve other purposes, some of the basic functions outlined during the first meeting held August 4 are:

1. To work toward making lands under the jurisdiction of the Department more useful to the public and prevent, insofar as possible, the spread of weeds to other lands.

2. To understand each agency's responsibilities and functions better, as well as its weed problems, so that coordination of weed work can be obtained rather than working separately and possibly against the interests of another agency.

3. To propose weed control problems needing further study.

4. To decide which agencies should undertake research in specific weed problems common to more than one agency to prevent duplication of work.

5. To find more economical and permanent solutions to weed problems through research conducted by Interior agencies or by or in cooperation with Agricultural or other agencies.

6. To exchange results of research and other findings concerning solutions to weed problems.

7. To propose and advise on legislation needed for advancement of weed control work in the United States.

8. To work with Weed Control Conferences, Council of State governments, and Federal, State, and local agencies interested in weed control.

Interior Officials Return from Paris Conference

Harvey F. McPhail, Director of the Branch of Power Utilization, and Wendall A. Morgan, head of the power system technical group, Denver, Colo., both of the Bureau of Reclamation, and Consulting Engineer Peter L. Bellaschi of the Bonneville Power Administration recently returned from the International Conference on Large Electric Systems held in Paris, France, the latter part of June and early July.

Mr. McPhail served as chairman of the American delegation which was sponsored by the State Department. In addition to the Interior Department representatives there were a number of other Americans from private corporations and Federal agencies interested in hydroelectric power. The purpose of the C. I. G. R. E., founded in 1921, is to provide for a free interchange of technical information between all countries engaged in power development. A comprehensive report on the conference is now being prepared by Mr. Morgan, a summary of which will be published in an early issue of the Era.

Columbia Basin—Future Dairy Center

Dairy production on the Columbia Basin project has been estimated at 41,000,000 pounds of butterfat annually when the project is fully developed, says a report on the project issued by the Bureau of Reclamation of the Department of the Interior. If the entire commercial output were to go to cheese production, the project could support 38 cheese plants of 8,000 pounds per day capacity, or 75 cheese plants of 4,000 pounds per day capacity.

WOLF POINT

(Continued from page 186)

and the irrigation tractor and pumps toppled into the stream. Though discouraged, Mr. Appelgren sought to rectify this mistake by constructing a barge large enough to carry a tractor and irrigation pump. This was satisfactory until the river flow decreased rapidly, leaving one end of the barge on the river bank and submerging the other, again dropping the tractor and pump into the river.

Mr. Appelgren then determined to obtain the services of an irrigation specialist—Mr. G. H. Bingham, of Malta, Mont.—who suggested that the land be leveled and prepared for irrigation. With a number of teams and men, about 20 acres were leveled. The expense ran rather high so irrigation was started on a 20-acre scale. As it was found that the two 6-inch pumps were not adequate for the job, a 16-inch pump was obtained with a steam engine for power. However, costs enter into everything, and it was found that this was too expensive with hired help, even though coal and wood were available on the farm. The acreage was increased within a few years to 65 acres. Still considering the cost, a smaller pump with a 25-horsepower Diesel engine was obtained and used until World War II, when it was necessary to cease irrigation because of a lack of available labor.

Since then 70 acres more have been leveled with modern machinery, bringing the total to 150 acres. A new pump has been purchased that will supply 3 to 4 thousand gallons of water per minute.

Other farmers who started to irrigate about the same time as Mr. Appelgren, and are still irrigating, are Hans J. Hansen, Joe Pipal, Cusker Brothers, and James Twitchell.

The Bureau of Reclamation started its office in Wolf Point in April 1946 with Wallace H. Whiting as project engineer. Mr. Whiting rented office space, organized the survey crews, and conducted the work until January 1947. Then Harold W. Mutch was transferred from the Tucumcari project to act as project engineer, with Mr. Whiting as assistant.

Project planning has progressed, securing information which will provide a determination of feasibility of the various units in northeastern Montana. Preliminary location has been made of the proposed Missouri River Canal, the diversion dam from the Missouri River, and the proposed Big Muddy Dam site. The over-all plan, as generally outlined in Senate Document 191, Seventy-eighth Congress, second session, provides for a canal with a capacity of 6,200 second-feet, with water diverted from the Missouri River approximately 10 miles below Fort Peck Dam.

The canal would have a length of approximately 110 miles and would flow by gravity diversion to the proposed Medicine

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NOTES FOR CONTRACTORS

Contracts Awarded During August 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2189	Missouri Basin, Wyo.	Aug. 18	Two 8,333/10,417 kilovolt-ampere and four 3,333/4,444 kilovolt-ampere transformers for Boysen power plant.	Westinghouse Electric Corp., Denver, Colo	$130, 492
2198	Fort Peck, Mont.	Aug. 16	Four 2,500 kilovolt-ampere transformers for Miles City substation, schedule 1.	General Electric Co., Denver, Colo	71, 055
2198	do	do	One regulating transformer for Miles City substation, schedule 2.	Moloney Electric Co., St. Louis, Mo	27, 000
2198	do	do	Two circuit breakers and 3 disconnecting switches for Miles City substation, schedules 4 and 5.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	35, 912
2198	do	do	Four lightning arresters and 3 current and 4 potential transformers for Miles City substation, schedules 7 and 8.	Westinghouse Electric Corp., Denver, Colo	11, 870
2202	Hungry Horse, Mont.	Aug. 18	Six 60,000 kilovolt-ampere transformers for Hungry Horse power plant.	Moloney Electric Co., St. Louis, Mo.	765, 982
2233	Columbia Basin, Wash.	Aug. 3	Six radial-gate hoists for Main Canal headworks at South Coulee Dam.	United Engineering Co., San Francisco, Calif.	40, 530
2263	Klamath-Tule Lake, Oreg.-Calif.	Aug. 30	Construction of earthwork and structures for Lost River diversion channel enlargement from Lost River to Klamath River.	George R. Stacy, Tulelake, Calif	549, 144
2269	Riverton, Wyo.	Aug. 31	Construction of earthwork, tunnel, and structures for Wyoming Canal; earthwork and structures for Muddy Ridge Canal; and laterals, sublaterals, and wasteways.	Morrison-Knudsen Co., Inc., Boise, Idaho	1, 589, 219
2271	Lewiston Orchards, Idaho	Aug. 12	Construction of one 15,000-gallon water storage tank for water treatment plant.	American Pipe & Construction Co., Portland, Oreg.	10, 385
2278	Hungry Horse, Mont.	Aug. 30	Four 13-foot 6-inch diameter penstocks for Hungry Horse dam and power plant, item 1.	Chicago Bridge & Iron Co., Chicago, Ill	699, 200
2282	Fort Peck, Mont	Aug. 31	Construction of one 7,500 kilovolt-ampere substation at Wolf Point, Mont.	Elliott Construction Co., Omaha, Nebr	267, 865
2285	Missouri Basin, Wyo	Aug. 6	Clearing Kortes reservoir site	Dawson and Corbett, Rawlins, Wyo	15, 000
2296	Boise, Payette, Idaho	Aug. 13	Construction of earthwork and structures for Sand Hollow wasteway (East Branch) and Willow Creek wasteway.	Vernon Bros., Boise, Idaho	105, 253
2307	Boulder Canyon-All-American Canal, Ariz.-Calif.-Nev.	Aug. 31	Construction of earthwork, pipe lines, and structures for lateral 97.1, and laterals 97.1-7.1W, 97.1-71NW, sublaterals, and wasteway, unit 5, Coachella Valley distribution system.	American Pipe & Construction Co., Los Angeles, Calif.	1, 489, 447
2322	Colorado-Big Thompson, Colo	do	3 steel expansion joints for intake pipes at Granby pumping plant.	Pacific Coast Engineering Co., Alameda, Calif	13, 425
2326	Columbia Basin, Wash	Aug. 12	Galvanized steel towers and appurtenances for 230 kilovolt tie circuits, Grand Coulee power plant.	American Bridge Co., Denver, Colo	58, 535
2333	do	Aug. 16	Fabricated structural steel for seat frame for floating caisson, Grand Coulee Dam.	George T. Gerhardt Co., Inc., San Francisco, Calif.	34, 000
2341	do	Aug. 31	Miscellaneous structural steel for cable trays RC to R9, Grand Coulee power plant.	Vinnell Co., Inc., Alhambra, Calif.	13, 882
R1-20	Deschutes, Oreg	Aug. 2	Converting 4 barracks to apartment building at Madras Air Base.	R. P. Syverson, Bend, Oreg.	34, 453
D-6820	Central Valley, Calif.	Aug. 5	Reinforcing steel	Bethlehem Pacific Coast Steel Corporation, San Francisco, Calif.	300, 549

Construction and Supplies for Which Bids Will Be Requested by December 1948

Project	Description of work or material
Boulder Canyon, Ariz.-Nev	Governors for units A3 and A4, Hoover power plant.
Central Valley, Calif.	Construction of earthwork, lining, and structures for about 15 miles of Delta-Mendota Canal near Patterson, Calif.
Do	Relocation of 7.2 miles of railroad spur above Keswick Reservoir between Middle Creek and Matheson, Calif.
Do	Painting 3 penstocks for Shasta power plant.
Do	230/196 kilovolt metering equipment for Shasta substation.
Do	3 bus reactors for Tracy switchyard.
Do	230/196-, 115-, and 69-kilovolt instrument transformers for Tracy switchyard.
Columbia Basin, Wash	Additions to 6,900-volt switchgear XLS, Grand Coulee power plant.
Do	Construction of North Dam, an earth-fill structure which is to form the north barrier of Grand Coulee equalizing reservoir, about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for 15.3 miles of West Canal near Ephrata, Wash.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder Canal near Coulee Dam, Wash.
Davis Dam, Ariz.-Nev.	13.8-kilovolt bus structure for Prescott substation.
Do	Main control board for Prescott substation.
Do	Structural steel for Davis power plant.
Do	Metal doors for Davis power plant.
Fort Peck, Mont	Construction of about 4.3 miles of 12.5-kilovolt wood-pole transmission line near Savage, Mont.
Do	Construction of 500-kilovolt-ampere substation which is to furnish power supply to the Savage pumping plant.
Gila-Wellton-Mohawk, Ariz.	Pumping units for pumping plants 1, 2, and 3.
Klamath, Calif.-Oreg	Improvements of Lost River channel in Langell Valley near Klamath Falls, Oreg.
Lewiston Orchards, Idaho	Construction of filter plant and Clearwater Reservoir which is to supply water to domestic and irrigation distribution systems near Lewiston, Idaho.
Minidoka, Oreg	Concrete canal lining at mile 2 in Milner-Gooding Canal near Burley, Idaho.
Mirage Flats, Nebr	Removal of portion of existing Cottonwood Creek siphon and lengthening of siphon near Hemingford, Nebr.
Missouri Basin, Kans	High-pressure gates for Cedar Bluff Dam.
Missouri Basin, Nebr	Furnishing and erecting 20 prefabricated residences for government camp at Superior, Nebr.
Do	Construction of Superior-Courtland Diversion Dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Do	Construction of earthwork and structures for about 12.5 miles of Superior Canal near Superior, Nebr.
Do	Construction of earthwork and structures for about 6.5 miles of Cambridge Canal near Oxford, Nebr.
Missouri Basin, N. Dak	Construction of 1,500-kva. Watford City substation, North Dakota.
Missouri Basin, Wyo.	Construction of about 1.5 miles of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Ogden River, Utah.	Construction of earthwork and structures for an equalizing reservoir for south Ogden lateral distribution system.
Do	Installation of Venturi meter in a 75-inch pipe line of the Ogden Canyon conduit.
Riverton, Wyo.	Construction of concrete structures for Lost Wells and Pilot laterals, near Riverton, Wyo.

Lake Reservoir. From Medicine Lake Reservoir the water would be pumped over into North Dakota and utilized to irrigate approximately 1,400,000 acres of the Missouri-Souris unit in North Dakota.

The unit will also include construction of 16 pumping units along the south side of the Missouri River in Montana, with a total area of approximately 36,000 acres. Under the main canal, on the north side of the Missouri River in Montana, about 48,000 acres of land will be irrigated by gravity. These lands lie between the canal and the river and extend from the diversion dam to Medicine Lake Reservoir. An additional 52,000 acres of land will be irrigated by pumping from the main canal, and about 67,000 acres by pumping directly from Medicine Lake.

Sufficient moisture, heavy yields and good prices of the last few years have brought hope and a minor degree of wealth to most of the farmers, but they have not forgotten those drought years from 1931 to 1940, low prices and "Black Blizzards." Many are anxiously awaiting development and completion of the Missouri-Souris unit that will so greatly benefit them and insure, through irrigation, greater economic stability.

THE END

The Reclamation ERA

OVEMBER
1948

Field of irrigated lettuce in the Salt River Valley, Arizona
Bureau of Reclamation photo by Ben D. Glaha

Reclamation Place Names in This Issue

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J. A. Krug, Secretary

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REGION V: H. E. Robbins, Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.
REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Letters to the Editor

Part of the Job

Earl W. Larsen, 337 South Albion Avenue, Burley, Idaho, with his remittance for a renewal to the Reclamation Era wrote:

I enjoy every copy, get a great deal of helpful information for my part of the job as Watermaster.

(Continued on p. 201)

Reclamation ERA

November 1948 **Vol. 34, No. 11**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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CONTENTS

Ruth F. Sadler, ***Editor***

Corrections

In "Gila Homesteaders Take Over," September 1948 issue, tenth line from the top of page 174, a typographical error was made in the amount of predevelopment payments to be made by the homesteaders after the first 10 years. The figure should have been $3.50 instead of $2.50 per acre.

The two excellent photographs on page 176 of the September 1948 issue, illustrating the article "Irrigation and Drainage of the Willamette Valley" were furnished the Era through the courtesy of Mr. John Burtner, Extension Editor, Oregon State College, Corvallis, Oregon. It is regretted this credit was omitted.

LETTERS (Continued)

Thanks to the Reclamation Era

Route 1, Box 923, Astoria, Oreg.,
September 9, 1948.

Dear Editor: I noticed in the July issue that the Northern Pacific Railway had about 30 farm units in the Pasco pumping unit to sell. I wrote in and fortunately qualified and purchased one of these units. Thanks to the Reclamation Era.

Truly yours,

Chester C. Dixon.

Irrigation District Members Included

Highley, Ariz.
July 7, 1948.

Dear Editor: Certainly your publication is most enlightening and helpful to me and I would not want to be without it. However, please note that I own land in an irrigation district, which I am not certain entitles me to the lower rate for subscription.

Enclosed I send you my personal check in the amount of 1 dollar. Does it entitle me to 1- or 2-year subscription?

Howard Martindale,
Roosevelt Water Conservancy District.

¶ To reader Martindale, thanks for the kind words; and for him and other members of irrigation districts in the West the Era is only 50 cents a year—Ed.

Associated General Contractors' Attitude

Via the former Chief Engineer's office we received the following communication from the Associated General Contractors' George H. Atkinson. We are printing this letter and Walker R. Young's reply as an acknowledgment and notification to contributors. Those connected with the publication of material appearing in the Reclamation Era have already noted this comment.

Guy F. Atkinson Co.,
Contractors and Engineers,
10 West Orange Avenue,
San Francisco, Calif.,
April 15, 1948.

Dear Mr. Young: As a member of the Associated General Contractors Contact Committee, an article in the December 1947 issue of the Reclamation Era written by Mr. William T. Easterday and titled "The Drama of a Big Bid Opening" has been called to our attention. One paragraph therein reads as follows:

The Government announces a date and place for opening of bids. At a certain hour, usually 10 a. m., all bids must have been submitted in sealed envelopes and the opening proceeds. Often the bids are received at the very last minute, since the firms' representatives gather together before the opening and try to find out what the others are bidding, scaling their own bids down to a minimum just before the deadline.

We are quite certain that Mr. Easterday intended no harm in writing this paragraph, but our members have taken exception to the inference made by the last sentence therein that representatives of the various competitive firms in any way compared bids before a letting. We are certain that no responsible contractor permits his representatives to in any way discuss a bid before it is opened, and believe that it is unfortunate that such an impression is gained on a first reading of this article. We are fully aware that many machinery salesmen and others do considerable "gossiping" before a letting, but know it is not customary for representatives of the contracting firms to join in any such discussions.

Since we feel that it is a matter of mutual concern to both your organization and to ours that no shadow be cast on the integrity of competitive bid openings, we are simply writing you to call this matter to your attention. We feel that it was undoubtedly unintentional and should be dropped in this instance. However, we suggest that you bring the matter to the attention of the editor so that future statements of this type may be avoided unless some specific case is cited.

With all best wishes,

Yours very truly,

Geo. H. Atkinson.

April 23, 1948.

Dear Mr. Atkinson:

I appreciate your informing me on the attitude of the A. G. C. members toward a paragraph of the article entitled, "The Drama of a Big Bid Opening," which appeared in the December 1947 issue of the Reclamation Era. I am particularly concerned about preserving the integrity of our competitive bidding practices, and I am sure that Commissioner Straus shares my concern. To advise him of the reception of the Era article by members of the A. G. C. I am taking the liberty of forwarding the Commissioner a copy of your letter of April 15, 1948. I am certain that he will be glad to see that such statements as you refer to are avoided in the future.

Sincerely yours,

Walker R. Young,
Chief Engineer.

IT'S NOT TOO EARLY . . .

to begin thinking of your Christmas shopping.

Solve your gift problems by sending subscriptions to the Reclamation Era to your friends. Each month they will be reminded of your thoughtfulness, and if you send your subscription in time, we shall mail a special Christmas Subscription Certificate to notify them of your gift. Simply fill in the blank below with the name of the person to whom the subscription is going, and add "Christmas Gift Subscription from ____________________" with your name clearly printed so that it may be inscribed on the certificate. Attach the names and addresses of additional persons to whom you wish to send the Era as a gift to the blank with your remittance.

____
(Date)

The Commissioner,
Bureau of Reclamation, United States Department of the Interior.
Washington 25, D. C.

Sir: Enclosed is a check, or money order (no stamps) made out to THE TREASURER OF THE UNITED STATES in the amount of ______________ for a __________ year subscription to the Reclamation Era.

Sincerely,

Check (√) if member of water users association ☐

____
(Name)

____
(Address)

____
(Include zone number, if any)

____
(Name and address of association)

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•

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OKLAHOMA—Region of Opportunity

Oklahoma—last of the States formed from the Louisiana Purchase—brought into the Union a wealth of natural resources: timbered mountains, treeless plains, fertile soils, valuable minerals and building materials, and rich reserves of petroleum. These resources attracted a restless, energetic people. When statehood was proclaimed November 16, 1907, and the union of Oklahoma Territory with the unorganized Indian Territory was consummated as the forty-sixth State, $1\frac{1}{2}$ million new citizens were added to the Union—a population greater than any of 20 States and four times as many as in any other State at its time of admission.

Oklahoma, though a young State, has encompassed much history within its borders. During most of the last century this region was Indian country, a dragnet that caught remnants of almost 50 tribes thrust from their native habitat by white expansion.

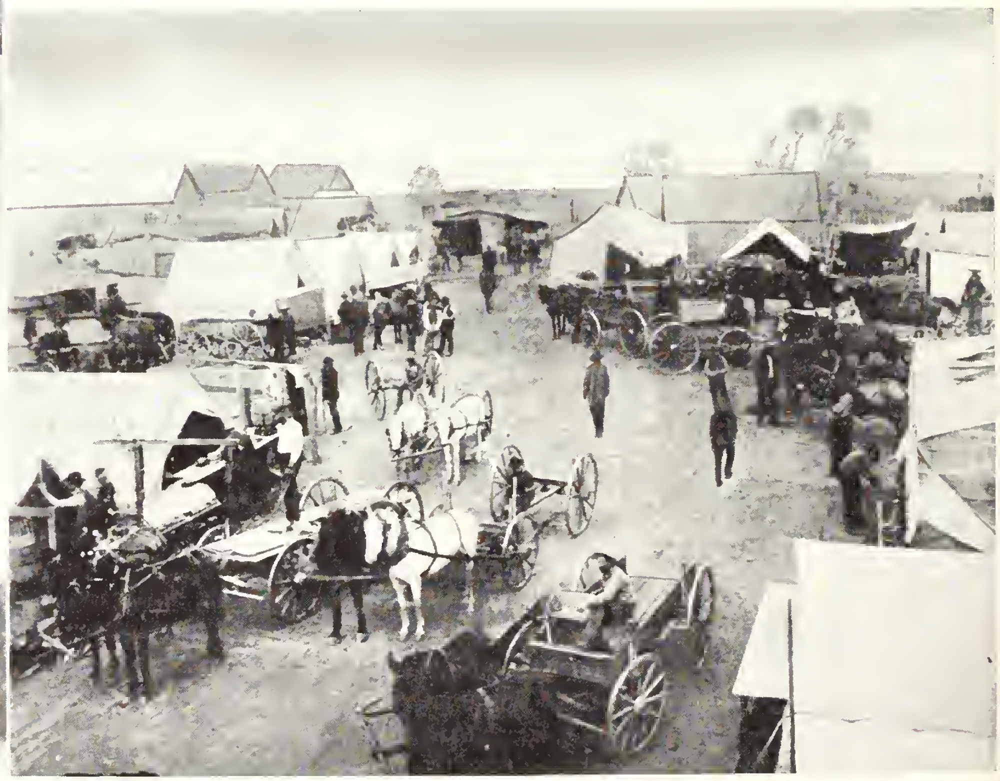
Here they found temporary respite from eventual absorption as land-hungry whites below, above, and beyond their land established territorial or State governments. Settled among the hills and valleys along the rivers and creeks of eastern Oklahoma were the Five Civilized Tribes, the Cherokee, Creek, Choctaw, Chickasaw, and Seminole Indians, dispossessed of their native lands in the Southern States, reluctantly lured by the shibboleth that this new country should be theirs "as long as the grass grows and the waters run."

These tribes included members and mixed-bloods who had been men of influence and substance in their former homes. Some owned slaves; many of these were skilled artisans. Building upon what they had salvaged from the removal, aggressive leaders fostered commerce and industry in the new land, established republican forms of tribal government and, midst the turmoil of mutually destructive jealousy, progressively advanced in adopting the white man's culture.

Because the Five Tribes sympathized with the Confederacy, the Federal Government forced concessions that brought about a great transformation in Oklahoma. The Five Tribes had to surrender most of their western lands; remnants of Indian Tribes were settled on reservations and once powerful nomads who had followed the buffalo were forced to an adjustment of livelihood and beggarly assistance that led to the allotment of lands and usually, to individual destitution.

The great range cattle industry flourished. Welsh and English emigrants were brought in to work the rich veins of coal owned by the Choctaws and Chickasaws. Railroads

Immediate left: An ancient and youthful member of the Kiowa tribe meet. They are only two of more than 100,000 Indians in Oklahoma, thousands of whom meet with Indians from all over the U. S. at Anadarko, Okla., to relive customs of the past. Bottom left: Pioneer Woman Memorial statue at Ponca City, Okla. Bottom right: A street scene in Oklahoma City, soon after Opening Day, April 22, 1889.



were constructed that speeded up the attraction of this rich, lovely land.

On April 22, 1889, the Federal Government opened the unassigned lands, a heart-shaped region of almost 2 million acres within the center of the State, to settlement. Five openings followed in the western half of the State while, meantime, the final dissolution of tribal sovereignty was taking place among the Five Tribes. After halting individual attempts by the two regions to enter the Union as separate States, single statehood was achieved November 16, 1907.

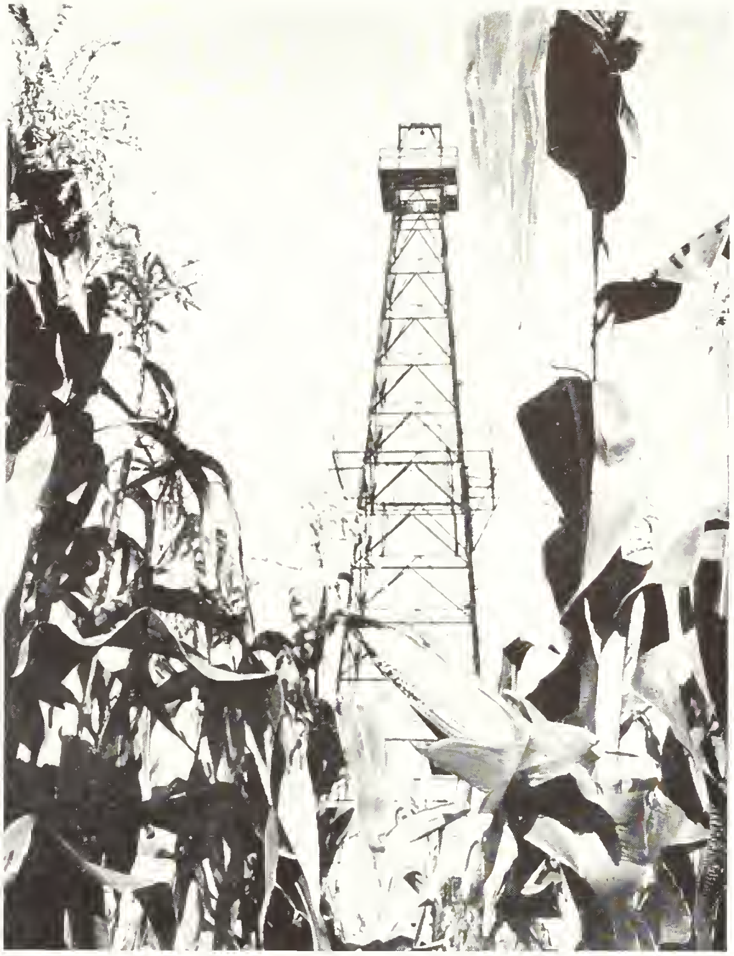
At this time Oklahoma's economy was predominately agricultural; urban population amounted to only 7.4 percent in 1900. Although the State has almost doubled in population—at statehood, 1,414,177 and in 1940, 2,336,434—a preponderant shift has been made away from the farms to the cities. Now, more than 60 percent of the State's labor force is employed in nonagricultural pursuits.

But agriculture remains the principal source of income. With nearly 35,000,000 acres of its total area of some 44,000,000 acres in farms, Oklahoma produces every major crop grown in the United States. Varied soils, contrasting topography and a spread in average annual rainfall—20 inches in the northwest to more than 45 inches in the southwest—have made possible great diversity in agricultural methods and products. Wheat, cotton, corn, oats, peanuts, alfalfa and alfalfa seed, broomcorn, pecans, watermelons, and other agricultural products returned producers last year $473,328,000. Livestock, dairy products, poultry and eggs brought this total to $742,253,000.

Indicative of the interest in improving agricultural practices, the State is blanketed by soil conservancy districts and is pushing this program to build and conserve its soil resources. And destined to continue agricultural advancement are members of the Future Farmers of America and 4–H Club organizations. These boys and girls have won more national awards in their project work during the past 20 years than those of any other State.

Present enrollment in 4–H Club work is 64,666; the State boasts a 4–H Club alumni of more than 800,000, many of whom are now successfully practicing their early lessons on farm improvement. There are 191 Future Farmer Chapters in Oklahoma with a membership of approximately 10,000. A proposal to double the youth farm program has the active support of Governor Roy J. Turner and other agricultural leaders. Such men, too, have sponsored the up-breeding of livestock by the youth organization; this year Oklahoma had 12 4–H Club winners in national achievement contests at Chicago, while a steer owned by Claude Millwee, a Future Farmer lad from Fort Cobb, won the grand championship at the International Livestock show.

The petroleum industry, long prominent in Oklahoma's economic life, has been a compelling force in industrial advance. Since the drilling of the first commercial producing well at Bartlesville, Cherokee Nation, in 1897, approximately 5,750 million barrels of oil valued at $7,700,000,000 have flowed from Oklahoma wells. Estimated additional reserves of 1 billion barrels remain underground. Daily crude oil production exceeds 400,000 barrels. Some of the older fields produce from six separate horizons while exploratory efforts open new fields or extend the boundaries of old fields each year. Oklahoma since statehood has never ranked below fourth among the States in the production of oil.



A mixture of oil and corn. Farm crops growing within the shadows of oil rigs are not uncommon sights in Oklahoma.

This led to the heavy concentration of oil refining in the State. There are now 25 active refineries with a daily capacity of 226,000 barrels of crude oil which produce innumerable byproducts. These plants in 1939 employed 5,133 workers who received $8,578,455 in wages for manufacturing products worth $106,666,837. The value added by manufacturing amounted to $18,085,209.

It would be difficult to estimate the influence the oil industry has had upon the State's development. Land-owners in every county have benefitted from leasing operations; there is probably no town in the State where none of the citizens have made money, lost money, or invested in this highly speculative enterprise. Lawyers, royalty-owners, lease-brokers, county and State governmental units benefit from the industry while hundreds of families are directly dependent upon the industry for employment in exploratory, drilling, pipeline, refining, wholesale, and retail operations. The manufacturing and handling of oil field supplies, too, is a leading industry.

Oklahoma has enough other minerals to give it fifth place among all States as a producer of mineral wealth. It has a coal reserve of some 55 billion tons, 125 billion tons of gypsum, and billions of tons of dolomite, limestone, volcanic ash, rock wool, rock asphalt and a host of other minerals. Leader in lead and zinc production, noted for its building stone and glass sand, Oklahoma is just beginning to realize the importance to industry of other minerals.

Probably of greatest recent significance industrially to Oklahoma has been the concentration of the glass industry in the State. Thirteen glass companies now operate plants near cheap, abundant fuel and one of the greatest supplies of glass sand in the Nation. This industry is growing and it has been prophesied its payroll in the State will soon rival that of petroleum refining, Oklahoma's greatest industry.

Food processing, wheat milling, and the manufacture of dairy products are tending to balance the State's agricultural production and processing economies while, in the southeastern part of the State, extensive timber resources are being used for the manufacture of timber products. From 1940–1944 manufacturing payrolls increased Nation-wide only 39 percent while in Oklahoma they increased 80 percent, largely because of the concentration of war industries in the Southwest. Recent estimates indicate that Oklahoma's advance in manufacturing during the postwar period ranks sixth among the 13 Southern States. There was five times more private construction of business houses, warehouses and factory sites last year than in 1939.

Legislation enacted last year made the tax structure more favorable to industry. Oklahoma makes no State-wide ad valorem levy; the State income tax was reduced one-third. Products sold for use outside the State are exempt from sales tax; machinery and equipment are exempt from sales and use tax. A new business corporation code with advantages incorporated in the liberal Delaware Code was adopted.

Factors, too, in the recent industrial expansion in Oklahoma are natural gas and electric power. Oklahoma has adequate supplies of natural gas to meet demands made by industrial expansion. The estimated reserves of 10,735 billion cubic feet assure heavier use of this important fuel within the State.

Approximately 12 percent of the electric power supply is owned by municipalities, 12 percent is under State or Federal agencies, and the remaining 76 percent is privately owned. Great generating plants have contributed toward increasing power output ten fold since 1920. Oklahoma exported electric power during the war and is capable of furnishing power to much more industry than is now within the State.

Oklahoma is the home of the W. C. Austin reclamation project, now nearing completion by the Bureau of Reclamation. This 45,000-acre project at Altus is further east than any previously constructed by the Bureau. As pointed out by Former Governor Robert S. Kerr of Oklahoma in his article, "Plow, Plant, and Pray" (see RECLAMATION ERA, May 1948), Oklahomans are optimistic about the future of reclamation in their State. There are 2,810,000 acres of fertile, alluvial lands in the flood plains of Oklahoma's streams. Oklahoma has an additional 1,300,000 acres of second bottom lands. The bottom lands are all classified as superior soils. Reclamation appears to be the most promising new frontier in the State. Under direction of a vigorous State Planning and Resources Board, Oklahomans are moving ahead toward reclamation and the next decade is expected to witness a halt in much of the water that has been moving unused to the Gulf since '89 and before.

Prompted by the war impetus, gifted with natural resources, aided by State legislation, Oklahoma is rapidly working out a more equitable balance between agriculture and industry—building, progressing, growing. THE END.

National Reclamation Association Convenes November 17

Oklahoma City, Okla., will be the site for the Seventeenth Annual Convention of the National Reclamation Association on November 17, 18, and 19, 1948.

In its official call to members, the National Reclamation Association outlined the objectives of the convention in these words, "To speed the completion of projects under way . . . to attain better economic conditions through reclamation development . . . to integrate the plans and actions of the Association with those of the States and of the public which it serves . . . and to coordinate those plans and actions with the agencies by which the work is done . . ."

Wednesday, the opening day session, will feature reports of committees and officers of the Association. State caucuses will be held to select State directors, members of the resolution committee and a State caucus secretary.

Thursday's session will be a Water Users' Day which will be devoted exclusively to the activities and problems of water users. Several irrigation farmers will participate in the program. There will be a discussion of Sprinkler Irrigation, followed by an actual field demonstration.

Topics of interest to irrigation water users will be scheduled as a series of round table discussions, featuring problems relating to irrigation, operation and maintenance, repayment contracts, legislation, relationships with the Bureau of Reclamation and other pertinent subjects.

The Friday session will be devoted to reports and papers by Commissioner Michael W. Straus of the Bureau of Reclamation, Department of the Interior; Lt. Gen. R. A. Wheeler, Chief of Engineers, Department of the Army; and J. C. Dykes, Assistant Chief, Soil Conservation Service, Department of Agriculture. President of the Association of Western State Engineers O. C. Williams will discuss "Ground Water Problems of the 17 Western States," and Fred E. Buck, Montana State Engineer, will discuss "State Responsibility for Small Project Development."

In a special message to all members of the National Reclamation Association and friends of resource development, Gov. Roy J. Turner of Oklahoma said, "The development and improvement of programs involving water conservation, irrigation flood control, hydroelectric power, municipal and industrial water, and recreational facilities are vital to a strong and productive national economy."

The Board of Directors of the Lugert-Altus Irrigation District, and the Board of Directors of the Altus Chamber of Commerce issued a special invitation to delegates and visitors to view Oklahoma's first Federal Reclamation project on Saturday, November 20, (see page 209) and become ac-

(Continued on page 220)

The "New Look" in Thanksgiving Turkeys

by PHIL MERRITT, Photographer, Region 1, Boise, Idaho
(Photographs by the author)

"You don't need colored marbles."

This phrase means very little to the average person, or at best it only recalls some incident years ago when he was playing for keeps and lost his choice "aggie." But to Mr. and Mrs. George Kratzberg of Notus, Idaho, it means a livelihood.

