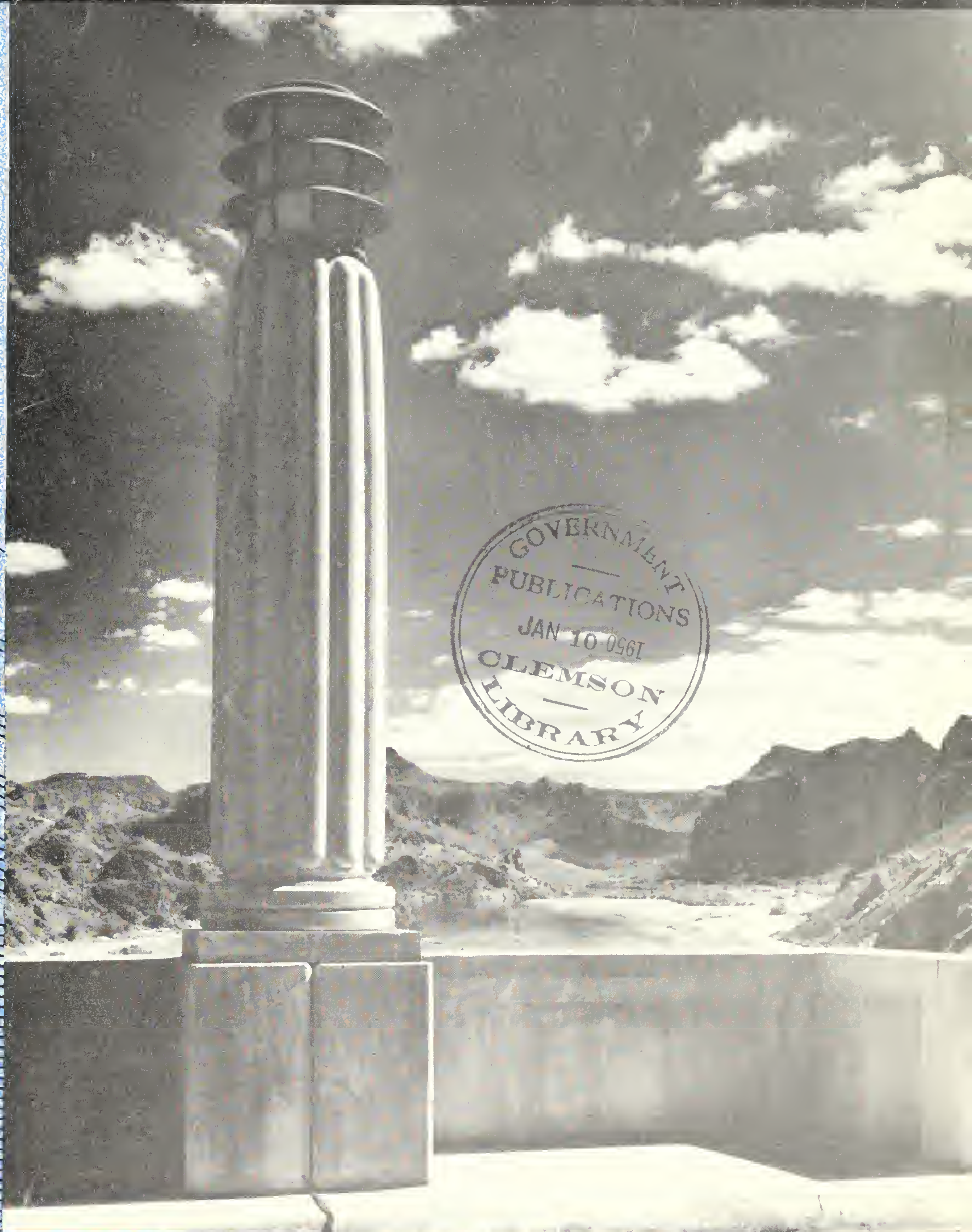
The Reclamation ERA

January

1950



The Reclamation ERA

January 1950

Volume 36, No. 1

Issued monthly by

The Bureau of Reclamation

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

Approved by the Bureau of the Budget

CONTENTS

FEATURE ARTICLES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO

IN THE ERA

President Wilson Urges Enactment of Soldier-Settlement Legislation

*We must see to it that our returning soldiers are assisted in every practicable way to find the places for which they are fitted in the daily work of the country. This can be done * * * in at least one very great field, by creating new opportunities for individual enterprise. The Secretary of the Interior has pointed out the way by which returning soldiers may be helped to find and take up land in the hitherto undeveloped regions of the country which the Federal Government has already prepared or can readily prepare for cultivation, and also on many of the cut-over or neglected areas which lie within the limits of the older States, and I once more take the liberty of recommending very urgently that his plans shall receive the immediate and substantial support of the Congress.*—From the message to Congress, December 2, 1919.

(From the January 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA, p. 2.)

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

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OSCAR L. CHAPMAN—
New Secretary of the Interior

Upon taking the oath of office as Secretary of the Interior on December 1, 1949, in the Department of the Interior Auditorium at Washington, D. C., former Undersecretary of the Interior Oscar Littleton Chapman said, "the future of our Nation depends largely on safeguarding, developing, and utilizing our natural resources necessary to sustain a free and thriving society." He further emphasized that this was a duty to be discharged by the Department of the Interior. "As Secretary of the Interior," he said, "I can do this important job best if I can continue to count on the same loyalty and cooperation which I have received from you [Interior employees] for the past 16 years."

Mr. Chapman, a member of the "Little Cabinet" for over 16 years, has served in that distinguished capacity longer than any man in history. He was appointed Assistant Secretary of the Interior on May 4, 1933, by the late President Franklin D. Roosevelt and has continued serving the Department ever since either in that capacity or as Under Secretary. As an ardent proponent of natural resource development he has long been a staunch supporter of Reclamation's irrigation and low cost public power program. During his faithful service in the Department he became known as "the spark plug" of Interior, and his appointment was hailed throughout the Nation as a just reward for merit. He is thoroughly familiar with the numerous activities of Interior, a Department whose major Bureaus outnumber those of any other executive department. Through the years he has administered affairs ranging from national parks to metallurgical research, conservation, and reclamation.

Based on his past record it is expected that the President's program for the construction of multiple-purpose projects will be accelerated. He is a firm believer in the reclamation of vast areas of western land and the development of low cost power for farmers, industries, and cities. A liberal, progressive administrator, he is fully aware of the importance of western development and its potential contribution to the prosperity and well-being of the entire country.

Left to right: Secretory of the Interior Oscar L. Chopman, former Secretory of the Interior J. A. Krug, ond Chief Justice of the United Stotes Supreme Court, Fred M. Vinson. *Photo by Glen Peort, Interior Deportment photogropher.*

Mr. Chapman, although born in Omega, Va., is a resident of Colorado where he attended the University of Denver and Westminister Law School. He later became assistant to the nationally renowned Judge Ben Lindsey, Juvenile Court of Denver, subsequently becoming chief probation officer. During his tenure of office he handled the cases of more than 10,000 juvenile delinquents. In 1929 he became the law partner of the late Senator Edward P. Costigan of Colorado, the noted liberal. He later managed his partner's successful campaign for election to the United States Senate and in 1932 he was the manager for another successful Colorado senatorial candidate, the late Alva B. Adams, in whose honor the famous Continental Divide Tunnel was named. He was also named a Colorado delegate to the 1932 Democratic National Convention. In later years he was the western campaign manager for the late President Franklin D. Roosevelt. In the last national election he took leave of absence and served untiringly and successfully as President Truman's "advance man" throughout the entire West.

He is married to the former Ann Kendrick of Louisiana. Their 5-year-old son "Jimmy," more formally known as James Raleigh Chapman, recently appeared on a Washington television program with his father on the day former Secretary Krug's resignation was announced, although he was not present at the December 1 ceremonies.

For that event, Chief Justice of the United States Supreme Court Fred M. Vinson administered the oath of office

(Please turn to page 6)

OUR FRONT COVER

STRENGTH AND SERENITY—are implied through the mojestic column atop Parker Dam which symbolizes the transformotion of o rampoging river into controlled illuminotion. The rugged splendor of Lake Havasu gives "a classicol feeling" to this mosterpiece of photography by George O. Bonawit, photographer, now of Phoenix, Ariz., who submitted this fitting inspirotional picture for our first front cover photo of the year 1950.

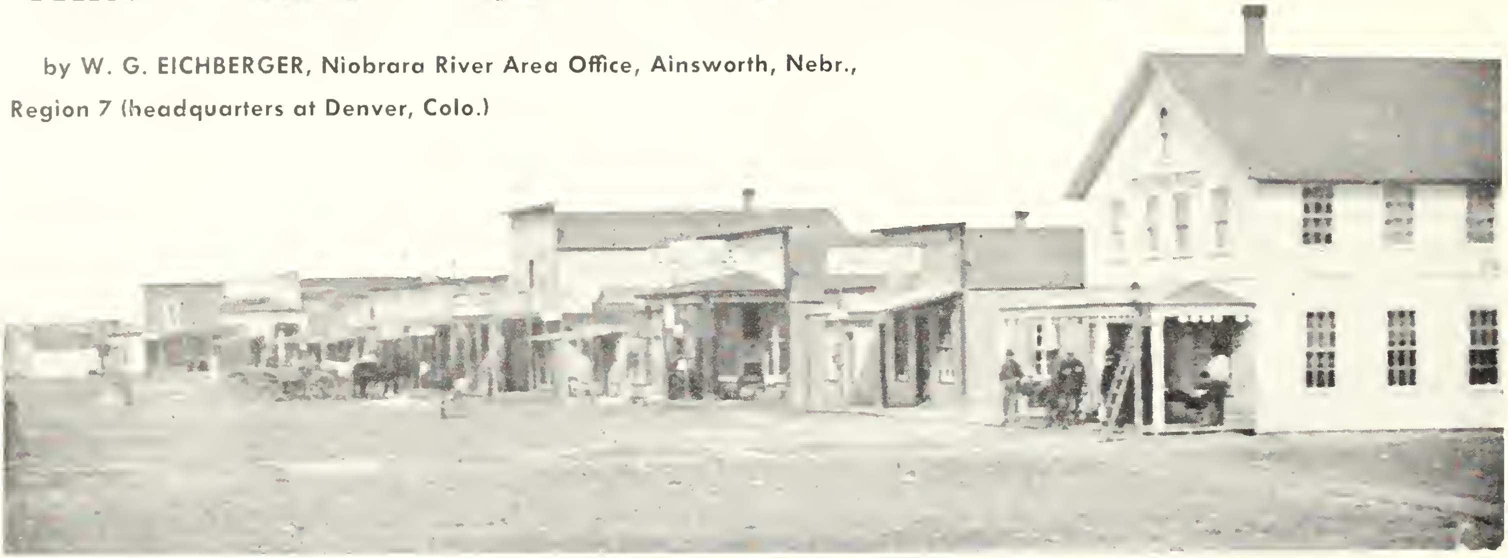
OUR BACK COVER

STRENGTH AND ACTIVITY—other aspects of the yeor just storting are typified through this home-making scene on the Hunt unit of the Minidoko project in southeost Idaho. Mrs. E. C. Wilbur and her son "Genie" ond daughter "Candie" watch Mr. Wilbur hit the nail on the heod os he prepares o cozy dwelling for the fomily, which by now is comfortably settled. *The photo wos taken in July 1949 by Phil Merritt, Region 1 photographer.*

MIRAGE FLATS PROJECT

PART I - EARLY HISTORY AND SETTLEMENT

by W. G. EICHBERGER, Niobrara River Area Office, Ainsworth, Nebr., Region 7 (headquarters at Denver, Colo.)



MAIN STREET OF VALENTINE, NEBRASKA, 1881. This and other old time photos obtained by the author on his own time at considerable personal expense.

If you were traveling in northwestern Nebraska in the Niobrara River Basin in the early morning just after the sun comes up, you might be lucky enough to see a mirage. Suddenly surrounding the flats would appear tall flat-topped buttes extending upward into the sky. While the horizon changed from moment to moment, some of the buttes would appear to be capped with snow—and you would know that you were in the Mirage Flats area, and had found the reason for the name of the Mirage Flats project.

The primary purpose of the project is to irrigate 12,000 acres of land 10 miles long and 6 miles wide, 12 miles south of Hay Springs in Sheridan County.

Mirage Flats has a history written in human toil, sweat and blood. The Sioux, the Pawnee, and the Cheyenne were in possession of the area until 1877. In 1874 the Government established the Spotted Tail Agency (named after the Brule Sioux Chief) approximately midway between the present towns of Chadron and Hay Springs. In 1877 the gold rush to the Black Hills began and the Government placed the Indians on the Pine Ridge Reservation in South Dakota. At this time Fort Sheridan was established just south of and replacing the Spotted Tail Agency, and was maintained until 1881.

With the Indians safely bestowed elsewhere, cattlemen began establishing large ranches in 1878. Grass was abundant in the Mirage Flats area and especially so in the adjoining Sandhills region. The first cattle were driven up the old cattle trails from Texas. A little later quality Hereford bulls were shipped in from the east and ranchers began to grade up their herds for the production of quality beef.

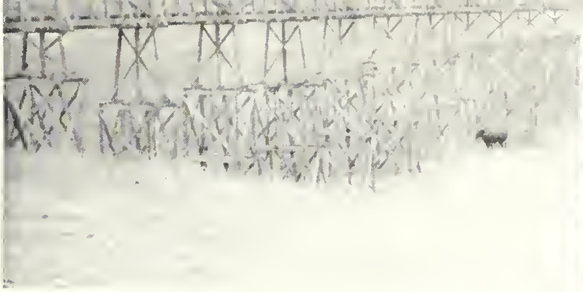
Cattlemen took over Mirage Flats as free range until 1883. Then came the settlers seeking homesteads. Among the first to arrive was Old Jules Sandoz. Looking at the Flats from the bluffs above, he immediately saw an ideal farming country and visioned the possibilities of establishing a community peopled with farmers. He filed on a homestead now known as "unit 120, Mirage Flats project," and here he had his first post office.

Old Jules worked hard to get settlers established, helping them to find corner stakes of plats and file on their homesteads. By 1885 the area was becoming rapidly settled, a homestead being established on nearly every quarter section. The first colony to settle on Mirage Flats came principally from Indiana and Iowa and consisted of many nationalities, German, French, Irish, English, and Swedish, although a large percentage were American born.

The early settlers experienced a few years of good crops, and immigration was greatly stimulated. Principal crops produced were corn, wheat, oats, and potatoes, and Old Jules went in for raising various kinds of fruit. During the early years the farmers realized yields of 30-bushel corn and 25-bushel wheat. Farming was expanded and the prairie sod was broken rapidly in an even widening area.

A severe drought which began in the late 1880's put an end to the rapid settlement and good crops. All crops were total failures in the extremely dry years of 1893 and 1894. Then began the war between the settlers and cattlemen, resulting in the Niobrara feud. Cattle rustling became rampant; crimes including murder became increasingly common.

Small wonder many settlers became discouraged and abandoned their homesteads. They were sold far below the purchase price, left to mortgagees to clear debts, or abandoned before they were "proved up on," and reverted back to public domain. A few hardy settlers remained. They knew that the soil would produce if sufficient water were available. But as no rain appeared, they decided that irrigation was the only answer to their problems. With the determination of people who had foresight and hope in the future, the settlers formed a mutual irrigation company. They had very little money for construction but they gath-



Above: Cottonwood Creek Structure, part of the original Mirage Flats irrigation project. At right: Present-day Mirage Flats Diversion Dam and Cottonwood Creek Siphon. *Right photo by Norton T. Novitt, Region 7 photographer.*

ered what materials were needed and donated labor, horses, and scrapers, to build an irrigation system. Each farmer furnished labor according to the amount of land he intended to irrigate.

Then came the problem of crossing Pepper Creek and Sand Canyon. It would require long flumes and money. The company raised it. Some of the settlers mortgaged their homesteads to the limit to help raise funds for construction of the irrigation system. The principal features of the project were a diversion dam near Dunlap; two flumes, each about 1,200 feet long; about 20 miles of main canal; and a distribution system.

There was no provision for storage, and the flow of the Niobrara River during the months of July and August was far below the irrigation requirements for that period. Some water was delivered for a few years but through a lack of cooperation, the entire planned system was never completed. Farmers located at the lower end of the project area received but very little water. The flumes were too small to carry the amount of water needed and when water was run through them they leaked like sieves. The flume across Pepper Creek finally collapsed and the other, across Sand Canyon, was destroyed by a prairie fire. The project was abandoned in 1903 after several of the settlers had lost everything they had.

Remnants of the old diversion dam and the main canal can still be seen. The old diversion dam, made of log pilings driven into the stream bed, contained very little concrete. The main canal on the present project closely parallels that dug by the early settlers. Where the old wooden flumes crossed Pepper Creek and Sand Canyon are now modern concrete siphons. Siphons are also used to carry water across other smaller draws and canyons where the old canal went around these to avoid crossing. Storage facilities are provided in the present system by Box Butte Dam to assure a water supply throughout the cropping season.

Another wave of immigration occurred around 1904 and those who were financially able to combine livestock raising with crop production found some degree of success, but those who depended entirely on crops were soon forced to sell out because of failures. By 1920 the Mirage Flats area was almost entirely owned by a pair of cattle ranchers who divided their ranch holdings into small units, and brought in a Danish colony from central Nebraska. These farmers endured many crop failures, but hesitated about building an irrigation system because of the unsuccessful venture of the early settlers.

Finally, after the drought period of the 1930's, the Mirage Flats public power and irrigation district was organized in 1937 to promote project development—too late to get a PWA grant. Whereupon Mr. Carl S. Horn of Hay Springs, promoter of the district, went to Washington and requested the Bureau to investigate the project to determine its feasibility.

The Mirage Flats project was authorized under the Water Conservation and Utilization Act and approved by the President on April 26, 1940, for construction by the Bureau of Reclamation. Work on the project was started in August of the same year. It was intended that the project would be constructed with the use of labor furnished by the Work Projects Administration. Surveys necessary for preparation of construction were made by the Bureau of Reclamation, and construction work was started with the use of WPA labor. However, due to the intervention of the war, construction work was suspended in December 1942, and the Work Projects Administration participation was terminated in January 1943. Construction work under the Bureau of Reclamation was resumed in May 1944, when this agency was made responsible for the completion of the project.

Development of the project was a joint venture of the Bureau of Reclamation and the Farm Security Administration. The Bureau of Reclamation accepted the responsibility for constructing the Box Butte Dam and Reservoir

Top photo: Livery stable at Hay Springs, Nebr., 1880. Center photo: The First Bank in Hay Springs, about 1880. Bottom photo: Early homestead in the Mirage Flats area.

and the distribution system. The Farm Security Administration, and after July 1, 1945, the Soil Conservation Service, assumed the responsibility for the purchase of the land, the subdivision of the land into farm units, the development of the land for irrigation, selection of settlers, and the sale of the land.

The Farm Security Administration purchased 14,785 acres of land in the fall and winter of 1940–41. The purchase price, averaging $25 per acre, was based upon long-time average crops and prices. Development work, consisting of subdividing the land into farms, the farms into fields, and the leveling of the land for irrigation began in the fall of 1941. Farm irrigation ditches and structures, and farm drains and structures were constructed in such a way as to make irrigation of the land as efficient as possible. Farm development work was resumed in 1944 at the same time construction work was resumed by the Bureau and all of the development work was completed in September 1948.

In the development of the farms the section lines, except on the main traveled roads, were obliterated. The farms were laid out to provide the best possible irrigation of the land. Naturally by this process the farms vary considerably in shape. It is the exception rather than the rule to find a farm on the project that lays in a rectangular shape. Usually a road, irrigation ditch, or drain forms one or more sides of each unit. This method of laying out farms eliminated many waste areas and made possible lower construction costs for the distribution system and the land leveling.

During the development period the land was farmed to dryland crops. The farms were leased to farmers until the land was ready for sale. If they proved satisfactory as tenants they were eligible to become purchasers. The farmers who sold land to the Government were given first opportunity to repurchase a family-type farm out of the land previously owned, providing they planned to stay on the farm and operate it. Preference was given to qualified veterans of World War II for remaining farms.

(CONCLUDED NEXT MONTH)

These Reclamation-designed trailer cottages are proving more popular than the usual construction camp home. At left: Typical dual unit cottage. One unit contains living, dining room, and kitchen; the companion unit contain two bedrooms and a bath. Photo by F. S. Finch, Region 5 photographer.

PLATORO HOUSING— Portable and Economical

by DAVID R. CERVIN, Engineer, Branch of Design and Construction, Region 5, Amarillo, Tex.

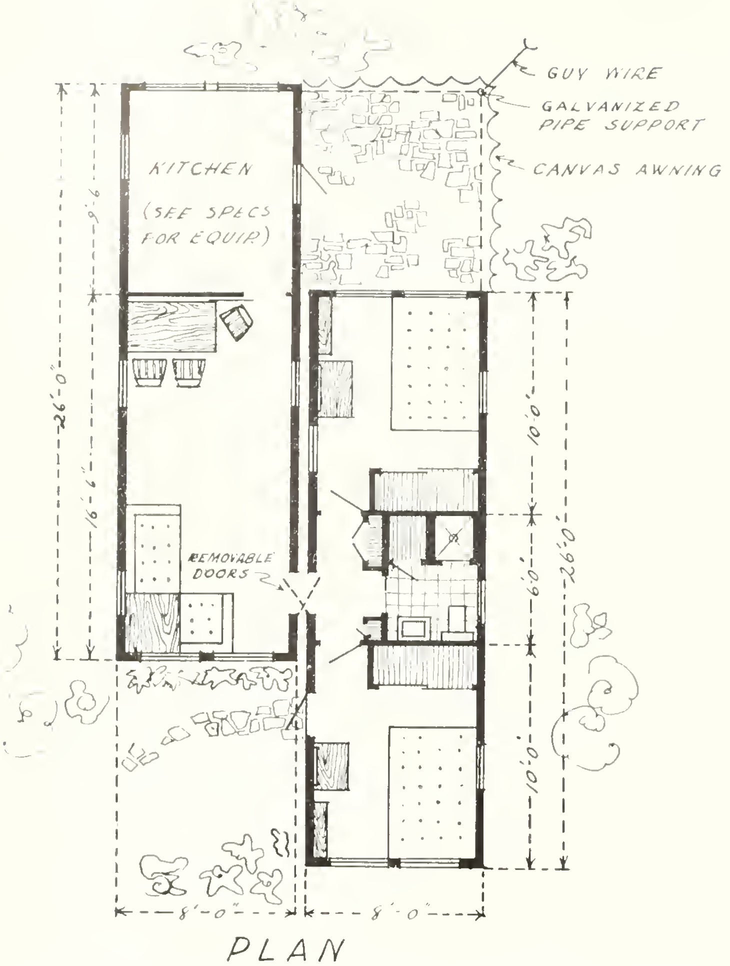
It is not often that two big birds can be killed with one well-directed stone, but engineers at Region 5 believe that they have done the trick.

The first "bird" was the problem of providing Government housing during the construction of Platoro Dam, Colo. As to the first problem, the construction site is located in a climatic area so severe that no more than 6 months heavy building activity can be hoped for during a year. Abnormal snowfall and intense cold encountered at 10,000 feet above sea level renders heavy winter construction economically infeasible. It would appear that two separate construction camps, one at the dam site and one in the valley below, would answer the problem. And this is just what has been done, except that the housing units are upon wheels and are constructed so as to permit ready connection with conventional fixed utilities at the two sites. Thus, when it is time for children to return to school, the entire family except the breadwinner can haul its deluxe dual trailer unit down into snug San Luis Valley where the thermometer only drops to 30, instead of 50, below, while the man of the family moves into bachelor quonset quarters.

The second "bird" was the problem of building a Government camp without invoking a congressional investigation due to excessive costs.

The economy angle should satisfy everyone, as single trailers suitable for couples and dual trailer units, custom-made for family use, were delivered on the site for $3,500 and $5,400, respectively. These trailers come completely equipped with electric storage water heaters, liquefied petroleum gas circulating heaters and kitchen ranges, 6-cubic-foot electric refrigerators, twin sinks, water closets, lavatories, showers, and house furniture of a quality not less than normally encountered in average American homes. All utilities have been carefully designed to permit ready connection to group facilities and are of standard operating quality. Not to be overlooked in killing the cost "bird" is another advantage of trailers over expensive prefabricated homes. The trailers can be salvaged after 4 years' use. Conservative estimates indicate the Bureau will realize well over 75 percent, including an allowance for reconditioning for further use on each trailer.

In killing the two "birds" of movability and cost, it was recognized that "the cure might be worse than the disease:" i. e., people who don't like trailers just won't live in them "nohow." Their objections can be summed up in three words, "not enough space." To meet this problem, a planning arrangement strictly new in the annals of trailer design has been concocted. At least the Trailer Coach Manufacturer's Association and all of over a dozen companies contacted had never attempted the solution proposed, but all showed keen interest in its outcome. Briefly, for families exceeding two in number, it is planned to place two custom-made trailers



Floor plan for the dual unit trailer. Drawn by Graphics Section of the Washington office, based on original design submitted by the branch of design and construction Denver, Colo.

side-by-side, offset about 10 feet, and having all the conventional rooms that a small home would have. (See drawing.) When so placed for a 6-month period, the communicating doors will be removed, stored under the trailer by metal brackets, and the open space will be sealed off by fastening strips of foam or strip rubber to the head, jamb, and sill of the door. To provide a useful outside area, and incidentally to add to the color, picturesqueness, and livability of the town, a colored canvas awning will be placed in one of the off-sets.

Although no one has yet been killed in the stampede to claim and live in one of these de luxe trailers (they are de luxe—the panelwork alone puts to shame the tapestried and ornate gold-trimmed rooms of Versailles Palace), the die-hard opponents of trailer life are reportedly making the construction engineer wealthy with bribes for choice plot locations and "me first." And at least one Benedict inspector has joined the Lonely Hearts Club so that he can live in a trailer instead of a quonset.

The answers aren't in yet, but Region 5 engineers and supply men think that they have aimed well in downing those two "birds," mobility and cost. And if the cost "bird" has been conquered and time reveals that the cure is not worse than the disease, then a new pattern for Government camp housing may have been set. THE END

Self-Government for Boulder City

On November 5, 1949, the first public meeting was called at Boulder City, Nev., to acquaint all interested persons with the local self-government plans for Boulder City, and give everyone an opportunity to be heard on the subject, and exchange information on municipal problems.

Dr. Henry Reining, Professor of Public Administration at the University of Southern California has been appointed hearings officer. Dr. Reining has had wide experience in municipal management and civic matters and will work as an independent consultant so that the Bureau of Reclamation, other Federal and public agencies, and citizen groups will have equal standing in the public hearings which have been so scheduled that it is hoped a report will be available by the end of this winter.

In appointing Dr. Reining as consultant and hearing officer, Commissioner Michael W. Straus said, "Because various interests other than the Bureau may be affected, it should be clear to all concerned that Dr. Reining is completely independent in his actions and recommendations. The Secretary of the Interior has authorized public hearings to receive information from the Bureau of Reclamation, other Federal agencies, the power allottees, Boulder City citizens, and other interests, with the Federal agencies to be heard on the same basis as other members of the community."

Dr. Reining's final report is to include facts and recommendations relative to (1) the form of local government considered most practicable, supported by a concrete plan for accomplishment; (2) the division of investments and operating costs, and a related plan of local financing; and (3) a feasible method of transferring real property holdings of the Government not required for project operations to private and municipal ownership.

Commenting on Dr. Reining's appointment further, Commissioner Straus said, "The development of practicable means for establishing Boulder City as a self-governing community on a basis conforming with American ideals of democracy and private property is a challenging assignment. Special and complex factors condition the Boulder City situation, including a high degree of national and regional interest in the great works of the project and its production of electrical energy. It is most gratifying that Dr. Reining has undertaken the difficult responsibilities of consultant." •

CHAPMAN (Continued from page 1)

to incoming Secretary of the Interior Oscar L. Chapman. On the platform at the swearing in ceremony were Mrs. Chapman, Senator Joseph C. O'Mahoney of Wyoming, who is also Chairman of the Senate Committee on Interior and Insular Affairs, retiring Secretary of the Interior J. A. Krug, Assistant Secretary of the Interior William E. Warne, and Assistant Secretary of the Interior C. Girard Davidson.

Mr. Chapman has had through the years a lively interest in the conservation and full utilization of our resources so that future generations of Americans can enjoy the benefits of our well-endowed Nation. His interest in natural resources and the many years he has served in the Department of the Interior have made him one of the Nation's authorities on resource matters. THE END

Reclamation's Hall of Fame

Nomination No. 5

Colonel ROBERT BRADFORD MARSHALL

C. V. P.'s Real Father

by MAX STERN, Regional Information Officer, Sacramento, California, Region 2

As the great Central Valley project's massive dams, canals, and other initial structures near completion, a number of Californians and their champions are emerging with legitimate claims of paternity. Indeed few reclamation projects can boast so embarrassing a number of "fathers" as this lusty super-baby of the far West. Yet the least boastful was the one to whom honor is most due—modest, able, generous Robert Bradford Marshall, author of the so-called "Marshall Plan," the real progenitor of the California State water plan, and its successor of the current era, the Central Valley project.

Robert Bradford Marshall, 82, a pioneer in the crusade for water conservation, died on June 21, 1949, survived by his wife and two daughters.

A soft-spoken native of Virginia, Robert Bradford Marshall—called Colonel Marshall, after the rank he attained in World War I—was a life-long crusader for the physical and economic integration of water, power, and reforestation.

"Land and water are eternal," he once said. "Credit and prices are ephemeral. No real progress will ever be built on waste."

In spite of his great contributions to the conservation of the Nation's resources, no footpath was beaten to Colonel Marshall's door. During the last 10 years, he lived in quiet retirement, almost in seclusion, with his handsome wife in their home in Gough Street, San Francisco. Slight, wiry, sun-tanned and erect, he was the typical engineer of the western plains and mountains. And he actually shunned publicity. The principal toll the years took was an impediment in his speaking voice, brought on by a throat operation, causing him to speak in a whisper through an artificial larynx. This affliction was the result of hundreds of speeches the Colonel made throughout California in promoting his plan for complete, comprehensive and unified water development for the State's famed Central Valley.

"Even though I knew it would cost me my voice, I'd do it again," he said. "I am only one man, but millions of people will benefit from this project. I don't care who gets the credit, just so the project is carried through to completion."

The little Colonel's dream was a big one—so big that many laughed at it, called it grandiose and Utopian. Here is how it was born.

(Please turn to page 20)

Colonel Robert Bradford Marshall and the valley of his dreams. *Marshall photo by G. V. Gidean, Region 2. Drawing by Graphics Section, Washington office.*

Siphons! Siphons! Siphons!

Dale Good using plastic siphons to irrigate his land on the Heart Mountain project in Wyoming. *Photo by Charles A. Knell, Region 6 photographer*

by R. E. WILBER, Reports Engineer, Big Horn District, Cody, Wyo., Region 6 (headquarters at Billings, Mont.)

SIPHONS! SIPHONS! Siphons! Big siphons, little siphons, inverted siphons, ordinary siphons, concrete siphons, steel siphons, plastic siphons—thousands of siphons are employed in the distribution of water on the Heart Mountain division of the Shoshone project.

The Shoshone project, one of the earliest developments of the Reclamation Service (now Bureau of Reclamation) is located in northwest Wyoming near the towns of Powell and Cody. When fully developed it will serve some 100,000 irrigable acres—over a thousand farms. Construction of the Heart Mountain division of this project has just been completed and settlement has been in progress since 1946. The land is public owned. Consequently, the farm units are available first to eligible World War II veterans. One opening was held in 1946, a second in 1948, and the drawing for the third was held September 23, 1949.

Getting back to our story about siphons, the Heart Mountain division offers a good example of the part siphons play in distributing irrigation water by means of modern irrigation facilities.

In the early days of irrigation development, canals could not be built where they would cross broad and deep coulees, or if they were, it meant constructing high, wood trestle flumes or tortuous contour canals which were precariously poised upon the steep slopes of the terraces which intersperse the numerous drainage courses in the foothills of the mountain county.

But nowadays, the siphon replaces the flume and the contour canal, eliminating the dangers of these structures which are subject to sudden failures with the attendant possibility of complete loss of crops.

As stated in previous articles, there are two principal types of siphons: the true or ordinary siphon and the inverted siphon, the difference being that the inverted siphon takes the same form as the ordinary siphon except that it is upside-down or **U** shaped, while the ordinary siphon is shaped like the small printed **N**. Every farmer who has had occasion to siphon gasoline out of a tank with a rubber hose, or the housewife who has siphoned the cream off the top of a milk bottle with a glass tube, is familiar with the principles of a true siphon. This type of siphon also plays an important part in irrigation. The inverted siphon, consisting of the **U**-shaped tube, is used in the conveyance of water across natural drainage channels and depressions. The **U**-shaped tube is merely placed across the draw with one end in the canal on the upstream side and the other end in the downstream side. The water runs into the tube until it is full and then runs out the opposite end.

On the Heart Mountain division the Heart Mountain Canal uses eight large-diameter siphons to cross various drainage courses on its route from the Buffalo Bill Reservoir to the last major area of irrigable lands on Ralston Bench, a distance of 28 miles. Steel siphons are used to span the Shoshone River and to cross Buck Springs Creek, and concrete siphons are employed to cross Trail Creek, Dry Creek, Cottonwood Creek, North Cottonwood Creek, Iron Creek, and Eagle's Nest Creek. These siphons range in diameter from 104 to 123 inches and vary in length from 1,813 to 3,200 feet.

The story of each of these siphons would bear relating, as in each instance there were special construction problems to be solved or particular water distribution facilities to be installed. Perhaps the most interesting of the siphons, however, is the one which crosses the Shoshone River at the head of the Heart Mountain Canal (see "Power at Heart Mountain," p. 145, July 1949 RECLAMATION ERA) and forms the connecting link between the Shoshone Canyon conduit and tunnel No. 1 of the Heart Mountain Canal.

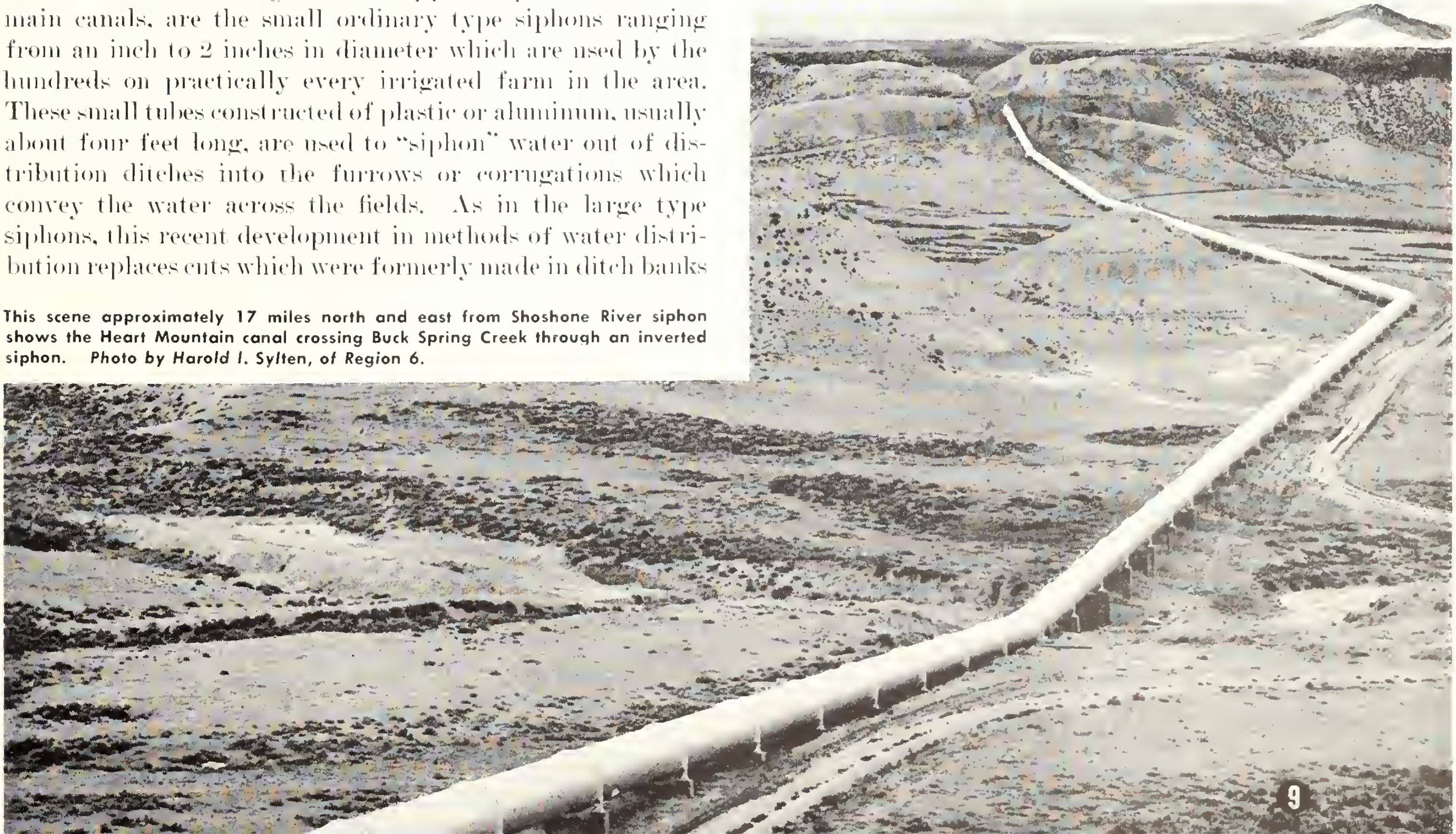
Concrete anchors were constructed at each edge of the Shoshone River gorge, a fixed anchor on the south side and a rocker bearing anchor on the north side. The pipe across the river between the anchors is in four spans, a 25-foot span ahead of the south anchor and a 150-foot center span, flanked by 80-foot spans, and these spans are self-supporting between vents (or supports on which the siphon rests). The center span of 150 feet is said to be the longest self-supporting steel pipe span in the world. The vents are of structural steel 16 to 45 feet high, supported on concrete piers, set in the rock ledge on the side of the canyon walls. Each steel vent or support is provided with a rocker bearing at the top and bottom so that the longitudinal movement can carry through four spans. Leaving the steel pipe on the north side of the river, the concrete siphon barrel then extends up the side of Rattlesnake Mountain in a backfill trench at a slope of 10° to 30° toward the portal of tunnel No. 1 of the Heart Mountain Canal.

Connections between the concrete siphon barrel and the steel pipe are by means of 10-foot 3-inch diameter steel thimbles cast into the concrete at the lower ends of the concrete barrel sections. The encasement sections are 45 feet long and have a shell thickness of 19 inches. A 12-inch gate valve located near the center of the river span supports, with steel grating floor plates, and pipe hand railing, was constructed on top of the siphon pipe from anchor No. 1 across the river to the north end of the steel pipe section. Three manholes, one near each end, and one near the midpoint of the pipe section, provide access to the inside of the pipe.

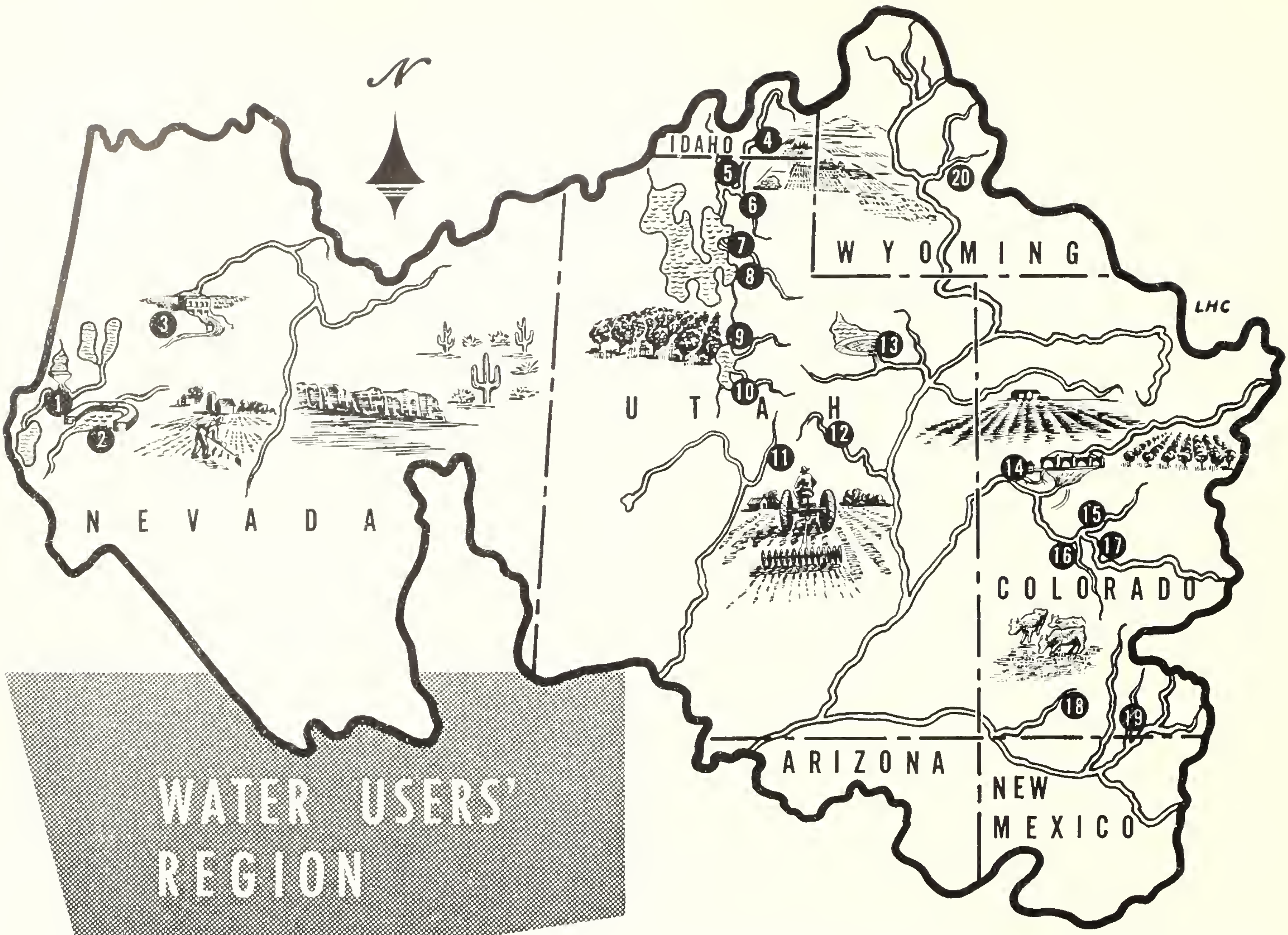
In contrast to the large inverted type of siphon used on the main canals, are the small ordinary type siphons ranging from an inch to 2 inches in diameter which are used by the hundreds on practically every irrigated farm in the area. These small tubes constructed of plastic or aluminum, usually about four feet long, are used to "siphon" water out of distribution ditches into the furrows or corrugations which convey the water across the fields. As in the large type siphons, this recent development in methods of water distribution replaces cuts which were formerly made in ditch banks to release water, or permanently installed "spiles" which were merely short lengths of pipe or other material installed in ditch banks to permit limited amounts of water to pass through onto the field. As in the case of the large siphons, the small siphons provide safer, cheaper, and more positive conveyance of water in the proper amounts than was obtainable through the openings in the ditch banks or permanently installed spiles that were formerly used. The modern siphon tube is extremely light in weight and can be readily transported by the irrigator to the point where it will be of use. The water in the field ditch is checked to a height above the land to be irrigated. The siphon tube is placed in the ditch and filled with water and then laid over the ditch bank with one end submerged in the water in the ditch and the other end located in the corrugation or furrow. If the irrigator is careful to assure that the tube is full of water when placed over the ditch bank, no difficulty is experienced in starting the flow of water through the siphon.

The amount of water discharged through an individual furrow is regulated by the size of the siphon tube and the difference in elevation of the water in the ditch and furrow into which it is distributed. Further regulation in the amount of water flowing through the siphon tube is obtained by permitting an air bubble to enter the tube. This bubble will locate itself in the highest portion of the tube and will reduce the flow through the tube in proportion to its size. The experienced irrigator readily achieves the "knack" of handling siphon tubes and can place several hundred in operation in the course of a few minutes.

Stories of the use of siphons in the distribution of irrigation water may be multiplied without end, yet probably very few people realize the importance of this simple device in the irrigation economy of the arid Western States. THE END



This scene approximately 17 miles north and east from Shoshone River siphon shows the Heart Mountain canal crossing Buck Spring Creek through an inverted siphon. ***Photo by Harold I. Sylten, of Region 6.***



WATER USERS' REGION

KEY TO PROSPEROUS PROJECTS: (1) Truckee River Storage, (2) Newlands, (3) Humboldt, (4) Preston Bench, (5) Newton, (6) Hyrum, (7) Ogden River, (8) Weber River, (9) Provo River, (10) Strawberry Valley, (11) Sanpete, (12) Scofield Dam, (13) Moon Lake, (14) Grand Valley, (15) Fruitgrowers' Dam, (16) Uncompahgre, (17) Paonia, (18) Mancos, (19) Pine River, and (20) Eden. *Drawing by Graphics Section, Washington, D. C., office.*

by MACK CORBETT,
Region 4, Salt Lake City, Utah

THE ARID COUNTRY in the heart of the Rockies comprising the Lahontan, Bonneville, and upper Colorado River basins is numerically the "irrigatin'est" region in the Bureau of Reclamation.

All told, there are 20 projects constructed or under construction by the Bureau within its Region 4 boundaries—9 in Utah, 6 in Colorado, 3 in Nevada, 1 in Idaho, and 1 in southwestern Wyoming.

With minor qualifications, all 20 may be said to be operating projects, inasmuch as irrigation is being carried on by means of existing works in instances where projects are under construction.

And, with the exception of the Provo River project in Utah, the Eden project in Wyoming, and the reservoirs on the Mancos and Pine River projects in Colorado, all are being operated and maintained by the water users.

Thus the skyline segment of the irrigated West approaches a 100-percent record with respect to water-user operation of its federally constructed reclamation projects.

Moreover, it is expected that the few projects still being operated by the Federal Government will also be turned over to the water users upon completion of construction and expiration of suitable development periods.

Meantime, there are good reasons for the few exceptions to the rule in Region 4. Construction is not scheduled for completion on the Provo River project until 1953. Operated for the past few years by the Soil Conservation Service, the Eden project must continue under Federal operation at least until completion of Big Sandy Dam and appurtenant works, recently reauthorized by the Eighty-first Congress. Possibility of a project extension to bring more lands under irrigation precludes turn-over of Vallecito Reservoir operation. Although Mancos project construction is essentially completed, difficulties with unstable terrain and other geological conditions make Bureau supervision of the Jackson Gulch Reservoir and appurtenant works advisable for a certain length of time before the water users attempt operation.

Adjoining this article is a complete tabulation of all the projects in Region 4, including the dates when those now in the hands of the water users were turned over.

It will be noted that latest on the list of projects consigned to the care, operation, and maintenance of the water users are the Gravity division of the Grand Valley project near Grand Junction, Colo., and the newly constructed Scofield Dam near Price, Utah. Both were turned over in 1949.

The Grand Valley project has been one of the most successful of the federally constructed reclamation projects in increasing crop values and improving the standard of living. In 1916, the first year for which crops were reported for the project, crop values averaged $35 per acre. In 1943, production reached an all-time high of $169 an acre, an increase of over 480 percent. That same year, the peach crop on the Orchard Mesa Division attained the phenomenal average of $1,190 per acre for 2,435 acres—believed to be a record for the entire West. In 1947, an outstanding yield of sugar beets accounted for a $95-per-acre average on the Gravity division as compared to a low of $16 in its earlier history.

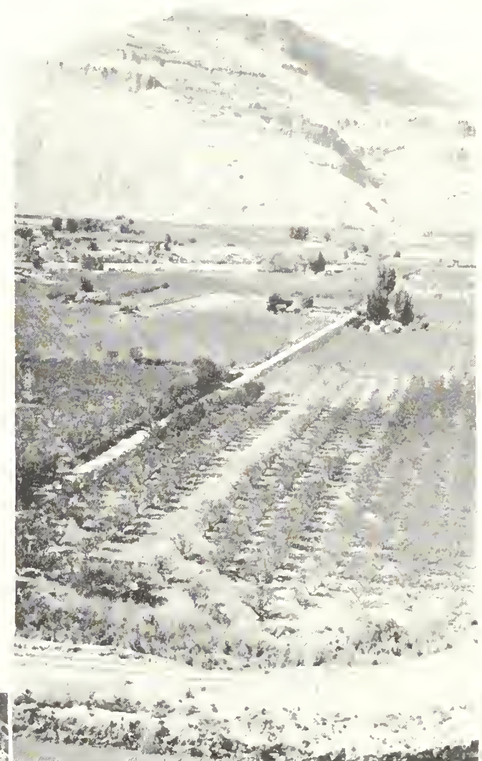
The Scofield project irrigates about 16,000 acres of land in southeastern Utah through a replacement dam on the Price River which conserves the early spring run-off water. It was constructed under special priority during the war years, as a combination emergency and war measure to avert threatened flood damage to the strategic coal industry and the Denver & Rio Grande Western Railroad in the project area. The new Scofield Dam replaces an old structure that had partially failed in 1928. Construction of the new dam was begun in September 1943 and finished in June 1946.

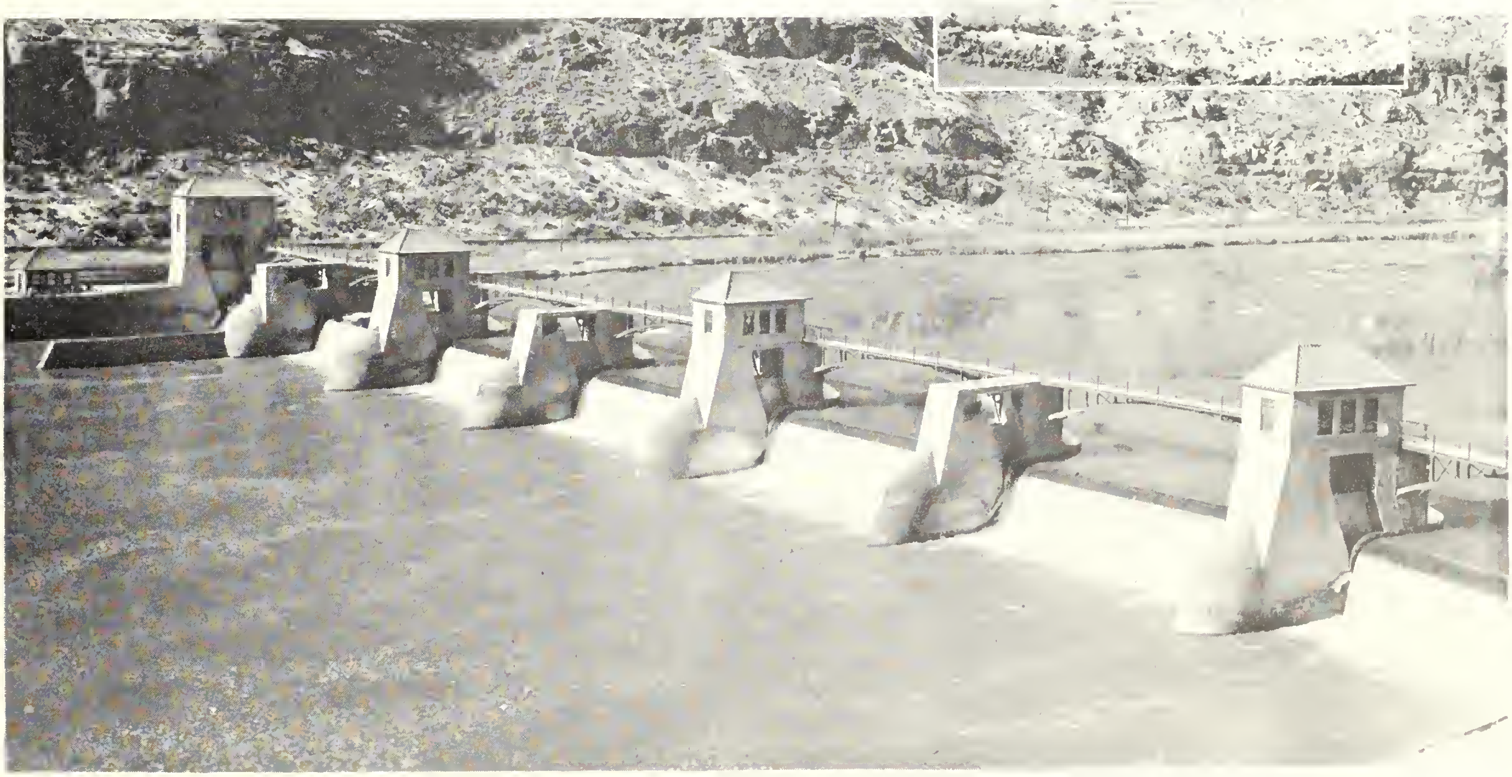
The Grand Valley project has made possible diversified and intensified farming in the Grand Junction area with a dependable maturing of such crops as peaches (for which the area has achieved wide renown), alfalfa, beans, sugar beets, seed tomatoes, corn, oats, potatoes, and wheat. The raising of seed crops and livestock are two important industries that have also developed with the project. In addition to the feeding of range stock during the winter months, dairying has assumed new importance with establishment of creameries as a ready local market.

Alfalfa is the principal crop grown on the Scofield project, with grains, beans, potatoes, some sugar beets, and fruits ranking next. A few berry crops are also produced.

About 48,000 acres of land in Mesa County near Palisade, Grand Junction, and Fruita receive water from the Grand

Immediately below: Irrigated orchards, a typical scene in the Grand Valley project of Colorado. Bottom of page: Diversion dam and headworks on the Colorado River near Palisade, Colo., Grand Valley project. ***Both photos courtesy Grand Junction, Colo., Chamber of Commerce.***





Valley project which develops its principal water supply by means of a diversion dam and headworks on the Colorado (Grand) River, 8 miles northeast of Palisade. An interesting feature of the diversion dam consists of its seven movable roller crests for regulation of the river at the canal intake. The project canals and laterals under the Gravity division total more than 200 miles in length and supply water on an individual basis to 30,000 acres of land. In addition 8,500 acres under the Mesa County and Palisade irrigation districts and 10,000 acres under the Orchard Mesa division are also served from the Colorado River. Water for the Orchard Mesa division generates electricity for all three project communities.

Development of the Grand Valley project has contributed greately to the growth and prosperity of nearby Grand Junction, a community of about 18,000, with creameries, flour mills, canneries, packing house, and other plants directly dependent upon crops. Grand Junction also has a daily newspaper, several banks, railroad shops and branch houses for packing and wholesale concerns using Grand Junction as a distributing center.

The Grand Valley Water Users' Association and the Orchard Mesa irrigation district are repaying the $4,156,663 costs of construction of the Grand Valley project in 40 graduated installments. If payments continue on the present current basis, the construction investment will be amortized in 1973. Write-off of $812,374 and suspension of $113,974 in construction charges against 29,770 acres of land deemed permanently or temporarily unproductive have helped to ease the repayment obligation.

The Scofield Reservoir capacity of 73,000 acre-feet is considerably greater than the 30,000 acre-feet needed for irrigation purposes. The extra storage provides such secondary benefits as allocation of 8,000 acre-feet of dead storage for fish protection and enough hold-over storage capacity (more than 30,000 acre-feet) to release normal inflows from Gooseberry Creek for transmountain diversion under the potential Gooseberry project.

If the Gooseberry project is developed, it is expected that water users of that district will assume $116,000 of the $247,000 reimbursable construction costs of the Scofield Reservoir. The Utah Fish and Game Department paid $31,000 of the reimbursable construction cost in return for fish protection. The Carbon County Water Conservancy District is obligated to pay to the United States $216,000 of the reimbursable costs. This obligation will be reduced by $116,000 if the Gooseberry project is constructed. The remaining portion of the $1,000,000 construction cost is charged to secondary benefits classed as nonreimbursable.

Price, Utah, the principal project community in the Scofield Dam area has a population of about 7,500.

With the recent addition of Scofield and Grand Valley projects, nearly all of Region 4's operating projects are in the custody of the people who underwrote the Federal loans and are repaying the costs of construction.

For all water users served by the 20 operating projects in Region 4, there is solid reassurance in the fact that the Federal Government retains control (of the reservoirs) on only 4 of these projects. The privilege of having Uncle Sam build the irrigation works that are too complex and costly for private financing does not entail forfeiture of independent operation or vested rights.

The following table shows the projects and the dates they were turned over to the water users:

RECLAMATION PROJECTS IN REGION 4

Project	State	Date turned over	Operating agency	Features
Strawberry Valley	Utah	1926	Strawberry Valley Water Users Association	Strawberry Dam, Reservoir, tunnel and power canal. Spanish Fork diversion dam and power plant. Indian Creek crossing diversion dam.
Newlands	Nevada	1927	Truckee-Carson irrigation district	Lahontan Dam, Reservoir, and power plant. Lake Tahoe Dam and Reservoir. Carson River and Derby diversion dam.
Uncompahgre	Colorado	1932	Uncompahgre Valley Water Users Association	Gunnison River diversion dam and tunnel. Taylor Park Dam and tunnel.
Weber River	Utah	1932	Weber River Water Users Association	Echo Dam and Reservoir. Weber-Provo diversion canal.
Humboldt	Nevada	1934	Pershing County water conservation district	Rye Patch Dam and Reservoir.
Hyrum	Utah	1936	South Cache Water Users Association	Hyrum Dam and Reservoir.
Moon Lake	do	1936	Moon Lake Water Users Association	Moon Lake and Midview Reservoirs. Yellowstone and Duchesne Feeder Canals.
Ogden River	do	1937	Ogden River Water Users Association	Pine View Dam and Reservoir, South Ogden, Odgen-Brigham and Highline Canals.
Sampete	do	1941	Ephraim Irrigation Co Horseshoe Irrigation Co	Ephraim Tunnel and Beck's south feeder canal. Spring City Tunnel, Cedar Creek and Brough's fork feeder canals.
Truckee Storage	Nevada	1942	Washoe County water conservation district	Boca Dam and Reservoir.
Fruitgrowers Dam	Colorado	1942	Orchard City irrigation district	Fruitgrowers Dam and Reservoir.
Newton	Utah	1948	Newton Water Users Association (canal system only)	Newton Dam, east, highline and main canals.
Grand Valley (Gravity Div.)	Colorado	1949	Grand Valley Water Users Association	Grand Valley Dam and power plant. Price-Stub pumping plant.
Scofield Dam	Utah	1949	Carbon water conservancy district	Scofield Dam and Reservoir.
Preston Bench [1]	Idaho		Preston, Riverdale and Mink Creek Canal Co	Station Creek Tunnel and Mink Creek Canal.
Mancos [2]	Colorado		Mancos water conservancy district	Jackson Gulch Dam and inlet and outlet canals.
Provo River [3]	Utah		Provo River Water Users Association Metropolitan Water District of Salt Lake City	Deer Creek Dam and Reservoir, Alpine-Draper, Olmsted, Duchesne Tunnels, Weber-Provo and Provo Reservoir Canal Enlargements. Salt Lake Aqueduct.
Pine River [4]	Colorado		Pine River irrigation district and Bureau of Indian Affairs.	Vallecito Dam and Reservoir.
Paonia	do		North Fork water conservancy district.	Spring Creek Dam and Reservoir. Fire Mountain and Overland Canal.
Eden [6]	Wyoming		Yet to be determined	Big Sandy Dam.

[1] The Preston Bench project was constructed in 1 year as an emergency measure to replace an existing canal. It was not necessary for the water users to relinquish operation of the project.

[2] Jackson Gulch Dam was completed in December 1948, dedicated on July 3, 1949, and is being operated by the Bureau of Reclamation during the development period.

[3] Completion of construction on the Salt Lake Aqueduct division is scheduled for 1950 and on the Duchesne Tunnel of the Deer Creek division for February 1953.

[4] Vallecito Dam was completed in 1942 and operation of the reservoir has remained with the Bureau of Reclamation pending action on proposed extension of the project.

[5] Bids for construction of Spring Creek Dam were rejected in 1948. Meantime, 3 contracts have been awarded for enlargement of Fire Mountain Canal as an initial phase of the project development.

[6] Completion of Big Sandy Dam, partially constructed as a WCU project with funds appropriated by Congress in 1940, was reauthorized by the Eighty-first Congress in 1949. Present plans call for resumption of construction in 1950.

Irrigation Farmers Need Fertilizer

by DR. C. H. DAVIS

Branch of Operation and Maintenance

Boulder City, Nevada, Region 3

FERTILIZER SHOWS RESULTS. At Mr. Vernon Bigler's right hand is the alfalfa yield from a strip of land which contained 150 pounds of P_2O_5. At his left hand is the yield from a similar strip containing only 50 pounds of the same available plant food. *Photo by W. J. Mead, courtesy of the United States Department of Agriculture's Soil Conservation Service.*

The irrigation farmer, even during a drought, can step to the phone and order water for his crops. He pays for this dependable water service in construction and operation costs. To offset these costs, the progressive irrigation farmer uses fertilizer to increase the value of his crops and insure a substantial return on his investment.

Fertilizer applications improve the quality of the crops with a resultant higher return for the farmer. Ray King, writing in the January 1949 issue of Crops and Soils, estimated that in 1947, $5 worth of fertilizer returned $40 worth of crops to the American farmer. Although the figure was not calculated separately for irrigated land, the irrigation farmer who can provide favorable tilth and moisture conditions increases his advantage over dry-land farmers through fertilizer applications.

As a matter of fact, irrigated crops require more fertilizer than dry-land crops. This was discovered during an analysis of background information made by the Bureau of Reclamation to find out how much electric power would be needed to take care of a potential northwestern phosphate industry. Crops grown on the average acre of irrigated land in southern California and Arizona removed 38 pounds of high analysis phosphate fertilizer in 1944, while only 22 pounds were removed by crops on the average acre of nonirrigated crop land. The phosphate removed by crops on irrigated land in the 17 Western States in 1944 was 148,000 tons. In the 10 years between 1944–54 the loss of phosphate through crop removal is expected to be more than doubled. The estimated removal for 1954 stands at 421,000 tons of high analysis phosphate fertilizer or the equivalent of over 10,000 carloads each year. This estimate was based on the probable increase in irrigated land by 1954, the proportionate acreage and crop yields of irrigated and nonirrigated lands, and the percentages of phosphates contained in each crop.

Irrigation farmers have become increasingly interested in encouraging phosphate production in the West. Soils in the western part of the United States, once considered inexhaustible, now need fertilizer. This need will increase with the increase in irrigated lands.

The Department of the Interior's analysis of information on phosphate deposits, demand, production, and use indicates that there has not been enough phosphate produced in the West to meet demands. Although the West holds the largest supplies of phosphate (estimates of the Federal Geological Survey show 60 percent of the Nation's supply is located in Montana-Idaho-Wyoming-Utah), the area produced in 1943 only 4½ percent of the national total. Tennessee, which holds only 2 percent of the total phosphate resources, produced 25 percent of the Nation's total in that same year.

Since western sources do not produce the phosphate fertilizer needed in the West, phosphate is transported from a variety of points in the United States. The movement of fertilizer long distances results in a higher cost to farmers in the West.