They raise turkeys, white ones to be exact. This particular breed is distinctly different from the ordinary bird. From the day the white poult is hatched it is a good eater and the Kratzbergs do not have to resort to the old system of putting colored marbles in the mash, which is used by some turkey raisers to attract poults to the feed rack. Since the success of raising turkeys depends upon the rapid rate in which they mature, "You don't need colored marbles" is an all important axiom on the Kratzberg ranch.

The Kratzbergs live on a 54-acre irrigated farm near Notus, on the Boise Federal Reclamation project. They are relatively new in the turkey business but are not without experience at farming. For many years they farmed on a share basis near Melba, Idaho. This experience taught them one thing—if you have a place of your own, the one way to make a better living is by raising the best stock, be it poultry or crop.

In 1947, 4 years after having purchased their present farm, they started raising the Beltsville turkeys, named after the Beltsville, Md., experiment station of the Department of Agriculture where they were developed. Their irrigated farm was an ideal location to try the new breed. They had good pasture land available for a turkey range and were producing alfalfa as an important green feed. The climate also was well suited for the projected enterprise. The location, available feed, maturity rate, and demand, all seemed to predict a successful venture which it has turned out to be.

From eggs laid by 40 hens during the summer of 1947 they hatched 1,996 poults for the following fall. This represented 83 percent fertility on all eggs hatched—an exceedingly high figure, and an encouraging start for the Kratzbergs.

The Beltsville turkey is different from ordinary turkeys in appearance and manners. It is all-white-feathered with a dark blue head and red wattles. The bird was developed by crossing White Holland, Black Narragansett, White Austrian, Bronze, and wild turkeys. The turkey is broad-breasted and carries more meat per pound of bird. It has a firm thick breast of white meat which cooks in a shorter length of time and retains more moisture and flavor. When mature the hens weigh from 8 to 10 pounds and the toms from 12 to 18 pounds. This lighter-weight bird fits the average family table and budget perfectly.

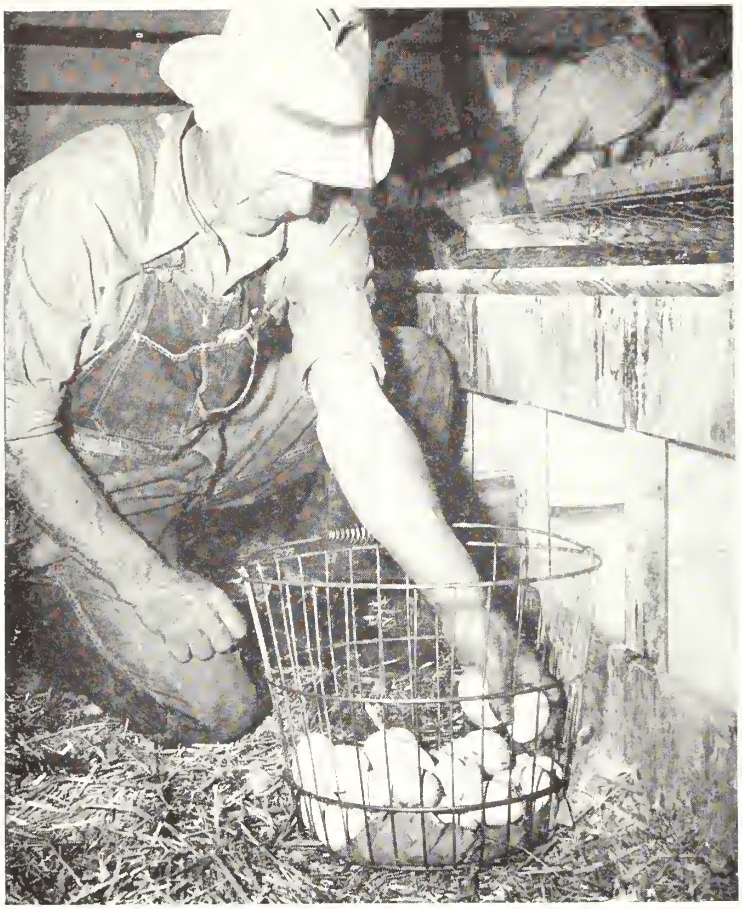
Too pretty to eat. Young Wallace Frank holds a typical white Beltsville turkey, product of the Boise, Idaho, Reclamation project. These birds are said to provide more meat than the ordinary variety, and are especially bred for small families.

The poults are started in electric brooders and fed mash for about 10 days, followed by a combination of mash and wheat. After graduating from this infant stage they thrive on mixed grain with wheat. In 8 weeks the poults are ready to take to the field, weather permitting. Within 6 months the turkeys are ready for market. During this relatively short time the turkeys have consumed less feed than their bronze relatives and will demand 5 to 7 cents more per pound when sold. Hatching occurs from April to August and marketing from October to February.

Last year the Kratzbergs retained 240 hens for the 1948 hatching season, the increased population requiring three brooder houses and three temporary tents for shelter. They have a standing order with the Beltsville farm for eggs and their stock is renewed yearly.

The birds are good year-around layers. Eggs are gathered four times a day. Because of their value, they are collected regularly and carefully. Once a week George takes the crates of eggs from his special cellar to the hatchery. Next year he hopes to have incubator batteries of his own.

During the winter months the flock stays inside on elevated pens and screened-in sun porches which aid the birds in living a clean and healthy life. A slat flooring on the porches simplifies cleaning operations. A wheelbarrow can



There are two birds in that hand. "Handle with care" is the slogan when Kratzberg collects turkey eggs four times daily. Value? $1.00 each.

"You don't have to use colored marbles" to get these birds to eat. This easy method eliminates footwork ordinarily required to get turkeys in and out of coop.

be run under the porches where the droppings collect. This valuable fertilizer is utilized on the farm, as all good farmers do.

George says that he does the work while Mrs. Kratzberg keeps the books and answers the correspondence, but he always has a big smile for the Mrs. when he says it. Their daily mail is an amazing assortment of orders and inquiries. Often Mrs. Kratzberg has 30 or more cards to write to answer the overwhelming assortment of orders, which amount to many times the number of eggs or poults for sale. Requests for 500 to 1,500 poults are common and, regretfully, they must be rejected, for the turkey farm is but a young 2-year-old enterprise and with the thoroughness required in raising turkeys successfully, large-scale production cannot be achieved overnight.

The Kratzbergs have two silent partners working full time on the farm, Bonnie and Laddie, two pure-bred Scottish border working collies. The dogs are natural herders. When the turkeys run loose on the alfalfa range and through the 5 acres of sunflowers planted for them the two dogs keep the birds in check. No fence is required to keep strays from running wild. The dogs work in a deliberate, slow, creeping manner, nosing the birds along in a flock. They never bark, bite or run when working turkeys. The dogs seem resentful that the Kratzbergs' chickens are fenced for they indicate that they would like to assume the additional responsibility. However, this spring Bonnie had a family of her own and she was more than busy trying to keep an eye on the turkeys in the pens and yet give her family the necessary attention.

The success that a person achieves is often measured by the enthusiasm he displays for his work, and this is no exception on the Kratzberg farm. Mr. and Mrs. Kratzberg have built their business on their own initiative. Long hours, patience and experience have taught them the right way to do things. All of their energy is directed towards bettering the production of turkeys. No detail is too small to be overlooked. If you visit the farm and express a desire to look at the birds, Mrs. Kratzberg will probably ask you, "Are your shoes clean?" or "Have you been in any other poultry house today?"

Early this spring they had already sold 5,000 poults for the coming season, and shipped 400 eggs to Iowa and 800 to Canada. In addition they filled a multitude of local orders for turkeys. Every day looks like a visitor's day at the Kratzbergs. There is a good demand the year around for the table birds. Next year, if all works out well, the Kratzbergs will have their own dressing plant, where the turkeys will be dressed and quick frozen for sale on the farm.

Even though the turkey business is a full-time job, the Kratzbergs have other duties to perform. They have 20 sheep, 12 Jersey cows, 20 Spotted Poland China hogs, 250 to 300 chickens and a few horses.

But the way the business is growing, some day the other animals will have to give way to the white-feathered bird which is the "King of the Kratzberg Farm" and the "Pride of The Boise Valley." THE END.

New Electrical Power Developments in Europe

by WENDAL A. MORGAN, Head, Power System Technical Group, Branch of Design and Construction, Denver Colorado

Early last summer Harvey F. McPhail, Director of the Branch of Power Utilization, and I attended the International Conference on Large Electric High-Tension Systems held in Paris. The organization, known familiarly as C. I. G. R. E. (Conférence, Internationale des Grands Réseaux Électriques á Haute Tension), was established in 1921, as a permanent international organization to promote the exchange of engineering information on technical matters related to the design, construction, and operation of large high-voltage electric power systems.

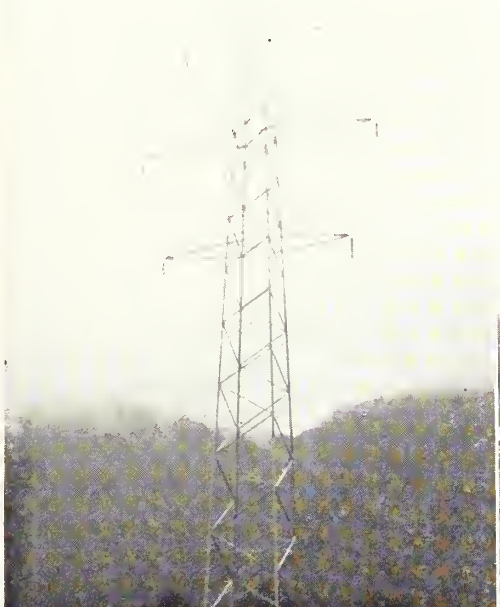
In attendance at the conference were 1,140 engineers from 40 countries including 15 engineers from the United States. Mr. McPhail acted as Chairman of the United States delegation of State Department representatives, and I presented two papers, served on an international study committee on power-system stability, and presided before one of the general meetings in the absence of Mr. L. N. McClellan, Chief Engineer of the Bureau, who was unable to attend the conference.

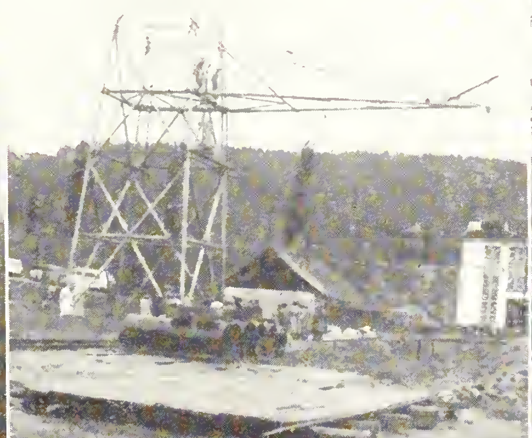
Over 100 technical papers, including 13 by United States authors, were presented at the conference, most of which were discussed at considerable length at conference meetings. The official languages were English and French, and the discussions were translated by an interpreter.

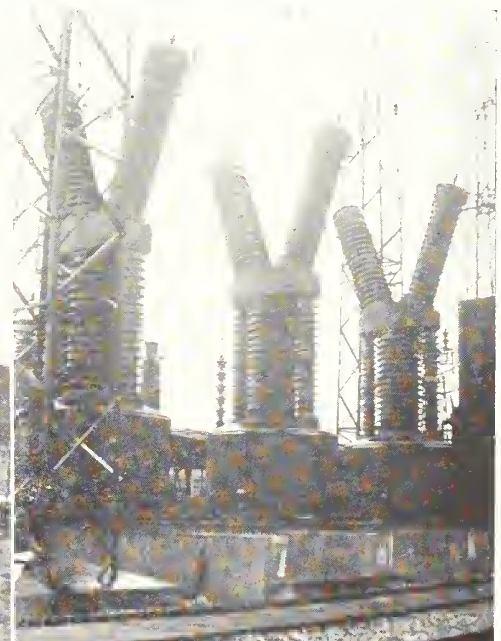
Foreign engineers at the conference exhibited great interest in technical advancements made in the United States and were most generous in supplying information on new developments in the countries which they represented. It is my conclusion from the conference that the United States is advanced technically in many fields of electrical engineering as compared to other countries, but in the field of high-voltage transmission, European engineering is ahead of that of the United States. This is probably due to the recognition in Europe of the necessity for concentrating on hydroelectric power development as a means of conserving coal and other fuel resources. Since hydroelectric power installations are usually widely separated from load centers, considerable pioneering and research in the development of long, high-voltage transmission lines have been required in European countries.

Inspection trips and discussions with European engineers after the meetings were as important as the conference itself in acquiring knowledge of hydroelectric power development practices. At part of the C. I. G. R. E. Conference, inspection trips were made to major power stations in Paris and to the new Genissiat Power Plant on the Rhone River in the French Alps. It was interesting to note that the French have had 230-kilovolt underground cable in use for 15 years and are using it quite freely, whereas 132-kilovolt is the highest voltage cable installed in United States. A visit was also made to the large hydraulic laboratory and equipment manufacturing plant of Negret Beglier and Piccard Pictet at Grenoble, France. The hydraulic laboratory is claimed to be one of the largest of its kind in the world and has models of ocean harbors, rivers, dams, and irrigation structures for Africa, Australia, Spain, and other countries. It was of particular interest because of the similarity to the Bureau of Reclamation laboratories in Denver.

At left: 380-kv double circuit transmission line under construction in Switzerlond. Towers of thin steel tubing members filled with concrete ore 173 feet high. Conductor spocing is about 29 feet. Below center: full scale model tower for unbolonced force tests of new type concrete-filled, steel-tube construction in Switzerland. The tower withstood about 17 tons, equivolent to 2½ times the unbolonced pull of two unbroken conductors. Below right: low oil content circuit-breakers for 230-kv, 2.5 million-kvo interrupting capacity services in France. The contocts ore in the upper bronches of the "Y."







Through contacts made at the conference, I arranged a trip to Switzerland to witness tests of a concrete filled, steel tube constructed transmission line tower and to inspect some unusual hydroelectric power plants. Swiss engineers of the Motor-Columbus Co. developed this new type of tower which uses considerably less steel than the conventional steel angle tower. The concrete increases the buckling strength of the thin tubes by taking the compression stresses. In Switzerland, where labor costs are low and steel tubing costs approximately twice as much as steel angles per pound, the towers cost about 35 percent less than the steel angle towers, an over-all savings of about 17 percent in transmission line costs. This new type tower is used on the double-circuit, 380-kilovolt line now under construction and also on 50- and 150-kilovolt lines, which I observed in operation.

The Chandoline Power Plant in the Rhone Valley in Switzerland, with a static hydraulic head of 5,740 feet is the highest head plant in the world. A hollow gravity-type dam creates a forebay reservoir at the base of three large glaciers, and a tail-race canal feeds directly into the Rhone River. Each of the five 37,500-kilovolt ampere generators has two 21,250-horsepower Pelton wheel turbines supplied from the two penstocks, so that the plant may be operated at half capacity when one of the penstocks is removed from service for maintenance. This plant has many features not found in American plants because of our practice of stressing economy of design.

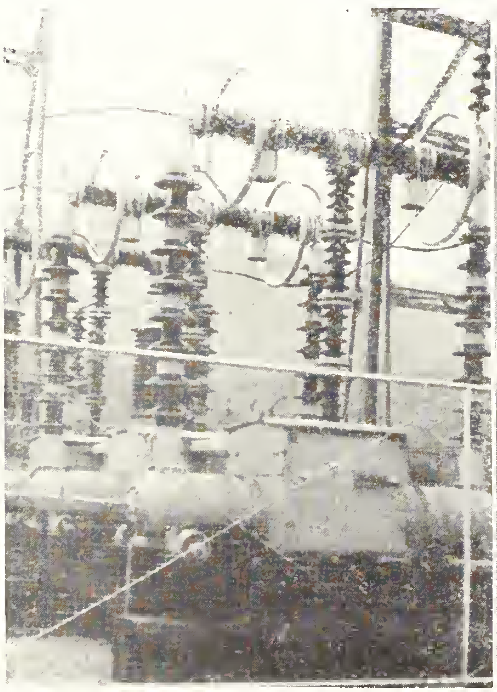
While in Switzerland, I inspected an underground power plant of 250,000-kilowatt capacity and observed two others under construction. Many such underground power plants are being built in Europe. Swedish engineers claim it is less expensive to excavate rock for a power plant than it is to construct an outdoor building. This is particularly true of a plant where a penstock can be brought down through a tunnel and where the surrounding canyon walls are steep. This plan of construction is considered good engineering practice as well as providing better protection from bombing.

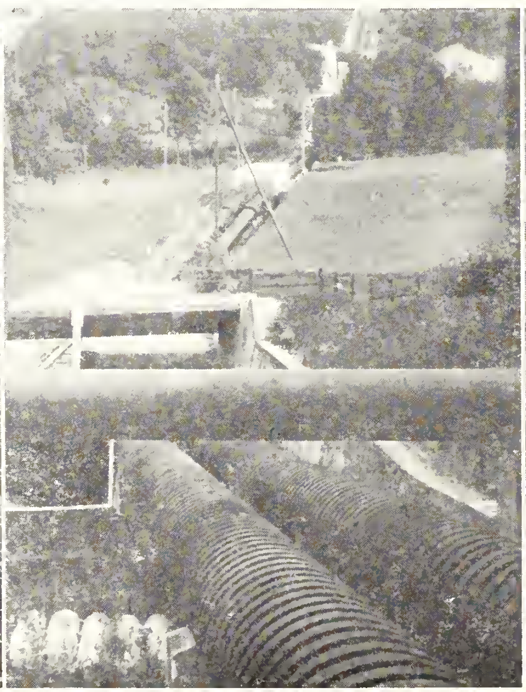
Considerable interest at the conference was manifested in extra-high voltage, alternating-current, power transmission over long distances. Sweden is building hydroelectric power plants which are about 600 miles from the load centers and which will be connected to the present 230-kilovolt transmission system by a 380-kilovolt transmission line. The 380-kilovolt system will go into operation in 1951. France has already constructed a 250-mile, 400-kilovolt line, although it is now in operation as a double-circuit 230-kilovolt line. French engineers anticipate the six conductors in this initial double-circuit 230-kilovolt line will later be rearranged to operate as a duplex conductor, single-circuit 400-kilovolt transmission line. Switzerland is constructing a double-circuit 380-kilovolt line, but it, too, will be initially operated at a lower voltage. Eventually continental European systems will be interconnected at 380 or 400 kilovolts. England is constructing lines for future operation at 275 kilovolts which is about twice the voltage of their present 132-kilovolt grid. The highest voltage transmission lines in the United States are the 287-kilovolt Hoover Power Plant to Los Angeles lines, and, although experiments are being conducted on voltages up to 500 kilovolts, no higher voltage lines than those now in operation are known to be in immediate prospect.

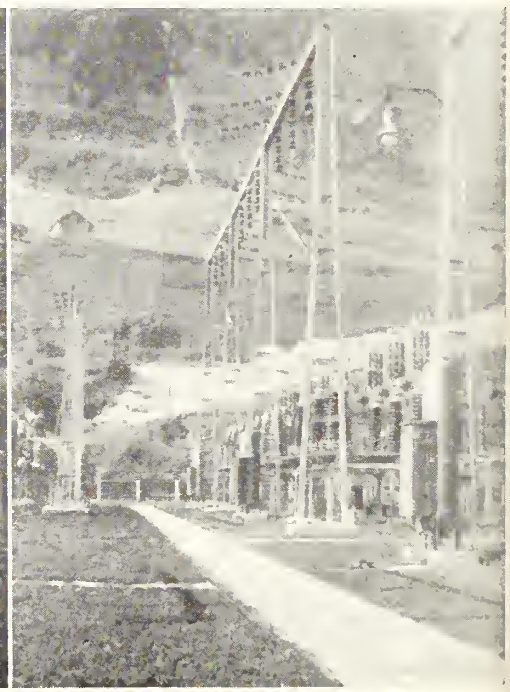
Extra-high voltage transmission introduces a problem of corona and radio interference. Experiments show this can be overcome by a single large diameter conductor or by two smaller conductors spaced about 18 inches apart. Indications are that the duplex conductor scheme is favored by most engineers because it has only 80 percent of the reactance of a single conductor and, therefore, will increase the

(Continued on page 218)

At left: European air circuit-breaker of new design for 150-kv service with interrupting time of 0.04 to 0.05 second and reclosing time of 0.20 second. Contacts are in horizontal part of "T" and air under high pressure comes up through center column and blows out the arc. Center: two penstocks of Chandoline Power Plant in Switzerland are reinforced with steel hoops over 1½ inches thick to take care of high pressures resulting from hydraulic head of over one mile. Penstocks decrease in size as pressure increases, from 4.65 feet diameter, 0.40-inch thick smooth pipe, to the 3.23 diameter, 3.11-inch thick, hoop reinforced pipe shown in the picture. At right: switchyard at Lucendro Power Plant in Switzerland, with penstock in background.







Visit the W. C. Austin Project

by MATTYE WILSON WILLIAMS, Manager, Altus, Oklahoma, Chamber of Commerce

All the folks on the W. C. Austin project, near Altus, Okla.—the first and only project constructed to date by the Bureau of Reclamation in the State—surely do like to have company.

These folks in southwestern Oklahoma are a friendly lot; and they're powerfully proud of their project, now nearing completion.

What's more, this project is smack on the road home for a great many delegates who will attend the National Reclamation Association Convention in Oklahoma City, November 17–19.

Convention delegates who accept an invitation to visit the project on Saturday, November 20, will have a mighty good time and a view of one of the prettiest reclamation projects in all the West.

The highways from Oklahoma City to the project area beyond to Amarillo, Fort Worth or El Paso, Tex., Denver, Albuquerque, Phoenix and everywhere west are excellent. (See map on next page.)

Convention delegates are invited first to the city of Altus. There, at the Chamber of Commerce, they will be provided with literature about the project, maps of the district and a personal guide to conduct them through the project and thence to Quartz Mountain State Park, close by the project area, where they will be guests of the project folks for a spell of refreshments by rock fireplaces in the park's picturesque Community Building.

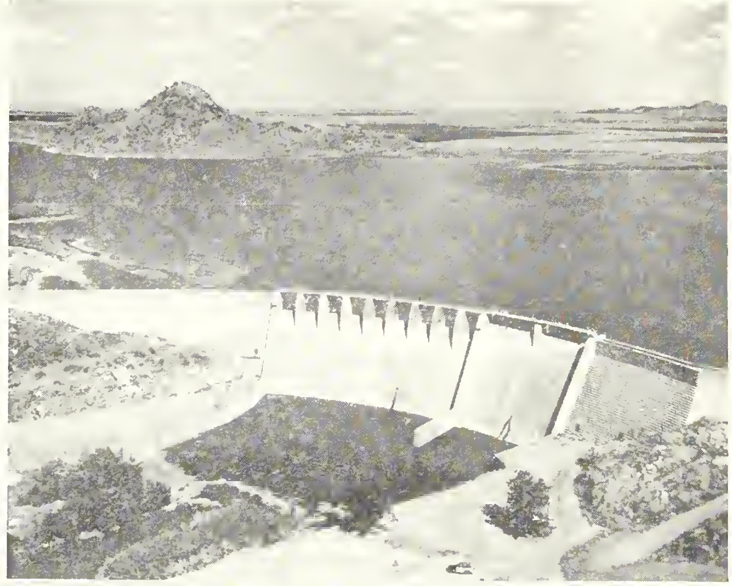
There is no set hour for arriving in Altus or touring the project. Visitors may arrive at any hour during the day. Then, when they decide they must light out for home, they'll be free to take to the open road.

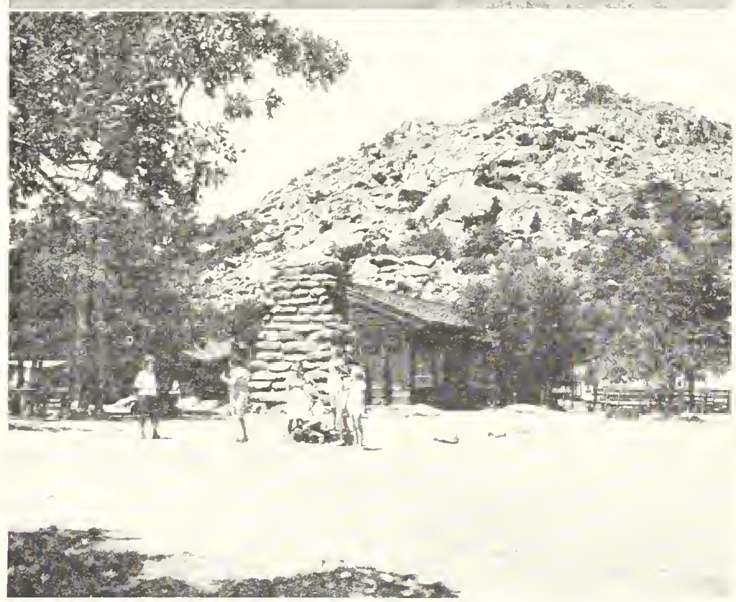
The project tour will include a view of late fall crops under irrigation, the structure of canals and laterals, the modern system of engineering that made possible this ultramodern reclamation project, including siphoning of water under the North Fork of Red River and over a mountain to the fertile soils over which it supplements the 26-inch natural rainfall of the area.

Altus Dam stores 152,000 acre-feet of water at Lake Altus needed for the semiarid lands of the tri-county irrigation district.

Waters, which otherwise would be wasted down the North Fork of the Red River and which on many previous occasions have resulted in flood damage, have become a constant supply to correct the uneven balance of natural rainfall.

The W. C. Austin project lies farther east in the subhumid zone than any other ever undertaken by the Bureau of Reclamation.





Top photo: Altus Dam and Reservoir, located 18 miles north of Altus, Okla., on the north fork of the Red River are the principal features of the W. C. Austin project. Center photo: Cotton will be white and ready for picking on the W C. Austin project when you receive this copy of the *Era.* Bottom photo: Quartz Mountain State Park nearby the project provides a retreat for visitors. *Top photo by Dale A. Hovey, formerly of Region V. Center photo by P. W. George, Region V. Bottom photo by R. N. Reynolds.*

Benefits are not confined to irrigation, however important it is in an area that sometimes experiences blasted hopes for a good crop year. The project also provides an unlimited municipal water supply for the city of Altus, flood control, and recreational facilities at Quartz Mountain State Park near Lake Altus.

The irrigation project is the realization of a dream of the past half century by men of vision. In 1935 a group of men gathered in Altus and enlisted the legal knowledge and support of the late W. C. Austin, who in the next 11 years, as a civic contribution, spent many hours and made many trips to get the project through. So great were his efforts that soon after his death President Truman signed legislation changing the name to W. C. Austin irrigation project.

A memorial has been erected at the dam by southwestern Oklahoma friends of the project's benefactor.

Preliminary survey for the project was initiated in 1936. Two years later the report was released and in 1939 first funds were allocated. Next the district was formally authorized by a vote of 338 to 42, giving Joe B. Zinn, first and only president, and other officials of the Lugert-Altus Irrigation District, the legal power to make contracts with the Bureau of Reclamation. Other board members are Carthal Mock and Bob Minor.

Construction began in 1941. Present plans call for completion of all details and water available to the entire acreage in the summer of 1949.

The project provides one acre foot of water per year for irrigable land in the district. The reimbursable cost of approximately $3,080,000 for Federal irrigation construction is being repaid to the United States Treasury over a period of 40 years, without interest, by the landowners benefitting from the project.

The city of Altus, in return for a stable water supply, underwrote payment of $1,080,000 of the reimbursable portion of the cost. Balance of the project cost was borne by the Department of the Army funds for flood control, by labor and materials contributed by the Work Projects Administration, plus cost of relocation of utilities and transportation arteries.

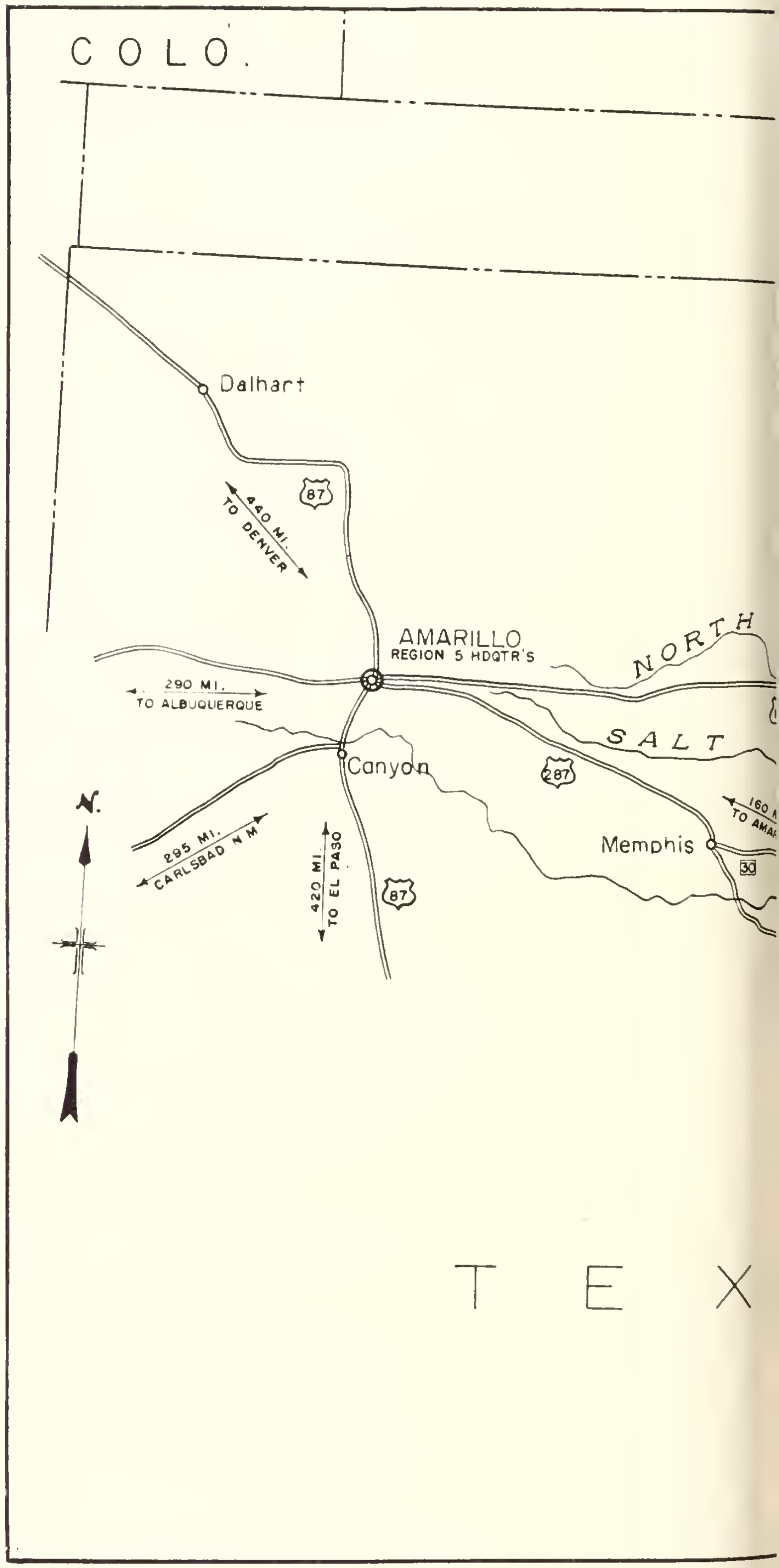
The dam is of concrete gravity type, a partially curved structure with granite masonry on the upstream face and the downstream faces of nonoverflow sections. It rises about 100 feet above the stream bed and has a crest of 1,160 feet. Four dikes hold back water in low points of the reservoir rim. Largest is Lugert dike, 6,000 feet long and 45 feet above the natural ground surface.

The project water supply is obtained by run-off water from 2,560 square miles of watershed, varying from a few thousand acre feet in dryer seasons to over 300,000 acre feet in abnormally wet years.

About 340 miles of canals and laterals are required to serve the district, centered around the cities of Altus and Blair. These canals vary in capacity from 790 cubic feet per second at the head end of the main Altus canal to a few second feet in the smaller laterals.

Demonstrating how irrigation pays are fields of various crops of alfalfa hay, grain sorghum, Irish potatoes, watermelons grown for certified seed; spinach, cotton, sweet corn, wheat, and oats.