It is recognized that the West now holds the Nation's only large inland supply of raw materials for phosphate fertilizer. Because of this and because irrigation farmers are aware of the increased earnings resulting from the use of fertilizer, the prospect of producing more phosphate in the West is a subject of much interest today.

In addition to the use of phosphate fertilizer, there is also a higher use of nitrogen fertilizer in the western irrigated lands than in the rest of the United States. Very little organic matter and nitrogen accumulates in the irrigated sections because of the low rainfall. The nitrogen required for all vegetative growth accounts for the extensive use of nitrogen fertilizer in western irrigated lands. In sharp contrast to the needs for phosphate and nitrogen in western soils, the supply of potassium generally is ample.

The drought hazard for the irrigation farmer is much less than for the rainfall farmer. He is in a better position to determine his fertilizer needs and to make the application in terms of crop response and value. He is also able to place the fertilizer in the soil just before, or along with, an irrigation, so that the plants will be able to use it at once.

The irrigation farmer must understand and supplement his irrigation service if he is to receive maximum returns from the water and land in which he has invested. THE END.

SAUDI ARABIA AND SOUTHWEST, U. S. A.

Introducing Reclamation Projects to State Department Representatives

At left: The author learns how to improve the quality of maize through irrigation. His instructor, Jess Walker of the W. C. Austin project at Altus, Okla. *Photo by F. S. Finch, Region 5 photographer.*

by J. RIVES CHILDS,
United States Ambassador to Saudi Arabia

When it was proposed, on my return from my post in Saudi Arabia on leave of absence, that I visit certain Bureau of Reclamation projects in the Southwest, I must confess that I viewed the proposal by Under Secretary Webb of the State Department with some skepticism. I could understand the practical value of such a tour to Ambassador Caffery in Egypt, or to Ambassador Crocker in Iraq, but in Saudi Arabia where the problem of irrigation is one of finding water rather than harnessing existing supplies, there seemed to be little that I might learn which might be used to practical advantage.

My skepticism was very quickly dissipated as a result of the insight given me into the remarkable work which the Bureau of Reclamation is performing. People like myself who have spent most of their lives in the eastern United States or in foreign lands know all too little about these projects.

I have seen the Pyramids, and Karnak, Persepolis, Baalbeck, and many other wonders of the ancient world but I know of nothing more inspiring to an American than the work which the Bureau of Reclamation is performing in harnessing the unruly rivers of the West, in diverting waters from one side of the Rocky Mountains to the other, and in bringing hitherto arid lands under cultivation.

What I saw was not only an inspiration in the knowledge given me of the wonderfully constructive work being undertaken by our government, but before my trip was over I had gained ideas which it is hoped may be put to use in the application in Saudi Arabia of the President's Point Four Program.

After interviews with many engineers and other officials of the Bureau of Reclamation, including in particular Mr. Ian Briggs, who traveled with me a great part of the way, I found that in Arizona and California there are also large areas which are characterized, as in Saudi Arabia, by flash floods.

I believe that the first-hand knowledge which I gained and the opportunity afforded for an exchange of ideas on the spot with so many who have spent their lives in dealing with American irrigation problems will be of the greatest practical benefit to me in my work as American Ambassador in Saudi Arabia in endeavoring to apply the lessons which our greatest experts have gained in the United States.

Through the courtesy of the Air Force I was able to fly from my home in Lynchburg, Va., on an 8-day tour in a C-47 piloted by Maj. Mathew Ferguson, which took us to Altus, Okla., the Salt River project near Phoenix, Ariz., the Yuma irrigation system, the El Centro and Indio areas, Hoover Dam, Nev., with a final visit to the remarkable laboratories of the Bureau at Denver, Colo. If I were making the tour again I would begin rather than end with Denver, and I believe it would be advantageous for future visitors to view the relief map of the Colorado River basin at Hoover Dam before visiting the great series of dams and the irrigation systems depending thereupon rather than to postpone, as we did, a visit to the Dam until the end of the tour.

I cannot express too greatly my appreciation of the uniformly friendly welcome accorded me, and the interest displayed in unfolding their store of knowledge by all the officials of the Bureau of Reclamation whom I met.

My first contact with the Bureau came in Wichita Falls, Tex., where I was met and taken in tow by Mr. Garford Wilkinson, of the Bureau's Region 5 office in Amarillo, who accompanied me to Altus where he had organized a most enlightening tour of the W. C. Austin project.

At Phoenix, Mr. Ian Briggs, of the Bureau's Region 3 office in Boulder City, became my guide and mentor and stayed with me until our arrival at Boulder City. At Denver I had the privilege of meeting the Chief Engineer of the Bureau, Mr. L. N. McClellan, who conducted me over the Aladdin-like laboratories of the Bureau where man rubs a modern lamp and riches of the soil pour forth.

May I take this opportunity, through the hospitality of the columns of the Reclamation Era, to express to those named, as well as many others who must remain unnamed for want of space, my warm thanks for the courtesies extended a member of another service of our Government. Through them my knowledge has been extended in a manner which cannot but enhance my usefulness as the representative of the United States in Saudi Arabia. At the same time they have made me a better American in the wonder and admiration which have been awakened in me for the modern miracles which our great country is realizing in the field of irrigation and hydroelectric power development under Commissioner Straus of the Bureau, and his associates. The End

What Is the Folsom Formula

Welcomed as a sound and statesmanlike solution to confusion resulting from jurisdictional problems between the Bureau of Reclamation and the Corps of Engineers in western river basin development, the so-called "Folsom formula" has been proclaimed by President Truman as a guide to further development in the Central Valley of California. In his letter of August 15 to the then Secretary of the Interior Krug, commenting on the Central Valley Basin Report prepared by the Bureau of Reclamation, the President said:

". . . I have reached the following conclusions:

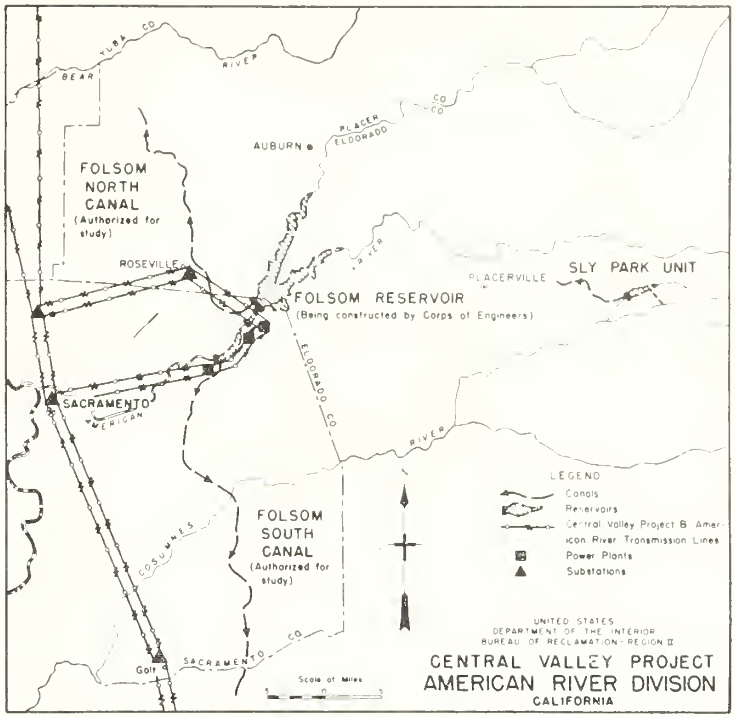
* * *

"(E) As additional individual proposed projects not now authorized are found feasible on the basis of detailed project reports, they will be approved for authorization in accordance with the Folsom formula: i. e., *multiple-purpose dams are the responsibility of the Bureau of Reclamation, and dams and other works exclusively for flood control are the responsibility of the Corps of Engineers.*" [Italics added.]

The formula grew out of the Bureau of Reclamation's insistence that the authorized flood control dam on the American River, under construction by the Corps of Engineers, with a reservoir capacity of 355,000 acre-feet, was inadequate for the conservation needs of the Central Valley.

The Engle Act (Public Law 356, 81st Cong.), passed in October 1949, reauthorizes and enlarges the Central Valley project to include the American River development, with Folsom Dam to have a reservoir capacity of 1,000,000 acre-feet, and "upon completion of construction by the Corps of Engineers, to the extent where water from said reservoir is ready to be turned either into the power plant or conduits, shall be transferred to the Bureau of Reclamation for operation and maintenance." The act further authorizes the construction by the Bureau of Reclamation of a power plant, afterbay power plants and necessary transmission lines to interconnect with the CVP transmission system, and Sly Park Dam with necessary appurtenant works for the delivery of water to lands in El Dorado County. The Secretary of the Interior is directed "to cause the operation of said works to be coordinated and integrated with the operation of existing and *future features* of the Central Valley project in such manner as will effectuate the fullest and most economic utilization of the land and water resources of the Central Valley project of California for the widest possible public benefit." [Italics added.] This provision is Congressional recognition of the necessity for further orderly expansion of the Central Valley project, as contemplated in the Bureau's basin report.

"The Folsom formula," said Congressman Clair Engle, author of the bill, "is of historic importance. It will settle for all time the controversy in the Central Valley as to which agency should build and operate the multiple-purpose features of the Central Valley project. It should settle for all time other jurisdictional disputes as to construction and operation of multiple-purpose projects throughout the Reclamation West."



Enunciated as a statement of policy on the highest governmental level, the Folsom formula is less sweeping than the recommendations in that direction outlined by the Hoover Commission on Governmental Reorganization. The Commission's report recommended that all flood control and river and harbor improvement work be turned over to the Department of Interior. The End

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White Sweetclover Seed Grosses Almost $180 per Acre for Sun River Farmer

White sweetclover seed production proved a profitable cash crop for Lawrence Beerman, farmer on the Greenfields Division of Sun River project. From 30 acres Mr. Beerman produced 38,702 pounds of first-grade seed, which sold for 13½ cents per pound, bringing $5,224.77; and 1,775 pounds of No. 2 grade seed, which was sold for 6 cents per pound, bringing $106.50. With no allowance being made for the value of the screenings, straw, and pasture, the crop brought a total of $5,331.27 or $177.71 per acre. (Editor's Note: Average crop value on reclamation farms for 1948 was $113.76 per acre.) Phosphate was used on this ground in 1948.

Growing sweetclover has the advantages of low production costs, plus improving soil tilth and increasing soil fertility. Generally only one irrigation is required and seeding costs are low. Most sweetclover on the Sun River project is seeded with spring grain, from which a normal grain crop is harvested the first season, and the following season the clover is either plowed under for green manure or harvested for a seed crop. (For further information on clover seed production see "Deschutes Project—Deep in Clover," p. 215, November 1949 Reclamation Era). •

HOW THE MAGIC IS MADE—from sagebrush land like that at the left where Bureau of Reclamation engineers are waving, not magic wands, but the scientific implements which result in modern miracles, comes productive land like that shown in the photo below. When water is applied in the southern Idaho area covered in the Bureau's benefit study popularized in this article, many arid stretches become "magic valleys." *Photos by Stanley Rasmussen, Region 1 photographer.*

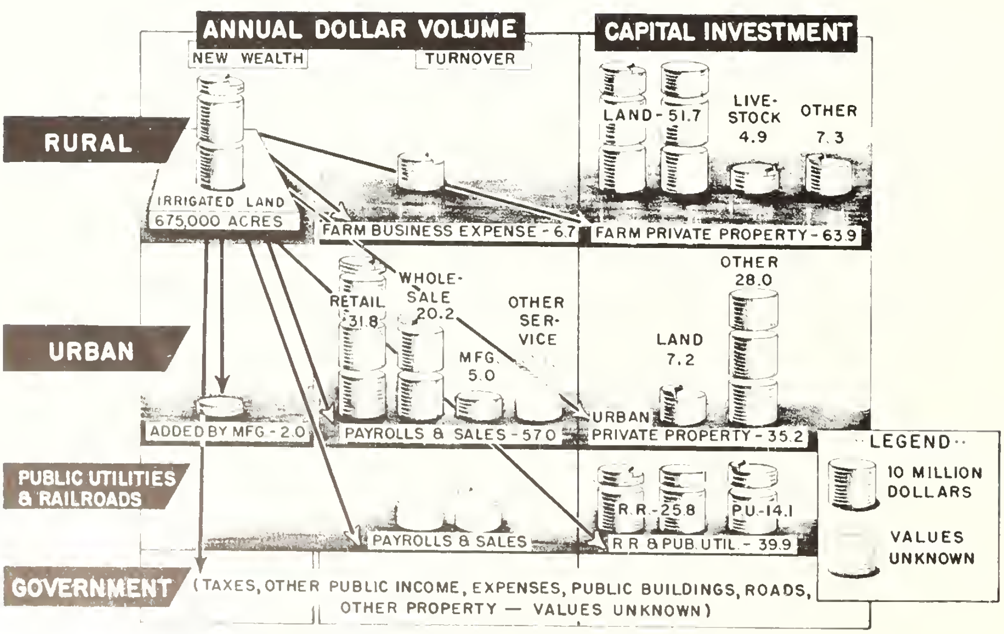
SIX COUNTIES in the MAGIC VALLEY

IN SOUTHERN IDAHO there is an irrigated oasis in the sagebrush desert called by its inhabitants the "Magic Valley." It has brought them the good things of life in proportions considerably above the average rural standards in these United States and, with better living, a large degree of contentment.

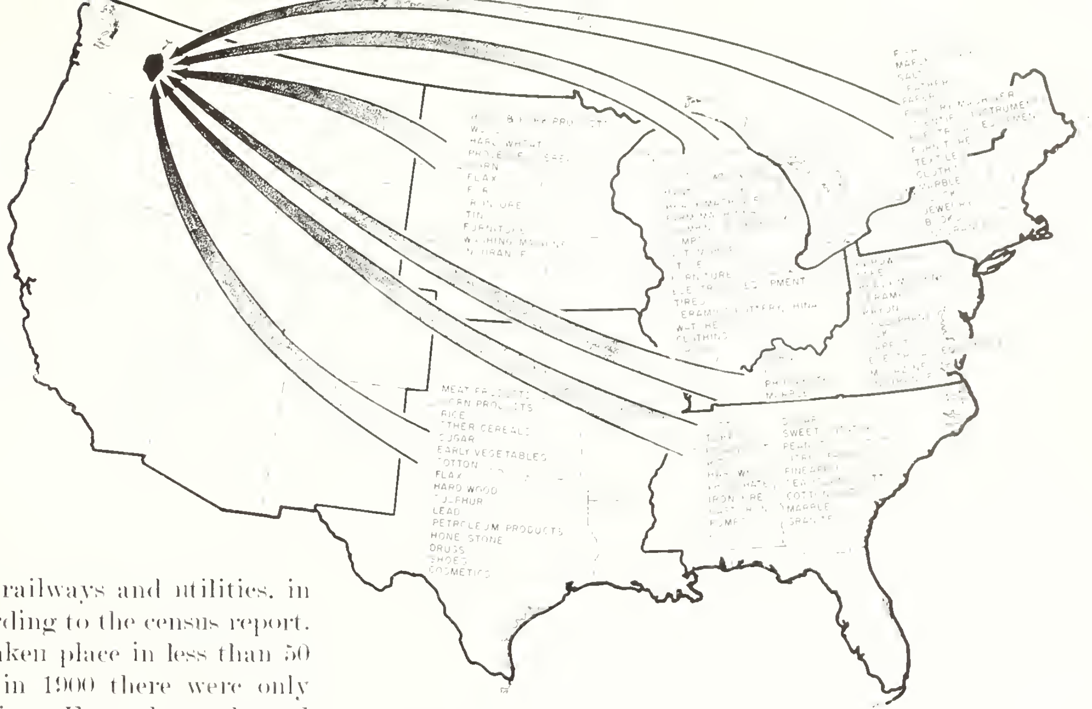
There are in the six counties of this Magic Valley—Gooding, Lincoln, Twin Falls, Jerome, Minidoka and Cassia—some 675,000 acres of irrigated land from which the wealth of the region flows. Without the water taken from the Snake River and its tributaries, via the Minidoka project irrigation facilities, this area would still be part of the primitive Idaho plain, useful only because of the sparse forage it provides for cattle and sheep in the spring before the summer sun burns it dry.

But today this section, with a population of 84,000 people, supports 1,600 business enterprises and provides jobs for 26,000 persons on farms and in its cities and towns. Upon what was once wasteland $130,000,000 in property values has been created. The value of farm land and buildings alone in 1940 was $71,000,000; and by 1945 this had risen to $107,000,000.

The dollar volume of farm business expenses, sales and pay rolls of retail, wholesale, and manufacturing concerns,



HOW THE MONEY PILES UP—wealth based on irrigated land of the Twin Falls-Minidoka-Gooding area picks up additional value as it rolls through the channels of business. Town and country benefit through the activities of the irrigation farmer, from the storekeeper who sells him his shovel, to the railroad which carries his products to market and brings him necessities and luxuries in return, to the Federal Government which receives sizeable income taxes from an area once barren of revenue. *Drawing by Graphics Section, Washington, D. C. office.*



HOW THE MAGIC TOUCHES THE NATION— **The purchasing power of the Magic Valley is evidenced in this pictograph which shows the flow of foundry machinery and electrical equipment from the New England to the Valley area. From the Central States, farm machinery, automobiles, and automotive equipment are imported, while the South ships marble, iron, pumps, phosphate and many other manufactured articles and equipment. Every State in the Nation benefits from western agriculture and we can truly say the Magic Valley area has created a "Magic Carpet" to convey the shipment of products required from outside the area.** ***Drawing by Graphics Section, Washington Office.***

not including service enterprises, railways and utilities, in 1940 amounted to $63,700,000 according to the census report.

Most of this development has taken place in less than 50 years. According to the census, in 1900 there were only 5,735 people in these 6 Idaho counties. From the creeks and small rivers which rise in the mountains north and south of the plain, water was led by simple diversions to about 48,000 acres of irrigated land. Hay and grain was raised for the cattle and sheep industry. In the winter the animals were brought in to the irrigated areas, in the spring they grazed on the surrounding desert ranges, and in the summer heat they were taken to the mountains. Today, a goodly proportion of the Idaho potato crop comes from the Twin Falls-Minidoka-Gooding area; but in 1900 only 282 acres were in potatoes.

The engineering difficulties and cost of diverting or pumping water from the great Snake River which flows through a canyon in these plains were too great for the resources of individuals or small groups. Both the Government and private groups, however, shortly after 1900 began the construction of large-scale diversion dams upon the Snake River and the Big and Little Wood River systems. From then on, intensive agriculture in the Magic Valley began. In 1927 the Bureau of Reclamation completed the American Falls Reservoir with a storage capacity of 1,700,000 acre-feet.

In 1900 the only town listed by the Census Bureau in this area was Albion with 306 people. Untouched by the magic of irrigation, and content to remain one of the most picturesque villages in Idaho, its population today remains a little more than 300. However, as irrigation began to transform the Valley, the city of Twin Falls sprang into being, and by 1910 there were 5,200 people living in this flourishing town. Today the city of Twin Falls numbers about 12,000 people—more than twice the population of the entire 6 counties 50 years ago. Throughout this fertile farming land a well-developed system of modern roads has been built, together with 250 miles of branch railroad.

With irrigated agriculture, the livestock industry was given a tremendous boost. Winter feed from alfalfa, beet tops and bean straw became available in far larger quantities, and the number of animals supported increased 20 times between 1900 and 1940. The natural range, however, has been depleted with the result that sheep raising has declined.

In 1940 all crops and livestock brought a cash return of $22,699,000, of which $8,675,000 came from 140,000 acres of potatoes, sugar beets and beans. In 1945 the agricultural income from these six counties rose to a total of $54,990,000. Cash returns probably went considerably higher in 1946 and 1947.

It is the irrigated agriculture which forms virtually the entire base for the prosperous business of this region, for the desert supports no forest resources and there are no large mineral deposits which have been developed. Of the 1,600 business enterprises which have grown up since the area was developed, 1,030 are retail establishments, 183 are wholesale houses, and 334 are service establishments, not including the offices of lawyers, doctors, banks, real estate operators, and so forth. Most of the 64 manufacturing plants are concerned with processing farm products.

The census report for 1940 indicates that at that time 12,857 persons employed in service industries, trades and professions, and 822 in manufacturing, called this area their home. Altogether the nonfarm population numbered 13,-739—1,528 more than the farm population of 12,211.

The Department of Agriculture has constructed an index to reflect the standard of living of people who live on farms and in rural communities. This shows that in 1940 the living standards of the farm people in the six counties in question ranged from 12 to 31 percent higher than the average for the United States, while the nonfarm inhabitants of these counties was from 9 to 35 percent above the average. New wealth created in 1940 measured by the value of farm products produced and value added by manufacture amounted to $37 per irrigated acre, or $294 per person. At that time the investment in private property for producing farm and manufactured products and for serving and housing the population had increased to $195 per irrigated acre of $1,548.

The golden touch of legendary King Midas was nothing compared to the touch of modern reclamation which has created many magic valleys of which the one in Idaho is a spectacular example.

THE END

How Modern Can You Get?

We Americans are fond of speaking of modern developments in irrigation, but here are two "modern" irrigation works in Ceylon, built 2,000 years ago. The first picture shows the Parakrama Dam, 9 miles long and 80 feet high. The second is of the discharge works. Both earth structures bear witness to the permanence of well built irrigation works.

However, very few of our present-day structures carry such colorful legends as these. The story goes that the "modern" structures replaced the personal swimming pool of the Goddess Pattini, and near this spot, she spied a "golden boy" dancing among the golden petals of the Sapu flowers. She made up her mind to marry him, and did. Maybe the story, too, is modern after all.

Bureau Studies Nation's Future Food Requirements

During the fiscal year 1950 the branches of operation and maintenance and project planning will collaborate in preparing a report which will show the contribution reclamation can make toward meeting future additional food requirements.

The study was started during 1948 in region 2, where procedures were developed for analyzing data by States, regions, and for the 17 Western States, of the probable long-term requirements for irrigated land based on several assumptions of population trends, national level of employment and income, per capita food consumption, levels of exports and imports, and changes in agricultural technology. •

Upper Colorado River Commission Organizes for Action

At the official organization meeting on August 5 and 6 at Salt Lake City, Utah, members of the Upper Colorado River Commission chose Grand Junction, Colo., as the permanent location of official headquarters. Besides Chairman Harry W. Bashore, former commissioner of the Bureau of Reclamation (see page 188, August 1949 Reclamation Era) the commission proper includes Clifford H. Stone of Colorado, who was elected vice chairman to act in the absence of Chairman Bashore, John Bliss of New Mexico, Harold A. Linke of Utah, and L. C. Bishop of Wyoming.

The Commission will meet twice a year, in March and September, and will make cooperative studies, findings, and reports providing for distribution and potential development of the water resources of the Colorado River. •

Eklutna Report Goes to Congress

Former Secretary of Interior Krug transmitted to Congress on September 14 the report on the Eklutna project, near Anchorage, Alaska (see "Eklutna—Number-One Job in Alaska," page 35, February 1949 Reclamation Era). The report recommends authorization for construction of a hydroelectric power plant of 30,000 kilowatts installed capacity to meet urgent demands for power for domestic, municipal, and military uses and for the development of recreational facilities.

Estimated cost of the project is $20,365,400 for the power features, and $1,215,500 for recreational facilities. The power costs would be returned to the Government with interest through revenues derived from the disposal of power.

The report was referred to the Senate Committee on Interior and Insular Affairs on September 15, 1949. •

Salt Water Continues Invasion of Orange Cove

Heavy pumping and below normal groundwater recharge is producing a continued inland advance of ocean water into the coastal area of California, especially the lands in Santa Ana Gap, according to a short report entitled "Status of salt-water contamination in the coastal part of Orange County, Calif., as of 1948–49," recently released by Director W. E. Wrather of the United States Geological Survey.

Further information may be obtained from the United States Geological Survey, United States Department of the Interior in Sacramento, Calif., or Washington 25, D. C. •

Conference Held on Water User's Problems

Regional Operation and Maintenance staff men met during a week-long conference in Washington, D. C., December 5–9, 1949. Problems relating to greater efficiency in the operation and maintenance of the Bureau's projects, and closer relationships with the water users were among the main topics of the conference. Senator Joseph C. O'Mahoney of Wyoming, Secretary of the Interior Chapman, Assistant Secretary of the Interior William E. Warne, Commissioner of Reclamation Michael W. Straus, and Assistant Commissioner Wesley R. Nelson were present at various stages of the conference to present their views on improving the Bureau's conservation, operation and maintenance programs in the West. The February issue of the RECLAMATION ERA will include many of the discussions presented at the conference. The conferees above, from left to right:

Front row: E. D. Eaton (*Assistant Director, Branch of O&M*), William E. Warne (*Assistant Secretary of the Interior*), Oscar L. Chapman (*Secretary of the Interior*), Michael W. Straus (*Commissioner of Reclamation*), Goodrich W. Lineweaver (*Director, Branch of O&M*).

Second row: Hollis Sanford (*Asst. O&M Supr., Region 1*), Ed Neal (*Irrigation Operations Dir., Columbia Basin Project, Region 1*), Arnold Boettcher (*Irrigation Operations, Commissioner's office*), Archie Goodman (*Allocations and Repayment, Commissioner's office*), Ruth Sadler (*Editor, Reclamation Era*), A. B. West (*O&M Supr. Region 3*), E. G. Lindley (*O&M Supr. Region 2*).

Third row: E. J. Utz (*Chief, Land Use and Settlement, Commissioner's office*), E. F. Landerholm (*O&M Supr. Region 6*), D. T. Bollingbroke (*Chief, Land Use and Settlement, Region 6*), W. H. Tuller (*O&M Supr. Region 1*), Martin Blote (*Supt. CVP, Region 2*), M. R. Lewis (*Chief, Irrigation Operations, Commissioner's office*), R. J. Shukle (*Head, Repayment Dir., Region 2*), Floyd Dominy (*Chief, Allocations and Repayment, Commissioner's office*).

Fourth row: O. F. Bartholomew (*Chief, Land Use and Settlement, Region 4*), W. F. Resch (*Asst. Project Manager, Rio Grande Project, Region 5*), Ralph Bristol (*O&M Supr., Region 5*), E. H. Reed (*Land Use and Settlement, Commissioner's office*), Robert Balcom (*Weed Control, Land Use and Settlement Section, Commissioner's office*), Forrest Byrns (*Irrigation Operations, Commissioner's office*), Gilbert Stamm (*Asst. O&M Supr., Region 1*), E. R. Brown (*Asst. Chief, Land Use and Settlement, Region 7*).

Fifth row: F. W. Maxton (*Spec. Asst., Commissioner's office*), Ian Briggs (*Chief, Land Use and Settlement, Region 3*), J. J. McCarthy (*Research Analyst, Commissioner's office*), Floyd Roush (*Chief, Irrigation Operations, Region 7*), J. J. Hedderman (*Asst. O&M Supr., Region 4*), D. S. Stuver (*O&M Supr., Region 4*), W. W. Johnston (*Project Dev. Supr., Columbia Basin Project*), I. B. Hosig (*Branch of Design and Construction, Denver, Colo.*).

Sixth row: C. L. Naffziger (*Chief, Dir. of Allocations and Repayment, Region 3*), Carl Thye (*Spec. Asst., Commissioner's office*), G. W. Wilcocks (*Irrigation Operations, Commissioner's Office*), John Spencer (*O&M Supr., Region 7*), John Toevs (*Chief, Land Dev. Section, Region 1*), Earl Fogarty (*Project Planning, Commissioner's office*), S. T. Larsen (*Chief, Irrigation Operations, Region 6*), John G. McGarrity (*Land Use and Settlement, Region 2*).

Photo by Glen Peart, Interior Department photographer.

DEATH OF ROLAND HARWELL SHOCKS TEXAS AND NEW MEXICO

The death of Roland Harwell in El Paso, Tex., on November 11, 1949, ended the career of a noted reclamationist, civic, and community leader.

Mr. Harwell, 59, stricken by a heart attack at Amarillo, Tex., had been manager of the El Paso County water improvement district No. 1 on the Bureau-constructed Rio Grande project since 1920. His services had been long recognized as instrumental in the gradual and orderly stabilization of the 155,000-acre project in Texas and New Mexico in the years following completion of the initial works and successive improvements.

A graduate of New Mexico A. and M. College, and a resident of El Paso since 1918, Mr. Harwell first served the public as county farm agent in Torrance County, N. Mex., in 1915. He later served as El Paso County farm agent and for a time as manager of the agriculture department of the El Paso Chamber of Commerce.

In addition to his devotion to western reclamation affairs generally, and Rio Grande project operations in particular, Mr. Harwell rendered outstanding services to his neighbors and the community in which he resided.

Because of his engineering background, the city of El Paso named Mr. Harwell to the municipal plan commission in 1930. He later served as American representative on an international commission to study the spread of boll weevils in the cotton-growing sections along the border and in Old Mexico.

As manager of the El Paso County water improvement district, Mr. Harwell was especially active in the plan to construct Caballo Dam, 20 miles south of Elephant Butte Dam in New Mexico. Only a few months before his death he was gratified to see the final stamp of approval placed on the municipal water contract between the city of El Paso and the Department of the Interior—a contract which he helped work out and which more than doubles the amount of water the city can take from the river, providing adequate storage and processing plants are available.

Bureau of Reclamation officials, including Commissioner Michael W. Straus and Regional Director H. E. Robbins at Amarillo, Tex., joined hundreds of other friends throughout the West in sending messages of condolence.

His survivors include a daughter, Mrs. Jack Teague, of Fort Sill, Okla.; his mother, Mrs. Stella Harwell Scott, of El Paso, Tex.; a sister, Mrs. Henry Young, of Pinos Altos, N. Mex.; and a brother, Gordon Harwell, of Houston, Tex.

Colonel Robert Bradford Marshall

(Continued from page 7)

The autumn of 1891 found Marshall employed by the Federal Geological Survey in the foothills of the Sierra near Nevada City and under instructions to proceed to San Francisco to do some mapping work. He was driving by mule team and buckboard down toward "The City" one evening. At Folsom, he drew up and gazed at the sunset. Before him he saw the Great Valley spread out like an empty banquet table. Along the rivers there were ribbons of green; the rest was sere and brown and unproductive. What wealth, he thought, could this vast valley yield if all these streams were harnessed in the foothills by dams, and their life-giving water spread out on the thirsty acres by a network of canals! Then and there he dedicated the years of his life to his huge engineering task. As he rose in his career and became assistant topographer for the Federal Geological Survey in 1889, and then Chief Geographer in 1908, he worked devotedly at his plan. A period in Washington, D. C., gave him the facilities to map and put to paper the wealth of data he had gathered in the field over years of study.

In that time, he made 5-foot contour maps of almost the entire United States. In 1915, he became superintendent of national parks, as well as geographer, and in 1917 he was commissioned in the Army Corps of Engineers, in which he rose to lieutenant colonel, to supervise military mapping.

Returning to California in 1919 as consulting engineer to the California State Irrigation Association, he was ready to announce "The Marshall Plan" for the full development and use of the many streams that water the Central Valley. From this master plan through the 30 years that followed grew the Central Valley project of today which, although enlarged and changed in many ways, is essentially the same in concept.

In a letter to Mrs. Robert Bradford Marshall, Commissioner of Reclamation Michael W. Straus said, "California's Central Valley project will stand, for ages to come, as a monument to the far-sighted vision and long and untiring efforts of your husband. I know of no other individual who could rightfully claim greater personal credit for this vast development than is due to Colonel Marshall. It must have been a source of much satisfaction to him that within his lifetime he could see the physical results of his dreams and efforts grow steadily toward full stature.

Your husband was a great man, Mrs. Marshall. We in Reclamation mourn his passing."

He rightfully earned and deserved his place in Reclamation's Hall of Fame.

THE END

Second ECA Group From Greece Visits Reclamation Area

Two engineering representatives of the Greek Government, A. Kalinski and D. Papanikelean, visited the office of the chief engineer and projects in regions 2 and 3 between September 21 and October 14. These engineers make up the second group to be sponsored by the Economic Cooperation Administration (see page 137, June 1949 RECLAMATION ERA), and are primarily interested in project planning and irrigation methods in the United States. •

NOTES FOR CONTRACTORS

Contracts Awarded During November 1949

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2749	Hungry Horse, Mont	Nov. 1	4 13.5-foot by 18.93-foot fixed-wheel gates for penstocks at Hungry Horse Dam.	Bethlehem Steel Co., San Francisco, Calif	$111,623
2762	Boise, Idaho	Nov. 29	Construction of Anderson Ranch Dam-Mountain Home 115-kilovolt transmission line using aluminum conductor, schedule 1.	City Electric Co., Inc., and Morrison-Knudsen Co., Inc., Boise, Idaho.	145,587
2769	Central Valley, Calif	Nov. 7	Completion of lower vista house, powerhouse adit, and elevator lobbies at Shasta Dam.	Haas and Rothchild, San Francisco, Calif	73,196
2775	Missouri River Basin, Nebr	Nov. 4	Construction of earthwork, canal lining, and structures for Cambridge Canal, and earthwork and structures for drains and channel changes.	Bushman Construction Co., St. Joseph, Mo	600,567
2781	Central Valley, Calif	Nov. 2	Constructing foundations and erecting steel towers for Perkins-Tracy 230-kilovolt transmission lines, schedule 1.	Muclark Co., Inc., San Francisco, Calif	134,163
2784	do.	do.	Stringing conductor and overhead ground wires for Perkins-Tracy and Oroville-Elverta 230-kilovolt transmission lines, schedules 2 and 3.	Barrett and Hilp, San Francisco, Calif	215,556
2786	Colorado-Big Thompson, Colo.	do.	Construction of Yuma-Wray 69-kilovolt transmission lines using aluminum conductor, schedule 1.	Malcolm W. Larson, Denver, Colo	125,336
2789	do.	Nov. 28	4 carrier-current telephone transmitter-receiver sets and 2,300 linear feet of coaxial cable for Green Mountain and Estes power plants, Granby pumping plant, and Flatiron substation, schedules 1 and 3.	Motorola, Inc., Chicago, Ill	10,080
2789	do.	Nov. 25	4 carrier-current line traps, three 115,000-volt coupling capacitors, one 115,000-volt potential device, and 2 carrier line traps for Green Mountain and Estes power plants, Oak Creek, Shadow Mountain, and Willow Creek taps, and Granby pumping plant, schedule 2.	General Electric Co., Denver, Colo	14,368
2796	Fort Sumner, N. Mex	Nov. 22	Construction of earthwork, concrete lining, and structures for main canal, including pumping plant.	Pecos Valley Construction Co., Carlsbad, N. Mex.	274,060
2799	Central Valley, Calif	Nov. 10	Construction of earthwork, concrete lining, and structures for Delta-Mendota Canal.	Morrison-Knudsen Co., Inc., and M. H. Hasler Construction Co., Los Angeles, Calif.	2,173,888
2806	Columbia Basin, Wash.	Nov. 17	Aluminum crest railings with lighting for Grand Coulee Dam	Seidelhuber Iron and Bronze Works, Inc., Seattle, Wash.	195,983
2807	Paonia, Colo	Nov. 9	Construction of earthwork, canal lining, and structures for enlargement of Fire Mountain Canal.	Thornburg Construction Co., Paonia, Colo.	197,768
2808	Columbia Basin, Wash	Nov. 22	Construction of river channel improvements, Grand Coulee Dam.	Morrison-Knudsen Co., Inc., Seattle, Wash	1,691,666
R1-CB-31	do.	Nov. 18	Construction of 12 residences at the operation and maintenance division headquarters at Quincy.	Modern Home Builders, Inc., Seattle, Wash	68,105
R2-74	Central Valley, Calif	Nov. 15	Double circuit steel towers for portion of Shasta-Tracy west side 230-kilovolt transmission lines.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	1,844,414
R2-78	do	Nov. 17	Pontoon barges at Shasta Dam	John C. Gist, Sacramento, Calif	31,337
R2-81	do.	Nov. 1	Clearing Shasta Reservoir, Squaw Creek area	Ross Layton Redding, Calif	26,732
R3-B-8	Boulder Canyon, Nev	Nov. 10	Removing bituminous walks and replacing with concrete, Boulder City.	Kirkham Bros., Culver City, Calif	24,004

Canstruction and Supplies for Which Bids Will Be Requested by March 1950

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Paving miscellaneous parking areas at Hoover Dam.
Do	Installing equipment and performing alterations to water treatment plant at Boulder City, Nev.
Do.	Main switchboards for units A3, A4, and A9, Hoover power plant.
Do	Auxiliary station-service equipment including 460-volt a-c power boards and 250-volt d-c distribution boards for units A3, A4, and A9, Hoover power plant.
Do	69-kilovolt oil circuit breakers and disconnecting switches for Nevada State switch yard.
Central Valley, Calif.	Construction of 80 miles of concrete pipe lines for the Lindmore irrigation district on the Friant-Kern Canal distribution system, near Lindsay, Calif.
Colorado-Big Thompson, Colo.	Construction of about 42 miles of 115-kilovolt, 3-phase, H-frame transmission line between Kremmling and Oak Creek, Colo., through Muddy Pass substation.
Do	Construction of about 5 miles of 115-kilovolt, 3-phase, H-frame transmission line from Flatiron substation, near Loveland, Colo., west to Pole Hill power plant.
Do	One 30,000-kilovolt-ampere generator for Pole Hill power plant.
Do	One vertical-shaft, 18,000-horsepower hydraulic turbine for Pole Hill power plant.
Columbia Basin, Wash	Relocation of 6.5 miles of county road including construction of one 400-foot long reinforced concrete and steel bridge, near O'Sullivan Dam, Grant County, Wash.
Do.	65,000 pounds of galvanized fabricated steel structures for 11.95-kilovolt station-service tie circuits, Grand Coulee power plant.
Davis Dam, Ariz. Nev	Construction of 21 miles of 34.5 kilovolt Wellton-Mohawk power supply transmission line near Yuma, Ariz.
Do	Stringing conductor for 280 miles of 230-kilovolt transmission line between Davis Dam, Nev., and Mesa, Ariz., and between Mesa and Coolidge, Ariz.
Do	Stringing overhead ground wires on 180 miles of the 115-kilovolt, single-circuit No. 1 transmission line between Phoenix and Tucson, Ariz.
Do	Construction of reinforced concrete control building and erecting steel structures for Tucson substation.
Do	75,000 pounds of gratings and support angles on transformer deck at Davis power plant.
Do	24,800 pounds of interior and exterior handrailing for Davis Dam power plant and transformer decks.
Do	Equipment for supervisory control of Maricopa substation from Phoenix substation.
Fort Sumner, N. Mex	Construction of Fort Sumner diversion dam, a concrete gravity structure about 870 feet long and 10 feet high, on the Pecos River near Fort Sumner, N. Mex. Construction of canal headworks and a gate sluiceway at left end of dam, and installation of two 20- by 17-foot radial gates are included.
Hungry Horse, Mont	Main and unit control boards and battery-room board for Hungry Horse power plant.
Kendrick, Wyo	Furnishing and erecting one prefabricated steel, or cement asbestos and steel, control house building with full concrete basement for the new Casper substation.
Missouri River Basin, Colo.-Nebr.	Construction of about 88 miles of 115-kilovolt, 3-phase, H-frame transmission line between Sterling, Colo., and Ogallala, Nebr.
Missouri River Basin, Mont	Construction of 4 3-bedroom and 10 2-bedroom residences, and 1,500 feet of sewer lines and 1,800 feet of water mains for Missouri diversion dam government camp in Nashua, Mont.
Do.	Construction of the Missouri diversion dam on the Missouri River near Fort Peck, Mont.
Do	Clearing a part of Canyon Ferry reservoir site between old Canyon Ferry Dam and the new Canyon Ferry damsite, about 16 miles northeast of Helena, Mont.
Do	3 oil-pressure actuator-type governors for the 23,500-horsepower turbines for Canyon Ferry power plant.
Missouri River Basin, Nebr	Construction of about 55 miles of 115-kilovolt, 3-phase, H-frame transmission line from Alliance to Chadron, Nebr.
Do	Relocation of about 6 miles of county roads at Medicine Creek Reservoir, including moving and salvaging 1 40-foot steel bridge and salvaging 1 55-foot steel bridge.
Do	Construction of 9-mile unlined section of Superior Canal, including channel changes, drains, and terminal wasteway.
Do	Relocation of 19 miles of single track railroad at Trenton Dam reservoir area.
Missouri River Basin, N. Dak.	Construction of about 56 miles of 115-kilovolt, 3-phase, H-frame transmission line from Voltaire to Rugby, N. Dak.
Do	Construction of about 61 miles of 115-kilovolt, 3-phase, H-frame transmission line from Rugby to Devils Lake, N. Dak.
Do	Construction of about 50 miles of 115-kilovolt, 3-phase, H-frame transmission line from Devils Lake to Carrington, N. Dak.
Do	Construction of about 52 miles of 115-kilovolt, 3-phase, H-frame transmission line from Carrington to Jamestown, N. Dak.
Missouri River Basin, S. Dak.	Construction of 1 3-bedroom house with utilities near Redfield, S. Dak.
Do	Clearing Shadehill reservoir site about 15 miles south of Lemmon, S. Dak.
Missouri River Basin, Wyo.	Construction of 110 miles of 115-kilovolt, 3-phase, H-frame transmission line from proposed Alcova switchyard, near Casper, Wyo., to Boysen power plant, near Thermopolis, Wyo.
Do	Relocation of 2¾ miles of single-track railroad at Boysen Dam.
Do	Construction of about 31 miles of 115-kilovolt 3-phase, H-frame transmission line from Seminoe to Sinclair, Wyo.
Palisades, Idaho	Construction of about 18 miles of Forest Service road at Palisades Reservoir site, about 56 miles southeast of Idaho Falls, Idaho.
Paonia, Colo	Enlargement of about 6.6 miles of Fire Mountain Canal to 165 cubic feet per second capacity near Paonia, Colo. This work includes about 1,100 feet of concrete lining.
Provo River, Utah.	Construction of a terminal reservoir on the Salt Lake aqueduct near Salt Lake City. The reservoir is to be 230 feet wide, 800 feet long, 30 feet deep, 40,000,000-gallon capacity.
Rio Grande, N. Mex-Tex	Construction of camp roads, including realignment, adjusting grades and paving the balance of the camp road system at Elephant Butte and Caballo Dams.
Do	Construction of foundations and erecting structures for the 2,000-kilovolt-ampere package-type Hollywood substation near Hollywood, N. Mex.
Santa Barbara, Calif	Construction of the 10-mile, 18-inch diameter, 77 cubic feet per second capacity, Goleta section of the South Coast reinforce concrete conduit from the end of Tecolote Tunnel to Santa Barbara, Calif.

The Reclamation ERA

February

1950

The Reclamation ERA

February 1950

Volume 36, No. 2

Issued monthly by

The Bureau of Reclamation

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

Approved by the Bureau of the Budget

CONTENTS

FEATURE ARTICLES

SHORT FEATURES:

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO

IN THE ERA

Broad Reclamation Policy Advocated

As a result of the organization of the Western States Reclamation Association at the irrigation congress in Salt Lake City, Utah, November 21–22, the executive committee of the association, together with the governors and lieutenant governors of a number of the States and several other State representatives, arrived in Washington, D. C., on January 14 with a view to urging Congress to adopt a broad policy of irrigation development.

The delegation included Governors Simon Bamberger, Utah; Thomas E. Campbell, Arizona; O. A. Larrazolo, New Mexico; D. W. Davis, Idaho; Robert D. Carey, Wyoming; Louis F. Hart, Washington; Lieutenant Governors, George Stephan, Colorado; William McDowell, Montana; and Frank W. Brown, secretary to Governor Davis.

(From the February 1920 issue of the Reclamation Record, predecessor of the Reclamation Era, p. 53.)

THE OPERATION AND MAINTENANCE CONFERENCE OF 1949

THE BEST POSSIBLE SERVICE to the 100,000 water users of the West living on 5,000,000 acres of reclaimed land and the protection of the Nation's billion and a half dollar investment in Reclamation projects were the goals of the recent Bureau of Reclamation's Branch of Operation and Maintenance Conference in Washington, D. C.

Every conceivable phase of improving operations and planning sound maintenance programs on the some 69 Reclamation projects were explored by the conferees. Problems related to the repayment of the reimbursable irrigation investment to the Federal Treasury within the ability of the water users was a major subject of discussion and benefits to individuals, localities, the West and the Nation as a whole were stressed.

At present, the Bureau releases about 20 million acre-feet of water from almost 200 storage and diversion dams through more than 15,000 miles of canals and laterals, to supply the needs for irrigation of 100,000 farms in the arid and semiarid regions within the 17 Western States. From these facilities water is also made available to numerous municipalities for domestic and industrial purposes. Looking to the future needs of the region, a 6-year program of Bureau operations and maintenance work anticipates water service for an additional 50,000 farms and a 5-million-acre increase in irrigated land to be served by new or supplemental supplies.

Among the principal speakers at the conference were Senator Joseph C. O'Mahoney, Chairman of Senate Committee on Interior and Insular Affairs, Secretary of the Interior Oscar L. Chapman, Assistant Secretary of the Interior William E. Warne, Commissioner of Reclamation Michael W. Straus, Assistant Commissioner W. R. Nelson, and Director of Operation and Maintenance G. W. Lineweaver.

Assistant Secretary of the Interior William E. Warne attended several of the sessions to tell the conferees that the Department of the Interior has offered its entire facilities to the program of conservation and use of the Nation's resources. He stated that the Bureau is attacking the conservation job in a very satisfactory way but there is a big program ahead. He urged the Operation and Maintenance field men to see first that all available water is used and, second that it is used wisely. He told them they must "rise above beaurocracy" and realize that conservation is a chain reaction clear to the end of the drain ditch.

Commissioner Straus pin-pointed his remarks by stating that although there was considerable glamour in building dams, the operation and maintenance staff comprised the hereditary legatees and were intrusted with these structures to see that they served the functions they were intended to serve. He stressed the fact that the self-policing aspect of Reclamation, wherein every water user is a partner in the enterprise of building, operating, and maintaining a project, is one of the most healthy things about the program.

In opening the conference, Assistant Commissioner of Reclamation Wesley R. Nelson, formerly Regional Director at the Amarillo, Tex., headquarters for Region 5, made several practical suggestions on improving operation and maintenance functions in order to cut costs. In particular he cited specific jobs which must be done to prevent extensive and costly rehabilitation and betterment. He stressed the fact that "the Rehabilitation and Betterment program is not and should not be, a continuing program." He urged the operation and maintenance men to check such items as quantity and quality of water, land and soils, drainage works, size of farms, financing of settlers, crop selection, economics of the area, and to use foresight in planning repairs and general upkeep on the projects. He attended many of the sessions to comment on progress made in ironing out difficulties and to give suggestions on how to attain greater efficiency in operation of the projects.

Engineer I. B. Hosig represented Chief Engineer L. N. McClellan at the conference and at the conclusion of the Saturday session stated that close liaison would continue to be maintained between the operation and maintenance men and the engineers to conserve water, cut costs, and insure better and longer-lasting irrigation facilities for the water users.

Director Lineweaver at the very outset of the conference stressed the importance of all in attendance airing their views. He emphasized the fact that the purpose of the conference was to iron out various problems which are bound to arise from time to time in any organization as large and widespread as Reclamation's Operation and Maintenance Branch. In conclusion as he summed up developments he said that he felt a very satisfactory conference had been held and that he did not believe any of the conferees had "pulled any punches."

All in all, much knowledge was obtained by the various members in attendance as a result of their exchange of ideas. Many excellent recommendations were made by the various committees operating throughout the conference.

The Committee on "Ways and Means for transfer of projects from Construction to Operation and Maintenance" made the following recommendations:

1. Arrangements should be made to place, on the construction staff, key personnel who have been selected to remain on the project during its operation phase. This plan will make these people familiar with construction details.

2. As soon as practicable after construction has been initiated a skeleton Operation and Maintenance organization should be set up, initially, including the key personnel responsible for the operation and maintenance of the project.

3. Operation and Maintenance should determine its requirements for office space, housing, shop facilities, communications, etc.

4. Operation and Maintenance should determine the equipment needed for use during operation and maintenance and it should be provided from construction funds.

5. Construction funds should be left available for priming and puddling, riprapping, and secondary construction. Riprap should be placed as operational needs indicate. Any portion of works proving inadequate in initial stages of operation should be rebuilt and costs charged to construction.

In the following pages will be found summaries of the most important topics discussed at the conference. ●

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Senator Joseph C. O'Mahoney (standing) addresses O. & M. Conference. Seated left to right (clockwise): J. W. Dixon, Director of Project Planning; John Spencer, O. & M. Supv., Region 7; Assistant Secretary of the Interior William E. Warne; Ralph Winchell, Land Use and Settlement, Commissioner's Office; Hollis Sanford, Asst. O. & M. Supv., Region 1; Secretary of the Interior Oscar L. Chapman; Director of O. & M., G. W. Lineweaver, and Commissioner of Reclamation Michael W. Straus. ***Photo by Glen Peart, Interior Department photographer.***

SENATOR J. C. O'MAHONEY

Requests O&M Point of View

The 1949 conference of Reclamation's Operation and Maintenance supervisors on December 6 heard United States Senator Joseph C. O'Mahoney of Wyoming, Chairman of the Senate Committee on Interior and Insular Affairs, express special congressional interest in Bureau of Reclamation relations with water users on projects under its jurisdiction. Senator O'Mahoney was introduced by Commissioner Michael W. Straus, who told the staff of the legislator's concern with effective legislation to advance the Reclamation program in the West.

Senator O'Mahoney opened his remarks with friendly references to Commissioner Straus and Operation and Maintenance Director Lineweaver and asked specifically for information directly from the field staffs as to the workings of the Reclamation program. He said:

"I would like to know from you gentlemen who have the tough job of operating and maintaining these projects whether Congress has approached these problems in an intelligent and constructive manner, and particularly whether the planning engineers really know what they are doing. How would you like to come up to the Hill some day and testify? That is more than being facetious, because the truth is that you gentlemen operating and maintaining the various projects are living with the people who live on the projects and you can know from your own experience to what extent the projects have been well planned—to what extent the projects are serving our basic purpose. But above all, I think that you gentlemen could give us all in the Department here and in the Congress a much better idea of what the future of irrigation and reclamation should be than we would get from any other source.

"There is one thing I am particularly happy to say to this group: While we hear a great many complaints about the planners and a great many about the bureaucrats and their various departments and agencies here in Washington, I am frank to say that I have never heard any complaints about you gentlemen who are down there on the projects living with the people and helping to operate and maintain them. You are the contact between Uncle Sam, so to speak, and the people on the reclamation projects, and the fact that there have not been complaints is to me a demonstration that you are doing a good job. You get along almost as smoothly with almost as little complaint as a letter-carrier in the Post Office Department. Since I was once First Assistant Postmaster General, I am sure you will pardon that allusion, particularly since one of the letter-carriers is now Postmaster General. Secretary Chapman has gone a long way after 16 years; after various administrative tasks in the Department he is now the 'top dog.' Donaldson began carrying the mail pouches on his back when he first entered the Post Office Department. It is that kind of personal contact by Government employees with the people, on an understanding and intelligent basis, which recognizes that everything we do is designed to increase opportunity for the people. The personal contacts you men have with the water-users demonstrate that when we in Congress establish these Bureaus we are not establishing Bureaus clothed with the power and authority to tell people what they must do and should do, but to live with people and help them work out their own problems. That is the essence of Americanism.

"The very lack of complaints about the personnel of Operation and Maintenance, convinces me and my congres-

(Please turn to page 30)

Secretary of the Interior Oscar L. Chapman addresses O. & M. Conference. Left to right, facing the camera: Hollis Sanford, Asst. O. & M. Supv., Region 1; Reclamation Commissioner Michael W. Straus; Direcor of O. & M., Goodrich W. Lineweaver; Secretary Chapman, and Senator Joseph C. O'Mahoney. *Photo by Glen Peart, Interior Department photographer.*

Secretary Chapman Stresses Key Importance of Project Operations

SECRETARY OF THE INTERIOR Oscar L. Chapman made his first appearance before a group of Interior employees since assuming his new duties on December 1 when he addressed the 1949 Conference of Reclamation's Operation and Maintenance supervisors. He stressed the key importance in the Reclamation and Interior programs of project operations.

The Secretary, who followed Senator O'Mahoney on the program, was introduced by O & M Director Lineweaver. He endorsed complimentary references made to the director by Senator O'Mahoney and added:

"Senator O'Mahoney understands the problems of the West, but also understands the problems of the East. He understands the problems that are integrated into our western economy. I think that that explains his effectiveness among his colleagues.

"I think that with people who have worked as hard for the West as Senator O'Mahoney has, the Department of the Interior is only a vehicle and mechanism through which to accomplish and carry out a program. You people of the service are in a strategic position in this Department. You are properly one of the most important links between the organization or Department and its public relations. You are one of the most important groups. What you do and how you do it means an awful lot to the standing of the Department—not just to the Bureau of Reclamation—it is a reflection on the entire Department. We are counting on you to continue to develop your techniques and public relations. You want to work with the people in your communities; the people there want and have a right to expect understanding from you on the program. They want to work with you on the problems involved. They have to finance them, but when the rules have been laid down, and laws passed, you are the ones who carry them out. How you do it means the difference between success and failure a lot of the time.

"We are reaching a stage in western development where the easier and less expensive projects have about been taken up. We have to be ingenious in our thinking, in our development of new programs, and of new projects. We must find ways and means for development of more land and water in the West. Census figures show that our increased population is putting the pressure on your job day by day. It is obvious that we must continue to develop the West in every basic resource that we can. Water is one of our principal resources—we must try to deliver it at as cheap a rate as possible to the citizens who have to use it.

Work Directly with the People

"As public relations men you are the most important people in the Interior Department. What others not in the field do is nothing compared with the functions of the people in the field. I want you to work with the people in the field, and when they understand you and what you are trying to do, that understanding is very quickly reflected in their representatives in Congress, and in public opinion generally.

"We have more than fifty active projects today and that many more in development stages. You are affecting approximately 1 million people directly and indirectly in the amount of land and water you administer and keep up as a maintenance program today. That many people in the West can change public opinion either favorably or unfavorably to the Interior Department. And this is an important Department. It carries on functions which strengthen our whole economy. The natural resources of this country must

(Please turn to page 30)

COOPERATION with Federal and State Agencies

by J. G. LINDLEY, Operation and Maintenance Supervisor, Region 2, Sacramento, California

THE POLICY OF THE DEPARTMENT OF THE INTERIOR as expressed by the Secretary in correspondence in the fall of 1947, and subsequent statements, requires the Bureau of Reclamation to seek actively the assistance of the land grant colleges and the agencies of the Department of Agriculture in carrying out the agricultural phases of the reclamation program. The Secretary stated that the Department desires to have these agencies participate, within the framework of the reclamation laws, as fully as possible with the Bureau of Reclamation in providing the maximum assistance to irrigation farmers. He further stated that he was recommending to the Commissioner of the Bureau of Reclamation that authority to develop cooperative arrangements and enter into cooperative agreements be delegated to field offices and that the land grant colleges and universities be considered as the focal point of coordination within their respective States. The Omnibus Adjustment Act of 1926 authorizes the Bureau to secure the active cooperation of the State agricultural colleges in the settlement program. In Report No. 661, Senate Committee on Appropriations, on Interior Department appropriation bill, 1950, the committee made the following statement:

"The committee directs the Bureau of Reclamation to continue the program of cooperation in the planning, construction and operation and maintenance of reclamation projects with western State agricultural colleges and the Department of Agriculture agencies concerned to avoid a duplication of personnel and unnecessary conflicts with due regard for the responsibilities of the Secretary of the Interior under the reclamation law and of the western State colleges and Department of Agriculture agencies concerned with conservation of western water and land resources. It is noted with satisfaction that the number of cooperative agreements reported by the Bureau of Reclamation is increasing, but it is felt that there is further room for advancing cooperative efforts along the lines that were explained to the committee during the hearings. The full resources of the Federal agencies as well as the State agricultural colleges and other State agencies should be brought to bear on the reclamation program, and it is hoped that the forthcoming conferences of the presidents and other officials of the western State colleges with Department of the Interior and Department of Agriculture officials at Salt Lake City in August (Editor's note—the conference was held at Kansas City, Mo., in October) will be fruitful in expanding and perfecting work programs at the field level which will be helpful in improving irrigation practices, crop production, and water saving programs through development farms and otherwise where such services are not provided for reclamation water users by other agencies. The Bureau of Reclamation is expected to make such transfers of funds to other Federal agencies and State colleges that will aid in avoiding duplication of personnel and services in these programs."

The policy stated by the Senate Committee in the above quoted paragraph was endorsed by a resolution of the National Reclamation Association at its meeting in Salt Lake City in November 1949. In line with this policy there are at the present time approximately 30 cooperative agreements in effect among the Bureau of Reclamation, the land grant colleges and universities and Department of Agriculture agencies covering various phases of the reclamation program. These agreements are in some cases of a general nature covering a wide variety of activities, and in other cases are directed specifically to such activities as settler

(Please turn to page 38)

TYPICAL GET-TOGETHER. Federal and State agencies are beginning to come into the picture more and more to assist the farmers. Left to right: Roland V. Snow, O. & M. Staff member; Ben Evick, President of the Jefferson County Water Conservancy District; farmer Green, and his son, of the Deschutes project, talk over their farm problems. *Photo by Stanley Rasmussen, Region 1.*

The scene at right shows what happens whenever the water users take over a project from the Government. These preparations were made to celebrate the final payment to the Government by the water users for the irrigation works on the Yakima-Tieton project in the State of Washington. *Photo by Stanley Rasmussen, Region 1 photographer.*

(Excerpts from discussions and recommendations at 1949 Operation and Maintenance Conference, Dec. 5–10)

WHEN THE WATER USERS TAKE OVER—WHAT?

When the time comes to turn over a project to the water users, consideration should be given to the ability and experience of the district's or association's governing body. Water users on new projects without much experience in handling and managing a project may be reluctant to assume managerial responsibilities. On the other hand, governing boards with years of experience in irrigation and management should be in a better position to assume operation and maintenance of a project.

Also the complexity, or lack of it, in the physical make-up of project works must be considered when arrangements are made to turn a project over to the water users.

Taking these factors into consideration, the contract should spell out plainly all actions to be accomplished in effecting the transfer so there is no possibility of misunderstandings on the part of the water users or the Bureau.

In the final analysis the district or association must be satisfied with the terms and approve the contract, which should protect both the interests of the district or association and the interests of the Government.

In turning a project over to water users a team from the regional office, plus the project forces, composed of specialists representing various branches and divisions each with a specific job to do in matters of finance, personnel, property management, operation and maintenance, should carry out the actual transfer.

A property inventory should be taken, physical property and records should be put in shape, and property transfers prepared and signed. Transfers, retirement, annual leave payments and other personnel matters must be taken care of. Some of the project personnel may work for the district or association, and the district manager or superintendent must be acceptable both to the Bureau and the district.

Contracts in force, such as grazing leases, leases on office buildings, utilities, etc., must be properly handled and disposed of. Real property should be appraised by the Bureau, the district or association, and an insurance firm and an insurance program agreed upon. Financial obligations and business must be closed out, records must be sorted, crated and disposed of, bond made for district or association personnel handling funds, and the water users do what is necessary to protect the water rights of the project.

After the project is transferred to the water users, the Bureau may prescribe operating regulations for certain transferred works if deemed advisable, and periodic inspections must be made by the Bureau after the transfer to check on finances, bookkeeping, records, operation and maintenance programs, and other aspects of project management in order to protect the investment of the Federal Government in the project works.

This inspection should be done by a man in whom the directors and management have confidence. He must know what they are up against if large increases in operation and maintenance costs are needed, he must give advice and encouragement to the district, and both the manager of the district or association and the Bureau should look ahead. When prices are up, water charges may be increased and improvements made, not when prices are falling.

The operating projects committee recommended that notices to water users' organizations announcing the transfer of control of projects to such organizations shall include the requirement that adequate staffs of competent employees be selected and maintained so that proper standards of operation and maintenance will be carried on at all times. ●

Immediate left: An abandoned homestead, symbol of farm failure. Lower left: Uncultivated but irrigable sagebrush land, awaiting reclamation and a realistic approach to the repayment problem. *Photos by Ben Glaha, Chief Photographer, Region 2.*

WHERE DO WE STAND ON REPAYMENT?

by GEORGE W. COLLIER, Chief, Division of Allocations and Repayment, Region 6, Billings, Montana

Let us review the historical record of financial adjustment and contract amendment on Federal reclamation projects.

There was the Extension Act of 1914, the repeated lengthening of the repayment period from 10 to 20 to 40 years, the Fact Finders' Act, the 1926 Adjustment Act, the moratoria of the 30's, the deferment of construction charges for some districts in other years, and the recent enactment of Public Laws 56 and 419 by the Eighty-first Congress which authorized amendatory repayment contracts with 12 irrigation districts. We will not go into the details of information with which you are already largely familiar. Those who wish to delve into the details might read Federal Aid to Irrigation Development, by Walt U. Fuhriman, formerly of the Columbia Basin project, who read this paper at the 1949 joint meeting of the American and The Western Farm Economics, Soil Conservation Service.

We know that the need for financial adjustment has been and is great. We should analyze the reasons why there was need for frequent financial adjustment in the past, and consider ways and means of avoiding or minimizing the need for financial adjustments in the future.

When we realize what a rare degree of judgment and prophecy would have been required to have correctly anticipated, at the time each contract was written, all of the conditions which have affected the development and the returns from lands in a specific irrigation district, we wonder why there haven't been even more frequent financial adjustments and contract amendments.

To correctly appraise the essentials of a livable contract requires accurate judgment with respect to the future performance of a considerable number of things. Increased experience is improving our foresight. Increasing attention to the needs of settlers and irrigation districts will lessen the gap between what we anticipate and what actually happens. However, for some of the things which determine whether a contract will be suitable 10 or 20 years from now, even a seer or a prophet could not be expected to have a batting average higher than that of a major league batting champion; namely, 34 to 40 hits per 100 times at bat. Therefore, even our currently written contracts, in which we take the most pride, may need adjustment in future years on account of unforeseen eventualities.

Among the large number of things which affect the future of an irrigation district, there are five broad categories: (1) land productivity, (2) water supply, (3) operation problems of distribution and disposal of water, (4) farm unit layout and development to facilitate application of water, and (5) that factor which permeates practically all of the others, the economic environment.

Land Productivity. While any of the above factors might be critical with respect to successful irrigation, land productivity is mentioned first because of its basic importance, and because many of our present difficulties on operating projects stem from it. A full supply of water, efficiently distributed to the farm, but applied to land over which it cannot be spread effectively, or whose soil characteristics prevent raising adequate crops, would still constitute irrigation failure. If we consider such land irrigable, and the farmers cannot raise the anticipated crops, the size of the farm unit is inadequate, operation and maintenance costs per acre of remaining irrigable lands are greatly increased, and, of course, full contract construction installments are not paid. This subject of land characteristics is well worth more detailed consideration.

Water Supply. Anticipated water supplies are necessarily based on limited records of stream flow over a rather short period. Planning for the next 50 years, with water supply records of oftentimes less than 20 years explains at least a small part of the uncertainty of contract payments.

Operation Problems of Distribution and Disposal of Water. The costs and efficiency of water distribution affect directly the productivity of the land and the irrigator's ability to pay construction assessments. Leaking canals seep the best of lands. Lack of maintenance lowers canal capacity and prevents delivery on time. Inefficient operating methods and organization increase costs, decrease revenues and thus increase the hazard of default.