Yields in irrigated areas in the 2 years that water has been available in some sections of the project have been from two to three times those obtained on dryland farms in the same areas. Various processing plants are being attracted to the area and the ultimate success of the W. C. Austin



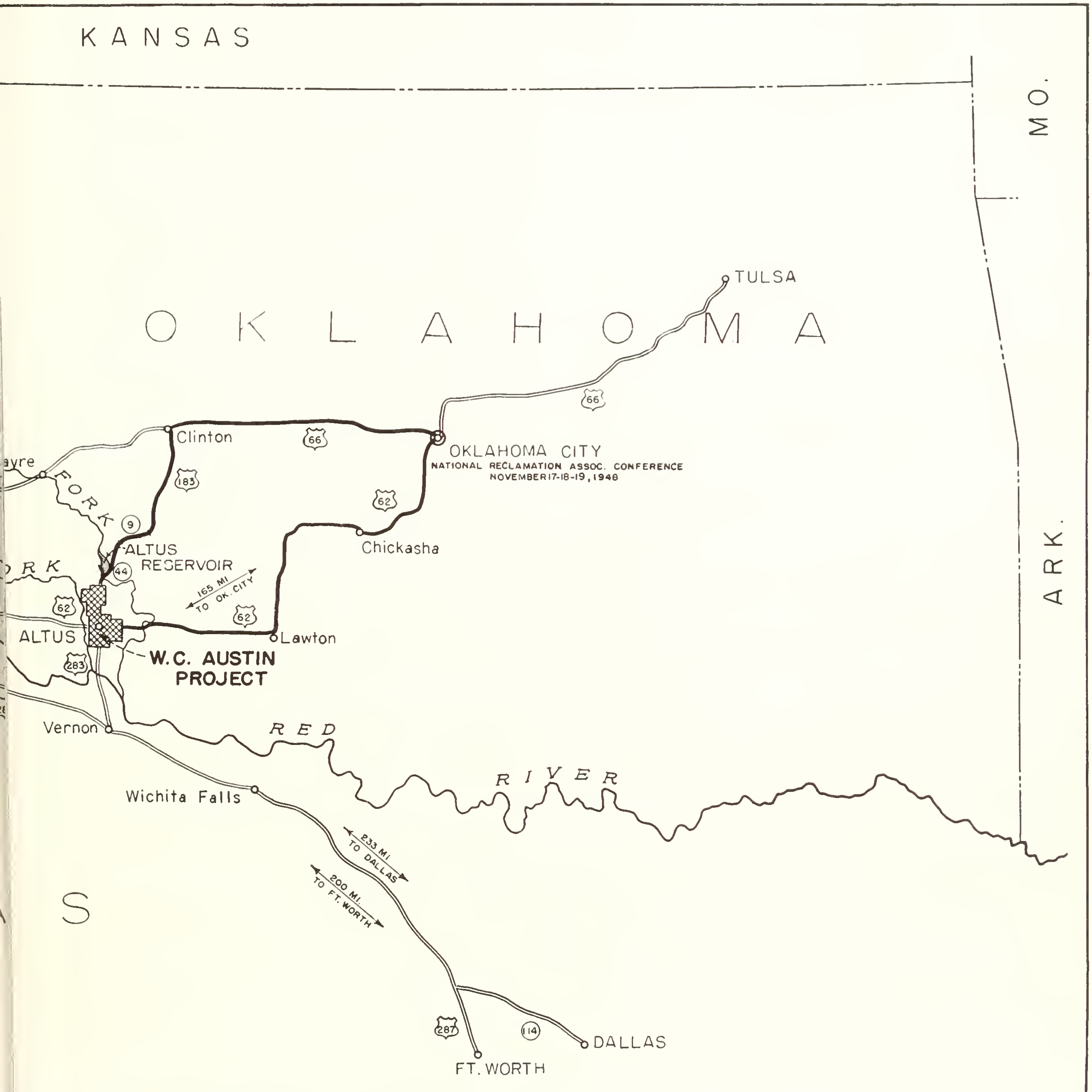
project will be an important factor in spreading the extensive benefits of reclamation eastward in the more favorable rainfall regions of the Nation.

Convention time for the National Reclamation Association will be cotton picking and row crop harvest time for folks on the W. C. Austin project. But they're planning to knock off work on Saturday, November 20, and show everybody who comes to see them what reclamation is doing for Oklahoma.

THE END

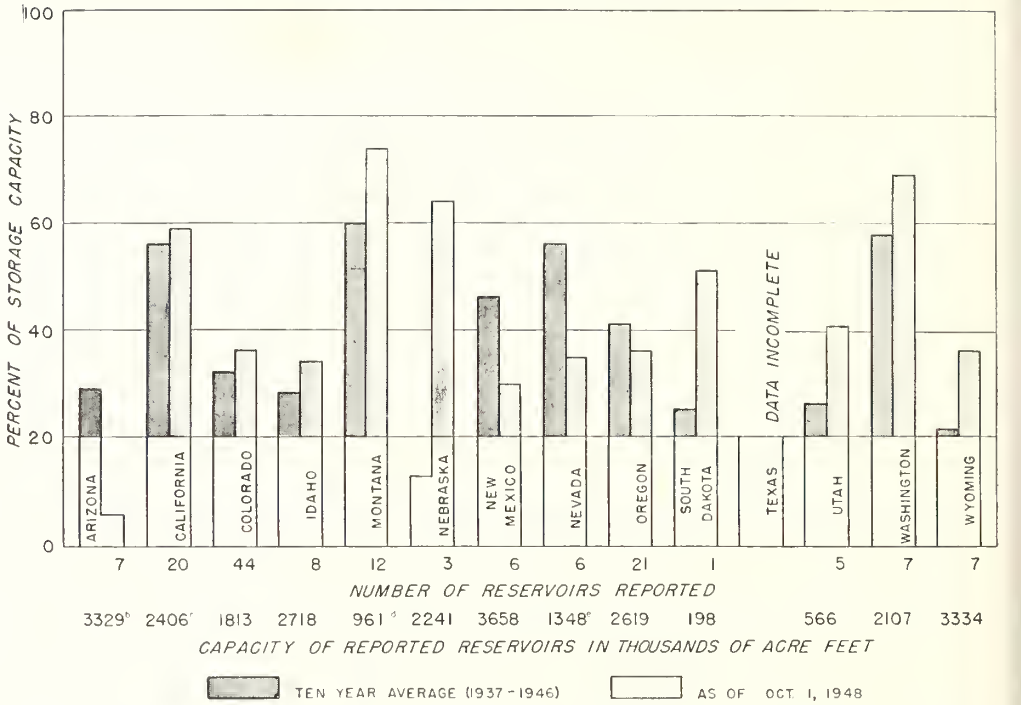
Index and Bound Volumes

As an economy measure, volumes 33 and 34 (1947 and 1948) of the RECLAMATION ERA will not be bound, as has been the custom in the past. Separate copies of the index will be printed as soon as possible, and will be available free upon request.



WATER REPORT

PERCENT OF RESERVOIR STORAGE CAPACITY
TEN YEAR AVERAGE (1937-1946) COMPARED WITH
STORAGE CAPACITY AS OF OCTOBER 1, 1948



Not all reservoirs in all States are reported, but enough are reported to give a reliable index of each State's storage supply.

(b) Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included.

(c) Does not include Narrows (Yuba River), Friant or Shasta Reservoirs. September 30 storage in these three reservoirs combined is 2,856,500 acre-feet, which is 66 percent of their capacity.

(d) Does not include Fort Peck Reservoir (capacity 19,000,000 acce-feet). September 30 storage is 14,820,000 acre-feet.

(e) Does not include Lake Mead Reservoir (capacity 31,140,000 acre-feet). September 30 storage is 22,200,000 acre-feet.

West-Wide Forecasts of 1948–49 Water Supplies Based on Work of the Western Snow Surveys

By Paul A. Ewing, Senior Irrigation Economist, and R. A. Work, Senior Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture.

Next Year's Water

Your weather may have been "unusual," your crops may have been hard-pushed for moisture (though they came through all right), and you probably wonder how irrigation supplies will be next year.

Well, so far as carry-over storage may promise, Western water supplies in 1949 will be normal—may be a little better than that. There are some bad spots, but a survey of 147 reservoirs, widely scattered throughout the Western States, shows that total October storage is about 106 percent of the corresponding 10-year average. Specifically, as reported by the Division of Irrigation and Water Conservation, Soil Conservation Service, the 147 reservoirs (not including Lake Mead, Fort Peck, and three large California lakes) hold 10,809,000 acre-feet; the 10-year average was 10,150,000 acre-feet. But total capacity of the 147 reservoirs is 27,298,000 acre-feet, so that winter and spring precipitation may double present carry-over and still leave room for more. Later paragraphs and the chart show the present condition of storage, State by State.

The Soil Conservation Service is the agency with which the Bureau of Reclamation has cooperated during recent years in water-supply forecasts based on snow surveys. An interesting feature of this cooperation has been the recent close integration of effort between these two agencies and the United States Forest Service in extending and mechanizing broad snow-survey networks in Montana and Wyoming.

Other agencies are involved in snow surveys. They include the Geological Survey and National Park Service, many irrigation districts, power companies, and the States themselves. Soil Conservation Service coordinates its own surveys with those of the other agencies in an effort to produce forecasts of West-wide significance. Some of the States do a similar job for their own interests. California, for instance, through its Division of Water Resources, makes its own forecasts, which are widely accepted by irrigation, power, and municipal interests.

Reclamation Era published the 1948 forecasts in its May issue. The following paragraphs tell how they turned out.

Accuracy of 1948 Run-Off Forecasts

Minor to noticeable departures of stream flow from amounts forecasted by April 1 snow surveys, occurred in various part of the West during the irrigation season of 1948.

The stream-flow year ends September 30. Consequently only a few flow records at the gaging stations are as yet computed. Enough are at hand, however, to provide an index of accuacy of 1948 run-off forecasts from snow surveys.

Wyoming, Colorado, New Mexico and Montana east of the Rockies.—Forecasts in this area were quite closely borne out by resultant stream flow. Average error of 9 forecasts in the area was 9 percent. In four of 9 cases the error was less than 5 percent, which is probably about as close as the stream flow of some stations can be gaged with precision. In most of these cases, measured flow was less than the forecasted flow, thus reflecting below-normal precipitation which characterized this general area during spring and early summer months of 1948.

Nevada and southwestern Utah.—Stream flows in this area were reduced by as much as 40 percent from the flows forecasted on April 1. It appears that watershed evaporation losses in this area were much greater than normal in the early run-off season of 1948. Chief reason for such accelerated evaporation losses was greater than normal movement of drying winds over the snow fields.

In western Nevada the April 1 forecasts were modified on May 1 to account for unusually heavy April snowfall, which was approximately 300 percent of normal. The May 1 forecasts of run-off were quite accurate, the difference between forecasted and obtained flow as a percentage for various streams, ranging as follows:

	Percent
West Carson at Woodfords	0
East Carson near Gardnerville	6
Carson River at Fort Churchill	4
Carson River near Carson City	14
West Walker near Coleville	1
East Walker near Bridgeport	2
Lake Tahoe (maximum storage)	8

California.—The California water-supply outlook was dismal on April 1, but heavy precipitation and resultant heavy mountain snowfall during April, subsequent to release of the April 1 water forecasts, did much to improve the water supply. In places, April snowfall ranged up to 400 percent of normal. This had the effect of greatly increasing run-off from the amounts forecasted on April 1. On a few streams the run-off did not differ materially from the April 1 forecast. These include: Feather River, error of forecast 2 percent; Yuba River, error of forecast 5 percent; Kings River, error of forecast 8 percent; Kaweah River, error of forecast 8 percent. In all cases except Kern and Kings Rivers, the actual run-off exceeded the forecasted run-off, owing to precipitation greatly above normal during April

Oregon.—As in California and the Pacific Northwest in general, spring precipitation in Oregon was very much above normal. Snow continued to pile up at higher altitudes through the month of April. This produced stream flow greater than that forecasted from snow surveys on April 1. April to June precipitation ranged from slightly above normal in the Owyhee Basin to 262 percent normal in the John Day Basin. For Oregon as a whole, April to June precipitation was about 160 percent of normal.

Very few flow records of forecasted streams are as yet available but all of those at hand show that the forecasts generally will be exceeded by measured April–September flow. This is illustrated as follows:

	Forecasted		Obtained
	April 1	May 1	
	Acre-ft.	*Acre-ft.*	*Acre-ft.*
Owyhee River above Owyhee Reservoir	150,000	225,000	234,620
North Fork, Rogue River	315,000	325,000	330,000
Upper Klamath Lake inflow	421,000	435,000	475,000
Gerber Reservoir inflow	6,000	14,500	21,940
Clear Lake Reservoir inflow	14,000	41,000	66,850

Columbia Basin (Washington, Idaho, parts of Montana and Oregon).—Stream flow, without exception in the data at hand, exceeded the amount forecasted on April 1. There appear to be two chief reasons for the difference:

1. *Precipitation over the northern and western part of Columbia Basin was markedly above normal in both April and May. In May it ranged up to as much as 400 percent of normal. For Oregon as a whole, precipitation for April to June, inclusive, was about 160 percent of normal.*

2. *Above-normal temperatures both day and night through the latter part of May and toward mid-June resulted in greater than usual water yield from the snow pack. This was due to accelerated snow melt and rapid run-off. Relatively less water infiltrated into watershed soils. This resulted in decreased opportunity for evapo-transpiration by watershed cover.*

The Status of Storage

The October 1 status of the carry-over, summarized State by State, is as follows:

Arizona.—The water shortage for Arizona was not relieved during the summer of 1948. To date, the extended drought continued and if greater than normal winter storms are not forthcoming during the coming season, the outlook for next summer will be for an extremely short water supply. Reports on seven Arizona reservoirs as of October 1, 1948, show that total storage on that date is only 6 percent of capacity and 21 percent of the 1937–46 average for October 1. Lake Mead, as of October 1, 1948, contained 79 percent of usable capacity and 96 percent of the 1938–46 average.

California.—As the opening of the rainy season is approached, California is better protected by stored water than was the case last year, only a few reservoirs holding less water than the amounts reported at the corresponding 1947 date. Thus 30 reservoirs above Sacramento and San Joaquin valleys held 4,663,195 acre-feet on September 30, 1948, or 64 percent of capacity, as compared with 3,656,631 acre-feet, or 50 percent of capacity on September 30, 1947. The 1948 storage was 127 percent of the 1947 total. By watersheds, the comparisons are as follows:

Watershed	Number of reservoirs	Capacity	Water stored	
			Oct. 30, 1947	Oct. 301 1948
		Acre-ft.	*Acre-ft.*	*Acre-ft.*
Sacremento	1	3,806,000	2,292,000	2,665,600
Feather	4	826,800	499,627	697,237
Yuba	6	312,600	121,154	202,591
Bear	1	7,180	1,110	300
American	2	30,200	13,248	19,618
Mokelumne	2	349,500	225,892	277,609
Stanislaus	3	145,500	20,133	33,103
Tuolumne	5	702,000	210,888	356,428
Merced	1	281,000	4,400	28,600
San Joaquin	5	854,400	268,179	382,109

Colorado.—Forty-four reservoirs with total capacity of 1,812,700 acre-feet, show October storage totaling 36 percent of that amount, as compared with a 10-year average of 32 percent. On the South Platte, storage is above average; on the Arkansas an unusually high carry-over of 147,000 acre-feet in John Martin Reservoir (not included above) will be available for withdrawals in 1949; the flow of Colorado River into Lake Mead was about 10,300,000 acre-feet between April and September.

Idaho.—Eleven reservoirs have 1,252,607 acre-feet in storage, as compared with 1,426,415 acre-feet at this time last year and a 10-year average of 1,118,297 acre-feet. While the storage is therefore below the total of 1947 at this time, it is better than average.

Montana.—Twelve reservoirs, with total capacity of 960,800 acre-feet, show October 1 storage at 74 percent capacity, as compared with 60 percent as a 10-year average. This comparison does not include Fort Peck Reservoir, which on October 1 held 14,820,000 acre-feet. Capacity of this reservoir is 19,000,000 acre-feet. The 10-year October average is 9,243,000 acre-feet.

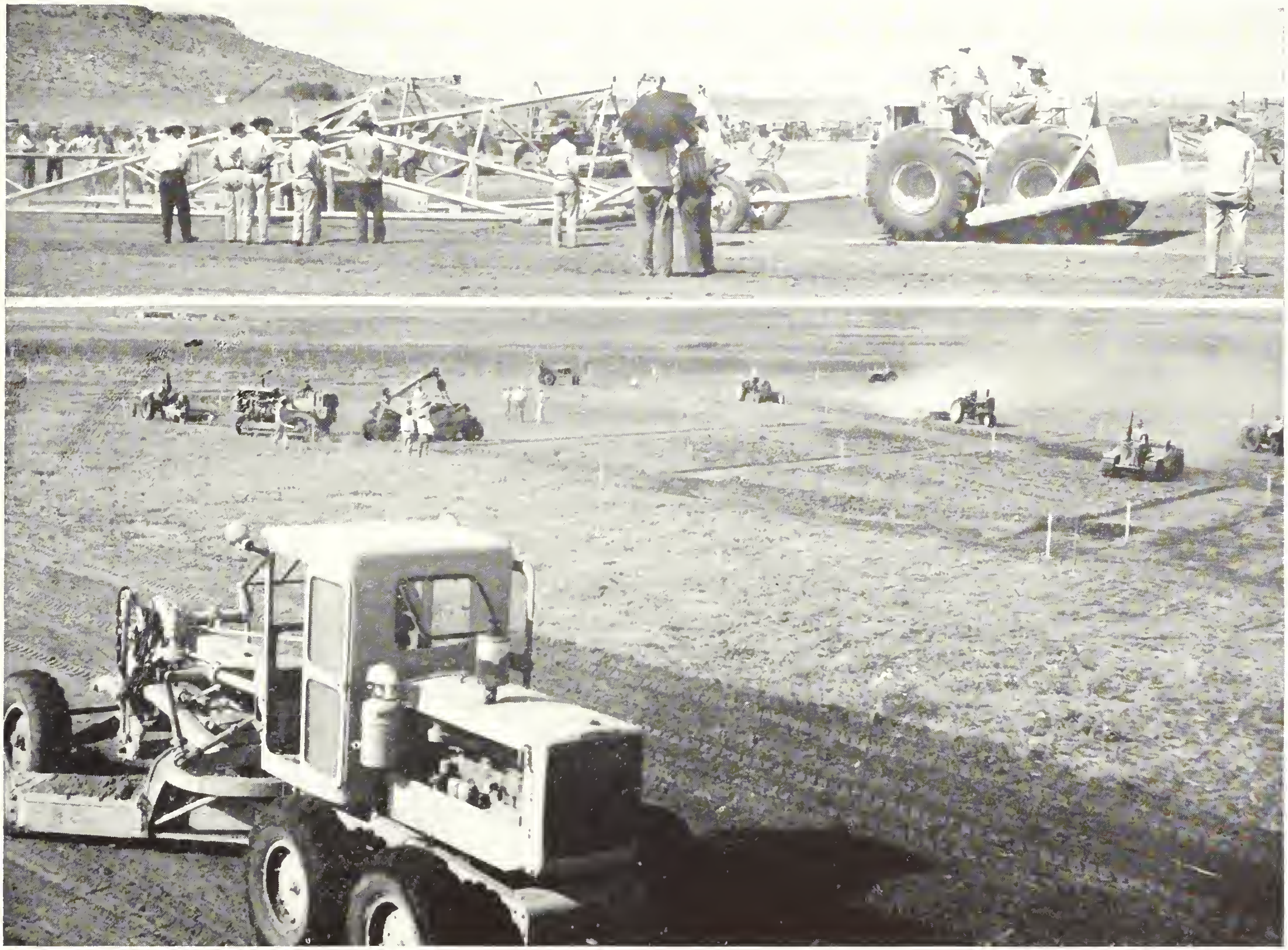
(*Continued on page 226*)

Modern vehicles like this make possible more extensive snow surveys in isolated mountain regions. ***U. S. Soil Conservation Service photo.***

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet)		
			Active capacity [1]	Sept. 30, 1947	Sept. 30, 1948
Region 1	Baker	Thief Valley	17, 400	700	2, 6
	Bitterroot	Lake Como	34, 700	10, 200	5, 0
	Boise	Anderson Ranch	464, 200	1, 800	12, 1
		Arrowrock	286, 600	84, 100	65, 4
		Deadwood	161, 900	53, 300	69, 7
		Lake Lowell	169, 000	40, 400	41, 0
	Burnt River	Unity	24, 600	600	7, 5
	Columbia Basin	F. D. Roosevelt	5, 220, 000	5, 190, 000	5, 200, 0
	Deschutes	Crane Prairie	50, 000	18, 100	48, 5
		Wickiup	187, 000	53, 200	24, 2
	Minidoka	American Falls	1, 700, 000	686, 800	664, 1
		Jackson Lake	847, 000	464, 000	234, 3
		Lake Walcott	95, 200	95, 200	87, 7
		Grassy Lake	15, 200	13, 200	12, 1
		Island Park	127, 300	75, 500	33, 2
	Okanogan	Conconully	13, 000	3, 300	9, 7
		Salmon Lake	10, 500	4, 200	8, 2
	Owyhee	Owyhee	715, 000	252, 200	223, 7
	Umatilla	Cold Springs	50, 000	1, 600	9, 9
		McKay	73, 800	10, 600	18, 4
	Vale	Agency Valley	60, 000	23, 600	27, 4
		Warm Springs	170, 000	11, 400	1, 2
	Yakima	Bumping Lake	33, 800	6, 600	7, 7
		Clear Creek	5, 300	5, 300	5, 3
		Cle Elum	435, 700	146, 100	197, 9
		Kachess	239, 000	141, 600	163, 8
		Keechelus	153, 000	35, 800	64, 9
		Tieton	197, 000	108, 300	111, 5
Region 2	Central Valley	Millerton Lake	503, 100	80, 500	132, 8
		Shasta	4, 389, 100	2, 166, 100	2, 539, 7
	Klamath	Clear Lake	437, 500	142, 000	135, 6
		Gerber	94, 300	14, 100	17, 9
		Upper Klamath Lake	524, 800	142, 700	235, 0
	Orland	East Park	47, 900	4, 200	26, 4
		Stony Gorge	50, 000	1, 400	4, 7
Region 3	Boulder Canyon	Lake Mead	27, 935, 000	21, 625, 000	22, 002, 0
	Parker	Havasu	688, 000	641, 500	631, 4
	Salt River	Bartlett	179, 500	10, 500	7, 2
		Horse Mesa	245, 100	164, 300	137, 7
		Horseshoe	67, 000	8, 400	1
		Mormon Flat	57, 850	25, 600	25, 8
		Roosevelt	1, 398, 400	12, 700	5, 1
		Stewart Mountain	69, 800	19, 300	24, 3
Region 4	Fruit Growers	Fruit Growers	4, 500	900	6
	Humbolt	Rye Patch	179, 000	107, 300	52, 0
	Hyrum	Hyrum	15, 300	7, 100	5, 2
	Moon Lake	Moon Lake	35, 800	6, 400	1, 2
	Newlands	Lahontan	273, 600	67, 400	108, 7
		Lake Tahoe	732, 000	387, 600	277, 2
	Newton	Newton	5, 300	2, 300	1, 3
	Ogden River	Pine View	44, 200	12, 800	9, 6
	Pine River	Vallecito	126, 300	95, 100	59, 9
	Provo River	Deer Creek	146, 800	122, 000	104, 6
	Scofield	Scofield	65, 800	13, 700	1, 3
	Strawberry Valley	Strawberry	270, 000	105, 500	87, 0
	Truckee River Storage	Boca	40, 900	10, 300	24, 4
	Uncompahgre	Taylor Park	106, 200	102, 100	53, 5
	Weber River	Echo	73, 900	22, 100	7, 7
Region 5	W. C. Austin	Altus	140, 000	60, 500	49, 9
	Carlsbad	Alamogordo	128, 300	8, 600	6, 6
		Avalon	6, 000	400	3, 0
	Colorado River	Marshall Ford	810, 500	203, 600	242, 8
	Rio Grande	Caballo	345, 900	12, 900	23, 7
		Elephant Butte	1, 817, 000	316, 900	543, 3
	Tucumcari	Conchas	300, 000	259, 500	225, 6
Region 6	Belle Fourche	Belle Fourche	177, 500	104, 300	100, 3
	Milk River	Fresno	127, 200	82, 700	94, 4
		Nelson	66, 800	41, 400	40, 3
		Sherburne Lakes	66, 100	4, 800	5, 4
	Riverton	Bull Lake	152, 000	121, 400	81, 3
		Pilot Butte	31, 500	3, 800	1, 5
	Shoshone	Buffalo Bill	456, 600	395, 500	338, 3
	Sun River	Gibson	105, 000	39, 300	40, 3
		Pishkun	32, 050	21, 000	16, 6
		Willow Creek	32, 400	15, 000	16, 2
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	144, 600	128, 6
	Kendrick	Alcova	190, 500	108, 900	131, 2
		Seminoe	970, 000	816, 800	673, 2
	North Platte	Guernsey	41, 050	5, 100	19, 8
		Lake Alice	11, 000	1, 100	1, 0
		Lake Minatare	57, 000	14, 500	13, 7
		Pathfinder	1, 040, 500	197, 600	158, 4

[1] Available for irrigation.



Machines used in the demonstration ranged from a giant Higly Land Plane pulled by a Tournedozer (top), and grader to small farm tractors (bottom).

Remaking a Farm in a Day

by GARFORD WILKINSON, Amarillo, Texas, Region V

The dust clouds that swirled above a section of the Tucumcari, N. Mex., irrigation project on Labor Day were silver lined for J. C. White, a lanky, sun-tanned veteran of World War II.

It was milking time. The sun vanished in a brilliant color of evening drapery and the last particles of wind-blown sand settled earthward. Young White, a new settler on the reclamation project, stood with his family in the farmyard and gazed out across his completely constructed irrigation system. The White family had seen a miracle of farming that day.

Soon after White finished milking that morning, the sun was slanting long, slender rays from the east. The chrome and red rays reflected from farm-home windows and bounced across irrigated fields in a thousand glories.

It was slightly after 6 a. m. when the first of several hundred volunteer workers, using 80 pieces of equipment, began building White's entire farm in one day. Work performed in the following 12 hours was estimated to be worth a minimum of $2,500. And it was said that the value of the 40-acre farm had been increased by a minimum of $4,000.

The demonstration—publicized as "Remaking A Farm In A Day"—was sponsored on the reclamation project by the Canadian River Soil Conservation District, in cooperation with the Bureau of Reclamation, the Soil Conservation Service, and the New Mexico State Extension Service.

At noon, prior to the formal speech-making program on a knoll overlooking the White farmstead, the Tucumcari police department supplied a western-type barbecue with all the fixings.

J. C. Dykes, assistant chief of the Soil Conservation Service, Washington, D. C., outlined the purpose of the demonstration and cited the critical need for an increased national conservation program. G. L. Boykin, associate director of the New Mexico Extension Service, told of extension's interest in reclamation and conservation work in the State.

Thousands of visitors from 11 States witnessed the dawn-to-dusk phenomena of modern irrigation engineering, men and machinery. The register carried names of persons from California, Illinois, Missouri, Michigan, Kansas, Oklahoma, Colorado, Arizona, New Mexico, Texas, and Utah.

Surveys of the irrigation farm had been made prior to the day of demonstration by the Soil Conservation Service and the Bureau of Reclamation. Terrace lines had been run; calculations had been completed on ground levels; machinery assembled and fuel trucks stationed on the farm.

All day long the farm was the scene of grinding, roaring machines. It was a battlefield—a battlefield for conservation and utilization of man's most important resources. There were no weak links in the supply lines of men or materials. Operators changed shifts at noon and the work continued without interruption. Caterpillar tractors, Ferguson tractors, Farmalls, Allis-Chalmers, Olivers, Minneapolis-Molines, and others were supplied by dealers. Road graders, carry-alls, floats, land planes and huge Graham-Hoeme All-Purpose Plows sliced, graded, leveled and cultivated the fields.

Fields were bordered and floated; a new irrigation system with 35 structures was installed. Approximately 125 feet of ditch had been concrete lined; there was even a demonstration in sprinkler type irrigation. Some of the fields were fertilized with hundreds of tons of manure. Then the land was planted to wheat, alfalfa, and pasture, for White is a dairy farmer. Water began to flow from nearby irrigation channels constructed by the Bureau.

The 42,000-acre project, now nearing completion by the Bureau of Reclamation, had been the center of one of the most spectacular agricultural events in the history of the Southwest.

"This is a much more significant occasion than may be apparent to the most of us at first glance," said Bureau of Reclamation Regional Director H. E. Robbins, in an address before the thousands of spectators. "Today we are witnessing the task of remaking a farm in a day. We see modern machinery achieving goals of modern soil and water engineering. We are witnessing the coming together here of friends and acquaintances, some from great distances, to observe the application of a science developed by skillful men to protect and conserve the soil and utilize the irrigation water available on a farm in the Tucumcari project area.

"But to me," Director Robbins continued, "these are not the most significant features of this demonstration. The greatest significance, in my opinion, is the spirit of democracy in action, stimulated by the people and their public servants in a coordinated effort to keep democracy alive and functioning through all time.

"The remaking of this one farm here today is not greatly important in itself, for it is but an infinitesimal part of the national pattern that must be woven across our fields and forests if we are to prevent the destruction of our country and, of course, the subsequent destruction of democracy itself."

Director Robbins said it was the spirit of the occasion that impressed him rather than the occasion itself. "This spirit multiplied many thousand-fold would soon overcome much of the Nation's losses which were taken through greed and lust for immediate profits, with no concern about those who live today or those who will follow after we are gone.

"This," he declared, "is a dramatic example of what can be done to conserve America's greatest resources and of the thing that must be done, not only in the Tucumcari project area; not only in New Mexico, but in every river valley and across every field and forest site in America if we are to have the abundance for all as God and Nature intended."

Director Robbins praised the cooperative effort of the various local, State and Federal governmental agencies, citing it as another example of unified service available on western reclamation projects. THE END

Illustrations in this article were made possible through the courtesy of the U. S. Soil Conservation Service, and the Amarillo, Tex., Daily News.

At left: J. C. White, whose farm was rebuilt in a day, observes the "miracle" brought about by cooperation and teamwork with Wayne Miles, SCS official of the Canadian River District. Center: C. A. Stinson and son refueling from mobile station. Right: Tucumcari's Police Chief Jack Nichols serving barbecue.

Project Repayment Contracts—Custom Tailored

by ROLAND V. SNOW, Region I, Boise, Idaho

Author Snow talks it over with farmers on the Deschutes, Oregon, project. Left to right: Snow, Ben Evick, K. S. Green, and Dave Green. *Photo by Stanley Rasmussen, Region I*

Most irrigation farmers are well aware that water costs are necessary. But it is surprising that many farmers on projects constructed with Federal funds do not know that only part of the annual assessment is for operation and maintenance, and that in addition a slice goes to pay project construction costs. Too many farmers are content to let their interest in the irrigation system stop at the headgate, and cuss the ditch-rider or the project manager if things don't go right.

Since 1902 the Bureau of Reclamation (until 1923 known as the Reclamation Service) has been building irrigation projects in the Western States. Up to 1947, 298 separate contracts had been entered into by water users for repayment to the United States of reimbursable funds expended. The money spent is interest-free, since the people of this Nation have recognized, through their duly elected representatives in Congress, that every project contributes to the national well-being over and above direct benefits from irrigation, power, flood control, fish and wildlife, and recreation.

The Reclamation Act of 1902 called for repayment of construction costs in 10 years. Later statutes have authorized longer repayment periods. The Omnibus Adjustment Act of May 25, 1926, lengthened the repayment period from 20 to 40 years and required that repayment contracts on new projects should be made only with water users' organizations. The Reclamation Project Act of 1939 authorized the making of new contracts, gearing payments to the ability, year by year, of the farmers to make payments.

The various laws passed since 1902 have been evidence of the need for more realistic repayment terms. Many of the early contracts were drawn up before cropping patterns became established. In other cases, pressures for getting projects into operation were so great that insufficient time was available for classification of soils or analysis of the ability of project farms to pay construction charges. The depression of the '30's proved that the terms of many contracts were not sufficiently elastic.

Prior to World War II there was recognition within the Bureau of Reclamation of the need for repayment contracts to be "custom tailored" to the economy of each project, rather than to make all contracts conform to the terms of an over-all law such as the 1939 Reclamation Act. This was particularly true for those projects on which construction costs were obviously too great to be repaid in 40 years. However, World War II delayed the necessary adjustment program.

In 1945 the Washington and Regional offices were staffed to begin a program of field investigations on projects needing reconsideration of contract repayment terms. Since these investigations involve a thorough economic analysis of operations on individual farms, agricultural economists have been relied upon to do a large part of the work. The program has gone forward and a number of reports have been written, with contracts drawn up to reflect the resulting findings and recommendations.

Some projects have been studied for the purpose of setting up new repayment contracts. On others, it has been found that the terms of existing contracts called for larger annual payments than water users were able to meet, particularly during periods of low farm prices, in which cases existing contracts needed to be amended or superseded.

The philosophy that has been adopted in making field investigations under the present program revolves around the assumption that the more you know about a situation, the sounder will be your conclusions concerning it. Operations begin by isolating the problem and bringing all contributing facts into focus. The investigator begins by collecting information. He discusses the project with everyone available who is familiar with it, reviews pertinent files, analyzes State laws, and studies project histories. After such secondary sources are consulted, operations are transferred to the project under study for a closer look.

Some of the questions that have to be answered during the initial stages of contacts with the project usually include: "Is this an attempt to try to get more money out of water users when they can't meet their present payments?" and "Why don't you write off the entire construction charge?" The investigator is glad to answer these and other questions to the best of his ability, since the resulting discussion helps to convince the project manager and board of directors that all he is trying to do is call a spade a spade.

Aside from contacts with project officials, assistance and advice are obtained from other Government offices and business establishments so that no important phase of the problem will be overlooked. Such sources are particularly valuable in providing local information on farm land prices, farm commodity prices, market outlets, marketing practices and problems, credit facilities, assessment and collection of taxes, weed and disease problems, and other significant considerations. Particularly helpful in this respect are the County Agricultural Agents, Soil Conservation Service officials, local bankers, members of cooperatives, and personnel at county courthouses, produce and commission houses, and canneries.

The most important information from this point on consists of first-hand facts from project farmers. Operations up to this point are all preliminary to gathering the information that can be obtained only from project farmers. Project officials help in the selection of representative farms, and farmers are notified of the nature and purpose of the interview. Needless to say, many an interview has started off with mixed feelings. Anyone who knows will agree that if you can come to a meeting of minds on the "highfalutin language," farmers are pretty fair economists themselves. And they aren't inclined to accept without question the views and findings of the college trained agricultural economist minus the calluses which denote familiarity with the business end of an irrigation shovel.

On the other hand, the interviewer knows beforehand that the welcome mat might not be out for him. Sometimes it seems to him that even the farmer's dog has been "coached" a little. At best he expects the farmer to be skeptical about whether the information requested is worth the time it takes.

From such uncertain beginnings the interview usually progresses with increasing understanding. Before it is finished the farmer ordinarily agrees with the objectives to be achieved and is willing to furnish records and opinions to the best of his ability. Many an interview has been interrupted by the interviewer staying for dinner at the farmer's insistence. Such cooperation is testimony of the soundness of the program, and proof that the Bureau is right in relying even more heavily on project farmers' help in working out project problems.

Farm records of operations for one calendar year, from approximately 10 percent of project farms selected to represent significant groups, are collected and analyzed with the help of general information on prices, farm operating costs, climate, markets, family living requirements, and project operation and maintenance expenses. The purpose of the analysis is to find how much per irrigable acre the majority of project farmers can pay on the construction debt in a year when prices and costs are in line with long-time or average conditions. This would be called the "base rate." Averages for the six years from 1939 to 1944 are used in this connection for most prices and costs. Project officials and farmers help to make the base rate reflect actual conditions. Cooperation at this point pays big dividends in the long run by making the resulting recommendations more authentic and also by demonstrating to the project manager and board of directors that an honest effort is being made to solve the repayment problem. That this latter point is of no small importance was voiced by one project official who stated: "We know that figures don't lie, but we're not so sure that liars don't sometimes figger."