Farm Unit Layout and Development. The layout and development of the farm unit, or stated more nearly correctly, the lack of adequacy thereof, is responsible for an-

THE BUREAU'S REPAYMENT POLICY AND PHILOSOPHY

by GILBERT G. STAMM, Assistant Operation and Maintenance Supervisor, Region 1, Boise, Idaho

The Bureau of Reclamation's policy is to establish as objectively as possible reasonable base rates of repayment and equitable plans of repayment that will adjust annual installments in some measure in accordance with fluctuating ability to pay.

In order for the base rate to be reasonable, it must be within the ability to pay of a high percentage of water users representing also a high percentage of the irrigable and assessed land. It should not be so high as to cause a break-down in project repayment.

Any base rate, however, will become inequitable as economic conditions change. In attempting partially to compensate for such changing conditions, the Bureau has introduced a variety of types of so-called "variable" repayment plans. Each type is intended to serve a somewhat different purpose, or a similar purpose under different circumstances.

Before adopting or developing a variable plan, the purpose to be served and the circumstances under which it will operate must be understood. The several types of variable plans are:

1. Those that adjust for changes in the current year's income as compared to a moving normal, but with the annual charge always tending to return to the base charge.

2. Those that adjust for levels of income with the annual charge remaining above or below the base charge as long as the current situation remains above or below that which prevailed in the base period for which the base charge was calculated.

3. Those that adjust for parity relationships affecting the purchasing power of the farmers' income. This type is sometimes combined with type 1 or 2.

It is important to bring about a full understanding of the Bureau's repayment philosophies and a clear knowledge of the several types of repayment plans with emphasis on their purposes and functions. This seems considerably more important than the development of rigid procedural statements.

In other words purpose should take precedence over techniques in the Bureau's repayment program especially as it relates to the Operation and Maintenance Branch responsibilities. •

(From the report of the Program and Budgeting Committee, December 10, 1949, composed, in addition to Mr. Stamm, of R. S. Bristol, Regional Operation and Maintenance Supervisor, Region 5; W. F. Resch, Assistant Project Manager, Rio Grande project, Region 5; and E. L. Struwe, Economics and Statistics, Commissioner's Office.)

other segment of unrealized anticipation with respect to contract payments. In other words, the anticipated results could have been achieved if some assistance, perhaps in the way of technical supervision or improved credit facilities had been available to settlers. Some farms, after 20 years of operation, are not so well developed as others that have been irrigated for only a fraction of that time. Units which were too small for the type of farming which later developed and were not well adapted to available farm equipment have been responsible for delinquent construction installments as well as a generation of irrigators with reduced living standards.

Economic Environment. If I have been a little harsh in assessing the blame for the nonpayment of contract installments on the first four of these factors, let us take comfort in the fact that the fifth factor, the economic environment, is sufficiently potent to explain most of them all by itself. The wide swings in farm product prices give an indication of the wide variations with which contract negotiators have had to cope. Here is a characteristic index of prices received by Montana farmers and ranchers in selected years:

Year	Percent of 1909–14	Percent change	Year	Percent of 1909–14	Percent change
1910	110	--------	1932	57	−45
1913	94	−15	1937	124	+117
1919	220	+134	1939	83	−33
1921	113	−49	1944	166	+100
1925	147	+30	1948	282	+70
1930	103	−30	1949 to date	252	−11

As you can see, since 1910, in selected periods, prices of farm products have fallen by more than 30 percent four different times, and have increased by more than 100 percent three times. Since the variation in farm cost rates has not always been parallel to that of prices received, the variation in net farm income has been even greater. Any variation in farm production could cause still further variation in farm income. Price decline has been responsible for more delinquent installments than all the other factors combined.

When farm product prices are low they affect more than one year's income. Credit liabilities contracted in one period become due in another period. In periods of low income, credit for capital expenditure by irrigators is practically nonavailable. Only a small fraction of the debts contracted in high price periods are repayable during periods of highest prices. In any event, the economist and contract negotiator must tear aside the price veil of the future and forecast the economic climate in the next 40 years in order to formulate an airtight and workable repayment plan.

An effective variable formula in repayment contracts would help to meet both ends of this dilemma, namely, protect irrigators from having to pay too heavy installments during periods of low income, and permitting them to offset higher payments when prices were up.

Several types of contract arrangements which vary the construction installments every year, have been available to specific irrigation districts. The 5-percent plan, authorized in 1924 and recalled or deauthorized less than 2 years later has been successful in certain cases, but it has two defects which make it unsuited to general use. Under the

(Please turn to page 42)

IRRIGATION OPERATIONS

(From the Report of the Operating Projects Committee, consisting of Chairman D. S. Stuver, Operation and Maintenance Supervisor, Region 4, Salt Lake City, Utah; F. M. Roush, Chief, Division of Irrigation Operations, Region 7, Denver, Colo.; J. J. Hedderman, Assistant Operation and Maintenance Supervisor, Region 4, Salt Lake City, Utah; G. W. Collier, Chief, Division of Allocations and Repayment, Region 6, Billings, Mont.; and F. E. Dominy, Chief, Division of Allocations and Repayment, Commissioner's Office.)

"The present problem is to hold down operation and maintenance costs and improve operation and maintenance efficiency.

"Because of the accelerated growth of irrigation under Reclamation, which is resulting in an increasing number of projects reaching the operation and maintenance stage with the completion of construction, the committee recommends that greater emphasis be placed upon all phases of irrigation operations as commonly known within the Bureau of Reclamation."

The Operating Projects Committee recommended that operation and maintenance "understudies" be trained who would be capable of promptly assuming more responsible assignments without interrupting essential operation and maintenance on projects constructed or now under construction. The committee favored encouraging water users' organizations, operating Bureau-constructed projects, to adopt measures which will be similarly effective.

The committee stated there is a definite lack of trained and experienced operation and maintenance personnel to fill the many future requirements of Bureau projects, and recommended that a training program for such operating personnel be set up by the Bureau in cooperation with the projects and the State colleges.

Increased Project Operation and Maintenance Costs

The conference brought out that the Bureau and the water users are greatly concerned over presently prevailing high costs of operation and maintenance on the various projects. The Operating Projects Committee stated that some of the increased costs, in many localities, can be attributed to factors over which neither the Bureau nor the water users have control. However, the report stated, failure to conduct adequate maintenance programs at times past when the maintenance of irrigation facilities could have been performed in a more orderly manner and at less cost is a factor which contributed in large measure to bringing about the present situation. The committee recommended that adequate annual operation and maintenance programs, properly conducted, are of first importance on every project, and the charges therefor be fixed accordingly after careful explanation of the reasons for and the purposes of the program to the representatives of the water users.

The Committee on Operating Projects strongly endorsed the program now being followed for the inspection of major and minor structures and expressed its appreciation of the helpful participation by the Office of the Chief Engineer in carrying out this important program which is valuable for determining the suitability of original designs or construction, the adequacy of operation and maintenance, and the need for and justification of, rehabilitation work.

Operation and Maintenance During Construction

Experience has demonstrated that there is sometimes the need for additional work and improvements which were not contemplated and could not be anticipated in the initial planning, design and construction of irrigation and drainage facilities. As a result operational difficulties have arisen which have been a burden on operation and maintenance funds, generally at a time when project development is in its earliest stage. The Committee on Operating Projects recommended that construction funds for "Operation and Maintenance During Construction" remain available for expenditure until the Regional Director is satisfied that such facilities are in proper condition.

Rehabilitation and Betterment

A Rehabilitation and Betterment program should be started long before the structures have deteriorated to the point where replacement is mandatory. It is difficult for water users to understand the need for wholesale replacement of small structures that have served them from the inception of the project.

A great deal has been said, since the rehabilitation and betterment program was started, about the desirability of a sinking fund for replacement. This discussion is academic so far as those projects now in disrepair are concerned. The problem now is to get them restored to an efficient operating condition by whatever means are available. The mechanics of repayment ought to be carefully worked out on the basis of good judgment, plus what can be determined factually by the engineers.

Most of the structures we are replacing are the first, or among the first, that the Bureau of Reclamation built. They have, in most instances, exceeded their expected life by a decade or more. The replacement structures, of concrete instead of wood, will, in all cases, last beyond the repayment period set up in the rehabilitation contract, and generally beyond the customary 40 to 60 years stipulated for new projects. If the repayment period exceeds 60 years, a sinking fund for replacement should be set aside or otherwise recognized in the debt retirement program.

Regular, frequent, inspection by alert project employees during the course of routine operation is perhaps the best guide as to when and how replacements should be scheduled.

The Committee on Operating Projects recommended that for rehabilitation work done under authority of Public Law 335 on a Bureau constructed project being operated by a water users' organization, there be a clear understanding with the water users that the rehabilitation work shall not be considered a justification for curtailment or reduction of effectiveness of the regular operation and maintenance program. •

Projects Under Construction and Development

(From the Report of the Committee on Projects Under Construction and Development, Chairman, E. F. Landerholm, Operation and Maintenance Supervisor, Region 6; W. W. Johnston, Project Development Supervisor, Columbia Basin Project; C. L. Naffziger, Chief, Division of Allocations and Repayment, Region 3; R. J. Shukle, Chief, Division of Allocations and Repayment, Region 2; and M. R. Lewis, Chief, Irrigation Operations, Commissioner's Office.)

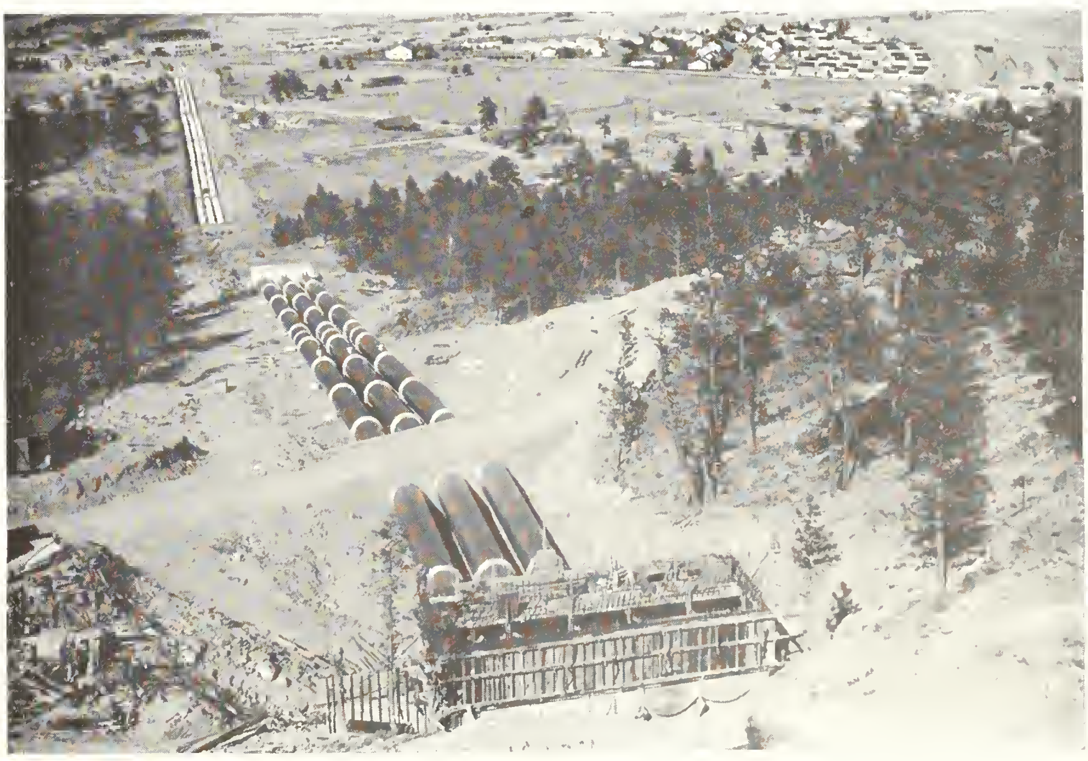
Large areas of land will come under irrigation, especially in the Columbia and Missouri River Basins, in the next few years.

To improve the irrigation facilities proposed for construction, in the light of operation and maintenance experience, the committee recommends that, so far as possible, project works are put in good operating condition as a part of the construction program, and that construction funds are provided for the completion or correction of those items which may be unavoidably overlooked or delayed until the project is in operation.

Full use should be made of the financing arrangements authorized by Congress with the passage of H. R. 2514, a bill to authorize extension of credit to homestead entrymen by the Farmer's Home Administration, and close working relationships should be established with the FHA so the needs of entrymen are met by extension of credit.

Now that efficient small sized pumps are available, and electricity can generally be obtained, there is need for ways and means to be found to provide for the irrigation of arable lands which may lie a few feet above the elevation of the farmer's delivery, through the use of small pumps or sprinkler systems owned and operated by the landowner. There is also need for making water available at reasonable cost to small bodies of class 6 land which are so situated with respect to other irrigable lands that they cannot be left out of irrigated fields under practical farm operations.

The committee recommends that operation and maintenance organizations, through their contacts with the office of Design and Construction, be ever watchful to see that we do not penalize efficient operation and maintenance for the sake of attaining cheapest construction. Since the success of the project and the ability to collect construction costs are dependent on the success of individual water users, it is particularly important that primary consideration be given to the protection of their land and water supply. ●



Estes Park Power System, a feature of the Colorado-Big Thompson project. The project, being built under close liaison between the Design and Construction and O. & M. staffs, will carry irrigation water from the western slope of the Continental Divide to 600,000 acres on the eastern slope. *Photo by K. R. Underwood, Region 7.*

Irrigation and Conservation Practices

The Committee on Operating Projects reported itself as being in accord with the views expressed by the Commissioner of Reclamation on December 5, 1949, that greater attention should be directed to the improvement of irrigation and conservation practices and that the cheapest water that can be made available is by the saving of water now wasted. The committee recognized, however, that there are numerous difficulties which must be overcome for the attainment of those objectives on projects operated by water users' organizations, and particularly on those projects where the distribution systems were constructed and are operated by private interests using water made available by the United States. The committee recommended that regional Operation and Maintenance staffs be constantly alert to the possibilities of devising and adopting every practicable means for accomplishing such improvements and water saving on reclamation projects, including those operated by the Bureau. Also that the Bureau render every assistance it can to water users' organizations which are the contracting entities with the United States so as to enable them to acquire more direct and complete control over irrigation facilities used for the delivery of Federally developed water supplies. •

Senator J. C. O'Mahoney Requests O&M Point of View

(Continued from page 22)

sional colleagues that you gentlemen are excellent representatives of Uncle Sam in this particular field. I should like very much if the opportunity were developed whereby you gentlemen would have the opportunity to tell us in Congress, both on the appropriations committees and on the legislative committees, what you conceive to be wrong with Reclamation.

"I should like very much, if it were possible, Mr. Secretary, to request your Operation and Maintenance men throughout the United States to write a brief memorandum, each man, a memorandum which could be signed or not, as the author thought best, in which he should set forth on the basis of his experience what he thinks could be done to improve the reclamation service, and particularly to broaden the opportunity of the Reclamation Bureau to create more opportunities for people to live upon the land and develop the water and other natural resources in the 17 Western States in which you operate.

Don't Hesitate to Express Your Ideas

"I know that there are a great many good ideas knocking around in the heads of these here. I also know that it is a common failing of human nature that we hesitate to express our own ideas. I have found that over and over again, in Congress as in various branches of the Department, and I for one think that a great gain would be obtained for Reclamation if you gentlemen had the opportunity to make such suggestions to your superiors, so that they would have the opportunity of getting the point of view of the men who are in closest contact with the great work that the Bureau of Reclamation is carrying on.

"Thank you, Mr. Commissioner, for the opportunity of my meeting with these gentlemen this morning. I appreciate it very much, to have this opportunity of meeting them and of saying these few and inadequate words. Mr. Secretary, you are now laying the heavy hand of authority for the first time upon your Operation and Maintenance people. I think that we can profit a great deal by what they say." •

Secretary Chapman Stresses Key Importance of Project Operations

(Continued from page 23)

and should be developed. They should be developed so that all the people may have an opportunity for their use.

"Again I repeat, you are the people who have one of the most important functions in the Bureau of Reclamation. With that I don't need to tell you that you have the greatest support that we know how to give you from Straus, Warne, and Lineweaver, and I certainly will myself, try to support you in your programs just as much as is humanly possible. You don't have to be a 'yes-man' to work in harmony on a team. You understand the difference between team-work and being a yes-man.

"I think that the memoranda that Senator O'Mahoney has asked for is an excellent idea. You are in position to give an idea as to how the programs are progressing—better than any other group.

"We are not building dams just to see who can build the biggest dam, or to give engineer training—that is all incidental. The ultimate purpose is what you are doing. The service you are giving to the people through the development of these large and small dams is what counts. We are glad that some of these projects are large and important and that the training is being given; but that is immaterial in regard to the services to the people. Keep that in mind at all times. You are not here to compete with someone else for the sake of competition unless it is related to the welfare of the people.

"I have no iron hand of the law to lay down. I can only relate the policies which under the laws have been set forth. If you think that they are not effective, say so in your memorandum. If you feel that our policies should be varied or changed in order to more perfectly carry out the law as intended, be free to say so. We will always back a man who has the intestinal fortitude to stand up for what is right and stands up for us." •

Assistant Chief Counsel John Geoffrey Will of the Bureau of Reclamation resigned December 31, 1949, to become Secretary of the Upper Colorado River Commission, the interstate agency formed to administer the Upper Colorado River Compact.

A "sure fire" method of eradicating weeds which has proved most successful. *Photo by Harry W. Myers, Region 3.*

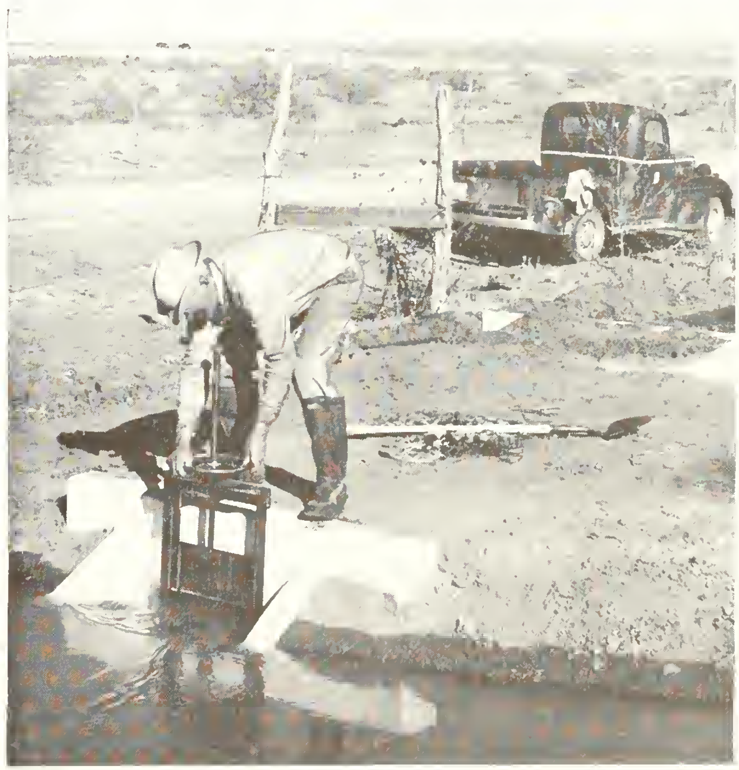
WEED CONTROL

Among other water conservation measures discussed at the 1949 Operation and Maintenance Conference, land and water weeds were cited as causing heavy losses of irrigation water and crop production and making necessary large expenditures for their control and eradication. The Committee on Operating Projects recommended that the Bureau of Reclamation continue the comprehensive weed control program it has developed because it is resulting in effectively reducing operation and maintenance problems and costs, and certain water losses. The committee also stated that further progress can be made in developing methods of land weed and water weed control, which will be even more economical and have more permanent results through the continuation of the Bureau's cooperative weed control program. The committee reported that the greater realization of the need for an efficient weed control program, together with the development of better control methods and equipment, should stimulate the program and result in its expansion wherever necessary and possible. •

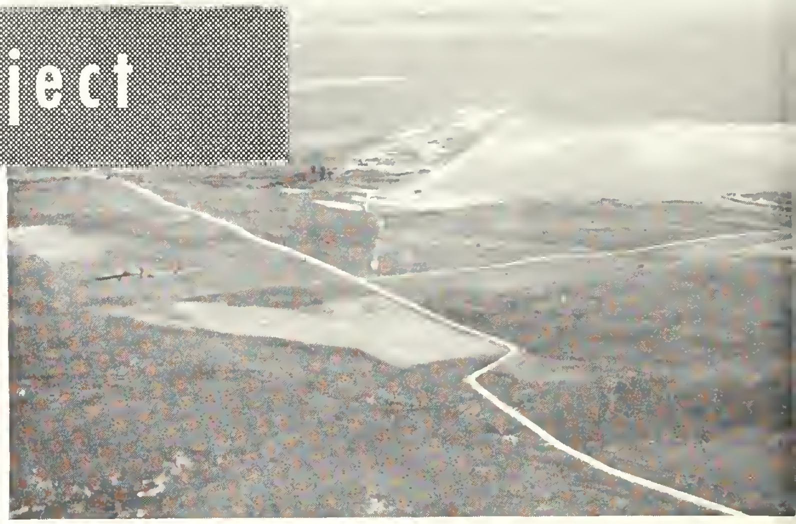
IMPORTANCE OF MEASUREMENT OF IRRIGATION WATERS

During the 1949 Operation and Maintenance Conference, much of the discussion centered upon the ever-increasing demand upon available water supplies for irrigation, municipal and other consumptive purposes which emphasizes the necessity for establishing procedures and providing facilities for taking and maintaining accurate water measurement records in all localities where adequate measurements are not now being made and recorded, particularly on and in connection with Reclamation projects and the delivery of water to individual farms. The Committee on Operating Projects recommended that appropriate steps be taken to initiate and carry out a more comprehensive water measurement program than now prevails with coordination of efforts between the Bureau and other interested agencies to effectuate such measures. •

At right: View showing water being turned out from the Sires Sublateral for irrigation on the Tucumcari project. ***Photo taken on the C. W. Reed property by A. S. Ross, Region 5.***



Mirage Flats Project



PART II
Benefits of Development

by W. G. EICHBERGER, Niobrara River Area Office, Ainsworth, Nebr., Region 7 (headquarters at Denver, Colorado)

LAND DEVELOPED FOR IRRIGATION on the Mirage Flats project is located in what was formerly four precincts of Sheridan County. In 1942 these four precincts were consolidated into one, known as Mirage Precinct. Prior to irrigation development the population of the area averaged 2.7 persons per square mile. With the change from dry to irrigated farming the size of farms has changed from 816 acres each to 130 acres, and the number of farms has been greatly increased. Population, along with the number of farms, has also increased. It is anticipated the population will be 18 persons per square mile when settlement is completed.

The first irrigation water was delivered to the project on July 16, 1946—a great day for descendents of the first settlers, some of whom remembered the early irrigation attempts.

Today the project is in operation. Settlers who took up the available farms are constructing new homes, and other necessary buildings are making their appearances as materials become available. Farm units have been planned in such a manner that it is possible for the farmers to maintain some livestock. Since the surrounding dry land is taken up mainly by large ranches, leaving little range land available to the irrigated farms, the dry-land pasture on the project is very important. It is especially important from the standpoint of making it possible for the farmers to keep enough livestock to maintain soil fertility without using a great amount of the good irrigable land for pasture purposes.

Irrigated farms on the project are producing alfalfa in excess of their needs even with the expected development of cattle- and sheep-feeding operations. The alfalfa produced in excess of livestock feeding requirements will be made available to the nearby range area, thus stabilizing the beef-producing industry of the ranches. It will make available, as much needed high protein, roughage that heretofore ranchers have been able to supply only through the purchase of such high protein feeds as cottonseed cake and range cubes to supplement the prairie hay which is so commonly produced and fed on the range. The proximity of a supply of alfalfa will also tend to reduce the cost of wintering beef breeding herds maintained on dry-land ranches.

The production of certified Ranger alfalfa seed has possibilities of becoming an important crop on the project. This variety of alfalfa is highly wilt-disease resistant and has a great demand in the alfalfa growing sections of Nebraska. Climatic conditions in the Mirage Flats area are favorable for alfalfa seed production and some seed is being produced at the present time. Practically all of the farms have established good stands of this variety—the only one of its kind growing on the project.

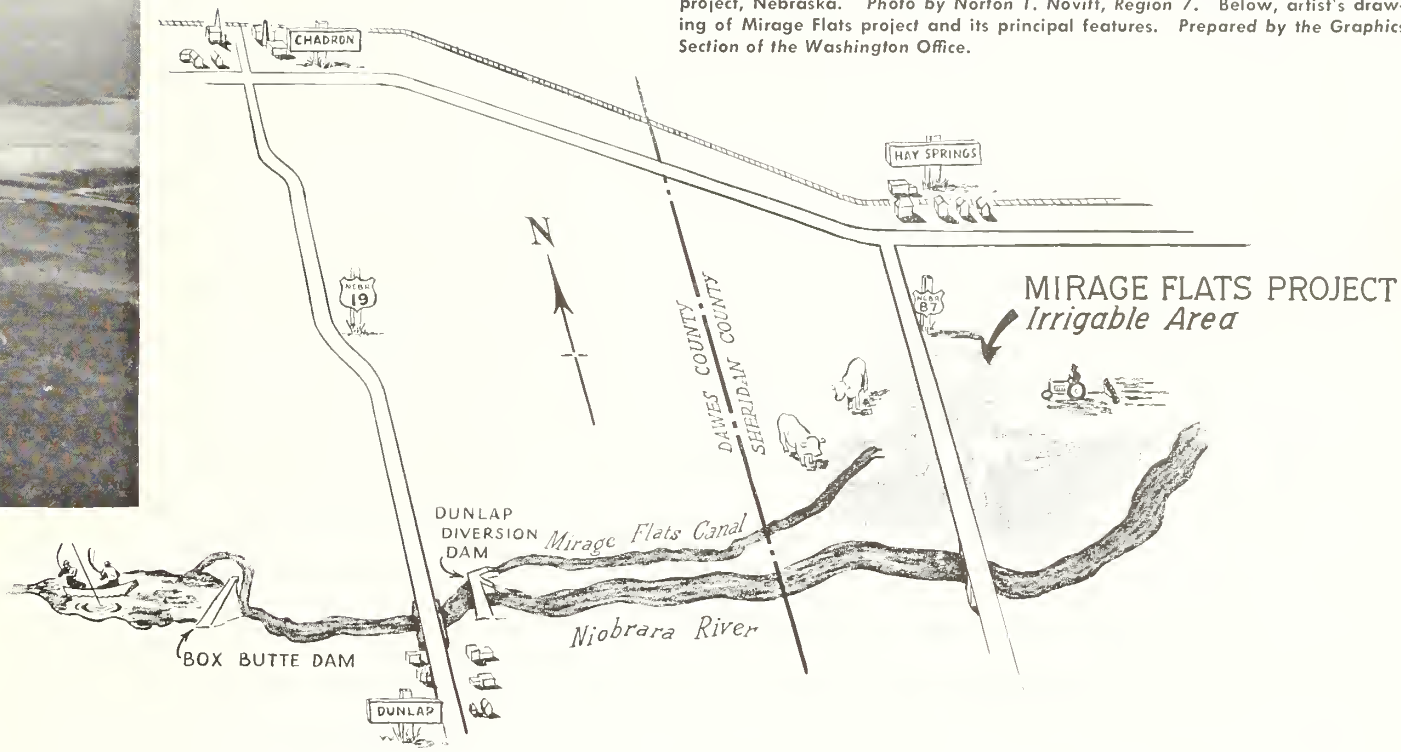
Irrigated Crops Top Dry Land Yields

Since the initiation of irrigation on the project, crop yields have greatly exceeded those obtained from dry land. Some damage to crops in 1947 resulted from heavy run-off occasioned by heavy rains during June and considerable damage resulted from hail in 1948. Notwithstanding these damages caused by the elements, average irrigated crop yields still exceed average dry-land yields by more than one-half. Potatoes, beans, and alfalfa have produced exceptionally well on the irrigated land.

Land development has also caused variation in crop yields. The land has been in production through all stages of development. Some high individual yields have been produced on the project. Some of these yields are as follows: Alfalfa, 5 tons; corn, 60 bushels; potatoes, 300 bushels; barley, 93 bushels; and beans, 40 bushels. All the individual yields cited were in 1948. While these yields may be somewhat exceptional and are above the expected long-time project average, they indicate what the land is capable of producing.

In 1946, approximately 2,900 acres were irrigated, 8,017 acres in 1947, and 10,169 acres in 1948.

Not only has there been a substantial increase in the gross value of crops produced but the increase in total gross value of livestock and livestock products has also been considerable.



Inset at left shows aerial view of Box Butte Dam and Reservoir, Mirage Flats project, Nebraska. Photo by Norton T. Novitt, Region 7. Below, artist's drawing of Mirage Flats project and its principal features. Prepared by the Graphics Section of the Washington Office.

The total value of all livestock on the project farms on January 1, 1948, was $56,200, while on January 1, 1949, it was $113,361, an increase of $57,161. Livestock and livestock products sold during 1948 totaled $87,834.

Motor vehicles and farm equipment on project farms increased from $173,965 on January 1, 1948, to $323,785 on January 1, 1949. This is an increase in dollar value of livestock, motor vehicles, and farm equipment on the farms of $263,181. This increase will be still greater as more owners who have not yet moved to their farms become operators.

Increased agricultural production in the area is reflected in the growth of retail and professional business in the town of Hay Springs. Since development of the Mirage Flats project the following new businesses have made their appearances: One implement and appliance store; one furniture store; the Mirage Flats Potato Co.; an architectural designer and builder; jewelry store, grocery store; a new cabin camp; filling station and garage; frozen food processing and locker plant; a new physician; a new attorney; a tax consultant; and a new department store. In addition to these new businesses the trucking business has expanded considerably and the Farmers Oil Co. has increased its business. The theater has been remodeled and the streets have been paved.

Box Butte Dam and Reservoir have made it possible for the people of Hemingford and Chadron as well as Hay Springs to enjoy recreational facilities not available to them prior to construction of the project.

The cooperative plan of marketing is well established in the Mirage Flats area. There are a number of active cooperatives in Hay Springs. The Farmers Cooperative Creamery operates trucks on established routes, providing an excellent market for dairy products, poultry and eggs. A Farmers Cooperative Shipping Association is in operation. In 1939 this organization shipped 110 head of cattle, 392 hogs, and 1,078 sheep. A cooperative elevator in Hay Springs handled 156,249 bushels of grain in 1944. These cooperatives will undoubtedly play an important part in marketing the products of the project.

Most of the 1948 crop of potatoes was marketed through the Mirage Flats Potato Co., an independent buyer. This firm buys the potatoes at harvest time and stores them in huge potato storage bins. During the winter months they are washed, graded, and shipped to distant markets or to Omaha and Kansas City. Some potatoes are shipped to Arkansas, Oklahoma, Louisiana, Florida, Texas, and other early market potato areas. At the present time farmers are investigating methods of building storage cellars, washing and grading facilities. If this can be accomplished, the farmers believe that with better market facilities, perhaps cooperatively, they can produce more potatoes and increase the incomes on individual farms.

Carloadings received and forwarded from Hay Springs have also shown an increase since irrigation began in 1946. During the period 1941–45 an average of 24.8 cars per month was forwarded and an average of 31 carloads per month was received. During the period 1946–48 the average car loadings per month were 35.5 cars forwarded and 33 cars

(Please turn to page 36)

Reclamation's Hall of Fame

Nomination No. 6

ARTHUR POWELL DAVIS

"Everyone should be made to see that water is conserved." These words were spoken more than 20 years ago by a man of many distinctions. He was the second executive head of the Reclamation Service, now the Bureau of Reclamation. He, and his Uncle "Wes"—Maj. John Wesley Powell—laid the foundations of modern water resource development and planned the harnessing of the Colorado River. He was an engineer of national and international renown who influenced hydraulic works in many parts of the world. He was a man of broad vision and practical engineering genius who foresaw the growth of population and importance of water conservation in the West. He wrote with unusual clarity and force, and an index of his prolific writings covers 15 pages of single-spaced typewritten abbreviated listings.

This man was Arthur Powell Davis—a man ahead of his time—who qualified for his place in Reclamation's Hall of Fame in four fields.

As a scientist—according to the American Society of Civil Engineers, A. P. Davis was one of the few men who evolved "what might almost be called a new science—irrigation engineering"—during the first two decades of the twentieth century.

As an international engineer—he shared his knowledge, his travels influencing the location of the Panama Canal, irrigation in Puerto Rico, China, Tsarist Russia, Soviet Russia, the construction of many high dams throughout the world, standard specifications for portland cement, and (as an indication of his versatility) the 1923 Pecuniary Claims Arbitration in London, England, for which he was a technical advisor to the United States.

As a conservationist—an advocate of water conservation through basin-wide river development, as early as 1903 and 1904, Arthur Powell Davis encouraged and took part in many surveys of the Colorado River, studying the possibilities of harnessing this unruly stream for agricultural and hydroelectric use.

As an administrator—although dismissed as Director of the Reclamation Service in 1923 ostensibly because he was an engineer, rather than a businessman, those who knew him state he had the knack of getting "on top of his job," never permitting the details of his work to crush him. His associates and employees always felt as if they were working *with* him, rather than *for* him, nowadays considered the essence of good administration. He was always receptive to suggestions, once telling his wife, who chided him for permitting his chauffeur to drive a party of inspectors along a different route than he planned, "Why, Molly, I wouldn't tell anybody I didn't want his suggestions—he might have a good one." The A. S. C. E., publishing the following tribute to Arthur Powell Davis, attests to this facet of his ability:

"As an engineer, Mr. Davis combined outstanding technical ability with excellent judgment, both as to measures to be undertaken and the men to execute them. Perhaps the engineering works he constructed were themselves no greater achievement than the creation of the enduring organization that built them. All over the West today are engineers who are proud to have been at one time in their careers a part of the United States Reclamation Service. The outstanding record of that organization is in no small part due to Mr. Davis' ability to select and weld together an efficient personnel. Early in the railroad company history, the chief engineer of the Southern Pacific Railroad Co. expressed the view in a discussion before the society that the Reclamation Service secured more per dollar expended than did the Southern Pacific Railroad itself."

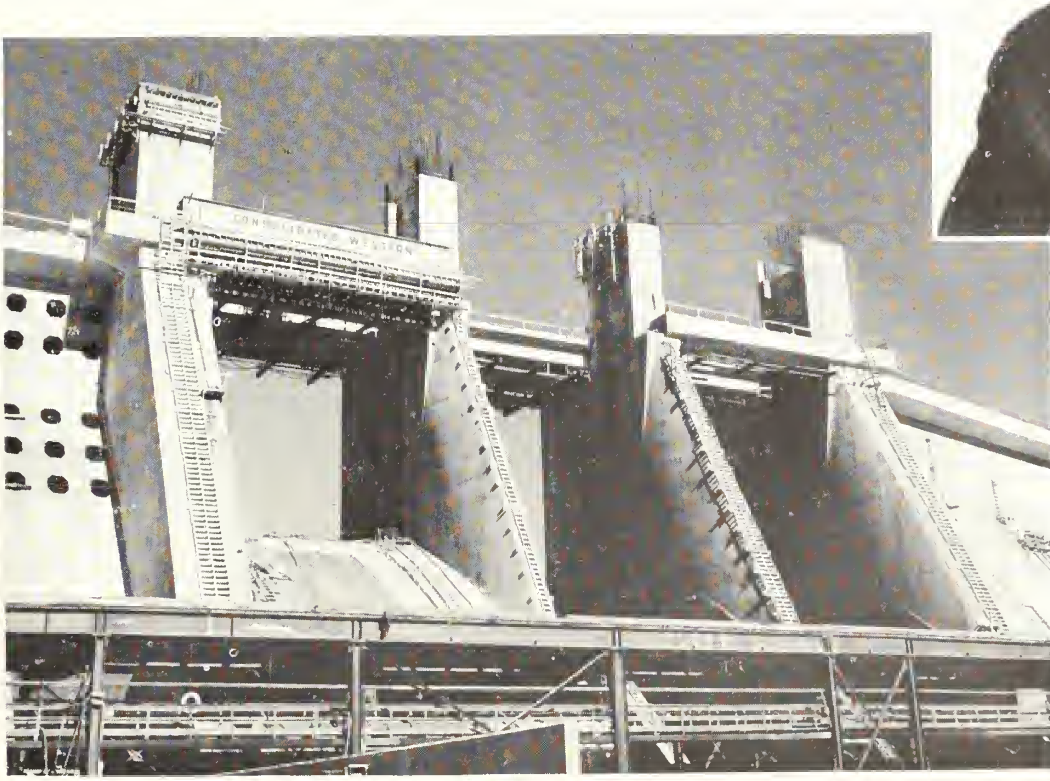
As a humanitarian—to the A. S. C. E. again we turn to an authentic source for this side of Arthur Powell Davis' character:

"Personally, Mr. Davis was a man possessing the highest attributes of honor, straightforwardness, and sincerity. Practical to the last degree in material affairs, he was of the happy few who find in the work of their hands an opportunity to express in concrete form their aspirations for the welfare of their fellow men. The ideal which found expression in the formation of the Reclamation Service was humanitarian, to provide an opportunity to the man with small capital to develop his own farm and carve out his own destiny; to provide homes where men who loved the soil and the fundamentals of existence could raise their families in peace and comfort."

During this mid-century year of 1950 he will be honored as a conservationist and an arch proponent of basin-wide water resource development. For this year, the dam which bears his name will begin to catch and hold the Colorado River, releasing its once destructive waters as life-giving flow for irrigation and hydroelectric power.

The vital statistics show that Arthur Powell Davis was born in Decatur, Ill., on February 9, 1861. His father, John Davis, sold his Illinois real estate (where now a goodly portion of the city of Chicago stands) to buy land in Kansas so each of his sons could have a farm. Came the grasshoppers, and none of the sons became farmers. Arthur's father became a newspaper publisher, later moving to Washington, D. C., when he was elected a Representative from Kansas in the Fifty-second and Fifty-third Congresses. Arthur was graduated from the Columbian (now George Washington) University in Washington, D. C., with a degree of bachelor of science in civil engineering in 1888. In 1917 he received the honorary degree of doctor of science from that university, and in 1920 the degree of doctor of engineering from Iowa State College. From 1884 to 1894 he was a topographer in the United States Geological Survey. It was during this time that he became interested in the unruly Colorado River and began to survey and explore Arizona, New Mexico, and California.

He was transferred to the Reclamation Service as principal engineer soon after the passage of the Reclamation law, June 17, 1902; was named assistant chief engineer and became chief



ARTHUR POWELL DAVIS, above, and at left the spillway of Davis Dam as it rapidly approached completion in October 1949. (Construction photo by *Phil Blew, Region 3.*) At the top of the opposite page, John MacGilchrist's drawing of the dam as it will appear when finished, a lasting monument to the foresight and engineering genius of the man whose name it bears.

engineer in 1907, a position which he held until 1914, at which time he became director of the Reclamation Service.

Davis took a leading part in demonstrating the feasibility of a dam at or near Boulder Canyon. He discussed with Secretary of the Interior Lane the method of constructing this dam as far back as 1914 when authority for the extensive investigations of the Colorado River was obtained.

Director Davis recommended Colorado River development which would include (1) construction by the United States of a highline canal from Laguna Dam to the Imperial Valley, to be reimbursed by the lands benefited (now the All-American Canal project); (2) public lands to be reserved for settlement by ex-service men (this has now become standard policy for the Bureau); construction by the United States of a reservoir at or near Boulder Canyon on the lower Colorado with costs to be reimbursed by revenues from power incident thereto (now Hoover Dam and Lake Mead). These and other of his recommendations made possible all of the downstream developments on the Colorado.

As water begins to rise behind the great Davis Dam, it represents another achievement in realization of the ideals for which Mr. Davis devoted a lifetime of outstanding service. In the course of the 17 years during which Arthur Powell Davis was chief engineer or director of reclamation, the Reclamation Service under his direction constructed more than 100 dams, many of them of outstanding importance.

Mr. Davis was a Fellow of the American Geographical Society; a past president and honorary member of the Washington (D. C.) Society of Engineers; a member of the Washington Academy of Sciences, the American Academy of Political and Social Sciences, and the American Philosophical Society. He was a member of the Commonwealth and Engineers' Clubs, of San Francisco, and past president and member of the Cosmos Club, of Washington, D. C. At the time of his death (August 8, 1933), he was a member of the Unitarian Church in Oakland, Calif.

He was elected as associate member of the American Society of Civil Engineers on June 7, 1893; and a member on October 4, 1899. He served as a director from 1917 to 1919, and as president of the society in 1920.

Arthur Powell Davis was married on June 20, 1888, to Elizabeth Brown of Washington, D. C., who passed away on April 13, 1917, leaving four children, Mrs. Rena Peck, Mrs. Florence Eslin, Mrs. Dorothy Smith, and Mrs. Elizabeth Smith. On June 19, 1920, he was married to Marie MacNaughton of Washington, D. C., who survives him.

His widow, who now lives in Oakland, Calif., the town which owes its stable water supply to her husband's engineering administration and foresight, plans to attend the dedication of Davis Dam next year. She has stated, "If he had been an Englishman, he would have been knighted, or if he had been a Frenchman he would have been awarded the Legion of Honor. At any rate, it was a great comfort to him during his last days when former Secretary of Interior Ickes appointed him consulting engineer and referred to him as the 'father' of the plan under which the Boulder (now Hoover) Dam was constructed. My husband was a man of peace but somehow seemed to be a target for criticism and in the center of controversies. He took his dismissal very philosophically, saying that if there was no further need for him, he would be glad to go some place where he could be of service. And he did. His whole life was devoted to service for others. He recognized the basic importance to any civilization of productive land and water and made a contribution wherever he could toward a more abundant life for the people of the world," and Davis Dam, the fourth major structure designed to chain the lower Colorado for the use of man in a land of perpetual drought, bears his name, as a lasting remembrance and recognition of his great scientific skill and practical foresight. THE END

MIRAGE FLATS PROJECT

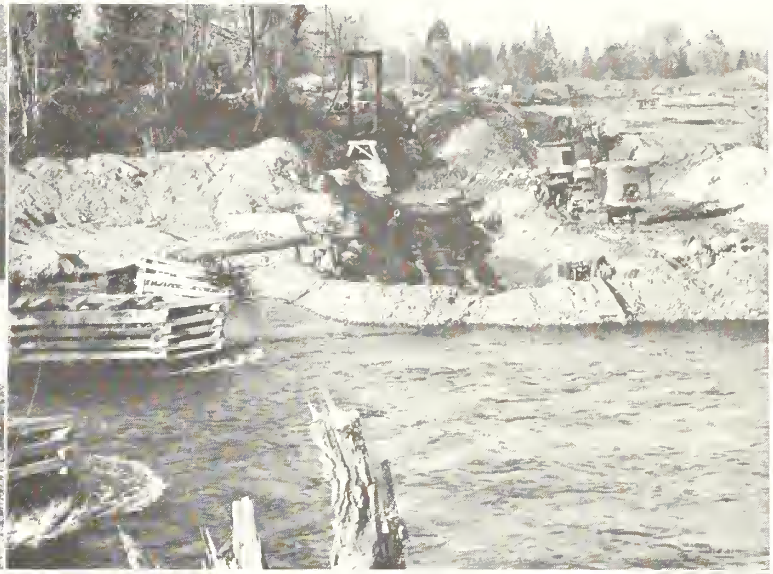
(Continued from page 33)

received. These figures, provided through the courtesy of Chicago & North Western Railway, would indicate that the Hay Springs area has changed from an import to an export community.

Aside from contributing to the public welfare by way of increased crop production, thus adding to the Nation's food supply so vitally needed to feed the world's population in these postwar years, the Mirage Flats project is also contributing to the national economy in increased income taxes. The amount expended for labor annually will approximate \$350 on the average irrigated farm on the project, which will amount to an average labor bill of \$40,000 per year. In addition to contributing to the national income through income taxes, the required labor will help stabilize incomes in dry-land areas from which a considerable amount of this labor will come. Increased taxes resulting from larger investment in land and equipment tend to increase local and State tax revenues.

Not all of the benefits accruing from the Mirage Flats area will be direct benefits. Some of the indirect benefits resulting from irrigation are difficult to appraise individually, yet they exert a tremendous influence on the economic life of the community. The full-time farms on the project will provide support for a farm population of approximately 500 people. That part of the net income spent annually for family living will total \$175,000. Expenditures during the development period for building materials, farm machinery and the like will approximate \$1,000,000. When all of the farms on the project are fully established, their continuing operating expenses will amount to approximately \$345,000 per year. The local businessman will be the first to benefit in a long chain of benefiting groups extending throughout the region and the Nation. Excepting the initial capital outlays, these benefits are permanent, coming each year as regularly as crops grow and mature. THE END

President Truman has appointed R. J. Newell, former Region 1 Director for the Bureau of Reclamation, to be United States commissioner on the Yellowstone Basin compact. Mr. Newell is also Federal representative on the Idaho-Wyoming Snake River compact commission.



THE BUREAU MEETS AN EMERGENCY

Above left: Removing old pipe line to avoid Rogue River highwaters. At top right: Precarious supports for old pipe line. Note new cylinder pipe being laid nearby. Immediately above: New concrete cylinder is seen edging toward river crossing. *All photos by A. E. Baker, Region 1.*

Some sort of a record for getting a job started in a hurry was set in Region 1 of the Bureau of Reclamation last fall, when in less than a month after a congressional appropriation for rehabilitation of an irrigation pipe line at the Grants Pass (Oregon) Irrigation District was approved, the construction was underway.

As a result, the 1,300 acres of district lands, situated in the Rogue River Basin in southwestern Oregon, near the town of Grants Pass, can be assured of an adequate water supply during 1950. Without the "hurry-up" action of the Bureau, farmers in the section would have had to live another season in a sword-over-their-head atmosphere.

The existing pipe line conveys water across the Rogue River from the district's north canal to its Hillside lateral. It is badly deteriorated and in case of high water would probably have been wiped out. The part of the pipe line crossing Rogue River was originally supported by a suspension bridge which was washed out in the flood of 1927. Since then, the river crossing has been accomplished by supporting the pipes on rock-filled timber cribs and concrete piers. At the end of each irrigation season those sections of the pipe supported on the cribs and piers and subject to damage by winter floods have been removed until needed for the next irrigation season. High operation costs have inevitably resulted.

Bureau engineers who examined the line reported back that it would be necessary to construct a new river crossing for the old pipe line before the start of the 1950 irrigation and before the high flows of the Rogue River, which ordinarily commence in December, made such construction impracticable. Thus, there could be no delay.

Bids for the construction were opened on October 11. It was found that the lowest of nine bids received exceeded the money allotted by $12,530. Accordingly, with the concurrence of the Grants Pass Irrigation District, a contract dated October 28, was negotiated by the Bureau with the Ramsey Construction Co. of Corvallis, Oreg., for the portion of the work which had to be completed ahead of high water, together with other sections, totaling approximately 3,300 feet in length. The original design was altered from pipe embedded in concrete to cylinder pipe, in order to bring the cost of the work within the limits of the available appropriation.

On November 8, less than 4 weeks after funds became available, the contractor moved in his shovel and dug up the first yard of earth. When the chips were down, Reclamation delivered.

The district itself will rebuild a wood-stave line, at one end of the line across the river, plus a major lateral. The End

Cooperation with Federal and State Agencies

(Continued from page 24)

assistance or the operation of development farms. The committee believes that very considerable progress has been made in securing the cooperation of the land grant colleges, and other State and Federal agencies in the program, and wishes to emphasize the importance of the Department's policy whereby the land grant colleges and universities are recognized as the focal point of coordination. The committee has given special emphasis to relations with the land grant colleges and universities and certain agencies of the Department of Agriculture. It is assumed that equal importance will be given the relations with other appropriate State and Federal agencies.

The committee had the following specific recommendations to make as a means of furthering this cooperative effort:

1. We believe that in too many cases the land grant colleges and universities and the Department of Agriculture agencies have been requested to cooperate primarily when specific problems or difficulties arise. It is strongly recommended that these agencies be brought into the program during the planning stages, to the extent that development and operating problems are involved, and that they continue to participate during the pre-construction, development and operating stages of the program.

2. The land grant colleges and universities all carry a heavy responsibility and a wide variety of essential activities benefiting the people of the State. The funds available from the various sources are often inadequate to meet these needs and the additional obligations brought about by the Bureau's rapidly expanding program. In order that the land grant colleges and universities can perform the needed functions in the cooperative program, in accordance with the Senate committee statement quoted above, it is recommended that arrangements be made similar to those whereby the Bureau provides the Salinity laboratory each year with an estimate of needed services, the cost of which will be reimbursed by the Bureau. This would permit the colleges to anticipate the workload they would be expected to carry and enable them to finance such assistance.

3. That each region schedule its land classification program several years in advance, if possible, and present such schedule to the State agricultural experiment stations and appropriate Department of Agriculture agencies with the request that they make every effort to carry out basic soil surveys of land capability surveys on these areas as a means of providing the soils information needed by the Bureau in connection with its land classification program.

4. That the regions continue to seek the assistance and cooperation of the land grant colleges and universities in repayment analyses for existing and proposed projects and, in addition, that representatives of these State agencies be invited to participate in the presentation of these analyses to the water users' organizations.

5. That the existing development farms are rendering a very valuable service in the Reclamation program is recognized, we believe, by everyone. Additional farms should be established on a cooperative basis in those areas where irrigation is relatively new, where particular problems of water distribution and land use exist, or where the need for agronomic information would be a limiting factor in the early and successful development of the area. That whether the purpose of establishing and operating development farms be educational or investigational, the State colleges and agricultural agencies be urged to participate in the program to the full extent of their technical resources, and financial ability.

6. That each region and district work closely with the appropriate representatives of the Farm Home Administration in determining credit requirements for Bureau project settlers and make every effort to assist them in securing adequate authority and funds to meet the credit requirements on Bureau projects.

7. That each region discuss with officials of the State colleges and universities their facilities for training prospective employees particularly in the field of operation and maintenance and the development of a cooperative training program through which undergraduates will be employed for summer work on various phases of the Bureau's program.

8. In carrying out these recommendations it may not be necessary in all cases to enter into cooperative agreements, but they may be found a useful tool and will in all cases be necessary where a transfer of funds is involved. •

(From the Report of the Committee on Participation of other Federal and State Agencies in the Reclamation Program, 1949 Operation and Maintenance Conference, December 5 through 10. Members of the Committee were, in addition to Chairman Lindley, Hollis Sanford, Assistant O & M Supervisor, Region 1; Ian A. Briggs, Chief, Land Use and Settlement, Region 3; D. T. Bolingbroke, Chief, Land Use and Settlement, Region 6; and E. J. Utz, Chief, Land Use and Settlement, Commissioner's Office.)

PROBLEMS of a Present Day Homesteader

by CARLYLE BUTLER, Homesteader From Hunt Project, Jerome, Idaho

WHAT ARE THE PROBLEMS OF PRESENT-DAY HOMESTEADING? We know that our problems of today are not nearly as great as those which homesteaders had to face some 30 or 40 years ago. However, in comparison with the present era, we still feel that we have a number of problems. If we were to try to compete with present high gear, modern type of farming, with the use of horses and grubbing hoe, we would certainly never make the grade and pay out on our new homestead farms. We must use tractors, heavy land moving machinery and all modern methods of farming adaptable to our farming area to make our farms produce the maximum in the least amount of time in order to compete with our neighboring farmers, who had been established for years.

I will first discuss irrigation as one of our homestead problems. In the particular area in which the Hunt project is located, there is no submoisture. Before the land was put under cultivation by the Japanese, as a Japanese relocation camp, it was part of the desert. Here, the water must be put on the land before any crop can be grown. If a portion of the field is missed during the irrigation, you can see the effect upon the corrugation and tell exactly how far down the corrugation the water has gone. This type of irrigation might be compared to an 80-acre garden. Every crop, including wheat and alfalfa, must be furrowed out, or corrugated, and water put in each of the ditches. Another of the things to consider along the irrigation line is the balancing of late and early crops to be sure of sufficient water during the time each crop needs the water. Under the American Falls Reservoir District No. 2, the water is allocated on the basis of $\frac{5}{8}$ inch of water per irrigable acre during the irrigation season. This is not enough water to have all land under heavy irrigation at the same time. The first year on our project we were advised to raise grain primarily. Most of the fellows did plant a high average of grain and in some cases lost a good share of it because everything needed water at once, and there just wasn't enough water to cover the land. If some beans and potatoes had been planted along with the grain, there would not have been so much trouble getting the water to the crops as they needed it.

Another of the problems that we had in our particular area was the problem of drainage. This is undoubtedly not a universal problem among all the homestead projects, but on our project it is a problem. About 50 percent of our 89 farm units are not blessed with natural drainage. The waste water runs down into the lowest pot holes and there it stands unless some method is used to do away with it. Sometimes this waste water covers a considerable area of good farm land. However, there are two methods that are satisfactory for taking care of this waste water: one is by pumping it up to higher ground to be reused; the other is to drill what is known as a sump well. In this method, a hole big enough to carry off the maximum of drain water is drilled through the lava rock until a crack is found that will carry off the waste water. This is not nearly as desirable as natural drainage, but it does serve the purpose.

Another of our major problems is that of finance. One of the qualifications that was required of us to apply for a homestead was the possession of not less than \$3,000 worth of assets that would be beneficial in working a homestead. Part of it could be machinery, negotiable bonds, etc. As you know, \$3,000 is not enough to clear, level, and operate 80 acres of raw sagebrush land to the point that it will yield a crop. We received financial aid from various sources. The majority of the fellows who needed machinery acquired a loan through the First Security Bank of Idaho as a GI loan up to about \$4,000. This was at an interest rate of 4 percent, payable over a period of 3 years. For land leveling and laying out of farm ditches, a substantial amount of the assistance was received from the Bureau of Reclamation in the farm survey, and also financial aid in the amount of \$10 per irrigable acre. That was to be repaid over a 3-year period. In most cases, the money for operating the farm for a year and for purchase of livestock and minor farm

Mr. and Mrs. Dick Pimm welcome relatives, Mr. and Mrs. Glenn Smith, on their Hunt, Idaho, farm unit. Since 1947 the Pimms have cleared sagebrush, and managed to get in crops as well as build a new home. *Photo by Stanley Rasmussen, Region 1.*

implements, has been furnished by the Farm Home Administration. The loans have been supervised loans repayable at the end of each year for operating, and over a 3-year period on livestock. The Farm Home Administration operating loan and the Bureau of Reclamation land leveling loan has certainly been the backbone of our financial program, without which we would have had, and would continue to have, an unnecessarily difficult time. At the present time, the Farm Home Administration for our vicinity is temporarily out of funds, which is curtailing many beneficial programs which should be exercised now. However, the Honorable Mr. Sanborn, Congressman from Idaho, informed me that an emergency fund is being made available for both the Hunt project and the Black Canyon project so that should alleviate the present shortage.

Other problems that we have to contend with are those of roads and schooling. Our project falls in a highway district that has many miles of road to maintain through a not-too-thickly-populated district. The district is taxed through property to the maximum that is allowed by State law. Yet, there is not enough revenue to take care of the present roads in the district, much less build new roads on the project. However, the State of Idaho has appropriated during the past 2 years approximately $20,000 to construct roads beneficial to the project. That, plus the cooperation of the highway district and the surrounding towns, has made it possible to construct two gravel roads into the project that have helped immeasurably. At the present time, the school districts that are serving the Hunt project are having a very hard time making room for the additional students coming in from the project. They must hire additional teachers, buy school busses, and other equipment—and their finances are short.

Another of the problems we have had is one of present Government laws concerning homesteaders in various Government agencies. The soil conservationist can do no work on our farms until we have received patent. This works a definite hardship as we must use our judgment as to irrigation runs, lay-out of fields, and land leveling. We spend large sums of money getting the land leveled in what we think is the best way, and 3 or 4 years later we will be changing the whole set-up. It would have saved much work and money if we could have had the advice of experienced engineers of the soil conservation department and had been right the first time.

Another of the agencies that has not been able to function completely on unpatented land, has been the Farm Home Administration. Up until recently the Farm Home Administration has not been able to take a mortgage against the unpatented land for funds for such improvements as fencing, wells, and building improvements. They have been limited to assistance for operating loans, livestock loans, and other forms of short-term loans. However, Congressman Sanborn, of Idaho, recently informed me that a bill had passed both the House and the Senate and had been signed by the President making it possible for the Farm Home Administration to take a mortgage against unpatented land for improvements of that land. This will be a great assistance to the present and the future homestead entryman.

In the way of conclusion, I would like to state how the settlers of the Hunt project feel about homesteading. We have been told many times by people off the project how lucky we are that we have been "given one of those farms." In actual dollars and cents we have "been given" nothing. However, we have been given a mighty fine opportunity to earn and pay for a piece of land from which we can make a living and a home. That is all that any of us wish to be given. To explain what I have said, I would like to point out that we have approximately $115 per irrigable acre construction costs against our land payable over a period of 40 years. Adding the cost of clearing, leveling, and ditching the land, brings the cost per acre up to the cost of surrounding farms outside the project. Therefore, we feel that we have been given nothing but an opportunity—which we appreciate.

Although I have confined my remarks to problems concerning the Hunt project, I am sure that a majority of these same problems exist on the other homestead projects which are to be absorbed into the various irrigation districts.

THE END

(From an address at the Eighteenth Annual Meeting of the National Reclamation Association at Salt Lake City, Utah, on November 2, 3, 4, 1949.)

Heart Butte Dam Completed Year Ahead of Schedule

Heart Butte Dam, on the Heart River in North Dakota, the second major dam to be completed by the Bureau of Reclamation as a part of the Missouri River Basin project, was finished at the end of 1949, almost a year ahead of schedule.

Commissioner of Reclamation Michael W. Straus stated that the contractors, C. F. Lytle Co. and Green Construction Co. of Des Moines, Iowa, were given notice to proceed with construction on March 22, 1948, and the contract called for completion by November 22, 1950.

"The early completion of the Heart Butte Dam," he said, "is indicative of the speed with which work is proceeding on the great basin-wide project to bring the Missouri River and its tributaries under control and put them to work. We have been bending every effort to that end since the war."

The Heart Butte Dam is located on the Heart River in the west central area of North Dakota and is a key structure in the Heart River unit of the Missouri River Basin project. It is an earthfill structure, 174 feet high and 1,850 feet long at the crest. It will create a storage reservoir with total capacity of 428,000 acre-feet which will be used for irrigation storage, flood control, and silt retention. Cost of the dam and reservoir was approximately $3,335,000.

Construction of pumping plants and an irrigation distribution system for the Heart River unit will begin in the spring of 1950 and initial water delivery to an ultimate 13,100 acres of land near Mandan is anticipated a year later. Power from the pooled Missouri River Basin project hydroelectric plants will operate the pumping plants. •

IS ANYBODY PERFECT?

On page 17 of the January ERA, the map showing the flow of nonwestern projects was based on data relating to the Columbia Basin project. That is why the "goods" are aimed at the State of Washington, rather than Idaho, wherein is located the 'Magic Valley." Don't blame anyone but the legend writer, who is doing penance.

The BLIZZARD of '49

Those who specialize in weather reports and predictions of things to come have ventured to state, as this issue goes to press, that no matter how bad things may be this year, the "elements" are not due to match their performances last winter. Out of the tragedies and discomforts of the blizzard however evolved some of the most dramatic examples of democratic cooperation and true American spirit. Meeting the emergencies of the storms, Federal, State, county, and local organizations, along with individuals connected with no particular group, banded together to save human life, livestock, and property in a hard-to-forget demonstration of true western pioneer perseverance. Photos are by Charles A. Knell, Thomas R. Broderick, of Region 6, and L. R. Murphy, of Region 1.

The Hereford calf, above, was younger and sturdier than some of his family and friends, and was able to enjoy his long-delayed dinner after it was convoyed to him in southern Wyoming. Other snow-bound animals were too weakened by the cold to eat.

Railroad passengers kept up their good spirits, in some cases, by writing "newspaper" accounts of their troubles as they awaited rescue from snowbound trains. Bulldozers followed by trucks and passenger cars battled the drifts and "evacuated" many travelers to the nearest shelter.

Wartime-learned lessons of "convoy" transportation came in handy for transporting food for livestock to isolated ranches. This scene was taken north of Rawlings, Wyo., one of the hardest hit of last year's blizzard victims.

Minks on Rattlesnake Avenue at Anderson Dam were of great concern to Mr. and Mrs. Floyd Landers who had invested heavily in over a hundred of the animals. Very few survived, and the Landers' home is also typical of the many damaged by the storms.

The Anderson Dam slides played havoc with the equipment yard, above, but in many other areas, the drifting snow was almost as damaging, finding even the smallest openings and leaving huge drifts inside as well as outside homes and buildings, like the Bureau of Reclamation building at Faith, S. Dak., shown at left.

Where Do We Stand on Repayment?

(Continued from page 27)

5-percent plan, the farmers pay 5-percent of the 10-year average crop value. One defect is the use of the figure 5 as a dependable index of what the farmers can pay. Such things as the intensity of crop production, the incidence of farm operating costs, and the amount of irrigation operation and maintenance costs make 5 percent as meaningless as 1 or 12 on an individual district or project.

The trouble with the 10-year moving average base to which the 5 percent is applied is that it is not sensitive to the annual variations in income.

The "normal and percentage plan" authorized by the 1939 act does not have the handicap of the 5-percent plan, and it is sensitive to annual changes in income. Under this plan the amount the district pays is the base installment plus or minus twice the percentage by which current crop value per acre exceeds or is less than average or normal crop value per acre. With the use of four symbols this plan can be expressed with the following formula:

If CI=current installment
BI=base installment
C=current crop value per acre
N=average per acre crop value of high 10 of last 13 years

Then $CI=BI\left[1-2\left(1-\frac{c}{n}\right)\right]$

Thus if the current crop value is $60 per acre and the average per acre crop value of the high 10 of the last 13 years is $40, the base installment is multiplied by 1.50; whereas if c=$40 and n=$60, it is multiplied by 0.6. This would mean a difference of 250 percent in the current installment, whereas under the 5-percent plan it would have meant only 14 percent difference, and 25 percent if the amortization capacity varied directly with crop value.

One aspect of the "normal and percentage" plan is the floating normal average from which the twin-motored annual variations take off. The current installment varies considerably depending on whether the normal is at high or low tide.

Another difficulty in applying the "normal and percentage" plan is in selecting a base installment. For any base, the ceiling percentage rather than other features of the plan should control the amount to be paid in a large proportion of the years.

The so-called "price-parity" plan, under which current prices and parity indexes alter the base installment has been specifically authorized for a couple of water service contracts only, cannot be used to discharge fixed repayment obligations in a fixed number of years. Its utility is based on the assumption that most of the annual variation in net farm income on irrigated farms is due to variation in price and cost rates rather than variation in production. Not being a panacea it will not cure income variations due to water shortage, hail, grasshoppers, illness, or divorce. However, it is simple of administration, does not require annual "negotiation" of crop values, and meets the test of being directly geared to the principal cause of income variation. It merits consideration for more nearly general use. ●

FROM OUR MAIL BOX

Suggestions Always Welcome

GREEN ACRES,
Colby, Wis.

DEAR EDITOR: Enclosed please find $1 for which extend my lapsed subscription for 1 year. I have had the ERA for years, in fact, I must have all copies on file. But I do not find the ERA as interesting as it used to be during the building age. You do not tell so much of the benefits as you used to. Why not insert, say one more article each issue on some interesting sidelight? Might I not suggest out of random in my own mind some things you might tell about. I believe your whole list of readers will enjoy them.