After the base construction rate is finally determined, a recommended procedure is included in the report for varying construction assessments each year in accordance with the ability of project farmers to pay during periods of fluctuating economic conditions. In addition, all other phases of the repayment problem are presented in the formal report and repayment plan. After approval by the Bureau's Regional and Washington offices, the report and repayment plan is submitted to project water users for consideration and approval.

The repayment contract is drawn up, using the report and repayment plan as a guide, and presented to project water users. The water users then decide whether they believe the contract should be adopted. It is at this point that previous cooperation between the Bureau and the project officials and water users acts as "bread cast upon the waters." The mutual confidence that has been built up can and does eliminate haggling, delays, and misunderstandings that might come about otherwise.

The period of repayment for many projects for which financial readjustment is now being considered will exceed the present legal limit of 40 years. This means that Congressional approval will be necessary. After favorable action by Congress, the repayment contracts will be executed on behalf of the Government and project water users will begin paying for construction according to terms of the new contracts. And you wouldn't lose by betting that the pay-out record will be better, because it will be sustained by a sound foundation of facts and supported by a mutual, and in many cases a new, spirit of cooperation. THE END.

New Electrical Power Developments in Europe

(Continued from page 208)

stability load limit by about 25 percent for long transmission lines.

There is a definite trend in Europe toward the application or air circuit-breakers for high-voltage transmission lines. In the United States, only oil circuit-breakers are used on such lines. Four main reasons were given as an explanation for the trend toward air circuit-breakers: shortage of oil in Europe; fire hazards of oil circuit-breakers, particularly during bombings; ease of maintenance of air circuit-breaker contacts; and performance of air circuit-breakers, now approaching that of oil circuit-breakers in the United States. Thus, by necessity, European engineers are developing air circuit-breakers which may have advantages over our oil circuit-breakers, just as necessity has forced the application of extra-high voltage transmission lines in Europe.

Conferences of the C. I. G. R. E. caliber are excellent media for the discussion of technical problems confronting engineers from all countries. By such free interchange of information and ideas, as existed at this conference, new approaches to common difficulties can be found and duplication of research can be avoided. The trip to Europe and the attendance at the international conference have given me a new perspective on the widespread technical advancements being accomplished by engineers throughout the world. THE END

News Round-Up

Minidoka Opening Scheduled

Applications are now being mailed to homeseeking veterans of World War II for 46 irrigated public land farms on the Bureau of Reclamation's Minidoka project located near Twin Falls, Idaho.

All applications received by December 30 will be considered as having been filed simultaneously. Both men and women are eligible to file, but married women must be heads of families in order to file. Approximately 3,600 acres of irrigated land in the Hunt Unit of the Minidoka project comprises the 46 farms.

Staple crops in the locality include alfalfa, wheat, barley, oats, beans, potatoes, and sugar beets. The area is also good for dairying, raising cattle, hogs and poultry.

Cooperative Pre-Survey on Land Classification Methods

As a result of an informal cooperative agreement, representatives of the College of Agriculture, University of California, and of the Regional Salinity Laboratory, the Lower Colorado River Research Project, and the Division of Soil Survey of the Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture, met with Bureau of Reclamation land classification specialists at Yuma, Ariz., on June 2 to 4, 1948, for the purpose of conducting a preliminary inspection of the Pilot Knob and West Mesa areas of the All-American Canal project in advance of the actual land classification.

The members of the party examined the standards and methods used by the Bureau in its land classification procedures and then toured the areas involved. Although the entire proceedings were strictly informal, Bureau personnel had the benefit of a complete and thorough analysis by the other representatives of the methods and procedures proposed for classifying the West Mesa and the Pilot Knob areas. Those participating in the tour mutually agreed upon the standards to be used in the classification, and several representatives of the participating agencies commended the Bureau of Reclamation for its thorough and up-to-date methods of classifying lands.

Central Arizona Project Report Sent to Congress

The Department of the Interior's project planning report on the Central Arizona project was formally sent to the Congress late in September. The report in no way attempts to decide or prejudice the California-Arizona water controversy on the Lower Colorado River.

The giant project has been found economically feasible by Secretary Krug who recommended that the Congress authorize its construction if Arizona's claims upon the Colorado River are substantiated to a degree that would provide sufficient assured water for its operation. Estimated benefits from the project, designed to meet Arizona's critical water shortage and ease the Southwestern power shortage, would exceed the estimated $738,408,000 cost by 50 to 60 percent.

The project plan calls for increased water supplies acutely needed in the highly developed Central Arizona area, including Phoenix. The Bridge Canyon Dam and power plant, which would be constructed to provide power needed for pumping water for diversion to central Arizona, would in addition produce hydroelectric power sorely needed by California and Arizona and other lower Colorado River Basin States.

"The showing in the report of the availability of a substantial quantity of Colorado River water for diversion to Central Arizona for irrigation and other purposes is based upon the assumption that the claims of the State of Arizona to this water are valid," Secretary Krug said in his letter of transmittal.

Power Supply Plan for Nebraska

Interior Secretary J. A. Krug recently announced that a plan is being worked out with Nebraska agencies for the marketing of hydroelectric power in that State in cooperation with the public power systems so that the benefits of low-cost power will be widespread and will accrue to the ultimate consumer.

All electric power utility systems in Nebraska are publicly owned, and no private utilities serve the area.

Under this plan, the Bureau of Reclamation, which acts for the Secretary of the Interior in marketing all Missouri River Basin project power, and public power agencies in the State would individually market power in that part of Nebraska lying west of the 101° 20 meridian. The Nebraska Public Power System would, in effect, be the sole marketing agent in the territory east of this line which is its normal operating area, except for the area served by the Omaha Public Power District.

The arrangement with the Nebraska Public Power System would provide for that system transmitting or "wheeling" Bureau power to other Federal agencies or establishments in the area served by the system, whose individual requirements are in excess of 2,500 kilowatts.

Although rates for the sale of power to the system have not been fully determined, it is expected that savings which will accrue from purchase of power will be passed on to the ultimate consumers in reduced rates.

Another Klamath Land Opening Scheduled

December 20 will mark the day on which veterans of World War II must have filed their completed homestead applications in order to receive considerations for one of the 86 homesteads on the Klamath project in Northern California which the Bureau of Reclamation plans to award soon.

All complete applications filed by veterans previous to the deadline day (December 20) will be considered as having been "filed simultaneously," and all will receive an equal chance in the drawing. The opening took place on September 21.

Notices and applications have been mailed to an estimated 20,000 persons who have already requested them.

The land comprises 86 new farms ranging from 72 acres to 135 acres, located on an established project where about 1,000 irrigated farms and a thriving agricultural and industrial community have been carved out of arid lands since the first Reclamation construction was started under the act of 1902. This will be the third homestead opening on the project since the end of the war.

Applications will be considered for awarding the farms in the order in which the names of the individuals are drawn from a bowl. Veterans' applications will be considered first. If any farms remain unclaimed, which the Bureau of Reclamation believes unlikely, consideration will then be given to nonveterans who have filed complete applications prior to the deadline. And, if any farms still are unclaimed, consideration will be given to persons filing complete applications after the deadline, in the order in which their applications were filed. However, this is most doubtful judging from experience with past openings.

A local examining board will review the applications in the order in which the names are drawn from the bowl to determine whether the persons fully meet qualifications for homesteading irrigated public lands. Among the qualifications to receive a farm, a person must have had at least two years of full-time farm experience or its equivalent, gained since his or her 15th birthday. Required is a net financial worth of at least $2,000 in cash or assets readily convertible into cash, or else the equivalent in such assets as livestock, farm machinery and equipment which would be useful in developing and operating a new irrigated farm. Both men and women may apply.

Details of the opening are contained in Klamath Project Public Notice No. 47, being mailed out to all persons who have requested them. Others may obtain them by writing either to the Klamath District Office, P. O. Box 312, Klamath Falls, Oreg., or the Regional Director, Bureau of Reclamation, Box 2511, Sacramento, California; or the Commissioner of Reclamation, Washington 25, D. C. Application blanks and instructions are attached to the notices.

"Technical News" Available

Commissioner Michael W. Straus recently called to the attention of all Bureau employees the availability of the publication entitled "Technical News."

This is a nongovernment publication, the official organ of the Technical Club with headquarters located in Denver. The club is a private organization which makes a substantial contribution to the Bureau of Reclamation by providing Bureau professional personnel with a vehicle for the exchange of technical information of general interest.

Subscriptions to the paper or membership in the club may be had by addressing the Secretary, Reclamation Club, P. O. Box 2852, Denver 15, Colorado.

National Reclamation Association Convenes

(Continued from page 204)

quainted with soil and water resources development in Oklahoma. The invitation, signed by Zoe B. Zinn, President, C. F. Mock, and R. W. Minor, Directors of the Lugert-Altus Irrigation District, and President W. O. Goodman of the Altus Chamber of Commerce stated, "Altus is the irrigation pioneer of Oklahoma and the Lugert-Altus District is the first reclamation project in Oklahoma. Information you receive from a tour of the district will be valuable to you and your local projects.

"Refreshments will be served during the day to project visitors in the Community House at Lake Altus. Guides will direct individuals on a tour of the project. Visitors will see harvest operations, crops under irrigation, recreational areas, farm experiment developments, soil conservation, and special modern engineering features."

In the Zebra Room of Oklahoma City's Municipal Auditorium 25,000 square feet of floor space will be devoted to the exhibits pertaining to Reclamation, States and commercial interests, including an exhibit of the latest innovations in irrigation farm machinery.

Many events have been planned in connection with the convention, including a leisure-time program for the ladies with a style show, reception at one of the exclusive clubs, and other special entertainment. A tour of Oklahoma City, stopping at many points of interest, including open-houses at homes displaying the most modern trends in home building, conveniences, and comforts will also be on the schedule.

WATER REPORT *(Continued from page 213)*

NEBRASKA.—Three reservoirs with capacity of 2,240,800 acre-feet, are holding 74 percent of that amount, as compared with a 10-year October average of only 13 percent.

NEVADA.—Reports from six reservoirs show October 1 storage of 35 percent of capacity and 61 percent of the 10-year October average.

NEW MEXICO.—Storage does not compare favorably with that of October 1947.

The 1948 summer was dry except for the extreme northern part of the State. Flow of the Rio Grande into Elephant Butte Reservoir is estimated to have been 24 percent less than the forecast of April 1, but irrigation demand in the lower Rio Grande Valley was unusually high. Storage in the Elephant Butte Reservoir is substantially the same as for April which is much lower than was anticipated. Storage in El Vado Reservoir, which serves the middle Rio Grande area, is 145,000 acre-feet, which is considerably above normal.

Six New Mexico reservoirs, with total capacity of 3,657,800 acre-feet, reported October 1948 storage of only 29 percent. The 10-year October average is 46 percent.

OREGON.—Oregon's reservoirs, 21 in all, show October 1948 storage as 37 percent of capacity, as compared with a 10-year average of 42 percent. (Total capacity of these reservoirs is 2,619,000 acre-feet.)

TEXAS.—Incomplete reports indicate that October 1 storage in two large reservoirs (Marshall Ford and Buchanan) totals 1,298,600 acre-feet, which is 45 percent of capacity. This storage equals 87 percent of the 1939–48 October 1 average storage for Buchanan Reservoir and 70 percent of the 1942–48 October 1 average for Marshall Ford Reservoir.

UTAH.—October storage in 9 reservoirs is 234,360 acre-feet, or 41 percent of capacity. This is substantially better than the 10-year average for October 1—144,958 acre-feet, or 25 percent of capacity.

WASHINGTON.—A better than average carry-over is in 8 major reservoirs with combined capacity of 2,106,600 acre-feet, the October 1948 figure being 1,465,590 acre-feet, or 69 percent of capacity, as compared with the 10-year average of 1,231,070 acre-feet, or 58 percent.

WYOMING.—Carry-over in 9 major reservoirs (not including Jackson Lake) was 1,050,000 acre-feet on October 1. This was more than twice the normal amount for that date, the current percentage being 39 as compared with a 10-year average of only 14 percent. Storage in Kingsley-Sutherland reservoirs is about where it stood on April 1.

THE END

NOTES FOR CONTRACTORS

Contracts Awarded During September 1948

Specification No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2260	Colorado-Big Thompson, Colo.	Sept. 2	Outdoor power transformer for Wiggins substation	Maloney Electric Co., St. Louis, Mo.	$33,965
		..do..	Outdoor power transformer for Brush substation	Westinghouse Electric Corp., Denver, Colo	10,424
2270	Hungry Horse, Mont.	Sept. 3	Two 290-ton motor-operated cranes and lifting beams	Shaw-Box crane and hoist division, Manning, Maxwell & Moore, Inc., Muskegon, Mich.	395,103
2278	..do	Sept. 8	Two 96-inch steel outlet pipes and appurtenances for dam and power plant.	Pacific Coast Engineering Co., Alameda, Calif	137,500
2283	Missouri Basin, Nebr	Sept. 2	Construction of 10,000-kilovolt-ampere substation at Alliance, Nebr.	Evans Electrical Construction Co., Omaha, Nebr	189,760
2286	Lewiston Orchards, Idaho	Sept. 30	Construction of irrigation distribution system main pipe line, Station 0+15 to Station 232+30.	Goodfellow Bros., Inc., Wenatchee, Wash	344,552
2290	Fort Peck, Mont	Sept. 2	Construction of 2 000-kilovolt-ampere substation at Savage, Mont	Elliott Construction Co., Omaha, Nebr	59,925
2292	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 24	Gates and hoists for Coachella Valley and All-American Canals	Isaacson Ironworks, Seattle, Wash	12,200
2293	Missouri Basin, N. Dak	Sept. 29	Steel structures for 115-kilovolt Williston-Garrison dam transmission line.	Daco Metal Products Co., Oakland, Calif	11,014
2297	Missouri Basin, Wyo	Sept. 16	Construction of 6,000-kilovolt-ampere substation, Pine Bluff, Wyo.	Killoren Electric Co., Appleton, Wis.	153,000
2313	Colorado-Big Thompson, Colo	Sept. 24	One power, lighting, heating, and direct current switchboard cubicle for Granby pumping plant.	Cutler-Hammer, Inc., San Francisco, Calif.	10,477
2315	Central Valley, Calif	Sept. 24	12 bulkhead gates, miscellaneous metalwork for Tracy pumping plant.	Gardiner Manufacturing Co., Oakland, Calif	16,340
2320	Missouri Basin, Wyo	Sept. 8	One 22,500-pound-capacity gantry crane for Kortes Dam	Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.	12,800
2323	Lewiston Orchards, Idaho	Sept. 2	Construction of east portion of irrigation and domestic water pipe distribution systems.	S. M. Gilbert Co., Seattle, Wash	157,350
		..do..	Construction of west portion of irrigation and domestic water pipe distribution systems.	E. F. Pugsley, Seattle, Wash	116,809
2330	Provo River, Utah	Sept. 13	Construction of pipe line and structure for Salt Lake Aqueduct	Provo Foundry & Machine Co., Provo, Utah	316,937
2334	Central Valley, Calif	Sept. 21	9 radial gates and equipment for Delta Mendota canal	Berkeley Steel Construction Co., Inc., Berkeley, Calif.	25,047
		..do..	9 motor-operated radial gate hoists for Delta Mendota canal	Northwest Marine Iron Works, Portland, Oreg	21,839
2337	Columbia Basin, Wash	Sept. 24	Control-board extensions and instruments for Grand Coulee left power plant.	General Electric Co., Denver, Colo	12,596
2356	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 8	70,000 barrels portland cement for Coachella Valley distribution system, units 2, 3, and 4.	Riverside Cement Co., Los Angeles, Calif.	178,500
2357	Columbia Basin, Wash	Sept. 13	Steel structure for right transformer circuits and 230-kilovolt tie circuits for right 230-kilovolt switchyard.	National Iron Works, Oakland, Calif	46,475
R1-21	Boise, Idaho	..do..	Construction of earthwork and structures C line canal, east laterals and Willow Creek Pump laterals.	Geo. B. Henly Construction Co., Caldwell, Idaho	328,047
H. H.-3.	Hungry Horse, Mont	Sept. 10	Clearing part of Hungry Horse Reservoir site	Wixson & Crowe Co., and J. H. Trisdale, Redding, Calif.	1,733,880
R1-25	Deschutes, Oreg	Sept. 20	Pneumatically applied mortar canal sealing, north unit, main canal.	American Gunite Co., Salt Lake City, Utah	21,012
R2-22	Central Valley, Calif	Sept. 16	Dismantling buildings, and construction of residences and appurtenant structures for Government camp, Delano, Calif.	Trewhitt-Shields & Fisher, Fresno, Calif	240,989
R2-32	..do	Sept. 7	Furnishing, hauling, and placing gravel, Delta-Mendota canal and Westley wasteway.	Hubert Sykes, Patterson, Calif	13,940
R3-LCRD-3	Boulder Canyon, Ariz.-Calif.-Nev	Sept. 29	Construction of highway and railroad culverts, drain line 8 B, Imperial Division, All-American Canal System.	V. D. Case Co., Long Beach, Calif	109,371
R6-11	Fort Peck, Mont	Sept. 2	Erecting 6 two-bedroom prefab residences and extending utilities at Fort Peck town site.	Elmer Johnson, Glasgow, Mont.	33,384
R7-18	Missouri Basin, Nebr	Sept. 1	Furnishing and erecting 30 prefab residences for Government housing at Trenton, Nebr., for Culbertson Dam.	Metcalfe Construction Co., Omaha, Nebr	278,640
R7-22	Mirage Flats, Nebr	Sept. 2	Construction of buildings, sewerage and water distribution systems and residences for operation and maintenance headquarters.	John Keller Construction Co., Longmont, Colo.	58,238
R7-24	Missouri Basin, Nebr	..do..	Clearing Enders Reservoir site, Enders, Nebr	Burks & Co., Denver, Colo	14,753
R7-26	Colorado-Big Thompson, Colo	Sept. 17	Furnish rails, rail accessories, miscellaneous structural steel for Granby pumping plant.	Vulcan Rail & Construction Co., Maspeth, N. Y	39,772
R7-29	Missouri Basin, Nebr	Sept. 21	Clearing Medicine Creek Reservoir site, Pt. 1, at Indianola, Nebr.	Gatewood-Lewis-Hadley, Pryor, Okla	55,853

Construction and Supplies for Which Bids Will Be Requested by January 1949

Project	Description of work or material
Boise, Idaho	Autotransformers, lightning arresters; instrument transformers, and metering equipment for Anderson Ranch switchyard.
Boulder Canyon, Nev	Processing of sand and gravel for concrete aggregate.
Do	Construction of 15 permanent houses at Boulder City, Nev.
Central Valley, Calif	Relocation of 7.2 miles of railroad spur above Keswick reservoir, between Middle Creek and Matheson.
Columbia Basin, Wash	Construction of North dam, an earthfill structure about 2 miles southwest of Coulee Dam, Wash.
Do	Construction of earthwork and structures for about 14 miles of the West canal, near Ephrata, Wash.
Do	Construction of earthwork and structures for about 1.5 miles of Feeder canal near Coulee Dam, Wash.
Do	Four power circuit breakers for 230-kv. right switchyard Grand Coulee power plant.
Davis Dam, Ariz.-Nev	Constructing and furnishing equipment for Blythe substation, 15,000 kva. capacity.
Do	Stringing conductors and installing insulators for 75 miles of 230-kv. transmission line from Davis Dam to Parker Dam.
Do	Stringing conductors and installing insulators for 55 miles of 230-kv. transmission line from Davis Dam to Hoover Dam.
Fort Peck, Mont.-N. Dak	Construction of 15,000 kva. capacity Williston substation.
Gila, Ariz	Construction of 18 miles of the Welton-Mohawk canal, about 20 miles east of Yuma, Ariz.
Do	Construction of pumping plants 1, 2, and 3 along Welton-Mohawk canal.
Klamath, Calif.-Oreg	Improvements of Lost River channel in Langell Valley, near Klamath Falls, Oreg.
Lewiston Orchards, Idaho	Construction of filter plant and Clearwater reservoir to supply water to domestic and irrigation distribution systems near Lewiston, Idaho.
Missouri Basin, Mont	Construction of about 8 miles of canal and laterals for the Savage Unit, near Savage, Mont.
Missouri Basin, Nebr	Construction of earthwork and structures for about 16 miles of Courtland canal, near Superior, Nebr.
Do	Construction of earthwork and structures for about 12.5 miles of Superior canal, near Superior, Nebr.
Do	Construction of earthwork and structures for about 6.5 miles of Cambridge canal, near Oxford, Nebr.
Do	Furnishing and erecting 20 prefabricated residences for Government Camp at Superior, Nebr.
Missouri Basin, Wyo	Construction of about 1.5 miles of access road at Keyhole dam, about 18 miles northeast of Moorcroft, Wyo.
Do	Elevator for Kortes dam and power plant.
Ogden River, Utah	Construction of earthwork and structures for an equalizing reservoir for the south Ogden lateral distribution system near Ogden, Utah.
Paonia, Colo	Enlargement of about 4 miles of Fire Mountain canal from its present capacity of 70 cfs. to a capacity of 200 cfs. Construction is located near Somerset, Colo.
Tucumcari, New Mex	Construction of last 15 miles of the Hudson canal and construction of lateral unit No. 7, including drains. Construction is located about 15 miles northeast of Tucumcari, New Mex.

Above left: Bonnie and Laddie "stand guard" over the flock on the sun porch. Above right: Marilyn Sperry, age 3, displays "turkey of tomorrow" in the form of a two-day old Beltsville baby poult. Below: A view of turkeys on sun-porch, their social and recreational area. The "dual-purpose" capes worn by the birds serve to prevent them from pecking each other as well as to preserve the "New Look." See story on page 205. *All photos by Phil Merritt, Region I*

The Reclamation ERA

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Bronze beauties from the Roza Division of the Yakima project, all ready for Christmas

Merry Christmas!

The horn of plenty is filled with foods of all kinds for the Nation. Thanks to Reclamation's projects. Photo by Phil Merritt and Stanley Rasmussen, Region I.

Reclamation Place Names in This Issue

Reclamation ERA

December 1948 **Vol. 34, No. 12**

Published by the Bureau of Reclamation, United States Department of the Interior, Washington 25, D. C. Approved by the Bureau of the Budget.

Subscription rate $1 a year for persons residing in the United States and Canada; $1.50 a year for foreign subscriptions; special rate of 50 cents a year for members of water users' associations.

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Ruth F. Sadler, *Editor*

OUR FRONT COVER

Mrs. A. W. Williamson, of the Roza project in Washington, holds a golden gobbler, one of 1,800 which she and her husband will send to market during the holiday season. Just one of the remunerative products made possible through Reclamation. This photo was taken by Stanley Rasmussen, Region I.

December 1948

Personnel and Project Directory

UNITED STATES DEPARTMENT OF THE INTERIOR, BUREAU OF RECLAMATION

WASHINGTON OFFICE: United States Department of the Interior, Bureau of Reclamation Washington 25, D. C.

Michael W. Straus, Commissioner **Kenneth Markwell, Assistant Commissioner** **Wesley R. Nelson, Assistant Commissioner**

Assistant to the Commissioner—Engineering, T. W. Mermel; *Assistant to the Commissioner—Management,* G. S. Ellsworth; *Chief Counsel,* Clifford E. Fix; *Chief Information Officer,* Leonard W. Mosby; *Chief Personnel Officer,* Glenn D. Thompson; *Director, Programs and Finance,* Alfred R. Golze; *Director, Branch of Operation and Maintenance,* Goodrich W. Lineweaver; *Director, Branch of Power Utilization,* Harvey F. McPhail; *Director, Branch of Project Planning,* John W. Dixon; *Comptroller,* William F. Kubach; *Director of Supply,* S. W. Crosthwait

Denver Staff Offices of the Commissioner: United States Department of the Interior, Bureau of Reclamation, Denver Federal Center, Denver, Colo.

Chief Engineer and Director, Branch of Design and Construction, L. N. McClellan; *Chief, Legal Division (Office of the Chief Counsel),* Robert B. Starke; *Chief, Hydrology Division (Branch of Project Planning),* John R. Riter; *Chief, Power Field Division (Branch of Power Utilization),* E. C. Schurch; *Chief, Denver Finance Division (Office of the Director of Programs and Finance),* Archie M. Rankin; *Associate Director of Supply (Office of the Director of Supply),* J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller),* Wendell Bramwell; *Chief, Personnel Field Office (Office of the Chief Personnel Officer),* Everett K. Gould; *Head Field Service Section, Administrative Release Division (Office of Management Planning),* Mrs. Catherine Coon

Alaskan Investigations Office, Juneau, Alaska, Joseph M. Morgan, Chief

REGIONAL OFFICES

REGION I: Headquarters, Post Office Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, R. J. Newell; *Assistant Regional Director,* J. Lyle Cunningham; *Assistant Regional Director,* H. T. Nelson; *Regional Engineer (Branch of Design and Construction),* Grant P. Gordon; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* W. H. Tuller; *Regional Power Manager (Branch of Power Utilization),* Don S. Campbell; *Regional Planning Engineer (Branch of Project Planning),* E. N. Torbert; *Regional Programs and Finance Officer (Programs and Finance Division),* A. W. Empie; *Regional Information Officer (Information Division),* H. C. Blonk; *Regional Land Officer (Land Acquisition Division),* W. B. Wallace; *Regional Counsel (Legal Division),* H. R. Stinson; *Regional Personnel Officer (Personnel Division),* V. L. Rushfeldt; *Regional Supply Officer (Supply Division),* James M. McCool

	Official in charge		Address
	Name	Title	
District and Project Offices			
Anderson Ranch Dam	Donald S. Walter	Construction engineer	Anderson Dam, Idaho.
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Payette Pump unit construction office	R. W. Adams	Construction engineer	P. O. Box 172, Caldwell, Idaho.
Cascade Dam construction office	Earl Harmon	do	P. O. Box 440, Cascade, Idaho.
Payette division O. & M. office	Theodore Nelson	Irrigation manager	Notus, Idaho.
Owyhee project O. & M. office	J. F. Spofford	do	Nyssa, Oreg.
Vale project O. & M. office	C. C. Ketchum	Superintendent	Vale, Oreg.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	P. O. Box 368, Ephrata, Wash.
Coulee Dam division	Alvin Darland	do	Coulee Dam, Wash.
Deschutes project	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hungry Horse project	C. H. Spencer	do	Columbia Falls, Mont.
Lewiston Orchards project	Wilred L. Karrer	do	Weisberger Bldg., 5th and Main, Post Office Box 621, Lewiston, Idaho.
Minidoka project	S. R. Marean	Superintendent	1359 Palisades, Idaho, Mail Address: Hansen Ave., Burley, Idaho.
Palisades project	I. Donald Jerman	Project engineer	Palisades, Idaho, Mail Address: Post Office Box 1259, Idaho Falls, Idaho.
Yakima project	O. W. Lindgren	Superintendent	P. O. Box 1377, Federal Bldg., Yakima, Wash.
Planning Offices and Independent Field Stations			
Kalispell planning office	Charles S. Hazen	Planning engineer	Ford Bldg., Post Office Box 97, Kalispell, Mont.
Salem planning office	Lee McAllister	do	460 N. High St., Salem, Oreg.
Walla Walla planning office	M. Boyd Austin	do	Bldg. T-208, Walla Walla City-County Airport, Post Office. Box 718, Walla Walla, Wash.
Rathdrum Prairie project, Post Falls unit, independent field station.	E. A. Lavonture	Watermaster	Route 2, Post Falls, Idaho.
Missoula Valley project, Big Flat unit, independent field station.	Pierre J. LaCasse	do	Federal Bldg., Post Office Box 1463, Missoula, Mont.
Umatilla project, independent field station	C. L. Tice	Reservoir superintendent	McKay Dam Pendleton, Oreg.

REGION II: Headquarters, Post Office Box 2511, Old Post Office Building, Sacramento 10, Calif.

Regional Director, R. L. Boke; *Assistant Regional Director,* R. S. Calland; *Assistant Regional Director,* Phil Dickinson; *Assistant to the Regional Director,* U. J. Gendron; *Regional Engineer (Branch of Design and Construction),* A. R. McGinness; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* J. G. Lindley; *Regional Power Manager (Branch of Power Utilization),* B. W. Creim; *Regional Planning Engineer (Branch of Project Planning),* S. A. Kerr; *Regional Programs and Finance Officer (Programs and Finance Division),* T. K. Vasey; *Chief, Land and Right of Way Division,* Joe H. Leech; *Regional Information Officer (Information Division),* Max Stern; *Regional Counsel (Legal Division),* L. O. Graham; *Regional Personnel Officer (Personnel Division),* H. F. Osborne; *Regional Supply Officer (Supply Division),* H. F. Halliday

	Official in charge		Address
	Name	Title	
District and Project Offices			
Delta district	C. H. Kadio, Jr	District manager	Post Office Box 1407, Sacramento 10, Calif.
	O. G. Boden	Construction engineer	Antioch, Calif.
	H. W. Thomson	do	Elverta, Calif.
Klamath project	E. L. Stephens	Project manager	Post Office Box 312, Klamath Falls, Oreg.
Sacramento Valley district	James K. Carr	District manager	Post Office Box 302, Chico, Calif.
	William J. McCrystal	Construction engineer	Redding, Calif.
Santa Barbara project	E. R. Crocker	Project manager	Post Office Box 701, Goleta, Calif.
Tulare Basin district	J. W. Rodner	District manager	406 Patterson Bldg., Fresno, Calif.
	R. K. Durant	Construction engineer	Friant, Calif.

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REGION III: Headquarters, Administration Building, Boulder City, Nev.

Regional Director, E. A. Moritz; *Assistant Regional Director,* L. R. Douglass; *Assistant to the Regional Director,* J. D. Earl; *Regional Engineer (Branch of Design and Construction),* C. A. Bissell; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* A. B. West; *Regional Power Manager (Branch of Power Utilization),* R. V. Sprague; *Regional Planning Engineer, (Branch of Project Planning),* E. G. Nielsen; *Regional Programs and Finance Officer (Programs and Finance Division),* M. E. Rains; *Regional Counsel (Legal Division, 458 S. Spring St., Los Angeles, Calif.),* R. J. Coffey; *Regional Supply Officer (Supply Division),* O. J. Littler; *Regional Personnel Officer (Personnel Division),* M. H. Mitchell; *Chiel, Programs Section, (Programs and Finance Division),* D. A. Dedel; *Chief, Office of River Control,* C. P. Vetter.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Lower Colorado River district	J. K. Rohrer	District manager	Yuma, Ariz.
All-American Canal (Imperial division).			Do.
Gila (Construction)	Murray J. Miller	Construction engineer	Do.
Gila (O. & M.)	J. P. Collopy	Superintendent	Do.
Yuma	W. A. Boettcher	do	Do.
All American Canal (Coachella division)	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon	C. P. Christensen	Director of power	Boulder City, Nev.
Davis Dam	H. F. Bahmeier	Construction engineer	Post Office Box 790, Davis Dam, Nev.
Parker Dam Power	S. A. McWilliams	Project engineer	Parker Dam, Calif.
San Diego	R. E. Burnett	Engineer	Escondido, Calif.
Project Planning Officers and Design Units			
Escondido planning office	R. E. Burnett	do	Post Office Box, 357, 414 West 3d St., Escondido, Calif.
Overton planning office	W. P. Adair	do	Johnson Bldg., Overton, Nev.
Phoenix planning office	V. E. Larson	Assistant regional planning engineer	337 West Washington, Phoenix, Ariz.
St. George planning office	J. D. McCoy	Engineer	Post Office Box 605, 53 N. Main St., St. George, Utah.
Davis Dam design unit	H. I. Fitz	Head, design unit	Box 1809, Aviola Radio Corp. Bldg., Phoenix, Ariz.
Davis transmission system design unit	A. J. Ecker	do	Do.
Coachella design unit	H. R. Voris	do	360 South San Gorgonio Ave., Banning, Calif.

REGION IV: Headquarters, 32 Exchange Place, Post Office Box 360, Salt Lake City 8, Utah

Regional Director, E. O. Larson; *Assistant Regional Director,* C. D. Woods; *Regional Engineer (Branch of Design and Construction),* C. H. Carter; *Regional O. M. Supervisor (Branch of Operation and Maintenance),* D. S. Stuver; *Chief, Resources and Development (Branch of Power Utilization),* L. E. Mathews; *Regional Planning Engineer (Branch of Project Planning),* Reid Jerman; *Regional Programs and Finance Officer (Programs and Finance Division),* F. J. Farrell; *Acting Personnel Officer (Personnel Division),* G. A. McDougal; *Regional Counsel (Legal Division),* J. S. McMaster; *Acting Regional Supply Officer (Supply Division)* E. G. Bywater.

	Official in charge		Address
	Name	Title	
Project Offices			
Grand Valley	T. L. Sundquist	Superintendent	Post Office Bldg., Grand Junction, Colo.
Mancos	D. R. May	Construction engineer	Mancos, Colo.
Paonia	R. W. Jennings	do	Post Office Box 623, Paonia, Colo.
Pine River	S. F. Newman	Reservoir superintendent	Vallecito Dam, Bayfield, Colo.
Provo River	L. R. Dunkley	Project engineer	303 Knight Block, Post Office Box 77, Provo, Utah.
Scofield	P. R. Neeley	Area engineer	City Hall, Post Office Box 71, Spanish Fork, Utah.
Area Field Offices			
Fallon	W. H. Slattery	do	Post Office Bldg., Post Office Box 849, Fallon, Nev.
Durango	J. J. Hedderman	do	Masonic Bldg., Post Office Box 640, Durango, Colo.
Grand Junction	C. H. Jex	do	310 Post Office Bldg., Post Office Box 780, Grand Junction, Colo.
Kemmerer	P. B. Delong	do	Town Hall, Post Office Box 591, Kemmerer, Wyo.
Logan	E. K. Thomas	do	46 East Center, Post Office 294, Logan, Utah.
Salt Lake City	F. M. Warnick	Acting area engineer	211 Federal Bldg., Post Office Box 360, Salt Lake City 8, Utah.
Spanish Fork	P. R. Neeley	Area engineer	Post Office Box 71, 24 N. Main, Spanish Fork, Utah.

REGION V: Headquarters, Post Office Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.

Regional Director, H. E. Robbins; *Assistant Regional Director,* A. N. Thompson; *Assistant to Regional Director,* J. A. Buchanan; *Regional Engineer (Branch of Design and Construction),* O. I. Craft; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* R. S. Bristol; *Regional Power Manager (Branch of Power Utilization),* A. H. Sullivan; *Regional Planning Engineer (Branch of Project Planning),* Rex E. Reed; *Assistant Regional Programs and Finance Officer (Programs and Finance Division),* C. L. Harris; *Regional Counsel (Legal Division),* S. L. Baird; *Regional Personnel Officer (Personnel Division),* H. F. Kirby; *Regional Supply Officer (Supply Division),* I. G. Campbell; *Regional Safety Advisor,* G. F. Peterson.

	Official in charge		Address
	Name	Title	
Project Offices			
W. C. Austin	J. A. Callan	Project engineer	Altus, Okla.
Balmorhea	Paul Powell	Irrigation maintenance superintendent	Balmorhea, Tex.
Carlsbad	H. H. Kidder	Project superintendent	Carlsbad, N. Mex.
Rio Grande	L. R. Fiock	Project manager	U. S. Courthouse, El Paso, Tex.
Elephant Butte Power & Storage	Labon Backer	Division superintendent and actg. constr. engineer.	Elephant Butte, N. Mex.
Las Cruces	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta	F. D. Postle	do	Ysleta, Tex.
San Luis Valley	W. H. Sweet	Acting project engineer	117 Jefferson St., Monte Vista, Colo.
Platoro Dam	Ernest Puckett	Construction engineer	Tucumcari, N. Mex.
Tucumcari	R. J. Lyman	do	Do.
	W. B. Bierce	Acting construction engineer	Do.
Valley Gravity	John C. Thompson	Project engineer	McAllen, Tex.
Project Planning Offices			
Albuquerque	J. L. Mutz	Area planning engineer	Post Office Box 95, 723 N. 2nd St., Albuquerque, N. Mex.
Austin	H. P. Burleigh	do	Post Office Box 817, Littlefield Bldg., Austin, Tex.
Oklahoma City	M. G. Barclay	do	Post Office Box 495, 516 Oklahoma National Bldg., Oklahoma City, Okla.

REGION VI: Headquarters, Yale Building, Post Office Box 2130, Billings, Mont.

Regional Director, Kenneth F. Vernon; *Assistant Regional Director,* W. E. Rawlings; *Assistant to the Regional Director,* George O. Pratt; *Regional Engineer (Branch of Design and Construction),* C. G. Anderson; *Regional Supervisor (Branch of Operation and Maintenance),* E. F. Landerholm; *Regional Power Manager (Branch of Power Utilization),* J. R. Walker; *Acting Regional Planning Engineer (Branch of Project Planning),* C. T. Judah; *Regional Programs and Finance Officer (Programs and Finance Division),* Duncan Mills; *Regional Land Officer (Land Acquisition Division),* W. N. McCormick; *Regional Counsel (Legal Division),* W. J. Burke; *Chairman, Interior Missouri Basin Field Committee,* W. G. Sloan; *Chief Reports Coordination Division,* Edwin E. Wilson; *Regional Personnel Officer (Personnel Division),* Howard M. Watts; *Regional Supply Officer (Supply Division),* Fred W. Gilbert; *Safety Engineer (Safety Division),* Charles C. Parsons; *Chief, Municipal Water Supply Investigations Unit,* Stanton J. Ware.

	Official in charge		Address
	Name	Title	
District and Project Offices			
Yellowstone district	Donald C. Ketcham	District manager	Box 1264, Billings, Mont.
Fort Peck	Allen Mattison	Construction engineer	Box 1245, Fort Peck, Mont.
Yellowstone pumping unit	R. B. Kuehler	Engineer	Box 720, Miles City, Mont.
Hardin unit	R. F. Herdman	Construction engineer	Box 516, Hardin, Mont.
Moorehead Dam	W. N. Sanford	Acting construction engineer	Sheriden, Wyo.
Upper Missouri district	Harold E. Aldrich	Acting district manager	Box 1629, Great Falls, Mont.
Milk River	Bruce E. Garlinghouse	Acting superintendent	Malta, Mont.
Canyon Ferry	William P. Price, Jr	Construction engineer	Box 517, Helena, Mont.
Sun River	C. L. Bailey	Superintendent	Fairfield, Mont.
Big Horn district	R. H. Workinger	District manager	Box 839, Cody, Wyo.
Shoshone-Heart Mountain	W. F. Kemp	Acting project engineer	Box 900, Cody, Wyo.
Boysen and Owl Creek	R. S. Lieurance	Project engineer	Box 1111, Thermopolis, Wyo.
Riverton	T. A. Clark	do	Riverton Wyo.
Missouri Souris district	Bruce Johnson	Acting district manager	Box 1050, Bismarck, N. Dak.
Missouri Souris	G. J. Cheney	Engineer	Box 1869, Minot, N. Dak.
Cannonball Dam	Floyd Jensen	Construction engineer	Elgin, N. Dak.
Dickinson Dam	W. W. Brenner	do	Glen Ullin, N. Dak.
Heart Butte Dam	do	do	Do.
Missouri Oahe District	Joseph W. Grimes	Acting district manager	Box 825, Huron, S. Dak.
Angostura and Rapid Valley	H. V. Hubbell	Project engineer	Box 812, Hot Springs, S. Dak.
Belle Fourche	S. T. Larsen	Superintendent	Newell, S. Dak.
Bixby Dam	H. M. Crowell	Construction engineer	Faith, S. Dak.
Keyhole Dam	F. W. Goebring	do	Box 278, Moorcroft, Wyo.
Shadehill Dam	D. M. Forester	do	Box 298, Lemmon, S. Dak.

REGION VII: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director,* W. E. Blomgren; *Regional Engineer (Branch of Design and Construction),* Herbert E. Prater; *O. & M. Supervisor (Branch of Operation and Maintenance),* John N. Spencer; *Power Manager (Branch of Power Utilization),* Harold R. Lee; *Planning Engineer (Branch of Project Planning),* John A. Keimig; *Acting Regional Programs and Finance Officer (Programs and Finance Division),* Harry M. Kent; *Land Officer (Land Acquisition Division),* Mark W. Radcliffe; *Regional Counsel (Legal Division),* Clarence Eynon; *Personnel Officer (Personnel Division),* Albert R. Novak; *Supply Officer (Supply Division),* William F. Sha; *Administrative Officer (Administrative Division), H. S. Varner, Jr.; Safety Engineer (Safety Division), Alton T. Cromwell.*

	Official in charge		Address
	Name	Title	
District and Project Offices			
North Platte River district	I. J. Matthews	District manager	Casper, Wyo.
Glendo	Murel M. Starr	Construction engineer	Glendo, Wyo.
Kortes	C. S. Rippon	do	Casper, Wyo.
South Platte River district	E. S. Huntington	District manager	Building 11, Denver Federal Center.
Colorado-Big Thompson	Vacancy	do	Estes Park, Colo.
Grand Lake	G. R. Higbley	Construction engineer	Grand Lake, Colo.
Kremmling	B. B. Dawson	Resident engineer	Kremmling, Colo.
Fort Collins	R. B. Ward	Construction engineer	Box 551, Fort Collins, Colo.
Loveland	C. E. Klingensmith	do	Loveland, Colo.
Narrows Dam	Charles Seger	Construction engineer	Fort Morgan, Colo.
Kansas River district	H. E. Robinson	District manager	Box 737, McCook, Nebr.
Bostwick Unit	Paul E. Strouse	Construction engineer	Superior, Nebr.
Enders Dam	U. V. Engstrom	do	Imperial, Nebr.
Medicine Creek	Clifford L. Mutch	do	P. O. Box 157, Cambridge, Nebr.
Cambridge Diversion Dam and Cambridge Canal.	C. M. Jackson	do	Do.
Cedar Bluff	R. J. Walter, Jr	do	Ellis, Kans.
Culbertson Dam	Ellis L. Armstrong	do	Trenton, Nebr.
Bonny Dam	Wayne S. Byrne	do	St. Francis, Kans.
Indianola	H. E. Robinson	District manager	McCook, Nebr.
Do	E. T. Bradford	do	Do.
Niobrara River area	C. E. Burdick	Area engineer	Ainsworth, Nebr.
Mirage Flats project	Fred Krauss	Construction superintendent	Hay Springs, Nebr.
Grand Island Area	P. L. Harley	Area engineer	Grand Island, Nebr.
Upper Arkansas River Area	B. F. Powell	do	Box 515, Pueblo, Colo.

Projects or Divisions of Projects of Bureau of Reclamation Operated by Water Users

Project	Organization	Office	Operating official		Secretary	
			Name	Title	Name	Address
Baker	Lower Powder River irrigation district	Baker, Oreg	Stewart Dolby	President	Marion Hewlett	Keating, Oreg.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Superintendent	Elsie W. Oliva	Hamilton, Mont.
Boise (Arrowrock division)	Board of control	Boise, Idaho	Forrest Sower	Manager	W. J. Farrell	Boise, Idaho.
Boise (Payette division, Notus unit)	Black Canyon irrigation district	Notus, Idaho	C. W. Holmes	Superintendent	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	O. E. Anderson	Superintendent	J. M. Shively	Redmond, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Tom Scheffer	do	Ralph L. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	A. P. Starr	President	William Griffith	Cory, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo	Carl Hicks	do	C. J. McCormick	Grand Junction. Colo.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo	J. J. Flanagan	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	do	W. A. Long	do	W. E. Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Robert S. Leighton	Secretary-manager.	John Holmstrom	Lovelock, Nev.
Huntley	Huntley project irrigation district	Ballantine, Mont	A. J. Bowman	Manager	H. S. Elliott	Ballantine, Mont.
Hyrum	South Cache Water Users Association	Hyrum, Utah	Lavor J. Hatch	Superintendent	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	R. E. Thomas	President	Leland W. Pettegrew	Bonanza, Oreg.
Klamath (Pumping division)	Horsefly irrigation district	do	Donald V. Philpott.	do	J. F. Heyden	Do.
Lower Yellowstone	Districts 1 and 2	Sidney, Mont	Axel Persson	Manager	Axel Persson	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	Mr. A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niebauer	do	M. A. McCarthy	Do.
	Harlem irrigation district	Harlem, Mont	Thos. M. Everett	do	LeRoy G. Powell	Harlem, Mont.
	Paradise Valley irrigation district	Zurich, Mont	J. O. Wilson	Superintendent	J. F. Sharples	Chinook, Mont.
	Zurich irrigation district	Chinook, Mont	C. A. Watkins	President	H. M. Montgomery	Do.
Minidoka (Gravity division)	Minidoka irrigation district	Rupert, Idaho	Roy Cunningham	Manager	G. E. Nickerson	Rupert, Idaho.
Minidoka (Pumping division)	Burley irrigation district	Burley, Idaho	Hugh L. Crawford	do	Frank O. Redfield	Burley, Idaho.
Minidoka (Gooding division)	American Falls Reservoir district No. 2	Gooding, Idaho	S. T. Baer	do	Ida M. Johnson	Gooding, Idaho.
Minidoka (Upper Snake River)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	R. Willis Walker	Rexburg, Idaho.
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louis Galloway	Supreintendent.	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hiibel	do	H. W. Emery	Fallon, Nev.
Newton	Newton Water Users Association	Hewton, Utah	Jesse B. Barker	President	Joseph R. Tudenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Joe F. Osback	Mitchell, Nebr.
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Superintendent	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington Wyo	Austin P. Russell	do	Mary E. Harrach	Torrington, Wyo.
North Platte (Northport division)	Northport irrigation district	Northport, Nebr	Mark Iddings	do	Mrs. Mabel J. Thompson.	Bridgeport, Nebr.
Ogden River	Ogden River Water Users Association	Ogden, Utah	David A. Scott	do	G. D. Cardon	Ogden, Utah.
Okanogan	Okanogan irrigation district	Okanogan, Wash	N. D. Thorp	Manager	N. D. Thorp	Okanogan, Wash.
Pine River	Pine River irrigation district	Bayfield, Colo	Roland Campbell	President	James F. Gore	Oxford, Colo.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Provo, Utah.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	O. L. Norman	Manager	J. F. Griswold	Phoenix, Ariz.
Sanpete (Ephraim division)	Ephraim Irrigation Co	Ephraim, Utah	George A. Jorgensen.	President	Joseph H. Thompson.	Ephraim, Utah.
Sanpete (Spring City division)	Horseshoe Irrigation Co	Spring City, Utah	Rudolph Hope	do	James W. Blain	Spring City, Utah.
Scofield	Carbon water conservancy district	Price, Utah	Ray Walters	do	J. Bracken Lee	Price, Utah.
Shoshone (Garland division)	Shoshone irrigation district	Powell, Wyo	Everett Stout	Manager	Harry Barrows	Powell, Wyo.
Shoshone (Frannie division)	Deaver irrigation district	Deaver, Wyo	Robert W. Fifield	do	William P. Peebler	Deaver, Wyo.
Stanfield	Stanfield irrigation district	Stanfield, Oreg	Leo Clark	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Strawberry Valley	Strawberry Water Users Association	Payson, Utah	William Grotegut	President	Robert E. Huber	Payson, Utah.
Sun River (Fort Shaw division)	Fort Shaw irrigation district	Fort Shaw, Mont	A. R. Hanson	Manager	A. R. Hanson	Fort Shaw, Mont.
Sun River (Greenfields division)	Greenfields irrigation district	Fairfield, Mont	D. R. Davies	President	H. P. Wangen	Fairfield, Mont.
Truckee River Storage	Washoe County water conservation district	Reno, Nev	Chester Taylor	Manager	E. S. Yoakum	Reno, Nev.
Umatilla (East division)	Hermiston irrigation district	Hermiston, Oreg	Roy W. McNeal	do	Roy W. McNeal	Hermiston, Oreg.
Umatilla (West division)	West Extension irrigation district	Irrigon, Oreg	A. C. Houghton	do	A. C. Houghton	Irrigon, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson.	do	H. D. Galloway	Montrose, Colo.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Westland	Westland irrigation district	Hermiston, Oreg	Ed Nunn	do	P. B. Smith	Hermiston, Oreg.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellenburg, Wash.
Yakima (Sunnyside division)	Sunnyside Valley irrigation district	Sunnyside, Wash	David C. Brooks	do	Pauline Osterhout	Sunnyside, Wash.
Yakima (Tieton division)	Yakima-Tieton irrigation district	Yakima, Wash	Guy Finley	Manager	Guy Finley	Yakima, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1948

The Upper Colorado River Basin Compact Is Signed

By N. B. BENNETT, Jr.,
Assistant Director, Branch of Project Planning,
Washington, D. C.

An Upper Colorado River Basin Compact, containing 21 articles, a preamble and a conclusion, was signed at Santa Fe, N. Mex., on October 11. Among the high spots of the compact are article III, providing for the apportionment in perpetuity between the signatory States of the consumptive use of water apportioned to and available for use by the upper basin under the original Colorado River Compact; article IV, providing for curtailment of use by the States in the event of drought or for other reasons; article VIII providing for an "Upper Colorado River Commission," an administrative agency; and articles X, XI, XII, XIII, and XIV, providing for the division of water of various interstate tributaries.

UPPER COLORADO RIVER BASIN COMPACT COMMISSIONERS AND ADVISERS, Santa Fe, New Mexico—October 11, 1948, Seated Left to Right: Judge Howell, Legal Adviser for Utah; Wm. R. Wallace, Adviser, Utah; Ed. H. Watson, Commissioner for Utah; L. C. Bishop, Commissioner for Wyoming; Grover E. Giles, *Attorney General, Utah;* H. W. Bashore, *Representative of U. S. and Chairman of* Compact Commission; Chas. A. Carson, *Commissioner for Arizona;* Fred Wilson, *Commissioner for New Mexico;* Judge Clifford H. Stone, *Commissioner for* Colorado. *Standing Left to Right:* Tom Jensen, *Utah;* Don Hunter, *Dove Creek,* Colo.; Judge M. A. Threet, Albuquerque, N. Mex.; John Erickson, *State Engineer's Office, Santa Fe, N. Mex.;* Ralph Meeker, *Engineering Adviser, Arizona;* R. J. Tipton, *Engineering Adviser, Colorado;* I. J. Cory, *Farmington, N. Mex.;* J. R. Riter, *Chief Hydrology Division, Branch of Project Planning, Bureau of Reclamation, Denver, Colo.;* J. S. Braitenstein, *Legal Adviser, Colorado;* John G. Will, *Assistant Chief Counsel, Legal Adviser to the Representative of U. S.;* H. H. Christy, *Colorado;* John Bliss, *State Engineer, Santa Fe, N. Mex.;* and William Wehrli, *Legal Adviser, Wyoming.*

JUNE 6, 1946, WASHINGTON, D. C.—Acting Commissioner of Reclamation William E. Warne speaking: "There is not enough water available in the Colorado River system for full expansion of existing and authorized projects and for development of all potential projects. The formulation of an ultimate plan of river development, therefore, will require selection from among the possibilities for expanding existing or authorized projects as well as from among the potential new projects. Before such a selection for ultimate development can be made it will be necessary that, within the limits of the general allocation of water between Upper Basin and Lower Basin States set out in the Colorado River Compact, the Colorado River Basin States agree on suballocations of water to the individual States."

JULY 22, 1946, CHEYENNE, WYOMING.—Governor Hunt of Wyoming speaking: "Gentlemen, I think you all know why we are assembled here this morning. It is a matter of tremendous importance to the Upper Colorado River Basin States, a matter that now has become almost a necessity that it be done and be done rapidly, if we expect development of the Colorado River Basin in the Upper Basin States to get under way."

OCTOBER 11, 1948, PALACE OF GOVERNORS, SANTA FE, N. MEX.—Federal Representative Harry W. Bashore speaking: "There is about to be signed here a document which will forever be an example of fairness, a demonstration of statesmanship of the highest order, and finally, a proof of the ability of States to deal with their mutual problems, no matter how complex, through the traditional and constitutional compact method."

Thus it started and thus the first step was accomplished.

Behind this simple presentation lies a magnitude of work by men of vision, by men of accomplishment, by men with the best interests of their respective States in mind but fully cognizant of the importance of collective action and of the interests of the Nation. These men must be named, they are: Charles A. Carson, Arizona; Clifford H. Stone, Colorado; Thomas M. McClure (deceased) and Fred E. Wilson, New Mexico; Edward H. Watson, Utah; L. C. Bishop, Wyoming; and Harry W. Bashore, Representative of the United States.

Counting the original meeting of the Governors in Cheyenne on July 22, 1946, there was a total of nine formal meetings of the Compact Commission and their Advisors. At the organization meeting at Salt Lake City, Utah, July 31, 1946, the Commission recognized the immediate need for a committee of engineer advisors. This committee was quickly formed, consisting of: J. R. Riter, Bureau of Reclamation, chairman; R. Gail Baker and R. I. Meeker, Arizona; C. L. Patterson (Mr. Patterson later resigned and was replaced by R. M. Gildersleeve), R. J. Tipton, and F. C. Merriell, Colorado; J. H. Bliss and J. R. Erickson, New Mexico; C. O. Roskelley and F. W. Cottrell, Utah; H. T. Person and R. D. Goodrich, Wyoming. Again the Commission, being fully cognizant of the gravity of its task, appointed a legal advisory committee, consisting of Charles A. Carson, Arizona, chairman; Jean S. Breitenstein, Colorado; Fred E. Wilson, New Mexico; J. A. Howell and E. W. Clyde, Utah; N. B. Gray and W. J. Wehrli of Wyoming. This same group with the addition of J. G. Will, Bureau of Reclamation, as chairman and L. S. Udall of Arizona, served as the drafting committee to translate the principles adopted by the Commission into the written word.

What the Commission and the advisory committees accomplished is perhaps best expressed in the words of Harry Bashore:

"The Upper Colorado River Basin Compact * * * will be a tower of strength to the States of Arizona, Colorado, New Mexico, Wyoming, and Utah, perhaps for centuries to come. It is a structure for the completion of which we have labored long. It is sound in design. Each part of it has been wrought with great care by men who are notably skilled in their professions and experts in the compact process. It has been builded by men of good faith. It has been builded by men of good will; and because it has been so builded, it will endure."

THE WHITE HOUSE

Washington

NOVEMBER 6, 1948.

DEAR MR. POLK: Recent years have brought a marked change in the scope, size, and character of the National Reclamation Program and have cemented its significance in the Nation's economy. I am highly gratified at the tremendous strides that have been made by my own administration and that of Franklin D. Roosevelt.

Our continuing objective is full mobilization of our water resources. To maintain this resurgence of western progress, we must push reclamation and allied resource developments to still greater heights. We must see that the benefits from irrigation and public power are spread widely among the people so that opportunities for economic security and advancement will be made available to the largest possible number of people.

I favor continuance of the family-size irrigated farm as a means of spreading the agricultural benefits of reclamation to the greatest number of people. I support Federal construction of transmission lines as essential to assuring low-cost public power to the West.

The most recent expressions on the part of the people of the West seem to reaffirm their adherence to those views.

I urge the National Reclamation Association to join with me in pursuing a course that will assure the greatest good to the greatest number.

Very sincerely yours,

Harry Truman

MR. HARRY E. POLK,
President,
National Reclamation Association,
Oklahoma City, Oklahoma.

THE SECRETARY OF THE INTERIOR

Washington

NOVEMBER 11, 1948.

DEAR MR. POLK: Please express to the convention my regrets for not being able to deliver this message in person.

President Truman's program for western development was given a tremendous vote of confidence and support on November 2. And this vote was a vindication of Commissioner of Reclamation Michael W. Straus and Regional Director Richard L. Boke whom the Eightieth Congress wanted to remove from office because of their vigorous and faithful execution of the mandates and objectives of previous Congresses.

The demands for power have so increased that only vigorous development of the Reclamation program will enable the West to meet the vital needs of its expanding population and higher industrial activity. The hand-in-hand development of public power and irrigation projects will speed the full utilization of western water resources. Transmission lines must be built to distribute public power economically and efficiently.

To serve the needs of veterans and others for the family-size irrigation farm, we must continue our support of the Reclamation law. Removal of acreage limitations would seriously retard western development and deprive many thousands of veterans and others of the opportunity to settle on irrigated farms. It would disrupt the establishment of a sound family economy and encourage monopoly.

The administration of the Reclamation law must not be hamstrung by appropriations riders. These must be repealed and avoided if the high objectives of Reclamation are to be met.

We must meet the mandate from the people of the West. We have won support by aggressive and forward-looking programs. We cannot do less for the future. It is a challenge to us all. I know you will accept it.

You have my best wishes for a successful convention.

Sincerely yours,

J A Krug

Secretary of the Interior.

MR. HARRY E. POLK,
President, National Reclamation Association,
Oklahoma City, Oklahoma.

"Reclamation Revelations—1948-49"

Commissioner of Reclamation Michael W. Straus, speaking on Friday, November 19, before the Seventeenth Annual Convention of the National Reclamation Association which was held at Oklahoma City, Okla., last month, highlighted President Truman's request of the Eightieth Congress last August that the restrictions placed upon the Bureau of Reclamation be lifted, and the original budget requests be restored. The complete text of his address follows.

This is one speech I am really happy to make. Now that the turmoil and shouting of our quadrennial is quieting, I am glad to be with the National Reclamation Association here in Oklahoma and counsel with you again—for the sixth time. There is a report that I have to submit, and there are certain observations and recommendations that are worthy of attention by this organization of which I have been a member for many more years than I have been Reclamation Commissioner.

We have listened to a lot of fine speeches by a lot of personages who have appeared before the National Reclamation Association in the parade of passing years. And listening, I, like any of you, have always pondered the motives, the angles, the influences, and the interests behind the various views that these orators voiced. Certainly, I have never heretofore uttered to you a single word without calculation and hope that it might help win for Reclamation something that Reclamation needed—perhaps, some money from the Congress or some policy designed to benefit and protect Reclamation.

Today you meet on one of those joyous occasions when you need not rack your minds for a single moment on any such mystery as to motives. For the first time in the history of the National Reclamation Association, you are hearing a speech warranted in advance to be totally devoid of any self-interest. In fact, it is blessed with a special act of the Eightieth Congress intended to guarantee it to be a simon-pure 100 percent objective presentation.

The Question of Qualifications

This purity has been attained by a unique process purporting to establish prerequisite qualifications of a Commissioner of Reclamation on which there seems to be a state of mind that is something short of unanimity. The last time that this came up was a few years ago when an incoming administration under President Warren G. Harding decided that the essential qualification for Commissioner of Reclamation was that he must, under no circumstances, be an engineer. Therefore, my distinguished predecessor, Commissioner A. P. Davis, in whose honor the great Davis Dam rising on the main stem of the Colorado River has been named, was thrown out of office. Both he and his bosses stipulated in official writing that he was ousted because he was an engineer and the then-incoming administration knew that Reclamation must not have an engineer—a prejudice I do not share.

Against a parallel background, even including a fight in support of public power that Davis also advocated, I have recently been legislated out of office on the grounds that the vital requirement is that a Commissioner must, under no circumstances, be a nonengineer but must qualify as a professional engineer of 5 years' experience. At least under the present law—or until the Eighty-first Congress reviews the matter and decides otherwise, which is possible—no other brand of Commissioner can be paid for service between 12:01 a. m., February 1, and 12:01 a. m., July 1, 1949. Any lawyer, farmer, editor, or other nonengineering candidates for the job here assembled have only to sit tight until next July and, in the absence of further legislation by the next Congress, they will automatically then become eligible.

Regardless of the logic, if any, of all that and the history and the facts as you know them—and many do because certain of you participated in those exercises—we are all now fortunate in the assurance that one beneficial result is that you are sure to get today an objective presentation. This is no ventriloquist's performance. So, here goes and, instead of taking our text from Exodus (as a preacher might say) today we take our text from Revelations.

But before we get into certain matters of policy, some recommendations that I shall offer, and into discussions of problems with which our National Reclamation Association must meet, let me present to you Reclamation's annual report to the West.

Yardsticks for Construction Progress

Today you have a Reclamation program of unprecedented size, scope, variety, and vigor. We are all glad that it is no longer a little waif hanging around the Nation's back door and occasionally catching a crust. It now stands forth in its own right and speaks for itself. Reclamation has come of age. In doing so, it is emerging from some of the growing pains of adolescence. Let's slap a few yardsticks on it and see how it measures up.

By any yardstick applied, Reclamation has done more work in the last 12 months than in any other year of its half century of existence. And having done that, it has won as its reward an opportunity to do far more during the coming months—an opportunity backed by a $246,058,942 appropriation for the year we are now in—which appropriation, incidentally, has more strings tied on to it, making it harder to use effectively to advance Reclamation, than any other of record. If anyone is interested in mathematical computations or likes to play the numbers game, he can observe that this represents an increase of 270 percent over the average annual regular appropriations for the 10 previous years. And I say that will not be enough for next year—it will not even be enough to continue next year at full scale work which we are starting this year, let alone getting new, authorized and needed works into construction.

Appropriations are merely a Congressional yardstick which has come into popular use. Another measuring rod of the program is work for which funds were available and which Reclamation wanted done but which, for innumerable reasons, was not done—which is another way of describing carry-over funds. These, at the beginning of the fiscal year, were roughly around $31 million compared with $91 million the previous year and $110 million 2 years ago. That shows that we translated more of the dollars that the Nation provided into beneficial works than ever before. I forecast that we will get more work in place this year. We probably will also have a bigger carry-over of undone work due to the new fetters hobbling Reclamation which the Eightieth Congress wrote into appropriation acts.

For the benefit of those many who are myopic enough to see Reclamation only in the terms of construction, let's slap on a third yardstick and read it off in terms of contractors' earnings, which is one way of measuring the works we have built. On Reclamation as a whole, we completed $169 million worth of construction work or 88 percent of the $191 million program laid out in the 12 months preceding the current fiscal year. This was better than the prior year. It looks to me at the moment as if the total payments for work put in place will be still higher in the current year even though the percentage of completion of a bigger program may be less—thanks again to the tangle of provisos, limitations, and prohibitions that the last Congress clamped on the program and that the next Congress will be asked to strike off. Even so, Reclamation construction under contract today breaks all records with outstanding contracts of a value of about $400,000,000 with a lot more work ahead of the builders than there is behind them.

Construction and appropriation statistics, however, tell only half-truths in measuring anything as dynamic as Reclamation. This association should be less interested in staggering construction totals than it is in the real end results sought in terms of crops and kilowatts. So, let's put on a few more meters on what comes out at the far end.

Value of Crops and Kilowatts

Last year's census of crops produced with Federal irrigation water had a total value of $555 million, approximately $25 million over the previous year. Both construction and crops in dollars reflect inflation. But tonnages and acres don't. The tonnages and acres of Reclamation crops were up as well as the values. Each year, Reclamation registers a new record both in acres watered and in food produced per irrigated acre and in every other way. Stated in different words, the crops produced last year on land under Federal Reclamation water have a value approaching half the total investment of Uncle Sam in Reclamation during a half-century. That's a good return on anybody's money. But we have to do better because there are still a lot of hungry people around in this world—there will be for a long time.

Crops are only one thing produced by Reclamation. We don't put a dollar sign on homes, communities, towns, or cities developed or on the recreational, fish and wildlife, and other benefits. But we do run Reclamation's kilowatts through the cash register. Last year power sales approximated $25 million—cash revenue that helps pay for water, and well up from previous years. That also has got to be better because the lights are still going out around the West. The kilowatts to meet your needs are not yet available—power shortages are getting worse not better—a fact that responsible citizens might remember during these ideological power debates.

I am glad to be able to tell you that the Bureau staffs are right now aggressively shoving the Reclamation program on every front in each of the 17 Western States and doing it against a handicap of an irrational requirement of having less men do far more work than has ever been required of Reclamation heretofore. I have never seen such a splendid staff. You're lucky to have them. It's time this Association recognized them.

Repairs, Repayment, and Ratification

Likewise, in the last 12 months since I have met with you, while a lot of difficulties have not been overcome, a lot have—items that have been drifting for years despite everybody's efforts. Rehabilitation and repairs on Reclamation works which were passed over in war years, with resultant deteriorating canals and weed-grown ditches, are now coming under control. Great structures that have not had the attention and inspection they merit have been brought under strict and scheduled surveillance and inspection. Unrealistic repayment contracts are being revised and brought down to earth. A lot of overdue payments have been made. Certain liberalizations in Reclamation law have been achieved and the way paved for more liberal repayment legislation.

And important agreements have been reached. Outstanding in this category is the achievement of the five Upper Colorado River Basin States—Utah, Wyoming, Colorado, Arizona, and New Mexico—which have, by their own determination aided by the good offices of Reclamation, finally after better than a quarter of a century of wrangling, reached an agreement on what water is whose in the Upper Colorado River Basin. Ratification by those five State Legislatures and consent by the 81st Congress of the United States will permit vast Reclamation development to proceed so that the Upper Colorado River Basin may reach its rendezvous with a rightful destiny.

So much for Reclamation's report. That record is written. Nothing can change it. More recently, Reclamation has been, I was delighted to observe, a major issue in a major political campaign. I happen to be a firm believer in such discussions and like to see the light let in. Every time the spotlight focuses on Reclamation, it benefits. Certainly, these last few months have been marked by examination of the record followed by competition among the candidates to outpledge each other in their devotion to Reclamation. For months now, it has been standard practice that whenever a speech writer got west of the Mississippi River he outdid himself with new-found proclamations of devotion to resource development and Reclamation. The campaign chorus is now over and only the melody lingers on. It was sweet music that was played but the West appears to have detected a few false notes for—at least according to the election returns—it made many changes in the orchestra and told it to follow the tune of the conductor.

The Eightieth Congress

You and Reclamation have a nice problem starting in January with the Eightieth-first Congress as to how the West is going to fare, but I think that on the President's record of performance instead of promise the West will fare quite well. It is no secret that in justifying this year's money before the Eightieth Congress I reported that a sum approaching half a billion dollars would be required next year to carry forward the program that has already been undertaken. During his campaign the President was specific both in his appraisal of Reclamation needs and policies and his views have been ratified.

Your fate was in the hands and under the control of the eastern majority. It is not only the money but also the basic policies and whole fundamental concept of Reclamation that were passing increasingly from western groups under control exercised or imposed primarily in appropriation bills under a variety of disguises. The result of this Appropriations Committee policy control is not a matter of opinion. And it was a mathematical fact that the 17 reclamation States were outvoted in the Eightieth Congress House appropriation groups 3 to 1.

In that Congress, your western groups took some punishment. It made little difference what policies the western Public Lands Committee or the Irrigation Subcommittee decided upon, the Appropriations Committees revised them or reversed them as suited their purpose. Sometimes they merely nullified previous western determinations as, for example, striking out of projects transmission lines that the communities wanted and which the Congress had authorized. Sometimes whole policies were thus reversed, aided and abetted by national lobbies under eastern domination. And this was not confined to projects now under construction, but it went back to laws of long standing upon which you relied. By direct or indirect action, they, through the same process, were reversed without any real consideration. This was done when by imposing an arbitrary personal services limitation on Reclamation staffs, whether or not they are paid by appropriated federal funds or water users' funds, the staffs were so butchered that irrigation districts found they have to take over operations which they had relied on the Bureau to perform after paying for such performance. The

(Continued on page 239)

FARMING FROM THE SKY

Applying commercial fertilizer to a rice paddy near Durham, Calif. Man in foreground waves flag to direct application of fertilizer. Photo by J. E. Fluharty, Region II.

By JOHN A. McKEAG,

Delta District, Region II, Sacramento, Calif.

"Remember dear, fly **low** and fly **slow**," the nervous mother cautions her pilot son in the old airmen's jest. Her advice has been ignored by most aeronautical researchers in their fight to lick the speed of sound. But it is the motto, the hope and the goal of a small, ill-financed band of resourceful mechanics, farmers, agricultural engineers, and scientists who have been struggling for years along a divergent research path, a path that leads away from man-made meteors and toward an airplane that will be an efficient, all-purpose farm tool. Their odd goal is an aircraft that will just barely jog up and down a field, 5 feet off the ground, making a neat 90° turn at each corner. The final end of their research may sometime be an all-purpose rig that can move along above any 40 acres, sowing, fertilizing, fighting weeds and insect pests efficiently, all the while managing not to kill the neighbors' crops, cows, and bees with drifting sprays: a machine that may even, on occasion, rise up and snatch a needed shower from a passing cloud.