When Hoover Dam was built, I inquired of Reclamation Service, why it was that this dam was not built even higher, in a damsite so ideal, so as to accommodate a higher one. Even the roadway through the river course would have had a simpler way to transverse the terrain. The answer was that a damsite upstream 115 miles would have been made or rendered useless. What a splendid article you now could devote to the distant building of some such dam.

Due to such a large amount of water diverted to irrigation purposes in the desert area; there of course is a tremendous amount of absorption into the air of vapor from plants and wet soils. What effect has this been on the climate and especially rainfall in areas compared to years back?

We understand Hoover Dam is 100 percent effective in the control of the Colorado River at all times. We would be glad to read of the approximate percentage of control of flood waters on various rivers having flood control dams. This could include the Tennessee River. Also what can be expected later as more dams are built on the rivers and their tributaries?

Why is it there is so much concern with silt in the lower Colorado River diversion, when there are still water lakes in number near upstream? Seems such sediment would be negligible.

Now this is a start of topics you can infuse upon us readers.

Sincerely,

H. M. FRISTAD.

We are always grateful for the suggestions of our readers and particularly appreciate Mr. Fristad's remarks. We hope the RECLAMATION ERA will continue to improve, and our readers will keep sending in their ideas. This magazine belongs to the people and must be useful and interesting to them to justify its existence.

Of course, we believe the Bureau of Reclamation is yet in the "building age" and in fact is surpassing all construction activities of years past in its current program. As to telling about the benefits, we shall continue to point out the facts, although in all cases we must comply with the Government regulation which specifies "Periodicals will not contain articles intended solely to foster and maintain interest in a Government agency, or articles which can be construed as propaganda in favor of increased appropriations or legislation."

Re Hoover Dam: at the time Hoover Dam was built, it was as high as economically feasible. The Bureau has been studying the Bridge Canyon damsite upstream, and as soon as possible, in accordance with the Government regulation noted above, the RECLAMATION ERA will carry an article on this project.

Re Reservoirs and rain: many people have asked if construction of dams, and the resultant creation of reservoirs, does not affect the climate of the area in which they are located. When one stands and looks out over the vast expanse of water that is Lake Mead, it seems only logical that the evaporation from such an area would materially increase the precipitation of the entire region. Yet experience has taught us that, except in the immediate vicinity of the reservoir, there is no noticeable change in climate as a result of artificial lakes. How can this be? A complete answer to this question would involve a lengthy and highly technical discussion. However, we get our first clue to the answer when we look at a map. Despite the magnitude of Lake Mead, its area represents only seven hundredths of 1 percent of the area of the river basin in which it is located. If all the water which evaporates from the surface of Lake Mead in an entire year were to fall as rain uniformly distributed over the Colorado River Basin, it would amount to less than six hundredths of 1 inch. Thus we see that, large as they may be, reservoirs amount to an almost infinitesimal part of the areas in which they are located. Even though evaporation from these reservoirs is enormous, it represents an insignificant portion of the normal rainfall on even an arid region.

Re flood control: this is a $64.00 question. Remember, at present the Bureau's responsibilities are confined to the area west of the 97th meridian and flood control, although one of the multiple purposes of some reclamation developments is not our prime function. However, we shall try to obtain enough information to publish an article soon.

Re Lower Colorado silt problem: upstream lakes, unfortunately, do not diminish silt deposits downstream to any great extent. Read "Silt—Despoiler of the Soil" by Wesley Nelson in the March 1948 issue.

Please keep writing, all of you.

HE'S PIONEERING AGAIN

MADRAS, OREG., *November 10, 1949*

DEAR EDITOR: Please change my address from Wilder, Idaho, to Madras, Oreg., Route 1, as I have sold my ranch on the Boise project and have a quarter section on the Deschutes project which I am bringing into production.

This my second experience in "pioneering" as I came to the Boise project in 1908 and farmed there until last November when I moved to this project.

Have received the Record and ERA continuously since its inception and have derived a great deal of benefit from them.

Sincerely yours,

G. M. EIDEMILLER.

THANK YOU, KIND SIR!

1410 GILPIN STREET, DENVER 6, COLORADO.

DEAR EDITOR: This letter is to thank you for your prompt mailing of the RECLAMATION ERA. I have received my second issue and am more than delighted with the magazine. For one who was born in the State of Rhode Island, and have been out in Denver and the West since 1946, and has seen different irrigated crops, soil conservation, and power generation which will grealy affect the economy of the West, this together with your most valuable magazine certainly gives one a broader insight to the great part that controlled water can do.

Thanking you for the past issues, and can hardly wait for future ones.

Sincerely yours,

STEPHEN A. BARLLETT.

Gasoline From Coal

The Bureau of Mines has released a new report which indicates that unlimited quantities of premium motor gasoline could be produced from coal at a cost that would increase the consumer price by only 3 or 4 cents a gallon. A free copy of the report may be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pa. •

HYDRAULIC ENGINEER JACOB WARNOCK DIES

Jacob Eugene Warnock, head of the hydraulic laboratory of the Bureau of Reclamation in Denver, Colo., died suddenly in General Rose Memorial Hospital on December 26, 1949, at the age of 46. He had attained a national and international reputation as an authority in the field of hydraulic engineering, and had been with the Bureau of Reclamation since 1931.

Mr. Warnock was born at Honey Creek, Ind., April 23, 1903. He has graduated from Purdue University in 1925 with a bachelor of science degree in civil engineering, and in 1934 he received a professional degree in civil engineering from the university. In 1939, he received a master of science degree in the same field from the University of Colorado.

His first job was with the Army Engineers, 1925 to 1929, followed by 2 years' employment by the Aluminum Co. of American in Pittsburgh. In 1931 Mr. Warnock came to the Bureau of Reclamation as an associate engineer and soon after became head of the hydraulic laboratory—a position which he held continuously until his death. His work at the Bureau figured prominently in the design of the hydraulic features in connection with Hoover, Grand Coulee, Shasta, Friant, and many other large dams and irrigation projects in the West.

Mr. Warnock was a member of the International Association for Hydraulic Structures Research. He was very active in the American Society of Civil Engineers, serving for a number of years on the National Hydraulic Research Committee and was recently appointed to the National Executive Committee of the Hydraulic Division. He was also an American Society of Civil Engineers representative on the National Engineers Council for Professional Development. •

Havre-Shelby Transmission Line Under Way

Award of contract for the construction of a 100-mile transmission line from Havre to Shelby, Mont., to serve four power-short northern Montana rural electrification projects was recently awarded by the Bureau of Reclamation.

The new line interconnects with the existing Fort Peck-Great Falls 161-kilovolt line at Havre, Mont., and will be 115-kilovolt, 3-phase, single-circuit, wood-pole, H-frame type. It will carry power from the Army Corps of Engineers Fort Peck Dam, located on the Missouri River in eastern Montana.

The Bureau of Reclamation, anticipating early completion of the line, has already executed contracts covering sale of power to Marias and Hill Counties Electrical Cooperatives. •

President Appoints Temporary Water Resources Policy Commission

President Truman, on January 3, 1950, named a temporary Water Resources Policy Commission consisting of seven members, to study and make recommendations to him on existing Federal legislation and policies in the water resources field, including reclamation. Members of the commission are to submit a final report to the President not later than December 1, 1950.

Morris L. Cooke, engineer and publicist of Pennsylvania, was appointed Chairman of the commission by the President. Other members are Paul S. Burgess, Dean of the College of Agriculture, University of Arizona, Tucson, Ariz., Gilbert M. White, President of Haverford College, Pennsylvania, Leland D. Olds, former Federal Power Commissioner, now living in New York, R. R. Renne, president of Montana State College, Lewis W. Jones, President of the University of Arkansas, and Samuel B. Morris, Chief Engineer and General Manager of the Department of Water and Power, Los Angeles, Calif. At the organization meeting held in Washington, D. C., on January 14–15, Mr. White was chosen Vice Chairman and Mr. Olds, Secretary of the commission. The second meeting of the commission is to be held in mid-February. ●

Santa Barbara Voters Speed Up Reclamation Program

When Congress appropriated funds for the construction of a $34,189,000 project to furnish an adequate water supply for the city of Santa Barbara and 29,650 acres of irrigable land in Santa Barbara County, Calif., it stipulated that work should not be undertaken unless the existing contract with the Santa Barbara County Water Agency was accepted by a vote of the water users.

On November 22, 1949, the city and four water districts in the county ratified the repayment contract by a three-to-one vote, and on December 1, 1949, Secretary of the Interior Oscar L. Chapman announced that the Bureau of Reclamation would proceed at once with the project.

The city of Santa Barbara and the four water districts voting favorably showed 15,107 votes in favor of accepting the contract as against 4,231 in opposition to ratification.

"The overwhelming vote in favor of the project and payment arrangements by the five key units of the Santa Barbara area illustrates recognition of the urgent need for water in this important California area for irrigation, domestic and industrial purposes, and the desire of the people to have the Bureau of Reclamation construct the project with all speed possible," Commissioner Straus said.

"The Bureau welcomes this opportunity to bring much-needed relief and assistance to the Santa Barbara area in its critical water problems. We are, of course, disappointed that the water users in the Santa Ynez District voted against ratification of the payment contract and thereby disbarred themselves from participation in the benefits of the project. However, we shall be glad to include the district in our plans at any time the Santa Ynez voters decide to accept the contract provisions."

Water users in the Santa Ynez District voted 991 in opposition to ratifying the contract, as against 502 for its acceptance. ●

Our Front Cover

Ironing out problems of future Columbia Basin settlers. In this photo taken by H. E. Foss, of Region 1, we see Kenneth E. Morvin, of the Pasco Development Farm, Irrigation Division of the Columbia Basin project. He is priming the 275 gpm (gallons per minute) pump which provides water for experiments on porous soil on the Bureau's development farm located on the Pasco Pumping Unit of the Columbia Basin project.

Two Million Dollars Saved On Hungry Horse Dam Site Clearing

Rejecting and readvertising for bids for clearing the 15,765 acres of the Hungry Horse reservoir site in Montana has resulted in a savings of nearly $2,000,000 over the original bids.

Secretary Chapman reported the savings when he authorized award of contract on remaining schedules of work in the amount of $4,931,210. Contracts for this work now total $5,446,610 as compared with an original combination of low bids for the work which amounted to $7,442,106. The Secretary said, "the savings will be reflected immediately in the amount of Federal funds available for other work on this project, and over the long run in a savings to the power users who will ultimately repay most of the cost of construction."

Hungry Horse Dam, which is now under construction on the south fork of the Flathead River in Montana, will be the fourth largest and third highest concrete dam in the United States. It will have a reservoir storage capacity of 3,500,000 acre-feet of water. ●

Philippine Engineer Gets Training at Denver Office

On September 21, Raymond R. Ravenzo, project engineer, Philippine Power Commission, arrived in the Denver office for a 3-month training period of technical advice and guidance. Mr. Ravenzo's principal field of interest is in project planning, construction of earth dams, and hydroelectric plants. ●

Bureau Men Receive NRA Awards

The National Reclamation Association awarded life memberships for outstanding work on reclamation to Harry W. Bashore, retired Commissioner of the Bureau of Reclamation, R. J. Newell, retired Regional Director, S. O. Harper, former Bureau of Reclamation Chief Engineer, and Floyd O. Hagie, former secretary-manager of the Association, at the NRA convention in Salt Lake City, Utah, November 1949. ●

"Retention of family-sized farms means the protection of trade as well as American community life", said former Reclamation Commissioner Harry W. Bashore.

When all the generators have been installed at the Grand Coulee power plant, Coulee Dam, Wash., it will be the largest power plant in the world with an installed capacity of almost 2 million kilowatts. Geared at top speed such a plant would be capable of supplying power for the production of approximately 2 million automobiles annually.

NOTES FOR CONTRACTORS

Contracts Awarded During December 1949

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2767	Colorado-Big Thompson, Colo.	Dec. 7	Overhead and underground remote control and local power system for Estes and Marys Lake power plants and penstock gatehouses, Olympus Dam, and Prospect Mountain conduit inlet structure, schedule 5.	Electrical Constructors, Inc. and C. M. Elliott, Chula Vista, Calif.	$162,126
2780	Columbia Basin, Wash.	Dec. 2	Electric heaters for Grand Coulee pumping plant, schedules 6, 7, 8, 9, 10, and 11.	Coates Electric Manufacturing Co., Seattle, Wash.	24,332
2791	Davis Dam, Ariz.-Nev.	Dec. 8	Carrier-current relaying sets, etc., for Mesa, Coolidge, and Prescott substations, schedule 1.	General Electric Co., Denver, Colo.	42,588
2792	Colorado-Big Thompson, Colo.	Dec. 20	Construction of Brush-Limon 115-kilovolt transmission line using aluminum conductor, schedule 1.	J & J Construction Co., Oklahoma City, Okla.	409,171
2794	Hungry Horse, Mont.	Dec. 14	1 6,000-kilovolt-ampere, 1 1,500-kilovolt-ampere, and 1 1,000/-1,150-kilovolt-ampere unit substations for Hungry Horse power plant, schedule 1.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	91,039
2794	do	do	1 500-kilovolt-ampere unit substation for Hungry Horse power plant, schedules 2, 3, 4, and 5.	Gough Industries, Inc., Los Angeles, Calif.	37,071
2804	Gila, Ariz.	Dec. 9	Construction of Wellton-Mohawk pumping plants 1, 2, and 3.	United Concrete Pipe Corp., Baldwin Park, Calif.	1,577,907
2811	Missouri River Basin, Mont.	Dec. 23	3 16,677-kilovolt-amperes vertical-shaft alternating-current generators for Canyon Ferry power plant.	General Electric Co., Denver, Colo.	887,074
2817	Gila, Ariz.	Dec. 21	3 5-kilovolt-ampere switchgear assemblies for Wellton-Mohawk pumping plants, 1, 2, and 3.	Westinghouse Electric Corp., Denver, Colo.	74,694
2821	Central Valley, Calif.	Dec. 9	Construction of laterals and sublaterals, Unit 1, Southern San Joaquin Municipal Utility district, Friant-Kern canal distribution system.	United Concrete Pipe Corp., Baldwin Park, Calif.	846,669
2822	Gila, Ariz.	Dec. 19	Construction of earthwork, tunnel, canal lining, and structures for Wellton-Mohawk canal.	Morrison-Knudsen Co., Inc., Los Angeles, Calif.	1,556,387
2825	Fort Peck, Mont.	Dec. 28	Construction of Havre-Shelby 115-kilovolt transmission line using aluminum conductor, schedule 1.	Smith Construction Co., Nashville, Tenn.	599,432
2834	Central Valley, Calif.	Dec. 27	Construction of Friant-Kern canal	Peter Kiewit Sons' Co., Porterville, Calif.	3,176,814
2836	Columbia Basin, Wash.	Dec. 8	Construction of earthwork and concrete foundations for Ephrata office building.	M. Hoard, Seattle, Wash.	33,116
2838	do	Dec. 23	Construction of area E-1, laterals and sublaterals, except lateral E L 20 and sublaterals, East Low canal laterals.	Collins Concrete & Steel Pipe Co., Portland, Oreg.	919,486
R2-79	Central Valley, Calif.	Dec. 16	Furnishing and erecting 2- and 3-bedroom prefabricated or site constructed residences, schedules 1, 2, 3, and 4.	S. O. Sprager, Los Angeles, Calif.	122,090
R2-79	do	Dec. 8	Furnishing and erecting 2- and 3-bedroom prefabricated or site constructed residences, schedule 5.	Bonner B. Terry, Colton, Calif.	36,168
R3-B-9	Boulder Canyon, Ariz.-Calif.-Nev.	Dec. 15	Construction of 10 5- and 6 4-room residences at Boulder City	Lembke Constr. Co., Las Vegas, Nev.	163,825
R3-PX-20	Parker Dam, Calif.-Ariz.	Dec. 9	Construction of a machine shop building at the Parker Dam	Sooy and Jackson, Redlands, Calif.	138,000
VII-92	Missouri River Basin, Frenchman-Cambridge division, Nebr.	Dec. 19	Construction of caretaker's facilities at Medicine Creek Dam and Cambridge diversion dam.	Northwest Realty Co., Alliance, Nebr.	37,356

Construction and Equipment for Which Bids Will Be Requested By April 1950

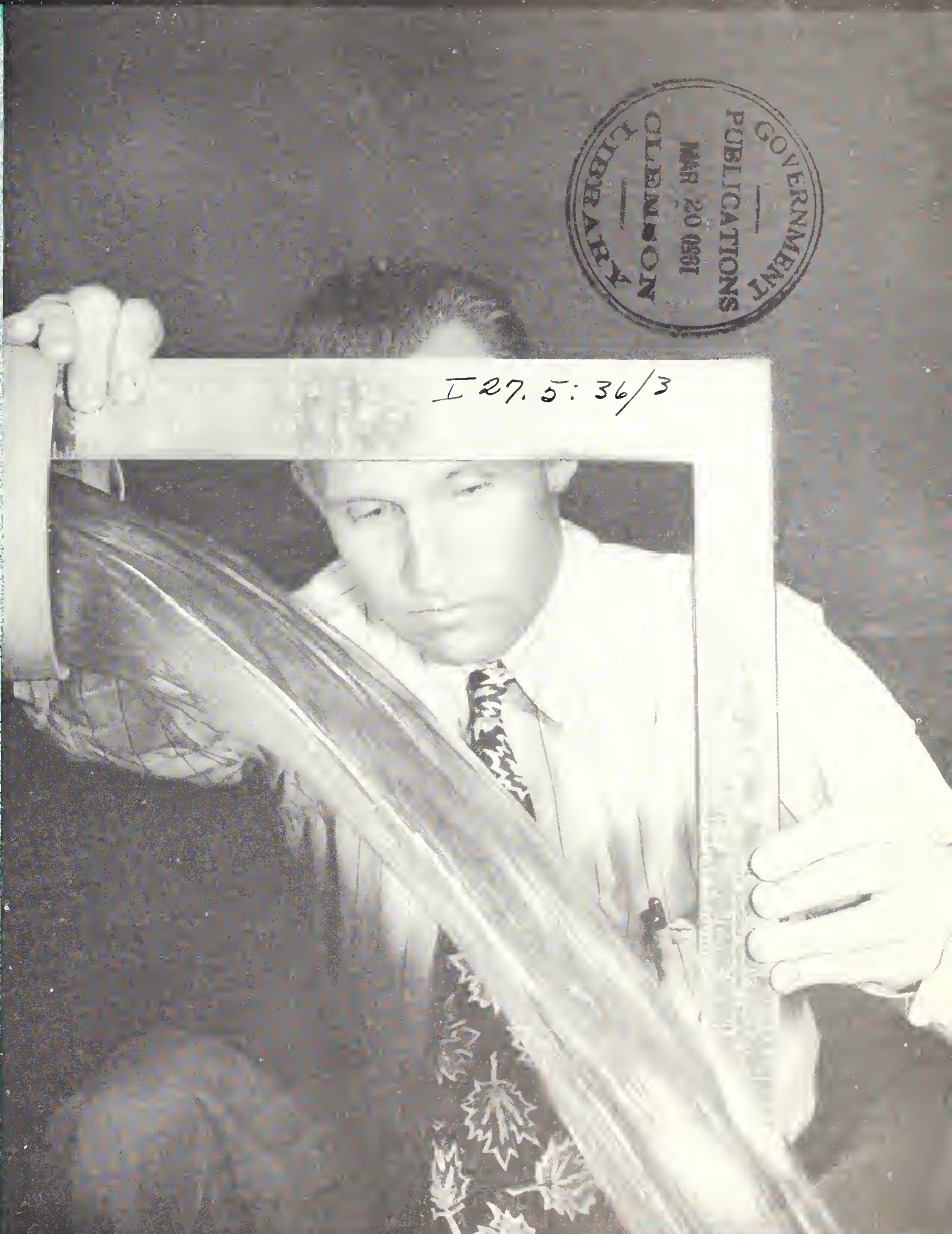
Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Construction of blacksmith shop, at Hoover Dam.
Central Valley, Calif.	Construction of 1 3- and 1 2-bedroom residences for ditch riders on the Madera canal, near Friant, Calif.
Do	Construction of 2 residences at the Kaweah River and Kings River for ditch riders on the Friant-Kern canal.
Do	Hauling, spreading, and rolling decomposed granite for surfacing Friant-Kern canal patrol road.
Do	Surfacing left abutment and right abutment roads and power plant parking area at Shasta Dam.
Do	Surfacing left abutment road and parking area at Friant Dam.
Do	Construction of foundations and erecting 8 transmission line towers for 6-mile crossing of the Sacramento and San Joaquin Rivers near Rio Vista, Calif.
Do	Construction of 69 miles of 12- to 48-inch diameter concrete irrigation pipe lines for servicing the Lindmore irrigation district on the Friant-Kern canal distribution system.
Do	Construction of 81 miles of 10- to 54-inch diameter reinforced concrete pipe lines for the Southern San Joaquin municipal utility district on the Friant-Kern canal distribution system.
Do	Laying 117 miles of pipe for unit 3 of Southern San Joaquin municipal utility district, unit 3 of Lindmore irrigation district, and unit 3 of Ivanhoe irrigation district.
Do	Construction of 8 miles of 4,300-cubic feet per second Newman wasteway on the Delta-Mendota canal.
Do	Construction of 17 miles of 69-kilovolt Tracy-Contra Costa single-circuit transmission line.
Colorado-Big Thompson, Colo.	Construction of Carter Lake Dam, an offstream earthfill structure 180 feet high, and construction of three earth dikes 75 to 35 feet high, about 8 miles west of Berthoud, Colo.
Do	Construction of Willow Creek storage and diversion dam, about 6 miles north of Granby, Colo.
Davis Dam, Ariz.-Nev.	Installing equipment and constructing 30,000-kilovolt-ampere Prescott substation.
Do	Stringing 280 miles of conductor for 230-kilovolt transmission line between Davis Dam, Nev., and Prescott, Ariz., and between Mesa and Coolidge, Ariz.
Do	Furnishing and installing air-conditioning system in Gila substation.
Do	Furnishing and installing about 2,300 feet of 5-inch conduit between Phoenix substation and dispatcher's building at Phoenix, Ariz.
Eden, Wyo.	Construction of Big Sandy Dam, an earthfill structure on the Big Sandy Creek, near Eden, Wyo.
Fort Peck, Mont.	Construction of $4\frac{1}{2}$ miles of 3-phase and 1 mile of single-phase 34.5-kilovolt single-circuit transmission line from Frazer, Mont., to N-Bar-N pumping plant.
Do	Installing equipment and constructing 30,000-kilovolt-ampere Havre substation, 7 miles southwest of Havre, Mont.
Gila, Ariz.	Construction of 900 cubic-feet-per-second, 30-mile, concrete-lined section of Mohawk canal, near Wellton, Ariz.
Kendrick, Wyo.	Repairs to existing tailrace of Seminoe Dam and power plant on the North Platte River, 37 miles northeast of Parco, Wyo.
Do	Installing equipment and constructing 34.5-kilovolt Hanna substation and control building, near Hanna, Wyo.
Missouri River Basin, Colo.	Clearing Bonny reservoir area on the South Fork of the Republican River near Hale, Colo.
Missouri River Basin, Mont.	Construction of Tiber Dam, an earthfill structure on the Marias River near Chester, Mont.
Missouri River Basin, Nebr.	Installing equipment and constructing 20,000-kilovolt-ampere Sidney substation.
Missouri River Basin, N. Dak.	Construction of 42 miles of 69-kilovolt Bismarck-DeVaul single circuit transmission line.
Do	Construction of 41 miles of 69-kilovolt single-circuit transmission line between Rugby and Rolette Junction.
Do	Construction of 21 small pumping plants, including installation of 23 pumping units and construction of discharge lines and lateral systems located along the Heart River.
Missouri River Basin, S. Dak.	Construction of 1 5-room residence for Angostura Dam.
Missouri River Basin, Wyo.	Construction of Keyhole Dam, an earthfill structure about 15 miles northeast of Moorcroft, Wyo.
Do	Construction of Anchor Dam, a concrete arch structure about 40 miles northwest of Thermopolis, Wyo.
Do	Relocation of State Highway No. 14 and relocation of county road at Keyhole damsite, about 15 miles northeast of Moorcroft, Wyo.
Do	Construction of caretaker's residence, and temporary camp approximately 35 miles west of Thermopolis, Wyo.
Do	Clearing about 1,000 acres of Boysen reservoir about 18 miles south of Thermopolis, Wyo.
Shoshone, Wyo.	Construction of C. J. Coulee siphon, a monolithic concrete structure, on the Willwood canal near Cody, Wyo.

The Reclamation Area

The Reclamation ERA

March

1950



The Reclamation ERA

March 1950

Volume 36, No. 3

Issued monthly by

The Bureau of Reclamation

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

Approved by the Bureau of the Budget

CONTENTS

FEATURE ARTICLES

SHORT FEATURES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

OUR FRONT COVER

WATER IS WEALTH but, unlike less fluid valuables, requires a multitude of counting-house methods for determining how much of this resource is available. Our cover photo shows a Bureau technician measuring well water flowing from a horizontal pipe which is partially full. After reading part one of "Measuring Well Water" on page 52, you may be able to figure out that this pipe is discharging at the rate of about 225 gallons per minute, after you know that *F* equals 2¾ inches, [illegible] equals 14 inches and *Y* equals 12 inches. The water is striking the square at a point 14¾ inches below the top of the pipe to allow for its freeboard.

30 YEARS AGO IN THE ERA

The conquest of new land is a bigger and harder proposition than we have realized. Men without adequate capital to finance their farming operations must have long-time credits at moderate rates of interest. They should have the opportunity to provide themselves with comfortable homes, good livestock, and the right kind of equipment. Many new settlers need expert advice. Plans are being formulated on the North Side Twin Falls project to inaugurate a department of farm engineering to furnish building plans, lay out service ditches, locate tap boxes and weirs, plan field lay-outs, experiment as to the best spacing of catch ditches and corrugations, make soil tests, plan rotation schedules and render every reasonable service to help get the new man satisfactorily established, and to eliminate for him so far as possible the problems which in the past have only been solved after years of experience.

(From the March 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA, p. 123.)

RECLAMATION PLACE NAMES IN THIS ISSUE

. . . from Nebraska to the sea . . .

excerpts from Oscar L. Chapman's address to the Nebraska Reclamation Association at Grand Island, Nebr., on January 26, 1950—his first official Reclamation pronouncement since his confirmation as Secretary of the Interior.

THE WEST HAS A BIG PART TO PLAY in the building of the country's future.

At this midpoint of the twentieth century, we are entering a period in which we shall have to develop our resources far more aggressively, depending increasingly upon those resources which have not been immediately accessible.

Reclamation is a word we all understand. It gives us access to the water, land, electric power, and other resources of our river basins. It controls our floods, it provides recreational facilities for better health and enjoyment of life. It provides power and light to help us in our homes, on our farms, and in our business.

It reclaims the material gifts of nature, and directs them toward the betterment of human life.

We are about to close the first half of the twentieth century with the job of reclamation far from finished. The development of irrigation is about half done, when we measure it by present methods, concepts, and legislation. Some 21 million acres have been brought under the ditch by private and Federal action. About 19 million still remain, waiting for water to bring them into productivity.

We have installed 3 million kilowatts of electric generating capacity out of a potential 37 million kilowatts that might be developed from our Western streams under Reclamation and allied programs.

We have been reaping benefits with over 500 million dollars per year in added crop values and more than 30 million dollars annually in direct revenues from power. Yet our total investment in project facilities has been under 2 billion dollars.

But what about the job to be done?

The part that the West will play in this growth is already clear. Under the spur of a driving, thriving economy that quickly absorbs every acre-foot of water, every new farm, and every kilowatt we can wring from the rivers, we must build and settle this great territory from Nebraska to the sea.

Projects now authorized by the Congress for the 17 Reclamation States will provide irrigation water for over 7½ million acres of new land and will expand power capacity by nearly 3 million kilowatts.

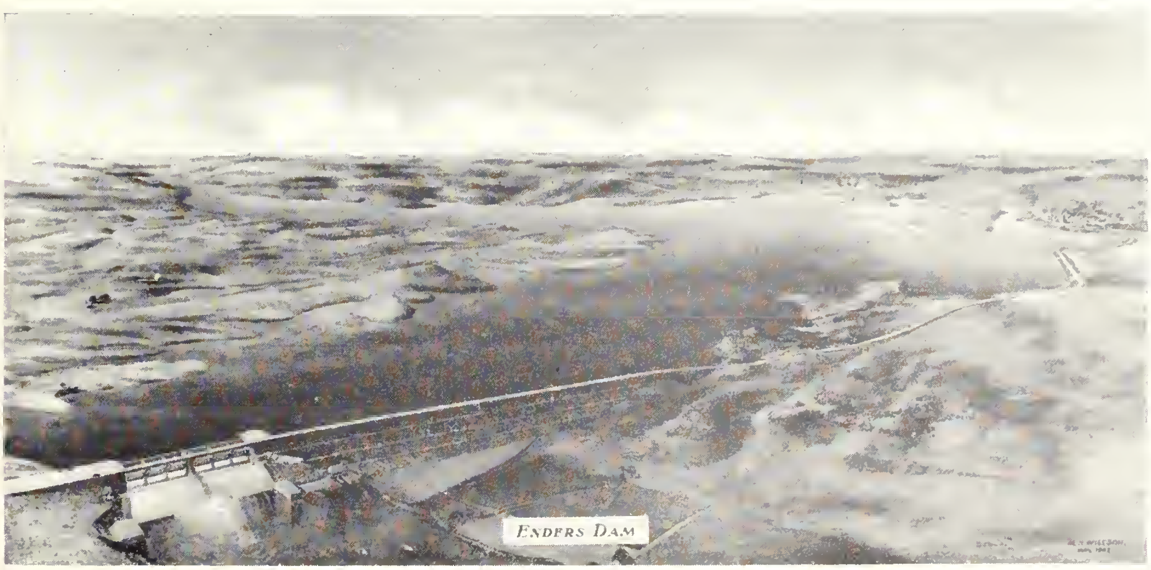
An outstanding example of the work that lies ahead in the vast national plan is the Missouri River Basin project.

For too long, the mighty Missouri has flooded periodically, has washed away billions of dollars in property and soil, and then has stranded the people "dry."

The Missouri Basin program grew out of the tragic drought of the 1930's, when billions of dollars were lost through crop failures, wrecked homes, and dislocated peoples. Most of the States of the basin came out of that period with decreased populations. Nebraska is still feeling the effects of the drought, and the census of 1950 may show that, in population, it has barely held its own during the past decade.

The whole Nation was shocked by the tremendous losses in money and in human assets during and following the great drought. Sectional lines were forgotten as the Congress approved a gigantic undertaking to rehabilitate the entire Missouri Basin—the first basin-wide multipurpose development program. During the intervening years, work on this program has progressed slowly. We are only now getting properly underway, and the work is beginning to accelerate at a fast pace.

We are not planning on a small scale. The Missouri is not a small river. The Missouri River Basin project, as now envisioned, will cost more than 4 billion dollars. This is a



Artist's conception of Enders Dam in Nebraska, a feature of the Frenchman-Cambridge unit of the vast Missouri Basin program. By the time this issue reaches you the structure will be practically completed. This photograph was made from the drawing prepared by artist M. H. Willson.

measure of your Federal Government's faith in this region.

The basin-wide concept of this project is the product of the coordinated work of the Department of the Interior and the Army Corps of Engineers. The execution of the program is going forward with the active cooperation of the Basin States, the Department of Agriculture, and the other Federal agencies operating through the Federal Inter-Agency Committee. We seek the earnest aid of the State colleges and universities of the Basin States as the focal point of coordination of the agricultural and human phases of this program.

There are many reasons why we are doing these things. We estimate that 53,000 new farms comprising 5 million irrigated acres—an area the size of New Jersey—can be established among the millions of acres of lands now relatively unproductive for lack of water.