After some 30 years of work (the first recorded use of an airplane in pest control was that of an old Hisso Jenny spraying lead arsenate on catalpa trees in Dayton, Ohio, in 1921) combatting pests with aircraft has become quite a fair-sized enterprise. In 1939 there were about 200 airplanes in the whole country doing such work, but on a scale less modest than their small number would indicate. For that year saw 223,000 acres of crop and range lands, growing some 25 different crops, assailed by 20 different pests, treated with 15 different insecticides and fungicides in California alone. Growth has been great since then with no less than 75 different companies now operating in that single State, some following crops from the Oregon line to the Mexican border. But the picture of their operations is still much as it was years ago—an old trainer rumbling up a field, spouting dust or spray, banking perilously to avoid a power line at the far end, then coming back down at 80 miles per hour, 8 to 15 feet off the ground. Pilots have learned much about the effects of climatic conditions—humidity, air currents, and temperatures, and they know how to time the best applications. However, in using dust especially, an occasional and unexpected "ill wind" will create a hazard by causing the material to drift. As much as 70 or 80 percent of the material, in certain cases, may be lost by drifting off the area being treated. And it sometimes settles where it will do more harm than good. Recent news stories allege a 15-mile damaging drift of 2,4-D spray in the San Joaquin Valley.

Typical spray-planes are small bi-wing types, but with 250 to 400 horsepower engines. These large power plants are necessary because spray rigs fly very low (the general idea being that if the spray does not kill the weeds, they will die from fright), and must be able to lift 100 to 200 gallons of material (800 to 2000 lbs.) suddenly over the power lines, trees, ditch banks, and buildings which often crowd the end of the short runs.

In general, there are about as many types of applicators as there are airplanes applying spray material or dusts. Three of the many types used are shown in the accompanying photos.

One is an ingenious device which uses a spinning wire brush powered by an airdriven fan on the leading edge of the wing. The solution is gravity-fed down a hollow shaft and is dispersed in droplet size by the propeller slip stream when spun off the brush. The rate of application is valve-controlled, usually at each brush, for instantaneous shutoff is necessary.

The other systems shown are of the "long boom" type, with nozzles spaced at about 12″ centers along the boom. In contrast to these, there are many "short boom" types, 6 to 8 feet long, in use. The blast from the airplane propeller and turbulence from the wing tips act as an added disperser to the sprays, also stirring up the air around the plants to the point where a very satisfactory coverage of all surfaces is achieved without the excessive use of spray or high pressures which are necessary with ground equipment sprays in the quiet morning air.

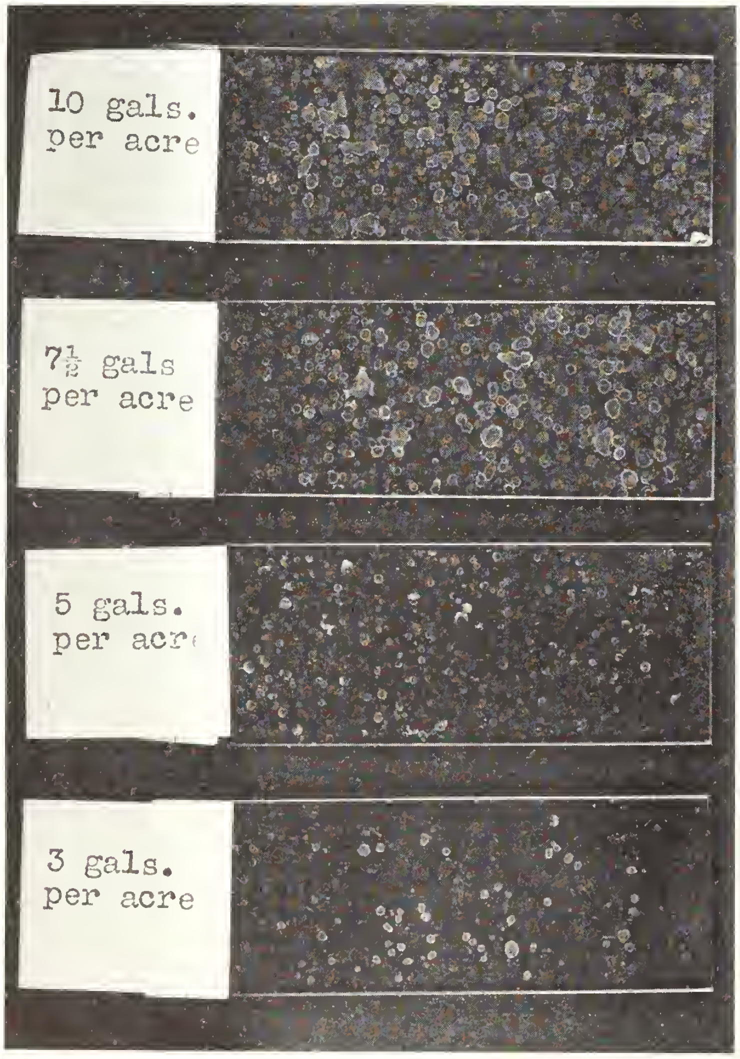
Size of Droplets Important

Droplet size of material sprayed from airplanes is of primary importance. Some materials, such as selective herbicides for controlling weeds in crops, seem to be more effective when applied as coarse sprays. This is fortunate because airplanes must produce droplets larger than those from ground machines to prevent excessive drifting and to prevent evaporation of water-diluted sprays before the desired surface is reached. Insecticides usually give a more uniform and effective deposit when atomized to smaller droplet size.

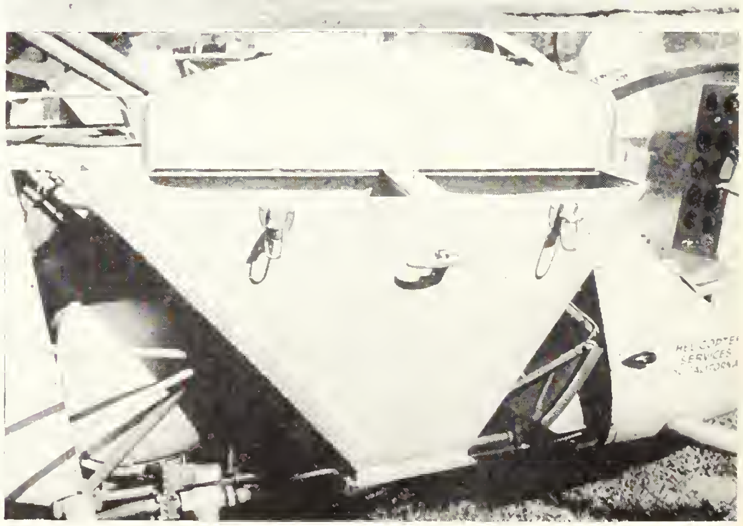
The accompanying photograph shows how the number of spray droplets are determined in field tests. The glass slides, placed in a field at the time of spraying, show the number of droplets per square inch at various rates of material per acre. The minimum effective dosage indicated by the slides for the test was five gallons per acre. The three-gallon application did not give sufficient coverage of spray material.

Pressure-developing devices are as numerous as applicator types. There are gravity systems, those powered by air-driven fans mounted between the wheels, some of which are gear-operated off engines. Those powered by air-driven fans are generally considered to be the best. Pressures used vary widely, from a few pounds per square inch to slightly over 100 pounds.

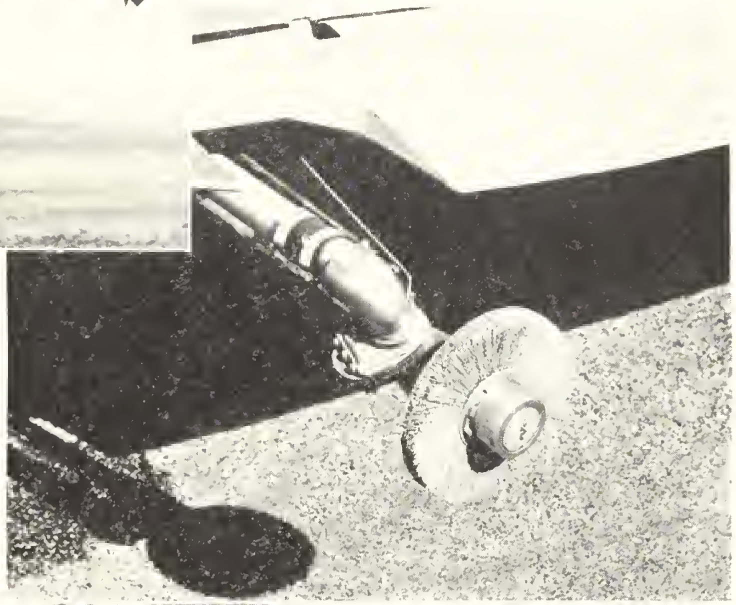
Insect-control was the first farm job undertaken by airplane. Spreading of herbicides for weed control is growing. Selective sprays, primarily 2, 4-D, are those most used. This type of spray is ideally suited for dissemination by airplane because of the low volume of material required—only 2½ to 6 gallons per acre. Airplane dusting, however, is losing favor in California because it is so much more difficult to control drift of dusts than liquid sprays, and progress in the development of sprays that can be applied in low volumes has increased their usability. Use of general contact sprays has been limited because of the relatively high

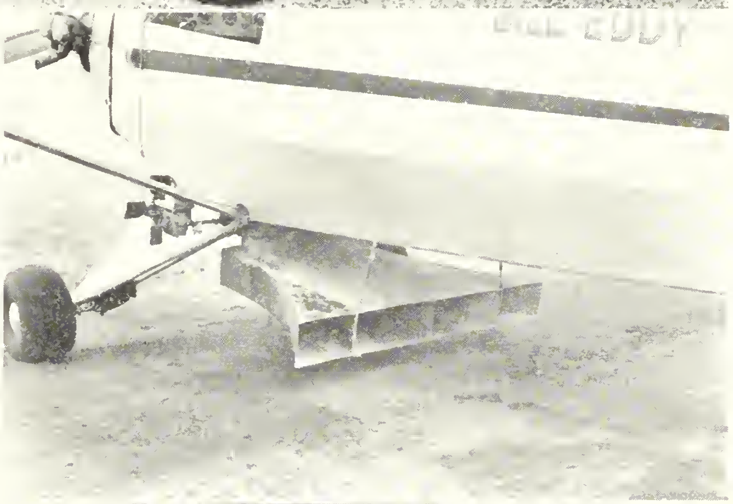


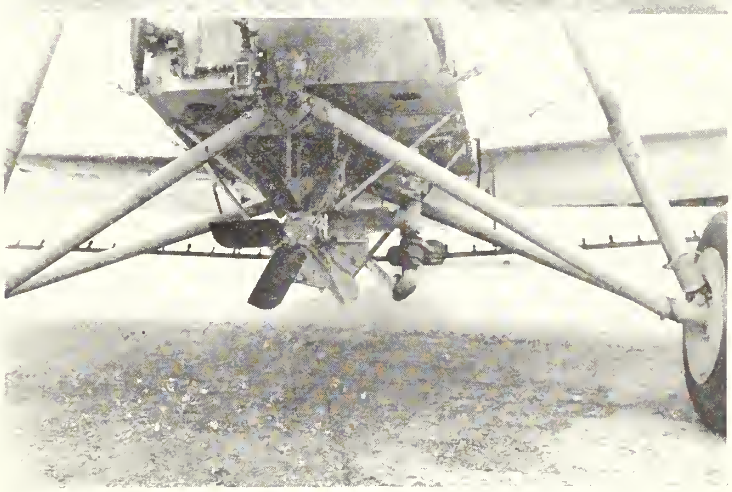
At left: Slides showing number of 2, 4–D droplets sprayed from plane at different dosage rates per acre. Below: Helicopter lands for refill on mountain meadow, inaccessible to ordinary plane. Bottom photo: Spray hopper on side of helicopter fuselage. *All photos courtesy State of California Department of Agriculture.*



At left: Airplane equipped with brush type spray applicators in operation. Below: Close-up view of brush spray applicator. Below center: Side view of "venturi" type spreader showing outlet of spreader and small square bladed propeller in background which drives dust agitator. At bottom: Front view of airplane equipped for weed control by means of chemical spray. The wind-driven impeller beneath the fuselage is connected to the feed pump. *Two top photos furnished by W. A. Harvey, University of California. Center and bottom photos by A. J. Burrows, Region II.*







volume of oils required per acre. An application of 30 gallons per acre is considered the upper economic limit for most airplane spraying. However, newly developed chemicals needing only 14 to 15 gallons of solution per acre are being successfully used on alfalfa, onions, peas, and other crops to which such selective sprays are suited. Weed control on cropped lands has been so successful that tests are now being made to determine the feasibility of spraying brush-infested range lands. Early results indicate the practice might be quite successful, with costs perhaps no more than $6 per acre.

Costs for airplane spraying are dependent upon several factors, principal of which is volume, or weight. Liquid sprays are applied for about 30 cents a gallon; dusts at 4 to 5 cents a pound. Indeterminate jobs are charged at a rate of about $60 an hour flying time. Other factors that determine spraying costs are distance to airfield or landing strip, size and shape of area to be flown, insurance rates, and any laws or local ordinances that prevail in the area. Keen competition between different companies is also an important factor. Average cost of applying spray to grain fields ranges from $1.25 to $1.50 per acre.

Use of airplanes to speed up and improve farm practices aside from insect and weed control is gaining ground steadily. Rice has been planted by plane for a long time with great success, for the heavy kernels zip right down through the water into the mud beneath with very little wastage. Other grains and grass seeds have been planted from the sky more recently and with less success. Grass seed, in particular, is very difficult because its extreme fineness and light weight make it necessary to mix such inert matter into the hopper just to get the seed to feed economically. The field is wide open for the development of "pelleting" light seeds and seeds that are to be sown in dry ground, to bring this practice to greater efficiency. Some work along this line has been done with tree seeds, in an attempt to reforest large areas, a very expensive process by usual means, but success has been small.

Fertilizing rice paddies from the air is already common practice (see picture). Water-covered rice was a "natural" for this type of operation, and it will probably be not too difficult to extend it to other field crops, but the exact placement of fertilizer necessary for row crops seems to leave them out of the picture.

Aircraft are exceptionally well suited to intercept invasions of grasshoppers, leaf hoppers, and crickets before they reach crop areas. These have been bombed from the air on several occasions with RAF vs. Luftwaffe success.

The most recent and spectacular use of aircraft, of course, has been the series of assaults on potential rain clouds which have made the mistake of tantalizing drought-stricken areas. There is no overwhelming technical reason why this may not be successful in certain places at certain times, but the Bureau of Reclamation is still planning to build dams as a stop-gap measure.

"Aircraft," of course, includes helicopters as well as airplanes. Helicopters more nearly meet the ideal of a machine that can fly very low and very slow. They are much safer than airplanes when operating in small fields bounded by power lines or buildings, and they can confine their spray more nearly to the area they are supposed to cover. The down-wash from the machine's rotor drives the spray into vegetation and at the same time spreads a wider swath. Helicopters can land at the field being treated, thus cutting down the added expense of an airplane's ferrying time.

Even though their original cost is higher, helicopter application of weed control materials is less expensive. By flying slower, there is less drift, and less gallonage is required to cover the same area.

At present, weed and pest control by airplane has proved itself on field crops, on canals, and irrigation ditches. But the very real problems presented by drifting toxic dusts and sprays, often carried upward from the quiet air near the ground into cross currents by the very turbulence which helps so much to spread them over plants, the difficulties and dangers of operations in close quarters, etc., has limited their usefulness in specialty-crop small-farm areas. These are the areas which could use them best. The possibility of thoroughgoing aircraft use would be a great boon to the family-size farm. It would make it unnecessary for the individual farmer to purchase a variety of expensive equipment for special jobs which have to be done in a hurry. With the cost of such work done by aircraft spread over a whole township of small farms, per acre costs would be as low as on the most efficient larger operation.

In fact, the difficult problems listed above have been responsible for the adoption of restrictive ordinances in airplane spraying with certain forms of chemicals. Careless applications have also been responsible for restrictive measures.

As a result of damage to susceptible crops from drifting chemicals in the last 2 or 3 years, the Civil Aeronautics Administrator now prohibits the use of 2,4-D dusts from airplanes. Indications are that there will be further restrictions placed on the use of this and other chemicals that cannot be controlled completely at the present time from airplanes.

This program of stern restriction indicates the need for research. There has been very little accomplished in a coordinated program of research on the problems involved in the use of this most imaginative, yet most practical of farming methods. Most of the drawbacks to these methods have been far outweighed by the substantial advantages of airplane work:

- speed and thus timeliness of application;
- independence of soil surface condition, which often prevents the use of ground equipment at the time when spraying is needed;
- thorough coverage without damage to the plant, possible because the turbulence in the air swishes any mixture around the plant instead of fire-hosing it against foliage and stems;
- complete lack of the mechanical damage to the crop which must always come from even the most careful use of wheeled equipment;
- reduction of labor time and equipment cost.

With further refinements in technique and equipment, wide use of airplanes could certainly save American farmers each year as much as a whole large scale research program would cost.

THE END.

EDITOR'S NOTE: The above article has drawn heavily on the work of O. C. French and F. A. Brooks of the University of California. Mr. French's "Use of the Airplane for Pest Control" (Agricultural Engineering, June 1947) is an excellent over-all descriptive survey. Mr. Brook's "The Drifting of Poisonous Dusts Applied by Airplanes and Land Rigs," in the same issue, is an important report on work which has pretty well defined the best particle size to prevent excessive drifting, and should thus serve as the basis for redesigning many types of dusting rigs now in use.

"VEX" VERDICT

Ole Man River Must Go To Work—By Order of the Court

Here is part of a 1928 court decision rendered by a county judge in Walla Walla County, Wash., ruling against the riparian rights principle. It was sent to the RECLAMATION ERA by Charles Cone, Columbia Basin Commission.

Furthermore, the necessity for, and the benefits accruing from irrigation in the arid West in this utilitarian age have resulted in the abrogation of the Old English view of riparian rights.

The doctrine that a riparian owner was entitled to have the stream flow by his door unvexed and undiminished even though he made no use of the water except to observe its beauty and listen to its babble, has been badly shattered by the materialistic courts of the far West.

Even our own Supreme Court, as sordid and unpoetical as such a doctrine may seem, has adopted the view in late decisions, that water is better employed growing onions and alfalfa than by reflecting the beauty of the moon while singing its way unvexed to the sea. Decision made on May 8, 1928, by E. V. Kuykendall, Superior Judge, County of Walla Walla, in the case of the *State of Washington* v. *Charles Achermann et al.*

The Low-Down on Ground Water

By HARRIS R. McDONALD,

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Ground-water conditions vary in different areas, and there are a few facts about ground water, deep-well irrigation and pumping that are often misunderstood.

For example, I was working on a ground-water investigation down in Arizona a few years ago, in an area where wells are extremely scarce, and I espied a little shack about half a mile off the road. So I drove over there. There was an old man sitting on the steps, and I asked him if he had a well. He says, "No, sir, I don't, but if you are interested in wells, come with me." So he went in the house and came out with a cigar box. He opened the lid, I looked in the box, and saw some Mexican jumping beans. The old man started walking off, and said, "Watch those beans." Pretty soon, he stopped suddenly, made a mark on the ground with his foot and said, "See those beans. They're jumping like all get out." And they were, too. They were really jumping around in there. He said, "Mister, we're standing over a pool of oil." Well, I didn't get the connection between the beans jumping and the pool of oil, but it was useless to try to convince him that his chances of getting oil there were pretty slim.

This illustrates the superstition that is commonly associated with phenomena that are not understood by the observer. There are several thousand dollars spent each year trying to locate water in similar fashions. For instance, the willow twig, called a "witching stick." Those who use it are called "water witchers." One is supposed to hold it in a certain manner, and of course, it always helps if you can assume a stance that looks as if you are communicating with a supernatural power. The supposition is that you walk around, and when you get over a vein of water the twig is supposed to dip down. The only trouble with this method is that when I hold it, the twig always pops up and hits me in the face. Of course, it is only a twig, and it has no knowledge of where the water is. I don't mean to infer that everyone who uses these sticks are intentional deceivers, but I do think that a large group of professional water witchers are deliberately defrauding the public. Back in the sixteenth and seventeenth centuries this stick was used to locate not only water, but gold and silver and other valuable minerals.

Let us not confuse these tricks with the modern methods of geophysical prospecting. In connection with the search for oil deposits, a number of different geophysical methods have been developed that are based on scientific facts. Perhaps you have heard of the magnetic airborne detector, that was developed by the Navy and the Geological Survey durthe the war to locate enemy submarines. This instrument operates on the principle that different geological formations, will affect the magnetic intensity of the earth. This instrument is carried on the end of a cable which is attached to an airplane. The airplane is flown at a constant altitude above ground level with the aid of a radar altimeter, and the automatic recording instruments inside the plane record the changes in magnetic intensity as this instrument is carried over the earth. A while back we made a survey of 240 square miles with that instrument in about two hours. By ground methods that would have taken about 140 days, and the cost would have been much greater.

Now there is an old saying that you never miss the water until the well runs dry. I think that statement is probably more true today than ever before, not only with individual wells but with the great underground reservoirs which constitute our ground-water resources. The requirements for water of the early settlers in the arid and semiarid regions of the West were confined largely to domestic and stock-water supplies. There was no question of legal rights or quantitative supply involved. But as we started to irrigate and use the surface run-off from our streams, there came a time when there wasn't enough water to go around, and some enterprising farmer dug a well, put in a pump, and started to irrigate. That was so successful that now almost every State in the West has some irrigation.

Ground water is adapted to municipal and industrial uses, particularly. The bacteria content of the ground water is usually low enough that it requires no treatment for human consumption. Another reason that ground water is adapted for these purposes is its constant temperature. Certain industries such as distilleries require cool water for condensing purposes. During the war the alcohol distilleries in Louisville, Ky., were used to manufacture alcohol for making synthetic rubber, and they had been pumping so much water there that they had depleted their ground water reservoir. An investigation there resulted in the diversion of treated surface water in the wintertime into the same wells from which water was pumped in the summertime for condensing purposes. That is, the temperature of the surface water in the summertime was so high that it couldn't be used for condensing purposes.

We realized then, with increased use of ground water, that our supply was limited and that the amount could be used only as it was replenished. This has led to ground water laws in a number of our Western States, including New Mexico, Utah, Washington, and Arizona. Several of our Western States have ground water laws which limit pumping in areas where the supply is not sufficient for the demand.

Another thing about ground water that is often misunderstood is the rate of movement. The velocity of ground water may be determined in a number of ways—sometimes by using salt, or dyes like Fluorscein. If you drop a speck of Fluorscein about as big as a pinhead into a glass of water it will fluoresce. If you let the ultraviolet light strike that for a while and bring it into a dark room, it will glow. It is practically impossible to remove this dye by filtering and it can be recognized in a solution of one part dye to ten billion parts of water. Another method of determining velocity is by pumping tests. By pumping tests we can determine the physical characteristics of the water-bearing material and compute the velocity. The average velocity found in nature is around 2 or 3 feet a day. Of course, there are exceptions such as cavernous limestone, fractured rock, or very coarse gravel, where velocities might run higher than that.

There was once a man who had a dug well, and said, "I struck my water in this well at 8 feet, and the water is flowing from the east side over to the west side." When asked how he knew it was moving that way, he replied, "When leaves fall down in there, they all collect over on the west side." He may have been right, but I suspect that the movements of air had more to do with the movement of those leaves than the movement of the water did.

You all may have heard the statement, "my water is 99 percent pure." From the standpoint of mineral solids, purity of water is usually stated in parts per million, and if water were 99 percent pure, that would mean it contained 1 percent of impurities. One percent of a million is 10,000, and no one would want to drink water that contained 10,000 parts per million of, for example, common table salt. And, of course, the same thing holds true from the bacteriological standpoint.

Here are a few practical points about well drilling and pumping. The first thing a person wants to know, of course, is where to drill a well. The best source of information is a reliable local well driller. These fellows have built up a great backlog of experience. They are familiar with the water-bearing formations, and very often they can tell you whether your chances are good or not of getting a good well in the area. Of course, nobody can be sure, but if he indicates that the chances are not very good that you will get a good well there, then it might be well to ask your county agent if there are any water supply bulletins out for that area. Sometimes these are very helpful.

Now there are two commonly used methods of drilling wells—cable tools and rotary. Cable tools are, just as the name implies, tools on the end of a cable, and I'm sure you have all seen wells drilled by that method. Every driller has his preference. Usually in shallow wells, they'll use a cable tool rig if they have one handy, because it is quicker to set up. In rotary drilling, the mud is circulated through the hollow drill stem, pumped down into the ground, and it brings up the drill cuttings. Then the heavy drill cuttings are allowed to settle out, and the mud is recirculated. In rotary drilling the casing usually is not put in until the drill hole is finished. That is one of the advantages of rotary, and it's fairly rapid unless you get loose boulders or something else that slows you up.

Many drillers will take great care in drilling a well, but they will pay very little attention to the development of it, but well development is just as important as well drilling. You might have a good hole, but if you cannot get water out of it, it is not of much use to anyone. Well development means the formation of a natural or artificial gravel pack around the screen or casing. Obviously, you have to remove the fine particles in the gravel surrounding the screen before

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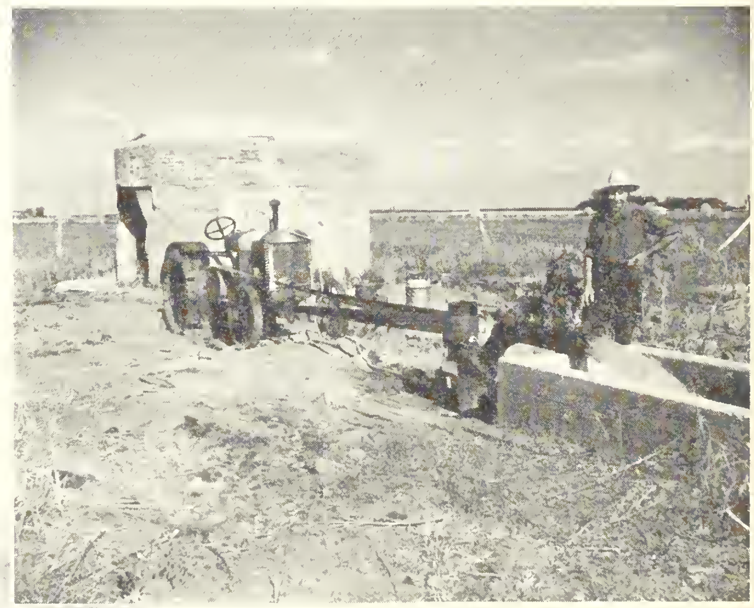
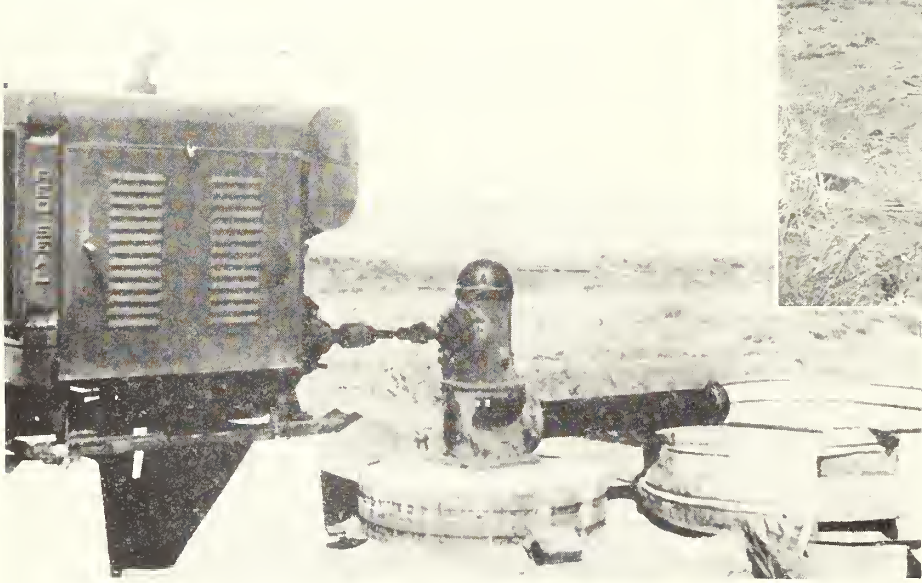


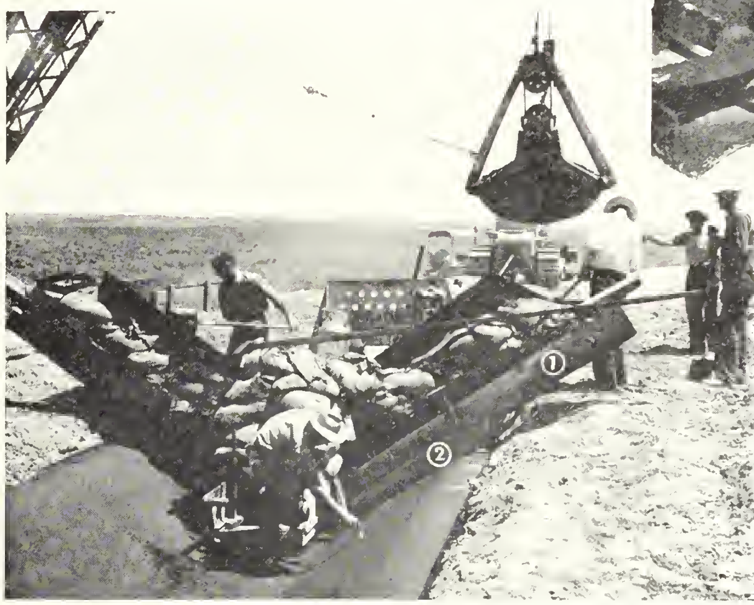


Left: Underground water irrigation pump, powered by natural gas, is located northeast of Goodland, Kans. Above: Darrel Bower, Ainsworth, Nebr., watching irrigation pump (note power source). Water is used to irrigate corn.

Asphalt Linings for Irrigation Canals

By HARRY M. SULT,

General Engineer, Office of Programs and Finance, Washington, D. C.



Above: Inside the asphalt lining machine, showing operators guiding the asphalt mix into the pan below the strike-off blades (1). The cable (2) is also shown. At left: In the wake of the paver, showing the other side of the screeds, or strike-off blades (1), and the hot irons (2) used to give a surface seal. *Both photos by A. F. Swanson, Columbia Basin project.*

Asphaltic concrete—the material which paves many of America's highways—may some day play a very important part in the future irrigation development of the West.

For a number of years the Bureau of Reclamation has been experimenting with various materials in a search for a dependable, durable and low-cost canal lining for the many hundreds of miles of unlined canals in the West. About 20 percent of the irrigation water which flows through these unlined canals is lost through seepage. That much water is worth saving, and bituminous materials are among those which are being given on-the-job tests in water conservation.

The potentialities of bituminous materials were fully appreciated when the Bureau recently completed a large canal construction project on the Pasco lateral system of the Columbia Basin project in Washington. This was in reality a gigantic large scale laboratory where several different types of lining were installed for the purpose of obtaining comparative data on efficiency, durability and cost under climatic conditions encountered in that area.

Much of the work involved placing about 86,000 square yards of 2-inch thick asphaltic concrete lining very similar in design, mix and placing to that used for asphaltic concrete highways.

Although a variety of bituminous linings have been under study during recent years, the five major types are as follows:

1. Linings constructed by mixing, either hot or cold, as in highway construction.
2. Bituminous membranes sprayed onto the canal subgrade.
3. Bituminous membranes sprayed on the subgrade and covered with about 18 inches of earth.
4. Prefabricated linings of asphaltic mixes on various mineral or vegetable fabrics.
5. Pneumatically applied asphalt.

Of all these, the hot mix lining is believed to offer the best possibilities. When properly designed and installed it is relatively impermeable, is resistant to cracking, offers low resistance to the flow of water and is resistant to mechanical injury by animals, erosion or canal cleaning equipment—all desirable characteristics in a canal lining. Perhaps of greater importance, it is adaptable to highly mechanized methods.

Asphaltic concrete linings are now being designed for workability of the mix, impermeability of the compacted material, resistance to weed growth and water action, and necessary strength to withstand slope pressures.

Just as in asphaltic concrete highway construction, the workability of the mix is particularly important in canal construction, as the density and strength of the finished product depends upon this characteristic. In turn, the permeability of an asphaltic concrete slab depends upon the density of the compacted material. Workability is of double importance in canal construction which requires more difficult and complex handling and placing operations than those involved in paving a flat surface.

Present practices indicate that a well-graded aggregate not exceeding three-quarter inch maximum size, but graded to fine rather than coarse, will permit a mix having the necessary workability. Adjustments of the mix during actual operations are usually required to achieve and maintain the optimum workability.

To be economically justifiable, any canal lining should have relative impermeability to water. Laboratory tests have indicated that an asphaltic concrete lining with proper design of the mix for workability, and with sufficient compaction to reduce the air voids in the compacted lining to less than 5 percent, will approach this standard. Such a high degree of compaction has been extremely difficult to achieve, and it has been the practice to apply a surface seal of asphaltic material to increase the impermeability of the lining. However, it has been found that in general such a surface seal reduces the resistance of the lining to a particular form of erosion which results from the drying and curling of the silt layer which usually forms on a canal surface. The curling of this mud film lifts and displaces the top layer of the lining.

Another factor that is important in the design of asphaltic mixes for canal lining is the resistance of the mix to what is called "stripping" action, in which the asphalt material is displaced from the aggregate itself. Where laboratory tests show possibilities of stripping, a new source of aggregates should be located or a commercially available anti-stripping agent should be employed in the mix.

Weeds Menace Asphalt

One of the greatest drawbacks to the extended use of asphaltic canal linings is their susceptibility to damage by weeds. A great variety of weeds, when germinated under an asphaltic surface, are fully capable of penetrating two inches of normally designed asphaltic concrete material. While the resistance of canal linings to this form of damage can be increased through the use of harder asphaltic cements, greater compaction, leaner mixes, and very dense aggregate gradation, sterilization of the subgrade is generally the only answer.

A number of different materials, such as sodium chlorate, borax and other borates, boric acids and other compounds of borans have been employed for soil sterilization but have not proven entirely satisfactory over a relatively long period of time. At present, experiments are being made with various compounds which are formed through the catalytic cracking of petroleum products, and these materials appear to offer considerable promise of providing a satisfactory solution to this problem.

Field experience has proven that a 1½ to 1 side slope is the steepest that should be employed, if sagging or flow of the asphaltic lining is to be avoided. Also, to prevent or minimize "heaving" or "blow-outs" at the junction of the side slopes and the base slab, the canal cross-section should be designed with a curved transition surface between the sides and the base. Present Bureau of Reclamation practices require an 18-inch radius at this point with a larger radius favored where possible.

The construction on the Pasco Lateral System was outstanding not only because it constituted a large outdoor laboratory for comparative studies on several types of linings under actual field conditions but also because a concerted effort was made to develop and use efficient mechanized equipment, particularly with respect to the asphaltic concrete lining. Specifications called for spreading, shaping and compacting the asphaltic concrete with a power-operated machine capable of producing a lining meeting the requirements.

The contractors used more or less conventional equipment for excavating and trimming the canal section and installing both the concrete and pneumatically applied mortar linings. However, they used a radically new machine for placing the asphaltic concrete lining. After making several field alterations and improvements, they were able to produce a lining which more than met the specification requirements.

This lining machine, called a "Canal Paver," was made to order for this job by an iron work company located at Huntington Park, Calif., and was designed so that the entire cross section of the canal could be paved in one operation.

Basically, the canal paver consisted of a large guide sled or "pan" with vertical strike-off blades attached to the rear. The guide pan, shaped to fit the canal cross section, rode upon the trimmed subgrade and furnished the necessary stability for placing a lining of uniform thickness. The strike-off blades, also in the shape of the canal cross section, were attached to the guide pan by means of iron beams which left an open area between the blades and the pan where the asphaltic mix could be dumped directly upon the subgrade ahead of the blades.

Hot screeds, heated by butane gas, rode directly in back of the strike-off blades, to which they were attached. At first, the machine was equipped with rollers, also attached to the strike-off blades, to compact the lining. A gasoline motor-powered winch, mounted on the guide pan, pulled the machine forward by means of a cable anchored to a deadman ahead of the machine.

Later on, the contractors decided to remove the rollers, which were scuffing and marking the lining. In addition, a flat plate was welded between the leading edge of the hot screeds and the leading edge of the strike-off blades, resulting in a short slipform. The hot screeds were then loaded with sand bags to obtain the necessary compaction. These alterations were both gratifying and startling, resulting in so dense and well finished a lining that Bureau engineers decided it was no longer necessary to apply a seal coat, except in localized areas where the lining was scuffed or damaged, and therefore this requirement was eliminated.

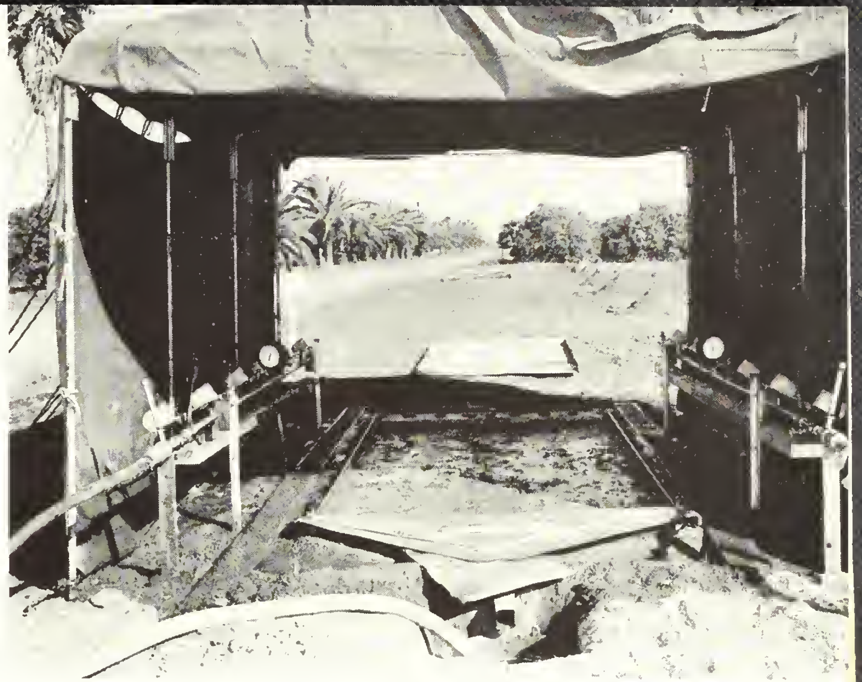
Another elimination was that of permanently sterilizing the subgrade—generally considered essential to the success of an asphaltic lining. This operation was omitted, in all but a few areas, because of the rather sterile soil encountered in the Pasco area, and the relatively high cost of sterilization. The exceptions which were made involved a few short lengths where the subgrade was sterilized to permit making com-

(Continued on page 244)

Reclamation Rain

By CHARLES R. MAIERHOFER,

Acting Chief, Drainage Division, Branch of Design and Construction, Denver, Colo.



Infiltrometer in operation. Nozzle hoods are raised, permitting "rain" to fall on the plot, but the run-off has not started. Rainfall intensity is 3.46 inches per hour. Calibration pan in the background. Ends of tent open to permit photo.

The Bureau of Reclamation has kept its eye on recent developments in rainmaking, but so far it has not seen fit to supplant nature's way of relieving thirsty lands. Neither does the Bureau, by producing rain artificially, expect to be able to substitute an airplane and dry ice for canals and reservoirs.

There have recently been circumstances, however, where artificial rainstorms were necessary in order to solve a fundamental drainage problem. This occurred on the Bureau's big Valley Gravity project in the semitropical southern tip of Texas. It seemed unlikely to us that nature would cooperate to the extent of delivering a storm of the proper magnitude even in the length of time required for a Reclamation engineer with four children, pets, and a mother-in-law, to rent a six-room house for $25—this is dry country! When we water lawns and wash cars the city water pressure drops from 55 to 15 pounds p. s. i. (pounds per square inch) and we have to call on Mexico, just across the Rio Grande, for water out of its reservoirs.

This is the land of mañana, and for many things we just have to wait until they happen, but not on this problem. Unreasonable as it may seem, we had to find a quicker way to get the answer than to wait 10 years for a storm, living off the taxpayers in the meantime. Seriously, we were as anxious as the next man to get the answer, because it was urgently needed for project cost estimates—and this is no climate in which to spend 10 years waiting. (Summers last 9 months; the other 3 we wear neckties.)

At this point, a summary of conditions leading to this urgent need for the storm might be worth while.

The major consideration with respect to the drainage phases of the project is a comprehensive system of outlet drains. During the 50 years that project lands have been irrigated, a high water table and the increasing salt content within the root zone which usually accompanies it, have taken over hundreds of thousands of acres of once fine lands and rendered them almost unproductive of the high value crops to which they were once so well adapted. To reclaim and protect such lands requires, among other things, many ditches to lead the saline groundwaters out of the soil and eastward to the Gulf of Mexico. It wouldn't require a very large ditch to carry this subsurface water but, whether we like it or not, when it rains these ditches are called on to carry stormwaters also, brought them by lateral and farm drains from about 1,000,000 acres of land. When it does rain, it is really a good one. A 10-year storm, or storm which can be expected to occur on an average of once every 10 years, is about 6 inches in 12 hours and a great part of it falls in the first few hours. Of course, all of this water doesn't find its way into the drains immediately. If it did the problem would be simple. The drains would have to be so large that they would be economically infeasible to build, and the Bureau would not be able to build them. What happens when it rains is that some water infiltrates into the soil, some evaporates, and a good slug of it runs down hill. This part of the rainstorm that doesn't go into the soil, but runs overland to the nearest ditch is the portion that made us lose sleep. We simply didn't know how much of it there would be to cause flood damage downstream if we built the drains too small.

Anyone who has had to design a drainage ditch knows that existing formulas for determining storm run-off are a dime a dozen and each gives a different answer. The problem here, then, was to predict accurately the amount of run-off to be expected from a storm of a given magnitude. A guess or formula used in other areas just wouldn't do, because if the system were built too large the cost would be prohibitive, and if too small, flood damage might be tremendous and we'd have the property owners on our necks.

After considerable scratching of heads we got in a huddle with the high I. Q. boys from Denver and the Regional Office and came out with the conclusion that we must create our own storm. To further complicate matters, local soils are so variable that just one storm wouldn't do the job. There had to be over fifty storms! The obvious answer, then, was a rainmaking machine which could be moved around over the different soil types and one with which we could conjure up any kind of a storm at will, even to the tropical hurricanes which sometimes visit us. We tried the nearest hardware store but they didn't have such a gadget handy, due to the steel strike; so, after more discussion and further unsuccessful attempts to find one by the red tape method of borrowing from another Government agency, which didn't have one anyway, but didn't know it at the time, the Boss put the squeeze on and said we'd have to build one. Well, most of us knew as much about building a rainmaker as we did about putting a porcelain filling in a 5-year molar.

We dug around in the literature for a while and found that some similar work had been done before, but that it wasn't too successful. However, the precedent was there, so we felt justified in going ahead with it. After getting all the information we could on the thing, such as drawings of the equipment others had used, methods of running the test, and such, we got together with the Master Mechanic in the W. C. Austin project's shops at Altus, Okla., and started the job of building the Bureau's first infiltrometer, as those excerpts from a plumber's nightmare are called.

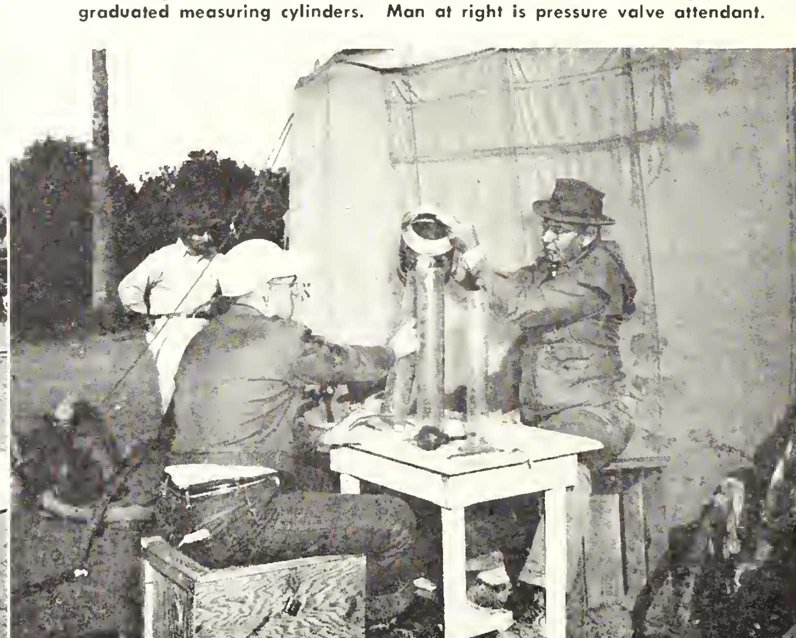
So far, the infiltrometer may appear to the uninformed like just so much junk from a boiler room put together so that it will squirt water. Not so! When rain falls, the hammering of the droplets compacts a thin layer of top soil with the result that there is some sealing effect and consequently more run-off and less infiltration than when water is applied by hose, irrigation, or most other means. In other words, to get results we had to simulate rain, not just sprinkle water on the ground. When it rains, each drop has a definite size; moreover, it falls with a characteristic terminal velocity or speed when it contacts the earth; this determines the extent of sealing and consequently the amount of run-off. In addition, the storm had to be uniform over the area tested for usable results. We couldn't have a 10-year storm on one side of the experimental plot and a 5-year storm on the other at the same time and expect to get by. When one considers those three fundamental requirements: drop size, terminal velocity, and uniformity of distribution, the equipment ceases to be plumbing and becomes a highly specialized, temperamental, delicate instrument used for observations of a highly scientific nature. (I'll bet the nuclear lads at Oak Ridge would be jealous.)

After considerable revision of plans, discussions, building and rebuilding, and test runs, we had about what we thought it would take to do the job. The rig was then mounted on several old, beat-up ton-and-a-half trucks and put through its paces. (New trucks are still hard to get, or hadn't you heard?) It took seven men and some boys to run the thing, what with pressure gages, precise sampling with laboratory glassware, recording, pumping, etc., to be tended to simultaneously. It was like an operating room, except the equipment wasn't sterilized and no one wore white.

Rain Maker in Action

The infiltrometer in its final form consisted of four accurately built border plates which enclosed a rectangular area exactly 6 by 10 feet. On each long side was installed, independently of the plot, a system of six complicated nozzles which would do all those fancy things with the raindrops mentioned previously. On each set of nozzles was a pressure gage and a valve so that pressure could be kept constant throughout the test. This entire part of the apparatus was enclosed in a tent so that the Gulf breezes wouldn't influence the test. The water supply consisted of clean city water in a 700-gallon tank mounted on a truck. A pump and motor capable of maintaining a constant minimum capacity of 15 gallons per minute at 110 feet head carried the water from tank to nozzles. Hoods were provided for the nozzles which could be simultaneously raised or lowered in an instant by moving one lever outside the tent. When the hoods were up it rained on the plot; when they were down, the water ran into a metal gutter and out of the tent, to be wasted. To calibrate the storm, a 6- by 10-foot pan was provided, which fitted snugly over the enclosed plot. This pan had a run-off

At left: "Undisturbed" soil sampling device completely assembled. The tube, with an inner tube made of 6-inch segments, is being forced into the ground with a hydraulic jack. The supports are soil augers held down by chains. Below: Measuring run-off sample during infiltration test. Sample is being poured into graduated measuring cylinders. Man at right is pressure valve attendant.



Infiltration Studies, Soil and Moisture Conditions, Valley Gravity Project, Texas

Depth inches	Mechanical analysis (percent)			Texture	Soluble salts (percent)			Lime percent	Apparent specific gravity	Actual specific gravity	Pore space (percent)	Field moisture content (percent)		Space occupied by: (Volume basis) (percent)				Pore space (percent)	
														A*		B*			
	Sand	Silt	Clay		A*	B*	C*					A*	B*	Water	Air	Water	Air	Capillary	Non capillary
0–6	76.0	14.4	9.6	24	0.03	0.04	0.03	0	1.34	2.58	48.0	7.8	16.5	10.4	37.6	22.1	25.9	32.0	16.0
6–12	76.0	12.8	11.2	24	.03	.04	.03	0	1.41	2.59	45.5	12.6	14.1	17.7	27.8	19.8	25.7	32.2	13.3
12–18	74.0	14.8	11.2	24	.03	.03	.03	0	1.52	2.57	40.8	12.8	11.4	19.4	21.4	17.3	23.5	34.3	6.5
18–24	72.4	13.4	14.2	24	.04	.04	.05	0	1.43	2.59	44.7	13.5	10.8	19.3	25.4	15.4	29.3	33.4	11.3
24–30	70.4	14.4	15.2	24	.04	.05	.05	.5	1.41	2.59	45.5	13.2	11.1	18.6	26.9	15.6	29.9	33.6	11.9
30–36	70.0	12.8	17.2	24	.05	.07	.06	.5	1.46	2.60	43.8	14.1	14.9	20.5	23.3	21.7	22.1	32.7	11.1
36–42	68.0	10.8	21.2	264	.06	.07	.07	1.0	......	......	......	15.2	14.8	......	......	......	......	......	......
42–48	66.0	12.8	21.2	264	.08	.08	.08	1.0	......	......	......	15.0	14.4	......	......	......	......	......	......

*Before infiltration test.
Texture legend: 1—Sand; 2—Fine sand; 3—Very fine sand, 4—Loam; 5—Silt; 6—Clay.
Plot No. 47. Soil type—Brennan fine sandy loam.

trough which extended outside the tent. After the pump and motor were warmed up, the valves were adjusted to the desired gage pressure, or inches of rain per hour, and allowed to run until constant run-off from the calibration pan indicated a constant rate of rainfall; then the hoods were lowered, the pan removed, and the rain was allowed to fall on the plot inside the tent.

At first there was no run-off because the soil absorbed the rain as fast as it fell. After a while, however, rainfall caught up with infiltration and then passed it and run-off began to appear. After some time, this rate of run-off became constant, which was the condition we wanted. This ended the first test, or "A" run (dry run).

Twenty-four hours later a similar test, or "B" run (wet run), was performed on the same plot. The reason, of course, is that maximum run-off generally occurs from the storm which follows a storm which has already saturated the soil. The same procedure was followed, but the results were quite different, maximum run-off being greater and occurring earlier in the storm during the "B" run.

This was not all of the test. In order to properly interpret the data obtained with the infiltrometer other information was also required. The soils of each plot were tested to a depth of 3 feet for mechanical analyses, apparent and absolute specific gravity, capillary and noncapillary pore space, soluble salts content, and lime content. The water supply was chemically analyzed because soluble salts might influence the rate of infiltration into the soil, by causing variable viscosities and surface tensions, and therefore yield results inconsistent with those from actual rain. Of course, temperatures of the water and soil were carefully noted throughout the tests.

The work also offered valuable information on leaching and flooding effects of the water which went down through the soil and of that which ran off by indicating the degree of effectiveness of irrigation and rainfall in removing excessive, toxic soil-salt accumulations.

The principal objective of the tests, however, was the factor known as "f_c" and defined as the final constant or minimum infiltration capacity of a given soil in inches per hour. This factor ranged from a low of 0.02 for heavy clay soils to a high of 0.57 for light porous sandy loams.

This constant isn't the final answer but only a figure comparable to the retention rate of a real measured flood-producing storm in a given watershed. With this information available, the Hydrologists gave it the technical once-over, turned some mental cogs, produced hydrographs, unitgraphs, hyetographs, dimensionless graphs, distribution graphs—and came up with run-off curves for each infiltration or retention rate that are the real McCoy. A run-off curve, by the way, is another graph that tells a designer of ditches and drainage structures how much water runs into a ditch if he knows how much it rained, the area drained by the ditch, and the type of soil in the area.

This almost ends the story except for one stroke of luck which will be used to brush off the skeptical. There is an old saying down here on the Rio Grande which goes like this: "When the Valley needs rain, it gets rain." We were strangers here, however, and had never heard that, so all we had to guide us were the records of the United States Weather Bureau. About the time the infiltrometer work was completed the bottom fell out and along came a storm about equivalent to the average ten-year frequency. We must live right, as this was too much to hope for; if offered opportunity to check the results obtained artificially against the real thing. And were the results good? Believe it or not, they were.

We do not claim that the infiltrometer is a cure-all, nor can we state unequivocally that our use of it was new. It has been used extensively by the Forest Service and the Soil Conservation Service in Texas, Kansas and California, but so far as we know, what we did at Valley Gravity could be called, without too much fear of contradiction, a successful operation.

(Continued on next page)

At any rate, the Hydrology Division, Branch of Project Planning, who are not known by their eagerness to latch on to a new thing that hasn't proved itself, decided to take over the infiltrometer equipment (old trucks and all) which was by then as useful as a slide rule in the dark, and apply procedures pioneered in Region V, on all Reclamation projects where necessity dictates. We'll all be hearing more of it.

For readers who begrudge an engineer his lighter moments and desire more specific information, we refer them to a well known journal of civil engineering in which it is intended to report full technical details in a long-haired symposium. THE END.

EDITOR'S NOTE: At the time Mr. Maierhofer wrote this article, he was in charge of drainage investigations for the Valley Gravity project in Texas, which is under the administrative supervision of the Regional Director at Amarillo. Previously he had been active in other regional drainage matters. Following the retirement of John R. Iakisch, former Chief of the Drainage Section, on August 31, 1948, Mr. Maierhofer was appointed Acting Chief of the Drainage Division in the Denver offices.

Six of One . . .

About 40 years ago a homesteader on the present Columbia Basin project of Central Washington, where rainfall averages 6 inches per year, was sitting on the shady side of his homestead shack one hot June afternoon when an old car stopped in front of his desert home. The driver needed water for the radiator and inquired if the homesteader could furnish the necessary aqua pura. The forlorn dry farmer led the tourist to a barrel, took off the lid and said, "Help yourself."

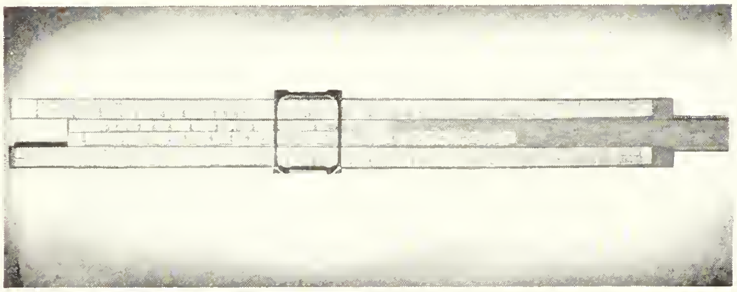
"Where do you get this water?" the tourist inquired.

"From the railroad siding 5 miles away," replied the settler.

"Why don't you dig a well?" asked the tourist.

"Oh, it's the same distance and harder work," explained the farmer.

Slide Rule for Weed Control



Nearly everyone is acquainted with the phenomenal growth of the use of 2,4-D for weed control. Many thousands of acres have been treated this year for annual and perennial weeds and woody plants, and experience has shown the importance of applying the right amount of the chemical. Overdosages may cause injury to crop plants while not using enough chemical to do a good job may be a waste of time and money.

Mr. L. S. Evans, Agronomist of the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, has devised a means for computing problems involving the use of 2,4-D which may aid in obtaining the proper application. The variables encountered when applying the chemical on a field scale are: gallons of the solution per acre, miles per hour of the equipment to be used, spacing of the nozzles, and gallons of solution per hour. With Mr. Evan's device any one of these variables can be determined if the other three are known or assumed.

The device consists of an inexpensive engineer's slide rule (some can be purchased for as low as 25 cents) from which the original scales have been removed and new ones substituted on 3-cycle semilog paper as shown in the above photograph. The variable to be determined is computed by using one of the following formulas and corresponding manipulations on the slide rule:

(1) $$\text{GPH} = \text{GPA} \times 0.01 \times \text{MPH} \times \text{inches}$$

(2) $$\text{GPA} = \frac{\text{GPM}}{0.01 \times \text{MPH} \times \text{inches}}$$

(3) $$\text{Inches} = \frac{\text{GPH}}{0.01 \times \text{MPH} \times \text{GPA}}$$

(4) $$= \frac{\text{GPH}}{0.01 \times \text{GPA} \times \text{inches}}$$

When:

GPH = gallons per hour per nozzle.
GPA = gallons per acre.
MPH = miles per hour.
Inches = inches between nozzles.

For example; to determine the gallons applied per acre when one nozzle discharges 4 gallons per hour, the nozzle spacing is 12 inches, and the forward speed of the sprayer is 5 miles per hour, use formula (2) above, and

—Set 12 on I scale opposite 4 on H scale.
—Move hairline to 5 on M scale.
—Read A scale under hairline = 6.7 gallons per acre.

It is believed that this quick method will be of particular value to custom spraying operators. However, it can be used equally well by farm operators who do their own spraying and if it seems to be a bit complicated it should not be difficult to find an engineer on an irrigation project who can give a more detailed explanation of the method.

A similar computer can be made for the calculation of problems where it is desired to determine the quantity of liquid or solid commercial 2,4-D formulations required for small experimental plots which will give a rate of application equivalent to a known number of pounds of 2,4-D expressed on an acre basis. However, this modification would be the most useful to those interested in test plot work. Full directions for making a rule of this type can be obtained by requesting the information from the Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture, Beltsville, Md.

Irrigation Laboratory at Santa Paula

By R. G. HOWARD,
Region II, Sacramento, Calif.

Ted Sharp irrigates two hundred farms. To be exact, Ted Sharp tells two hundred farmers how to irrigate and they love it.

He tells them exactly what to do and exactly when to do it. But from one year's end to another, you'll never hear a word about "paternalism," "crackpot professors," or criticisms like "all right in theory but no good in practice."

The reason is simple. The orange, lemon, and walnut growers on 4,000 acres of land around Santa Paula, Calif., realize that you don't fool around with $3,000-an-acre groves trying this and trying that, or guessing and ruling with your thumb, any more than the owners of a $12,000,000 company which must produce a high quality product would handle their production problems by guess and by golly. No, you do just like the corporation management would do. You hire a highly qualified expert and give him a field staff sufficient to keep checking on conditions everywhere along the manufacturing line, and you listen with respect to his recommendations and carry them out.

That's why, when a grower gets a note from Mr. Sharp recommending that he irrigate or apply fertilizer, he carries out the instructions to the letter.

The Santa Paula growers learned the hard way. Nearly 25 years ago it became apparent to a number of fruit growers in that locality that their fruit and trees were suffering, probably because of wrong irrigation methods. Too much fruit was of low quality and too many trees were sickly and short lived. It looked as if too much water or water at the wrong time was causing it. With high production costs you could lose money hand over fist, if volume and quality declined even slightly. Better fruit wouldn't cost any more money—probably less.

The Santa Paula growers were people who were able to draw reasonable conclusions from hard experience. Instead of blaming the Lord, or the economic situation, or each going separately along the road he thought best to correct conditions, they decided to set up a laboratory to find out exactly what they were doing wrong. Accordingly, a number of fruit-grower associations jointly sponsored the laboratory under the name of "Fruit Growers' Laboratory, Inc." They picked Ted Sharp to handle it because, even then, he was recognized as a competent agricultural technician with a thorough knowledge of, and deep respect for plant–soil–water relationships.

Ted Sharp had certain sound scientific ideas. He believed that irrigation isn't just "watering," but instead is a very serious major soil treatment. Dry permeable soil (a perfect conveyor of moisture to where it's needed) is changed to mud (a substance with entirely different properties), by irrigating—which means the application of more water than

Soil samples to determine moisture content are taken from 0–12-inch zone and 12–30-inch zone in citrus groves with a third and deeper sample taken in walnut groves. Two samples are taken at each site and mixed together to yield a composite sample. *Photo by A. J. Burrows, Region II.*

a normal rainstorm. In addition, the mineral content of irrigation water, even though small in percentage, usually adds up to far more in weight and importance than that applied through fertilizers. Altogether, he felt that over-use of irrigation water was one of the worst practices of irrigated agriculture. He knew that types of trees differed widely in their needs and tolerance of water. Most important, he knew that generalizations about how to handle a particular tree crop were almost worthless because every acre of the land the crop was growing on was likely to differ substantially in fertility, mineral requirements, moisture holding capacity, and the need for drainage.

So Mr. Sharp had a pretty good idea of what he was going to do when he set up the laboratory. Over the years the work has been systematized to a maximum.

If a new orchard is to be studied, Mr. Sharp or his assistant, Mr. E. J. Curran, goes with the sampling crew to the field and selects representative locations. Successive samplings are made at the same sites. For oranges and lemons, two samples are taken to determine the conditions in the surface to 12-inch zone and in the 12- to 30-inch zone. In walnut groves, a third and deeper sample is obtained. Each sample is a composite from two holes. The number of samples taken

Top photo: E. J. Curran (at right), Assistant Director of Fruit Growers' Laboratory, Inc., explains to R. G. Howard, Bureau of Reclamation, an example of over-irrigation where too many small streams result in excessive use of water which will probably damage trees. Middle photo: Quality of water determination and other requisite chemical tests are made by Chemist Ruth Hardison of the Laboratory. Bottom photo: General view of building which houses the Laboratory. *All photos by A. J. Burrows, Region II.*

depends on the size of the orchard, but usually represents about one location per acre. Mr. Sharp feels that all these locations are necessary. Experience has taught him that conditions vary so much within a single field that fewer samples do not present a true picture. As they take samples, the field men note the general conditions, appearance of trees, signs of moisture, and similar factors. They report their opinions of moisture conditions and the need for irrigation. The fact that even after long experience they quite often miss the moisture percentage badly, points out the necessity of laboratory determinations of moisture content.

The samples taken by the field men are carefully weighed in the laboratory and oven-dried to determine moisture content. By comparing the moisture content with the wilting points (point at which plants will wilt) of soils previously taken from the same location, Mr. Sharp can estimate within a few days the proper time for irrigation. He keeps a record of all reports on every field and after a number of such reports, he can estimate quite accurately the rate of moisture use and can predict very closely the proper time for reirrigation.

Mr. Sharp interprets the reports of field men and laboratory technicians and makes his recommendations to the farmer. In his report, Mr. Sharp tells the farmer when he should irrigate, how much water to apply, how to apply it to best advantage, and how to tell when he has irrigated the proper amount. He also tells whether to add fertilizer and how much, depending on the laboratory analyses of the soil and water quality. His instructions to the irrigators are concise, practical and easily understood. There is no opportunity for the farmer to misinterpret nor is he required to read through lengthy introductory paragraphs.

A typical report to a farmer says, "Irrigate all sections August 27–September 1, two furrows on each side of tree row using 2 to 2¼ acre inches of water per acre, obtain 24 inch penetration at lower end of run." Another report says, "No irrigation until resampling, please be prepared to reirrigate around September 12 on short notice. Nitrates are declining, renitrate within 30 days." In addition, a sketch map shows the sampling locations and the percentage moisture content of the soil samples are compared to their wilting percentages.

The original cost of establishing the laboratory was taken care of by a small per acre charge on all lands within the several associations which jointly sponsored the work. Individual growers who request the laboratory service pay the annual operating costs which vary from year to year. In 1947, the cost was $8.86 per acre. The cheapest cost was for 1935–36 with $4.88 per acre. The fact that the laboratory has continued in operation for 24 years and that its work is generally growing, proves that the advice Mr. Sharp furnishes is well worth the money.

You feel that the laboratory, for Mr. Sharp, is a labor of love rather than a livelihood. He says himself that he "enjoys research work and is engaged in this work to test the theory that privately or industrially owned research or control laboratories in agriculture can survive even in the face of popular demand for public support of similar institutions."

Mr. Sharp owns several citrus groves and farms, and willingly takes advice that Tom Sharp, scientist, gives Tom Sharp, orchardist. The Laboratory takes pride in those groves under service which have lived longer or borne better than groves that have not used the facilities of the Laboratory. True enough, there are good and poor groves in and out of Laboratory service. Even under the best conditions and under rigorous technical control, it can hardly be said that farming is as yet a truly scientific procedure. He feels however, that research investigations and applied laboratory control will eventually eliminate much of the uncertainties in agriculture.

Mr. Sharp summed up the lessons of his 24 years' work when he said, "Nearly everyone uses too much water. Some trees can't stand 'wet feet.' Some soils retain moisture longer than others and some soils can reach a much lower moisture content before the crops begin to wilt. Proper water use cannot be determined here on a large-area basis. There must be careful study of soils of individual fields and rate of moisture use before an adequate program of proper irrigation can be worked out.

"What goes for citrus and walnut groves is just as valid for any other irrigated crop. We realize the importance of the scientific use of water here because our investments and operating costs are so high that a single bad year can be disastrous. But an irrigation lab, with a field-testing service, would pay for itself many times over on field crops too. If you can use 6-acre inches less water and raise the yield of barley, let's say, 3 or 4 bushels an acre, or get less lodging, you've justified your investment. And if soil fertility can be maintained by avoiding unnecessary leaching, you're building up your investment! But the biggest and most important thing is that water is always a scarce article in irrigation areas. There's nearly always more land than water to irrigate it. So when you save irrigation water, land elsewhere—land otherwise without water—can be irrigated and made highly productive.

"Every farmer can't be a scientist. But every farmer ought to have the best scientific advice available to determine the way he should irrigate and fertilize every individual field on his place. It might not be so important now when 30 percent of the income from some crops is profit. But when prices go down, a little less water and a higher yield and quality can well mean the difference between net profit and net loss. Over the long pull, scientific water use is one very important factor in ending up with a farm that can support your son and your son's son as it supported you, instead of being a wornout 'piece of land'—a wasted natural resource that will send them off to the city to work for some-

THE END.

"Reclamation Revelations—1948-49"

(Continued from page 224)

securing of funds and protecting them against irresponsible legislation by appropriation riders is one of your biggest problems. I recommend that you recognize it.

Power as the Paying Partner

Then there's a little matter of power policy. For 16 years, to my personal knowledge, that fight has been going on. The Reclamation program has taken giant strides forward under a public power law that has brought low rates, new industry, and a better way of life to the West in addition to paying a lot of irrigators' water bills. Continuance of Reclamation hydroelectric development is a prerequisite to establishing economic feasibility of most of the irrigation projects that you want because power is the paying partner. Also, with dwindling and irreplaceable oil and gas resources, it would be the acme of national shortsightedness if we did not capture, under the Reclamation law, quickly our potential hydro energy, which is wasting to the sea.

Among the pledges out—not by top-line candidates but by legislative leaders, some of whom will still be with us next January—are promises to reverse the public power program under which the West has prospered. I am proud to report that Reclamation's line has held so far, and I rejoice I helped hold that line. Not a single public power law of Reclamation is repealed to date. When the Eightieth Congress recessed, the antipublic power bills were snowing into the committees and the private power lobbyists, who don't care whether public power pays irrigation bills or not, were blocking the corridors in the Capitol. The basic legal structure still stands intact. And the country re-examined it. The Eighty-first Congress convenes in 2 months. Now let's get this power policy settled. And that's your problem.

No Fooling With Family-Sized Farms

Also, there's that not-so-little matter of Reclamation's acreage restriction designed to keep it on the basis of the greatest good for the greatest number. Under it, Reclamation has prospered since Uncle Sam went into the irrigation business in 1902. Some of you do not like this family-sized farm requirement. Certain groups principally from California with some Texas support, which you can name as well as I can, have spent a lot of their time and more of other people's money to bust that wise provision. It always has been and still is my judgment that most of the members of this association and, certainly, most of the public supported that provision. It has been assailed, impeached, and lied about for the last several years, and parallel treatment is assured in advance to its supporters. But I am proud again to say that it remains intact and inbedded in the law. I believe we can keep it there and I hope that's settled. I hope the National Reclamation Association will not again go on record, as it will be urged to do, in favor of providing interest-free Federal Treasury funds to perpetuate corporate farming through irrigation for the big fellows and resultant exclusion of veterans and others who might be the real builders of the West.

Now some people have pledges out to throw it in the ash can next year as they tried to do and failed this year and last. I make to you now a positive policy recommendation that, for the good of Reclamation, you preserve the principle of the family sized federal irrigation farm. And that's another one of your problems.

No Looting of Reclamation Law

A lot of fancy footwork has been going on in some States to get water outside the principles of Reclamation by assorted dodges and subterfuges such as calling irrigation, "flood control" to get water for free or making exceptions to the

Reclamation Law. That law, which you wrote and which is your Magna Charta, will only survive if applied justly and without discrimination. It is doomed if it is made inequitable and a travesty by wholesale exception. You and I have supported uniform and nondiscriminatory liberalization of the Reclamation Law. It will be liberalized but it must not be looted, or Reclamation and the West will not prosper. Again, this Reclamation policy of full repayment for irrigation investment without interest is still intact. I want to recommend that it be preserved and that you all work together to get a recognized and uniform liberalization preserving the basic principles or nondiscriminatory repayment and not try to run the ends or steal an advantage one over the other by subterfuge. And that's your problem.

But perhaps the greatest problem of all that is before you as an association is what kind of an association you are going to be. As dues-paying members of this association, we have seen a few changes going on in N. R. A.—some of which are, in my opinion, bad. This Association was founded to foster and support Reclamation in the development of the West. To most of us, it is and can continue to be what it purports to be. But it is in peril. It houses a lot of varying and conflicting views. But, beyond that natural democratic conflict, in recent years some interests moved in that have special ends. They are not Reclamationists or water users. They are powerful corporations or corporate agents and employees who paid a good price for admission and claim the paymaster's privilege of calling the tune.

We do not like to talk about it very much in these meetings but the monopolists—certainly power monopolists and some fellow traveler land and water monopolists—are with us today. There were 59 members affiliated with public utilities the last time Congress saw the score, and nobody revealed how much money they put up. Now these utilities, according to their own testimony in Congress, are more interested in preserving their own power monopolies than advancing Reclamation. It is their undeniable right and privilege to protect their monopolies if they so desire. And you can rest assured that the power utilities can be trusted to care for themselves without the National Reclamation Association carrying that burden for the power companies.

No Cuckoo's Nest in the West

They may be just as sincere and honest by their lights as is the cuckoo bird which is famed for laying its eggs in another bird's nest to be hatched by deceived foster parents. The National Reclamation Association was organized by the West for its own legitimate purposes to hatch its own eggs. A cuckoo bird steals the eggs from the nest it invades and substitutes its own.

So, you have before you the proposition of determining whether the National Reclamation Association is going to be what its constitution provides—an association "to promote the development, control, conservation, preservation and utilization of the water resources of the Reclamation States" —or whether it is going to be made a camouflage and a shell—a cuckoo's nest used to hatch the eggs of special and monopolistic interests.

There is no reason why this association must become a cuckoo's nest or even a vocalizing roost for the cuckoo in charting western policy. Perhaps the individuals sponsored by corporations put up the heavy money and have become super-industrious and super-articulate in voicing their own views under the Association's banner. But in membership, according to the rolls, the corporate representatives are only a bit over 10 percent of the total. The majority of real irrigationists who want to advance Reclamation above all else can call the tune in harmony with our constitution any time they organize or insist on so doing.

So that you won't be misled into thinking that this is only personal opinion, there is here placed before you from the Congressional Record a resolution which has been sent you by one of your constituent State Associations since we met last year. That State Reclamation Association at its annual meeting passed this as its Resolution No. 1. It reads as follows:

> WHEREAS, we recognize that the greatest obstacle to progress in the field of Reclamation is the subversive influence of special interest groups, and
>
> WHEREAS, these groups operate under various pretenses as interested in the public welfare and under names often misleading, and
>
> WHEREAS, Associations with genuine interest in progress are frequently infiltrated with a purpose to hamper their efforts,
>
> NOW THEREFORE BE IT RESOLVED; that we urge state associations and the National Reclamation Association to safeguard democratic processes in their activities and to avoid undue influence of special interest groups seeking selfish ends.

That's the resolution of your State association. You now have it before you. It remains undisposed of. And that resolution No. 1 is your problem No. 1.

I enjoy being with you. Many of you are my friends and have been my friends ever since long before I took over as Commissioner in 1945. You and this organization have done great works. It is my good fortune to have become the postwar Commissioner who served as Reclamation was revitalized. It was my humble privilege to serve during three years when Reclamation received nearly $600 million to carry on—a sum approaching half the total that the Nation appropriated to Reclamation in the 46 years of its existence. Many, many people made that possible. Many more people will have to do other things if the full possibilities of Reclamation are to be realized.

This country has just concluded a great political debate. All these principal questions that I have raised today were issues in the Reclamation States. The verdict was rendered by the greatest jury in the world—the American electorate—on November 2.

Today, as a result, there is open to this association and the West an opportunity to move forward on all Reclamation fronts which is without precedent. That movement can be of a scale and scope dictated by the economy of today and tomorrow and not of yesterday or 20 years ago.

To seize this chance it is necessary to abandon the squabblings that have divided and weakened Reclamationists and this association. There never was—and perhaps there never will be—a better chance than in the coming months. You have a pledged administration with a fresh mandate and a united Congress than can bring the West what it needs in irrigation and power as never before if you heed the verdict—and if Reclamation, this association, and the West present a united front.

For Reclamation, which I have been in only because I wanted to be in it and where I expect to remain, I pledge you our best effort to seize this opportunity. The time is now and the chance is ours.

God bless you one and all!

An account of the Seventeenth Annual Conventiton of the National Reclamation Association will appear in our January issue.—Ed.

News Round-Up

Night Into Day at Hungry Horse

In order to make possible "round the clock" construction at the Hungry Horse dam site, Montana, General-Shea-Morrison, the contractors, have started installing "star" lights. These powerful lights are suspended over the canyon about 500 feet above the river and will afford general illumination to the scene of operations. The first string, slightly downstream from the dam site, was started about the middle of September. Another will be swung across the river upstream from the site. Night construction activities will offer a spectacular view from the access highway, but visitors are urged to be extremely careful when driving to the dam site at night.

The Interior Department Appropriation Act for 1949 (H. R. 6705) carried a "rider" or amendment for the payment of salaries or expenses after January 31, 1949, to the Commissioner, Assistant Commissioners, or Regional Directors, of the Bureau of Reclamation, who have had at least five years' engineering and administrative experience. This "rider" was aimed directly at the removal from office of Commissioner Michael W. Straus and Regional Director Richard L. Boke, of Sacramento, California, neither of whom is an engineer. It was attributed to resentment in certain quarters over the enforcement by these two officials of public power and acreage limitation provisions of the Reclamation Law in California and followed an "investigation" by a subcommittee of the House of Representatives.

President Truman, at the special session of Congress in August, recommended repeal of the "ouster" amendment and will renew his recommendation when Congress reconvenes in January 1949. With the change in the political complexion of both Houses of Congress as a result of the November 2 election, President Truman's recommendation for repeal of the "rider" is expected to receive favorable consideration. During his successful campaign, the President advocated the public power and acreage limitation policies which Straus and Boke have defended.

In any event, the "rider" applies only to the payment of salaries, and not to the exercise of official duties. Pending action by Congress, Messrs. Straus and Boke will continue in their respective positions.

Willwood Repayment Contract Approved

William E. Warne, Acting Secretary of the Interior, recently approved the draft of a repayment contract between the water users on the Willwood Division of the Shoshone project, in northwest Wyoming, and the Federal Government.

In substance, this draft of the contract is acceptable to the Wildwood District Board and the Bureau of Reclamation, and paves the way for ultimate final negotiations leading to acceptance by the water users, execution of the contract by the Irrigation District and the Secretary of the Interior for the United States and eventual approval by the Congress.

The proposed contract calls for repayment by the District of $1,500,000 which will cover the costs of construction to date, as well as construction in progress, which is necessary to complete the Division. Also included in the total are certain rehabilitation costs providing for work necessary to assure that the irrigating system is in good condition when turned over to the water users for operation and maintenance under the terms of the contract.

Settlement on the Willwood Division, where approximately 12,000 acres of land are being irrigated, began in 1928 and progressed slowly through the years of low farm prices during the depression.

The water supply which is obtained from the Buffalo Bill Reservoir on the Shoshone project insures the production of an abundance of forage, as well as beans and other irrigation crops in a flourishing livestock area.

Everett T. Giles Retires

Everett T. Giles of Amarillo, Tex., veteran Reclamation employee, retired as special engineering assistant to the Regional Director at Amarillo on June 30. He had been with the Bureau continuously since 1917, with the exception of four years during which he worked with the Corps of Engineers, War Department, as Special Irrigation Engineer.

He saw service on many Reclamation projects including Strawberry Valley in Utah, Colorado River and Rio Grande in Texas, as well as in the Commissioner's Office in Washington where he spent several years as Chief of Planning and Liaison Section, Engineering Division. After leaving Washington, D. C., he joined the Region V staff at Amarillo, Tex., where Wesley R. Nelson, now Assistant Commissioner, was Regional Director at that time. His vast experience proved an invaluable aid to Mr. Nelson in setting up a smooth running organization and solving many engineering problems in his assignment.

Summit City Water Rental Contract Executed

Acting Secretary of the Interior William E. Warne recently executed in behalf of the United States a long-term municipal water service contract with the Summit City Public Utility District of California.

This service will alleviate a shortage of municipal water suffered by Summit City area for many years because of the necessity of pumping from wells, a source inadequate in dry seasons and one which, according to tests, is contaminated.

The Summit City district, located 2½ miles south of Shasta Dam, key feature of the Central Valley project in Shasta County, will obtain the water from Shasta Reservoir through the Government's enlarged pumping plant and ten-inch pipe line which also serves the Government camp at Toyon, Calif., and the Shasta Dam Area Public Utility District. Maximum rate has been set at 20,000 per acre foot, which is equivalent to about 326,000 gallons.

The Low-Down on Ground Water

(Continued from page 230)

you can get a great deal of water through it. All the water you pump out of your well has to go in through your screen and has to go through the gravels immediately surrounding the casing, so the process of development is to wash those fine materials out and get a good flow of water into the well. Occasionally you will find formations that have so much fine sand of such uniform size that your well will just keep pumping sand. That condition can sometimes be overcome with artificial gravel packing—in other words, by introducing a layer of gravel around the outside of the casing or screen to form a gravel envelope that will hold back the finer materials and allow water to collect and flow into the well.

There are a number of methods of developing wells. Some people use dry ice. Some people use acid where they have a lot of lime cemented formations. Other people just simply put in an old pump and surge the well by turning the pump on and off. When you turn the well off, the water in the column pipe rushes back down the well and out into the formation and produces an agitating effect that will tend to wash those fine materials back into the well where they can be removed. Gravel packing of wells requires very careful manipulation and sometimes runs into a good deal of money.

The cost of well drilling varies so much that it is very difficult to give a general figure. I have been in areas where the costs run from two dollars to twelve dollars a foot, depending upon the diameter. Some drillers estimate the cost of drilling to be the cost of the casing plus a fixed fee. Pumping costs likewise vary greatly from place to place depending upon the cost of power or fuel. In one place where I've worked, it takes about two kilowatt-hours of electricity to pump an acre-foot of water through a lift of one foot, so you can see that every time you drop your water level a foot it costs you just a little bit more to pump it. In some of our western valleys the water level has dropped or declined as much as 100 feet. If prices of agricultural products drop, some of our pump irrigators will find it very difficult to make ends meet. THE END.

EDITOR'S NOTE: *The above article was adapted from the transcript of a meeting held at Goodland, Kansas, at which Mr. McDonald appeared as the principal speaker before the Goodland Rotary Group.*

Long-Range Agricultural Policy and Program

The Committee on Agriculture and Forestry of the United States Senate has published a report (S. Rep. No. 885, Eightieth Cong., second sess.) entitled "Long-Range Agricultural Policy and Program." The subcommittee preparing the report held extensive hearings both in Washington and in various regions throughout the Nation.

Following are some excerpts from the report which are of particular interest to the Bureau of Reclamation:

BASIC OBJECTIVES

A major objective of a long-range agricultural policy is to achieve an abundant production of food, fiber, and forest products adapted to the wants and physical well-being of all domestic consumers and to develop a strong export trade.

CONSERVATION

Maintenance of an abundant production demands the conservation, restoration, and development of our soil, water, and forest resources.

The conservation, restoration, and development of our soil, water, and forest resources pose one of the most serious long-range problems facing American agriculture.

There should be more adequate provision for the coordination and expansion of Federal and State soil surveys and other investigations, and for experimentations and research pertaining to the conservation, restoration, and development of our natural agricultural resources.

FAMILY-SIZE FARM

The owner-operated family farm, long an accepted ideal of American farm policy, needs to be continued and strengthened as the basic type of unit of our farm economy.

A successful farm must use the labor of the operator and his family effectively and make efficient use of capital, machinery, and modern technology. * * * The family farm must also provide an adequate income for the farmer's family to purchase the quantities of goods and services required for a good level of living.

Size of farms must be kept flexible because farm families differ widely in their technical knowledge, managerial capacity, and desires to operate particular types of farms. Furthermore, because of soil, topography, and other natural conditions, farms are not adapted to any standard size for economic operation.

RESEARCH AND EDUCATION

Agricultural progress is dependent upon increasing production per worker through continued advancement in agricultural technology and science based upon expanded research, experimentation, education, and demonstration.

It seems clear that action agencies, with definite programs to administer, should in no respect be responsible for research conclusions as to the effectiveness of their own accomplishments. Those directly responsible for basic research and those concerned with the administration of action programs should be independent and responsible only to the top officials in either State or National agricultural administration. Research workers should never be placed in a position in which they can be accused of letting the stated objectives of a program and its administration confuse and bias the analysis of the accomplishments of that program.

While farm people are now adopting new production techniques and are improving farm practices more readily than at any time in the past, there remains a major task of teaching and demonstrating new or improved farm and home methods to rural youth and adult farmers as they developed. The Extension Service was organized to do this work and has demonstrated that it is qualified to do the job.

COORDINATION

The widespread criticism by farm people to the effect that various existing agencies are carrying on duplicating services, that advice to farmers frequently does not meet local needs, that recommendations of the several agencies frequently differ, that some agencies disregard or oppose other agencies, and that recommendations frequently do not recognize the farmer's financial situation are potent arguments for more effective coordination of all agencies at local, State, and National levels.

The State agricultural experiment stations and the research agencies of the United States Department of Agriculture have contributed to solving many agricultural problems in the interest of an abundant, low-cost food supply. The research and educational work of these agencies should be substantially increased.

Although the division of responsibility between the various levels of Government is not well defined, many phases of long-range agricultural policy are the responsibility of the several States.

The foregoing excerpts are not intended to cover the report in its entirety or to indicate its scope, but are confined to those parts which are of special interest to the Bureau of Reclamation.

Above: Minidoka Dam on the Minidoka project located on the Snake River in Idaho was constructed in 1909. Dam is of rock-fill, faced on upstream side with impervious earth-fill, and creates reservoir known as Lake Walcott, with storage capacity of 107,240 acre feet. The power plant has 7 generators with a kilowatt rating of 13,400.

Above: American Falls storage dam and the Idaho Power Co. dam on the Snake River. Center box: Arrowheads, knives, and spears found along Snake River and American Falls and Lake Walcott reservoirs. A number of these were found by D. G. Martin, pioneer engineer, who located many of the canals on Minidoka. *Photos by F. B. Pomeroy, Region I.*

Speaking of Settlers

By LYNN CRANDALL,
Watermaster, Water District No. 36, Idaho Falls, Idaho.

Relics of prehistoric days furnish mute evidence of the truly "original" settlers of the West.

In any of the older towns on the western reclamation projects one may still find some of those men and women who settled there when the projects were first built. They grubbed the sagebrush and built the first homesteaders' cabins and used the first water that was turned into the ditches. Today we enjoy listening to their stories of the early days and honor them personally while we are still able to do so.

In doing this, however, we should not forget those earlier nomadic occupants of these lands—the American Indians. One of the darkest pages of American history is that upon which is recorded the white man's treatment of these original Americans, how he expropriated their lands, destroyed the game upon which they lived, and decimated their numbers by slaughter and diseases such as smallpox.

They were here long before any white man knew of this continent. Among the sand blow-outs in the Lake channel region adjacent to Lake Walcott and along the beaches of American Falls Reservoir, Idaho, an experienced observer can still occasionally pick up pieces of those flint or obsidian projectile points with the long longitudinal grooves which demonstrate that the so-called Folsom man passed this way some 15,000 to 20,000 years ago and paused long enough to spear himself a fish or deer or buffalo. Also can be found flint points left by the so-called Yuma man, who followed the Folsom man, with the narrow ribbon-like parallel flaking across the stone surface which no subsequent persons, either red or white, have ever been able to duplicate.

The same camp sites were occupied for many centuries by later generations of Indians, extending down to the time of the white man's appearance, but the workmanship of these later Indians in stone was generally of a cruder nature than that turned out by their earlier predecessors. These old camp sites are most easily located by the flakes and spalls of obsidian and flint that were left by the arrowmakers, and by the small piles of stones marking the location of fires. It is believed that the stones were heated and then dropped into earthen jars until the water was sufficiently heated to cook food, or that they were used in some process of cremation.

Many of the old camp sites were covered by the waters of Lake Walcott and American Falls reservoir which were created by the Government when it built the Minidoka project in Idaho. Relics can still be picked up at some of these camp sites when the reservoirs are drawn down to low levels. Many of the sites, however, are now buried beneath silt deposits resulting from erosion by waves of the bluffs surrounding the reservoirs. In places where the reservoir banks are flat and somewhat gravely, the waves have washed away the finer soil particles, and a few of the old stone and flint implements and arrowheads are washed out of the soil and can be found each fall on the exposed beaches after the annual withdrawal of stored water.

The drifting sand ridges, dunes and blow-outs are a notable feature of the landscape on the Snake River plains between American Falls and Minidoka and by some have been attributed to overgrazing. In the bottom of most of these sand blow-outs, however, there will be found the telltale marks of ancient Indian camps, proving that these features of the topography existed there centuries ago. The drifting sands cover up some of the camps but uncover others and each spring after heavy winds a diligent searcher can almost always finds a few arrowheads. THE END.

Asphalt Linings For Irrigation Canals

(Continued from page 232)

parative studies on the effectiveness of the sterilants used.

Construction cost data taken on this work, while it was not too conclusive, due to the experimental nature of the asphaltic concrete installation, indicated that the cost of the asphaltic concrete lining, without soil sterilization, was substantially less than the cost of either 2-inch portland cement concrete lining, or the 1½-inch pneumatically applied mortar lining.

Based on the results of this work and previous test installations, asphaltic concrete appears to offer considerable promise as a low-cost lining. But—two questions remain unanswered, and only time can tell what the answers will be. One question is, "How much maintenance will they require?" The other: "How much will such maintenance cost?" Highways paved with asphaltic concretes are known to have long serviceable lives if properly maintained. But how about canals—our water highways? The Bureau's experience with asphaltic concrete linings, subject to many entirely different destructive agents and forces, has been too limited to permit an accurate evaluation of the probable life of these linings, and we can only estimate how much maintenance will be required and what it will cost. Therefore, these installations of asphaltic linings will be watched with a great deal of interest to determine whether they are a solution to the problem of low-cost canal linings. THE END.

Top of Dam Wide Enough for Two-Lane Highway

The top of Davis Dam, on the Colorado River in Arizona-Nevada, will be wide enough for a two-lane highway—50 feet. The dam, now under construction by the Bureau of Reclamation, will be 1,600 feet long, rising 200 feet above bedrock. The reservoir behind the dam will impound 1,820,000 acre-feet of water. The $21,462,505 contract was the largest awarded by the Bureau during the last fiscal year.

Almost 4,000,000 cubic yards of earth and rock-fill will be required to form the dam.

OUR BACK COVER

For your convenience and handy reference we suggest that you clip the list of Regional Office listings below and attach it to our back cover, a contour map of the Reclamation area.

REGIONAL OFFICES

REGION I: R. J. Newell, Regional Director, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho.
REGION II: R. L. Boke, Regional Director, Box 2511, Old Post Office Building, Sacramento 10, Calif.
REGION III: E. A. Moritz, Regional Director, Administration Building, Boulder City, Nev.
REGION IV: E. O. Larson, Regional Director, 32 Exchange Place, P. O. Box 360, Salt Lake City 8, Utah.
REGION V: H. E. Robbins, Regional Director, P. O. Box 1609, Old Post Office Building, 7th and Taylor, Amarillo, Tex.
REGION VI: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION VII: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Long Range Program Report Available

Copies of the Bureau of Reclamation's 1948–54 Program Report are now available for public distribution. The Report summarizes field data on the development and conservation of land and water resources in the West.

It was issued at the request of Chairman Richard J. Welch (Representative from California) of the House Public Lands Committee. For copies address your request to the Bureau of Reclamation, Department of the Interior, Washington 25, D. C.

Resolution Passed by Water District 12–A

WHEREAS the future growth, development and prosperity of the State of Idaho are dependent upon a full utilization of its water supply, and

WHEREAS over a long period of years the United States Bureau of Reclamation has been engaged in building and developing reclamation projects within the State, including the Minidoka project and the Boise project, two of the oldest and most successful projects in the West, and

WHEREAS these projects have long since proven the wisdom and the soundness of the development of reclamation projects and the building of homes throughout the West, and

WHEREAS Idaho has perhaps greater opportunity for future reclamation development than any other State in the West, and

WHEREAS the Bureau of Reclamation is now engaged in studying and investigating projects with a view to recommending them for authorization and development as they are proven feasible, and

WHEREAS the Bureau of Reclamation has given primary consideration to the development of projects to provide supplemental water for existing areas and is making rapid progress toward the solution of this problem, and

WHEREAS the water users of Water district 12–A feel that we in region I are exceptionally fortunate in the fact that the regional director, as well as quite a number of his assistants, are men who have lived in this area for a long period of years and are thoroughly familiar with the problems of the region, are acquainted with the people living in the region, and are most cooperative in every way.

NOW, THEREFORE, BE IT RESOLVED, by the water users of water district 12–A, in annual meeting assembled this 1st day of March 1948 that we do hereby express to the regional director of region I, United States Bureau of Reclamation, and his capable staff, our sincere appreciation of their splendid cooperation, not only in providing supplemental water for the Boise Valley and other valleys, but for their thorough, careful and painstaking consideration of the entire problem of developing the water resources of the region.

BOISE RIVER WATER USERS.
(Signed) Ed Straus, *Chairman*.
I. A. WEAVER, *Secretary*.

U. S. GOVERNMENT PRINTING OFFICE: 1948

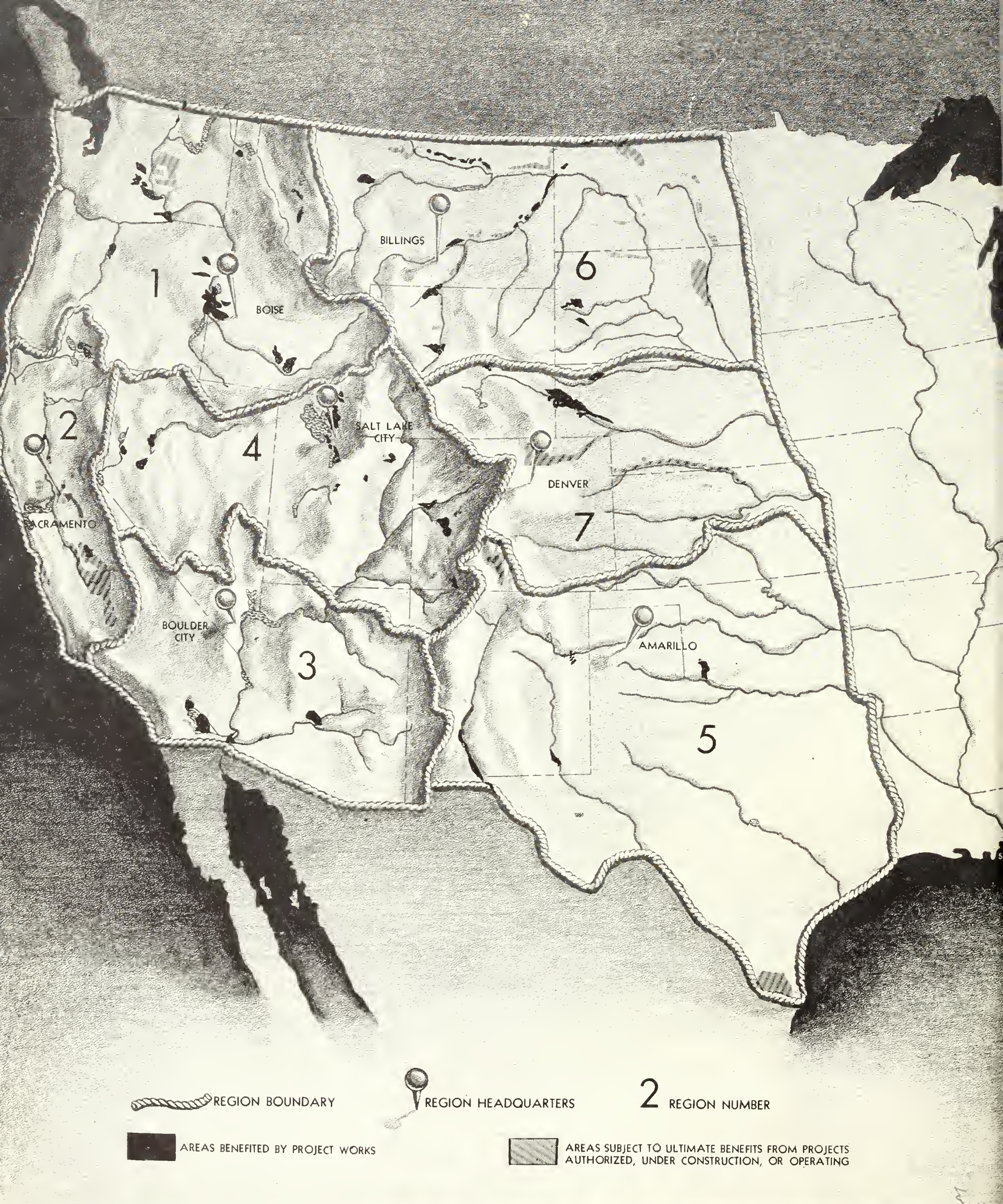
NOTES FOR CONTRACTORS

Contracts Awarded During October, 1948

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2204	Davis Dam, Ariz.-Nev	Oct. 12	Constructing foundations and erecting steel towers for Davis Dam-Hoover Dam, Davis Dam-Prescott, and Prescott-Phoenix 230-kilovolts transmission lines.	Stolte Inc., United Concrete Pipe Corporation, Arizona Sand & Rock Co., and Ralph A. Bell, Oakland, Calif.	$2,794,686
2265	do	Oct. 7	Four 20,000-kilovolt-amperes transformers for Mesa substation, schedule 1.	Moloney Electric Co., St. Louis, Mo	525,605
2279	Central Valley, Calif	Oct. 6	Installation of three main generators in Keswick power plant	Wismer and Becker, Sacramento, Calif	146,676
2310	do	Oct. 11	Fourteen radial-gate hoists for Friant-Kern Canal, items 5 to 9	Western Gear Works, Seattle, Wash	31,275
2321	Hungry Horse, Mont	Oct. 21	Two 96-inch hollow jet valves for outlet works at Hungry Horse Dam.	Goslin-Birmingham Manufacturing Co., Inc., Birmingham, Ala.	174,500
2324	Columbia Basin, Wash	Oct. 13	Construction of Long Lake headworks, Main Canal, schedule 1	George B. Henly Construction Co., Inc., Caldwell, Idaho.	293,777
2324	do	do	Construction of canal lining and structures for Main Canal, schedule 2.	Western Contracting Corporation, Sioux City, Iowa.	1,933,391
2325	Central Valley, Calif	Oct. 1	Fifteen 15,000-volt circuit breakers and eight potential transformers for Tracy switchyard, schedules 1 and 3.	General Electric Co., Denver, Colo	172,347
2325	do	Oct. 5	Seventy-eight 15,000-volt disconnecting switches and two 15,000-volt air break switches for Tracy switchyard, schedule 2.	Cole Electric Co., Culver City, Calif	16,613
2329	Columbia Basin, Wash	Oct. 7	Production of concrete; completion of pumping plant, bus runway, and excavation for feeder canal; construction of water supply reservoir and pump discharge outlet structure; installation of pump discharge pipes; assembly of face caisson; and miscellaneous work at Grand Coulee Dam.	Morrison-Knudsen Co., Inc., and Peter Kiewit Sons' Co., Seattle, Wash.	13,348,419
2338	do	Oct. 20	One 14,000 horsepower hydraulic turbine and one oil pressure governor for unit LS3, Grand Coulee power plant.	Pelton Water Wheel Co., San Francisco, Calif.	139,155
2344	Provo River, Utah	Oct. 22	Construction of pipe line and structures for Salt Lake aqueduct	United Concrete Pipe Corp., Baldwin Park, Calif.	2,429,201
2350	Missouri River Basin, S. Dak	Oct. 15	Construction of earthwork, structures, and surfaci g access road at Bixby Dam.	Daane Bros. Construction Co., Sturgis, S. Dak.	12,473
2351	Davis Dam, Ariz.-Nev	Oct. 1	Furnishing and installing an electrically operated elevator for Davis power plant.	Westinghouse Electric Corp., Denver, Colo	65,041
2354	Columbia Basin, Wash	Oct. 21	Three 4,300 ampere bus structures for pumping units P1 to P6, Grand Coulee pumping plant, schedule 1.	I-T-E Circuit Breaker Co., Philadelphia, Pa	996,285
2354	do	do	Six 3,000-ampere air circuit breakers for pumping units P1 to P6, Grand Coulee pumping plant, schedule2.	Westinghouse Electric Corp., Jersey City, N. J.	207,214
2372	Yakima, Wash. (Roza)	Oct. 8	Construction of earthwork, pipe lines, and structures for lateral distribution systems for pump areas 13 and 14.	Pfeiffer and Hohner, Spokane, Wash	118,284
2377	Boise, Idaho	Oct. 11	Installing and painting 66-inch outlet pipe, radial gates, radial-gate hoists, and miscellaneous equipment at Cascade Dam.	Humphrey-Ketchen Co., Boise, Idaho	39,901
2389	Colorado-Big Thompson, Colo	Oct. 21	Furnishing and installing one electrically operated elevator for Granby Dam.	Otis Elevator Co., St. Louis, Mo	22,748
2391	Davis Dam, Ariz.-Nev	Oct. 12	Indoor disconnecting switch hangers, cable trays, and brackets for utility building and control cable tunnel at Parker switchyard.	Gardiner Manufacturing Co., Oakland, Calif.	12,390
2396	Boulder Canyon, Ariz.-Calif.-Nev	Oct. 22	Furnishing and installing one 82,500-kilovolt-ampere generator for Hoover power plant, schedule 1 (including accessories, tools, appliances, and spare parts).	Allis-Chalmers Manufacturing Co., Denver, Colo.	1,408,987
2408	Columbia Basin, Wash	Oct. 13	Structural steel for ramp, roadway, parking area, and storage building roof framing, Grand Coulee pumping plant.	American Bridge Co., Denver, Colo	136,682
2409	Missouri River Basin, Nebr	Oct. 14	Galvanized steel towers for 115-kilovolt Gering-Sidney transmission line, section B.	Do	19,200

Construction and Supplies for Which Bids Will Be Requested by February 1949

Project	Description of work or material
Boulder Canyon, Nev	Construction of additions to existing 1-bedroom brick houses at Boulder City, Nev.
Do	Processing of sand and gravel for concrete aggregate.
Central Valley, Calif	Completion of construction of Clayton and Ygnacio substations and pumping plants near Antioch, Calif.
Columbia Basin, Wash	Deicing transformers, current transformers, and disconnecting switches for Grand Coulee power plants.
Do	Extension to 6,900-volt station service switchgear, Grand Coulee left power plant.
Do	Elevators for Grand Coulee pumping plant.
Deschutes, Oreg	Rehabilitation of Ochoco dam, spillway, and outlet works. The dam is an earthfill structure about 125 feet high and 970 feet long, located near Prineville, Oreg.
Davis Dam, Ariz.-Nev	Power circuit breakers and air switches for Gila substation.
Do	Distribution transformer, step voltage regulator, switching equipment, and instrument transformers for Prescott substation.
Do	Main control board for Mesa substation.
Do	Main control board for Prescott substation.
Do	Construction of 30 miles of 115-kilovolt transmission line from Coolidge substation on Phoenix-Tucson No. 1 line to electric district No. 5 substation on Phoenix-Tucson No. 2 line, near Ely, Nev.
Do	Constructing and furnishing equipment for 15,000-kilovolt-ampere Blythe substation, located about 12 miles north of Blythe, Calif.
Do	Constructing and furnishing equipment for 10,000-kilovolt-ampere Cochise substation at Cochise, Ariz.
Klamath, Oreg.-Calif	Flap gates for Modoc pumping plant.
Minidoka, Idaho	Power transformers and oil circuit breakers for interconnection substation.
Do	34.5-kilovolt oil circuit breakers for Minidoka switchyard.
Missouri River Basin, Colo	Outlet pipes for Bonny Dam.
Missouri River Basin, Mont	Construction of about 8 miles of canal and laterals for the Savage unit (Yellowstone Pumping), near Savage, Mont.
Do	Construction of streets, sidewalks, sewerage and water distribution systems, and electrical distribution system for Moorhead government camp, approximately 5 miles southwest of Moorhead, Mont.
Do	Construction of Savage pumping plant, including intake and outlet structures and lateral distribution system, near Savage, Mont.
Missouri River Basin, Nebr	Construction of Superior-Courtland diversion dam, a 300-foot long concrete gravity overflow structure, on the Republican River near Guide Rock, Nebr.
Missouri River Basin, S. Dak	Construction of streets and sidewalks, sewerage and water distribution systems, and electrical distribution system for Bixby government camp, South Dakota.
Missouri River Basin, Wyo	Construction of streets, sidewalks, sewerage and water distribution systems, electrical distribution system, residence, pump house, and wash house; furnishing and erecting prefabricated, sectionalized, or precut wood office building and bunkhouse, prefabricated metal garage, shop, laboratory building, and warehouse; and moving and erecting 6 Wingfoot residences, for Keyhole government camp, about 16 miles northeast of Moorcroft, Wyo.
Do	Construction of about 1.5 miles of access road at Keyhole Dam, about 18 miles northeast of Moorcroft, Wyo.
Do	Oil circuit breakers and disconnecting switches for Boysen switchyard.
Parker Dam Power, Calif.-Ariz	Construction of 8 residences at Parker Dam, Calif.
Santa Barbara, Calif	Construction of exploratory tunnels and test pits for Cachuma dam site near Santa Barbara, Calif.
Yakima, Wash	One 12,000-kilovolt-ampere transformer, 115-34.5-kilovolt oil circuit breaker, and 115-34.5-kilovolt disconnecting switches for Roza switchyard.



The Reclamation Area