Million Dollar Crops Ahead

Even at prewar prices, additional crops from these farms would be worth 130 million dollars per year. At current prices, they would be worth much more. Stabilized feed supplies, produced in tributary valleys, will permit far more productive use of millions of acres of range lands.

The program as now conceived calls for about 2,366,000 kilowatts installed hydroelectric capacity. This power will be produced without any drain upon our exhaustible fuel supplies.

Low-cost power will encourage new industries in scores of communities. It will permit the local processing of local produce. It will encourage the development of the still untapped mineral resources of the basin.

The control of floods will be of major importance to the people of the entire region. The newly created reservoirs will provide recreation for the people of the basin and for thousands of tourists. Fish and wildlife resources will be improved. Adequate water supply will bring better living and better business to many cities and towns. Control of the headwaters will help provide a navigable channel from St. Louis to Sioux City, providing an opportunity for cheap water freight that can benefit the entire region. The benefits of silt detention and the abatement of water pollution will be felt increasingly as the program is developed.

As we move forward in this planning and building, various segments of the Department of the Interior are working on ways to multiply the benefits from this development in conservation.

In addition to the work of the Bureau of Reclamation, the Bureau of Mines and the Geological Survey are probing the earth's surface, and subsurface, to learn what materials can be developed, and new and economical ways to produce and use them. The Geological Survey is looking after the measurement of the waters that are available.

The National Park Service is developing plans for making the fullest recreational use of the new reservoirs that will be available to the people.

The Fish and Wildlife Service is attending to the enhancement of our fish and game life.

Our Office of Indian Affairs already is exploring the favorable effects of this program in changing, beneficially, the lives of our original Americans.

The Bureau of Land Management is surveying the problems of improved protection and use of our range and other public lands, problems naturally arising in the development of such a broad resource program.

Nebraskans know what irrigation and public power mean. Nebraska was among the pioneering States in public power development. The North Platte project in the Scotts Bluff area was one of the first reclamation projects undertaken and is an outstanding example of what can be done with dry land through irrigation.

The Republican River is being brought under control by a series of flood-control and irrigation dams.

Work is underway preparatory to the development of the Lower Platte River Basin, including areas up and down the river from Grand Island, and the Loup and Elkhorn areas. Potential irrigation undertakings that may cover more than a million acres along the Platte and its tributaries are now being investigated.

The Frenchman-Cambridge division again will receive more money than any other single element in the Missouri Basin program, and the Bostwick division also will be one of the major items in the budget. The Mirage Flats project is already complete except for finishing activities.

A sizable share of our proposed transmission-line expenditure will go into Nebraska. We expect to complete three lines and to begin on some of the smaller feeder lines. We also want to build a tie line between the Garrison and Fort Randall power plant to the Northward.

Ultimately the power plants included in the Missouri Basin program, as now conceived, will be linked into a single backbone grid, extending from Western Montana into Iowa. We used to hear that we would be producing power for the jackrabbits. Yet, with the Missouri Basin program scarcely begun, it is already apparent that we have not planned for enough power to meet the demands of your region.

Small Dams Increase Power Potential

When the Missouri River Basin program was planned, we contemplated developing only the more advantageous power sites. It appears now that we must consider the possibilities of expanding power from other sites including installations at some of the smaller dams.

I cannot overemphasize the importance of power to our economy, and to the successful development of the entire program. We must have power to pump irrigation water, and we must have power revenues that can carry the financial repayment load which exceeds the water users' ability to repay.

Power production and transmission are being firmly and intelligently integrated, basin-wide, into the physical and financial structure of this program. The Department of the Interior adheres fully to this integration.

So far, the legally established and approved public power program has withstood all assaults. In the 1950 appropriations, the Congress gave the Bureau of Reclamation the funds necessary to make vigorous progress on power. The 1951 budget request contemplates more progress.

Attacks upon the public power program will continue. They will be both direct and indirect, open and under cover.

But as long as the people and their Government remain alert, and fully informed, these attacks will fail.

Our Reclamation laws are still sound. They attest to the vision and the superb craftsmanship of the far-sighted men who have fashioned those laws over the past half century. But they need some modernization to help us do the ever-changing job ahead.

We are also giving attention to the important question of sharpening our administrative and technical skills, in order that we can do a better, more efficient, and more economical job.

The Missouri River Basin program presents one of the biggest and most complex planning, construction, and operating jobs ever to challenge the American people in peacetime. Though we are making progress, there is still much room for improvement. We must be constantly alert for defects and inadequacies in legislation and policy, and in administrative machinery, and courageously take action to correct them. As the program develops, we must be prepared to make the changes that are necessary in the best interest of the region and the country.

Teamwork Essential to Missouri River Basin Program

To plan and build and operate this project requires the efforts of many Federal and State agencies, working together with the people who are in full partnership in this undertaking.

All of the Missouri Basin States' Governors are demonstrating to the world how democracy, in the highest sense, can really serve the people.

Each of the Federal departments and agencies, and each of the States, has its own complex problem of adjusting and integrating conflicting interests. Just as we in Interior must thresh things out among ourselves and settle upon policies that best serve our mutual interests, so must the people within each State resolve their problems before they can participate fully and effectively in the Missouri Basin program.

This program is a tremendous undertaking in teamwork, and in reaching great common goals through the democratic process. Its results will be worth everything we put into it.

THE END

In making this, his first official Reclamation speech since his congressional confirmation, Secretary of the Interior Chapman stopped at Grand Island, Nebr., on his way to Washington, D. C., from Los Angeles, Calif. Accompanied by Dale E. Doty, his Special Assistant, the Secretary was met by Operation and Maintenance Director Goodrich W. Lineweaver, and Assistant Regional Director Emil Lindseth of the Bureau's Region 7 office who represented Regional Director Avery Batson, at the time in Washington, D. C., on official business. Arrangements for the occasion were made by John Spencer, regional operation and maintenance supervisor, and Ralph Williams, regional information officer. Secretary Chapman was introduced by State Senator C. Petrus Petersen, while President Ray Campbell of the Nebraska Reclamation Association presided at the meeting. During the afternoon the Grand Island Recreation Association, a group of Reclamation and other Interior Department employees headed by William J. Mullen, president, honored Secretary Chapman at a luncheon at the Bureau of Reclamation's Grand Island headquarters. The luncheon was followed by a reception at which the Secretary commended the cooperative spirit of the employees.

Assistant Secretary Warne Confers with California Conservationists

On January 26, 1950, Assistant Secretary of the Interior William E. Warne held a conference with Representative Clair Engle of the second district in California and members of the subcommittee of the joint interim committee on soil conservation of the California State Legislature: Assemblyman Francis C. Lindsay of Loomis, Calif., State Senator Presley Alshire of Geyserville, Calif., and Ralph W. Mitchell, staff consultant to the committee. Assemblyman Thomas M. Erwin of Los Angeles, Calif., the third member of the subcommittee was unable to attend.

In addition to Assistant Secretary Warne, a native Californian, other officials of the Interior Department who participated in the discussions were E. D. Eaton, Assistant Director of Operation and Maintenance, Bureau of Reclamation; G. M. Kerr, Chief of the Division of Grazing, Bureau of Land Management, and Lawrence N. Stevens, Special Assistant to the Commissioner, Bureau of Indian Affairs.

According to Assemblyman Lindsay, the California State Legislature has appropriated about 1 million dollars to provide equipment for soil conservation practices in California, and the meeting was called to further unified Federal and State action in order to increase the effectiveness of the erosion and sedimentation control program. Mr. Warne pointed out the Department's general policy of decentralizing authority to permit closer cooperation with State and local groups, and specific instances of the need for general authority to include various Federal areas in soil conservation districts were brought out.

During the course of the meeting, all phases of the Bureau of Reclamation's soil conservation program were discussed.

Mr. Kerr and Mr. Stevens spoke of the general problems of soil conservation under their jurisdiction and particularly those affecting California. Mr. Eaton mentioned the serious problems caused by upland erosion and sedimentation, adding "Another danger that deeply concerns us is that of water losses * * *. It has been estimated that as much as 40 percent of the total of the water stored for irrigation in the West is dissipated in one way or another and is not put to beneficial use on the farms."

Problems concerning lands under the jurisdiction of the Bureau of Land Management, Bureau of Indian Affairs, and the Bureau of Reclamation were aired, illustrating the need for working out long-range soil conservation projects through Federal and State agencies. Further action was planned as soon as it was possible to receive reports from field representatives of the Department. •

Power Production Hits New Peak in 1949

Bureau of Reclamation projects turned out a record-breaking 19 billion kilowatt-hours of hydroelectric power production in 1949 in an effort to meet the West's soaring power demands. This represents enough electricity to meet the full needs of two cities the size of Chicago, and was made possible only by driving big generators to produce above rated capacity and running every plant at near capacity most of the time. •

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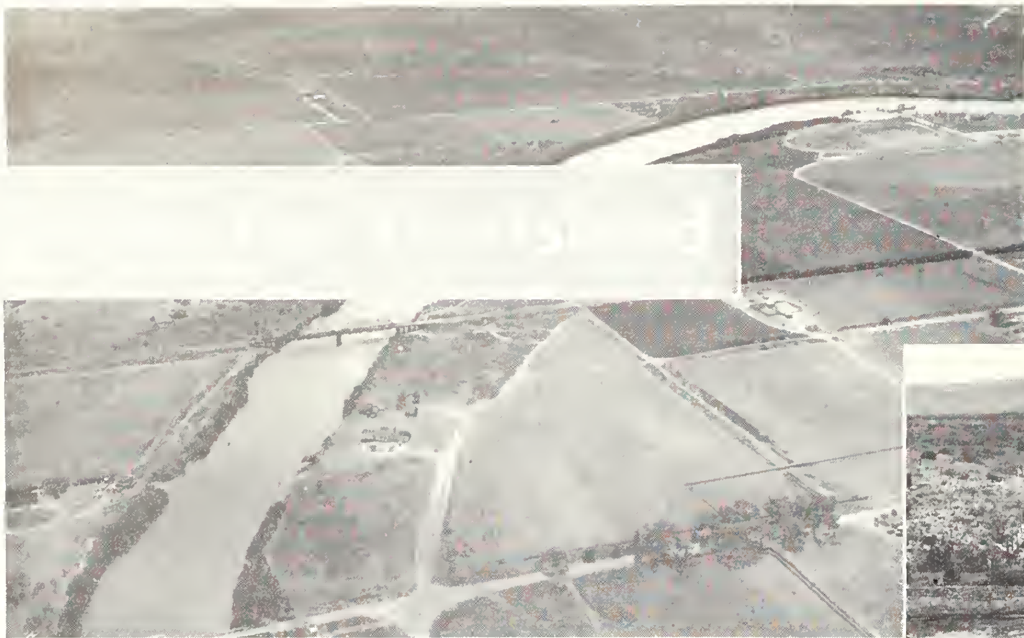
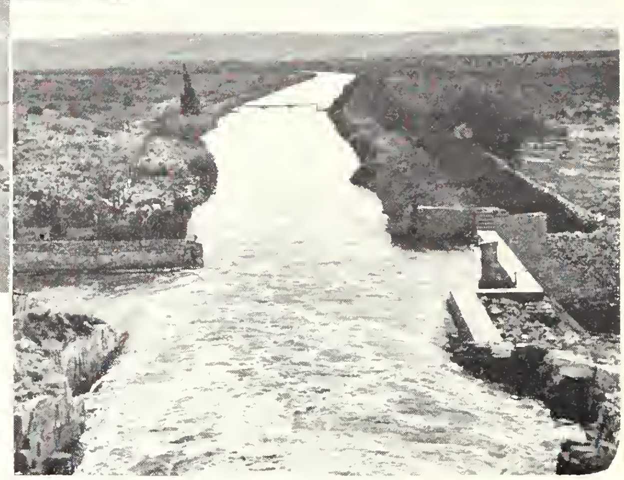


At left: aerial view of the Pecos River which supplies water for Avalon, Alamogordo, and McMillan Reservoirs, principal features of the Carlsbad, N. Mex., project. Below: Downstream view of the main canal taken from the crest of Avalon Dam. *Photos by Dale Hovey, formerly of Region 5.*



by LEON W. HILL

Branch of Operation and Maintenance
Region 5, Amarillo, Tex.

THE EVER-SWINGING CURTAINS on Reclamation's vast western stage have closed on more than four decades of the Bureau's operation on the Carlsbad, N. Mex., irrigation project.

A formal notice, devoid of rich drama and the experiences of a lifetime, transferred the care, operation and maintenance of the project to the district board on October 1, 1949.

Jared C. Howard, for 16 years secretary-treasurer of the Carlsbad irrigation district, is the new project manager for the water users, succeeding former Superintendent Harold Kidder, now employed by a private firm in South America. Some of the Bureau's local employees remained on the project; others were transferred.

Transfer of the project's operations from the Bureau to the District had been contemplated for several years under provisions of the repayment contract of November 14, 1932. Initially the transfer date was set for January 1, 1938. However, construction of Alamogordo Dam and Reservoir, 175 miles upstream from the project, and later the effects of World War II, resulted in postponement of the Bureau-district action. The Bureau had been operating the project on funds advanced by the district; an arrangement commonly known as "trust fund operation."

Works to be operated by the district consist of McMillan and Avalon Dams and reservoirs, diversion works, 179 miles of canals and laterals, the drainage system, buildings, and equipment. The Bureau of Reclamation will continue to operate Alamogordo Dam, where the major portion of the project's water supply is impounded. A supplemental contract covering this operating arrangement has been executed.

The Carlsbad irrigation district contains approximately 50,000 acres along the Pecos River in the vicinity of Carlsbad, N. Mex. However, water rights are confined to a total of 25,055 acres.

Active interest in irrigation in the project area dates from 1888 when the Pecos Land & Valley Ditch Co. was organized. Following efforts of the initial company, the Pecos Irrigation & Investment Co. completed construction of McMillan and Avalon Dams and an irrigation system in 1893. The works again changed hands in 1900 when they were taken over by the Pecos Irrigation & Improvement Co. The difficulties of these early developments were compounded by the caprices of Old Mother Nature. Heavy rains and the resulting flood of 1893 caused heavy damage to the irrigation system, and washed out Avalon Dam. McMillan Dam was preserved only by alert action in dynamiting a large section in the earth embankment, permitting excess water to escape. The works were repaired and some 13,000 acres were under irrigation when Avalon Dam was again destroyed by the floods of 1904. This flood damage, together with the accumulative impairment of McMillan Reservoir by sediment and increased leakage, and the financial inability of the irrigation company to make major repairs, led settlers to seek project rehabilitation by the United States Reclamation Service.

The Reclamation Service began surveys and investigations in January 1905. The findings were approved by the Secretary of the Interior and the project was authorized in 1906, with the first irrigation water available the following year. Substantial improvements were made in succeeding years, including two enlargements of McMillan Reservoir. However, despite these enlargements, and embankments to prevent water from reaching some of the larger sink holes, construction of Alamogordo Dam in 1937 was necessary to provide the project with replacement storage. Dense stands of salt cedar in the delta area of McMillan Reservoir have arrested sedimentation to a large extent, but they are excessive water consumers and hamper the passage of irrigation releases from Alamorgordo Reservoir. A cooperative soil and moisture conservation program between the District and the Bureau is now underway in search of a solution to this particularly knotty problem. Some relief was afforded last irrigation season by constructing a temporary channel through the delta area to accommodate irrigation releases from Alamogordo, pending research findings with respect to economical means of eradication and control of salt cedars.

SHADES OF THE PAST—Extreme left: Pier for southern approach of concrete flume across Pecos River. Above: Reclamation Service kitchen-mess hall at Avalon Dam. Immediate left: Construction activity reaches high pitch at Avalon Dam, Carlsbad project, N. Nex. *All of these photos were taken in 1906 by W. J. Lubken.*

The faith of early settlers in the future of Carlsbad irrigation has been substantiated over the years. Since the Reclamation Service took over in 1907, project farmers have harvested crops valued at more than 45 million dollars which, despite the tribulations attending the early years, is an average of more than a million dollars a year. A variety of crops are grown on the project, although King Cotton predominates, with alfalfa ranking second in importance. Small grains, forage and pasture crops, vegetables and truck, and even pecans do well, but have not been successful in displacing cotton as a money crop. Dairying and a limited amount of livestock feeding have found favor with a few farmers, but the majority of the farms are operated on a cash crop basis.

The district's repayment record is outstanding. Repayment of the cost of the initial works was begun in 1910 and completed in 1947. The Carlsbad irrigation district undertook a second obligation in 1938 for cost of construction of the Alamogordo Dam and Reservoir. Repayment began in 1946 and all maturities to date have been met. As can be expected on any project where some of its facilities have been in use for more than half a century, the system is in need of considerable repair and replacement to bring it into first class operating condition. Many irrigation structures should be replaced; several laterals have eroded badly and should be relocated; some lined sections need repair to prevent further deterioration; capacity of some canals should be increased to improve service; some buildings, which have exceeded normal life expectancy, should be thoroughly reconditioned; and considerable water could be conserved by channelization work above McMillan Reservoir. An investigation to determine the cost of rehabilitation is nearing completion. The district's directors, R. T. Spence, president, Francis Tracey Jr., Enea Grandi, C. F. Beeman, and James Craft, are aware of the need for improvements and are considering ways and means of effecting them.

In a recent letter pertaining to the transfer of operation and maintenance to the irrigation district, Assistant Commissioner Markwell assured President Spence of the Bureau's continued interest in the Carlsbad project. "The Bureau of Reclamation," Mr. Markwell said, "stands ready to assist the district in every way possible to make operation by the district successful." THE END

"Force Account" Outlay Smallest in Years

Bureau of Reclamation expenditures for force account work—construction performed by the Bureau itself with its own forces instead of through contracts with private industry—totaled $5,741,000 in fiscal year 1949, or 2.6 percent of the years $217 million dollars' worth of construction.

The percentage figure was the smallest for this type of work by the Bureau in seven years, and was approximately half the 5.4 percent ratio and $10 million expenditure for force account work in the 1948 fiscal year.

From 1928–48 (except for 2 years during the war for which figures are not available) force account work was 4.5 percent of the total reclamation construction program. •

Extreme left: Mrs. Frank S. Thayer, the first representative of the trio. Center: John E. Thayer of the second generation is still carrying on at Laurel, Mont. Above right: Leon Banks and family. *Photos by Donald H. Demarest, Region 6.*

THREE IN A ROW

HEART MOUNTAIN FARM WINNER COMPLETES THREE GENERATIONS OF SHOSHONE HOMESTEADERS

by R. L. BRANAM, Region 6, Billings, Mont.

Good things, like bad, come three in a row.

This adage was proven again on September 23, 1949, when Leon A. Banks of Powell, Wyo., won the number 30 priority for selecting an irrigable homestead unit on the Heart Mountain division of the Bureau of Reclamation's Shoshone project.

Banks, an ex-G. I. with overseas service, is married to the former Laura Thayer, whose father and grandfather both homesteaded on the Shoshone project.

The elder Mr. Thayer, Frank S., who died 5 years ago, was a native of New York. His family traveled West when he was a young man and settled in South Dakota near Hot Springs. There he met Lela Fuller, a school teacher, whom he married in 1894, and it was on a South Dakota dryland farm that John E. Thayer was born. Many people of the area decided to push farther west, and when a wagon caravan was formed and the slow-moving vehicle started off across the plains the Thayers were among those present. By the time the caravan reached Hamilton, in western Montana, illness had become an unwelcome passenger in the Thayer wagon and they stayed behind. In that locality, Frank Thayer became employed in farming until he could return to the Dakotas. However, this time he picked North Dakota and a sheep ranch about 50 miles from Sentinel Butte. Life was hard—it took three days to go to town for supplies—and the profits small.

So, in December 1908, when the elder Thayers heard of the opportunities for farming on the newly opened Garland division of the Shoshone project—a place where farming was sure and a stable supply of irrigation water was readily available—they packed and left for Powell in the heart of the Shoshone project.

Frank Thayer won a farm—a 160-acre farm with 77 acres irrigable. The couple settled down and built a house, a house that would stand, and which, with additions, is now one of the more attractive homes in the area. The stable irrigation supply made possible consistently good yields. A bean crop of more than 2,000 pounds to the acre was not uncommon.

In 1926, after 18 years of farming on the Garland division, Thayer sold his farm to Niles A. Reed and took over the operation of a smaller Shoshone project farm near Ralston, Wyo. He continued to be a Shoshone project farmer until his death.

During this time the son, John Thayer, had grown to manhood and married. He too wanted a Shoshone project homestead and soon after the Willwood Division was opened to settlers in 1927, he won an 80-acre unit. On the Shoshone project, Laura was born. John Thayer continued with his farming operations on the Shoshone until about three years ago, when he purchased an irrigated farm about 4 miles east of Laurel, Mont.: where he could better accommodate his registered Shorthorn cattle.

The elder Mrs. Thayer, now 76, went with John—but not until she had satisfied a life-long ambition. She wanted to climb to the top of Heart Mountain—a nearby sentinel peak silhouetted in the western sky, and with all the fortitude and stamina that characterized the early settlers, she made it.

While touring the homesteads of the Shoshone, I saw the original Thayer farm on the Garland division and the homestead taken by John Thayer at Willwood. They were good farms. Niles Reed, like Frank Thayer, harvests beans running more than 2,000 pounds to the acre. His hay crop flourishes and, with his home-grown grain, he is able to feed from 30 to 40 calves a year and maintain a breeding herd of 8 to 10 head. In addition, Reed has helped his son establish himself on a neighboring farm of 160 acres, with 65 irrigable.

The John Thayer farm is now operated by LaVern E. Johnson, a young man and new father and the son of a Shoshone irrigation farmer. This is Johnson's first year on the 80 acres. But, he too is reporting good crops, with his bean harvest exceeding 48 tons from the 70 acres planted.

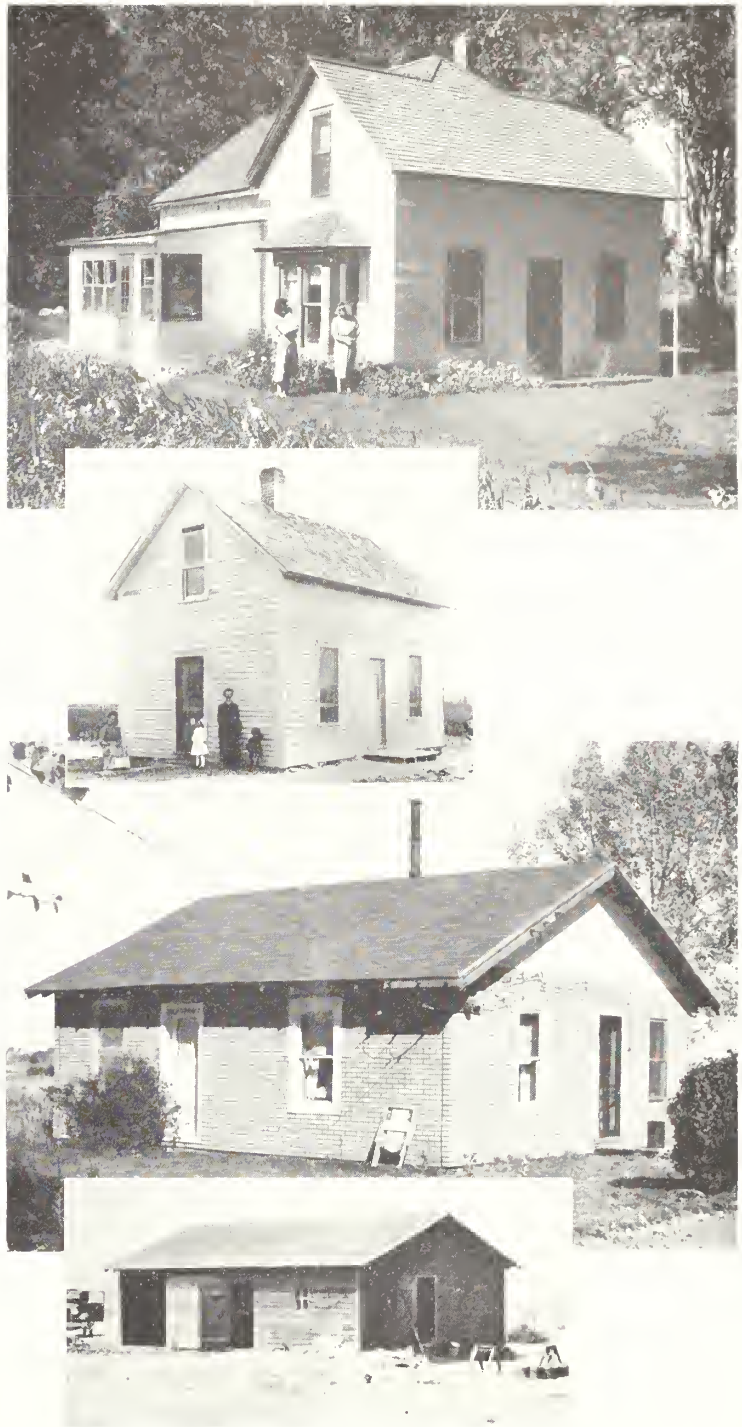
Banks, who has fallen heir to the Shoshone homestead family tradition, has wanted his own farm for many years. A native of the area, from the time he was old enough until entering the Army Air Corps in March 1944, Banks worked on Shoshone project farms. He helped his father—another project farmer—and hired out to others. His desire for his own Shoshone project farm became stronger during the time he served in the Pacific theater of operations. After his discharge in August 1946, he returned to Powell and became employed by the Beaver & Sons Bean Co. Incidentally, the senior Mr. Beaver started and prospered as a Shoshone homesteader.

In September 1948, Banks became a postal clerk in the Powell post office.

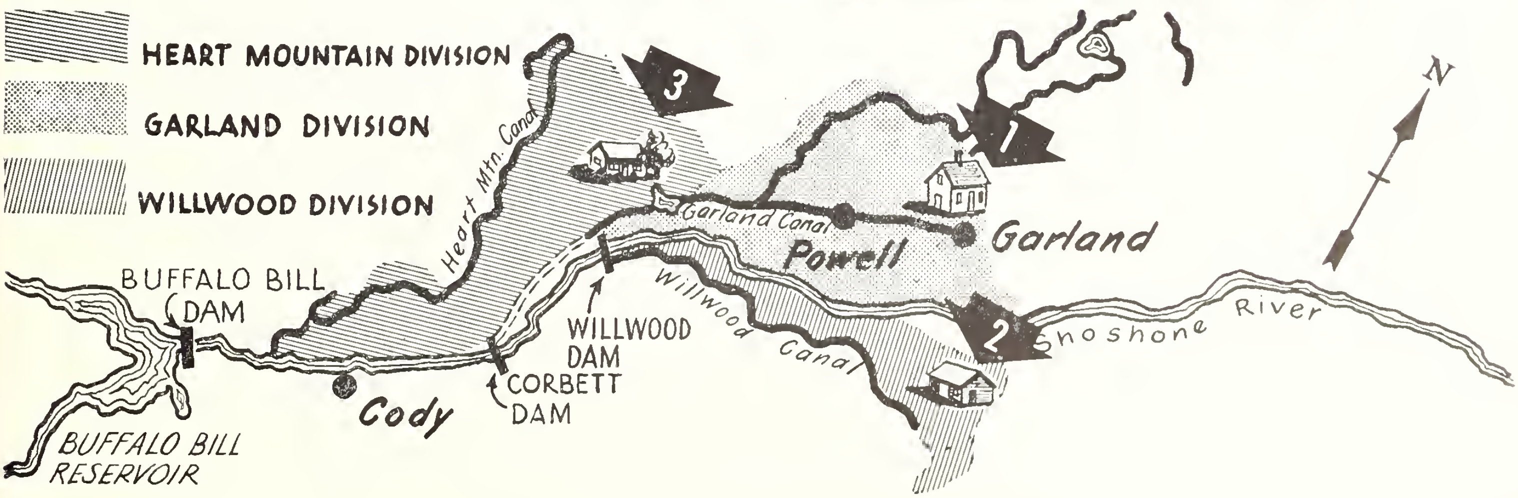
Banks, like those before him, will be a successful Shoshone project farmer. He is aggressive, intelligent and has the "know how." He is a highly respected member of the community, the owner of an attractive home in Powell.

The opening of the Heart Mountain division fits perfectly into Banks' plans. He confessed that although he has wanted his own farm, he has been reluctant to saddle himself with the burden of the heavy debt that the purchase of an estab-

(Please turn to page 57)



PIONEERS PROGRESS—In photos at right from top to bottom we see the home of Niles A. Reed, the front part of which was the original home of the Thayers, back in 1909 on the Garland division as shown in second photo. In the third photo is the present home of LaVern E. Johnson which was the original farm building of John E. Thayer on the Willwood division. In the artist's drawing of the project below, No. 1 shows site of Frank Thayer on the Garland division, No. 2 the home of John Thayer on Willwood division, and No. 3 the home of Leon A. Banks on the Heart Mountain division. *All photos by Donald H. Demarest, Region 6. Map by Graphics Section.*



Measuring WELL WATER

by

H. R. McDONALD, Engineer, Hydrology Division, Branch of Project Planning, Denver, Colo.

Anyone who can use a yardstick and carpenter's square and who has the ability to read charts and graphs should be able to find out how much, and how fast, water is pouring from his wells by following the methods used for many years by Bureau engineers in making groundwater studies.

In fact, we used these same formulae and graphs quite successfully in computing the discharge from many of the 6,000 wells located around Monte Vista, Colo.

If you know how much water is discharged from a well, it will help you to determine the total amount of water used on certain crops. As these methods are not too time-consuming, you can repeat the process, and use the measurements as a guide to indicate whether you are pumping too much or too little water—or whether you should repair your well or pumping equipment.

If you want to find out how many gallons per minute are pumped from a horizontal pipe (see fig. 1a) use the following equation:

$$Q=\frac{3.61AX}{\sqrt{Y}}$$

Q = discharge in gallons per minute

A = area of pipe in square inches

X = distance (in inches) along the axis of the discharge pipe through which the stream of water moves from the end of the pipe to point s[1] of the stream

Y = the vertical distance (in inches) through which the stream of water drops in falling to point s.

First, you measure the inside diameter of the pipe with an ordinary rule to find the diameter in inches, then refer to table 1, which shows the diameter in inches, along with the corresponding area in square inches, of pipes from 2-inch to 16-inch diameter. You now have the A in the equation. To get X and Y use a carpenter's rule as shown in figure 1a.

We have used a constant value of $Y=12$ inches for the sake of convenience, and have worked out an easy graphical solution for this equation as shown in figure 2. You will not find it necessary even to multiply 3.61 by A times X, divided by

[1] [illegible] point at which the vertical angle meets the dropping flow of the [illegible]. Not shown on figure 1, but would appear at the bottom right [illegible]

Editor's Note:

Waste no water!

Nowadays not only the West, but the entire Nation, is adopting this motto. Usually, when a valuable resource becomes scarce, people first take an inventory of what they have available so they can make it last longer and devise methods of increasing the supply, if possible. Inventories of groundwater and rainfall would be highly desirable, but in their absence, irrigation farmers have many ways of figuring how much water they have available so they can use what they have to the best advantage.

In this issue of the Era, Engineer H. R. McDonald explains how to figure out how many gallons of water per minute flow from pumps which discharge water from horizontal pipes, or pipes discharging at an angle of less than 90°. In next month's issue we shall publish the formula for calculating the discharge from vertical pipes, as well as a formula for discovering how many kilowatts of power are used in pumping the water.

TABLE 1.—Areas of Pipes of Given Diameter

Diameter	Area	Diameter	Area	Diameter	Area
Inches	*Square inches*	*Inches*	*Square inches*	*Inches*	*Square inches*
2. 00	3. 14	6. 75	35. 78	11. 50	103. 87
2. 25	3. 98	7. 00	38. 48	11. 75	108. 43
2. 50	4. 91	7. 25	41. 28	12. 00	113. 10
2. 75	5. 94	7. 50	44. 18	12. 25	117. 86
3. 00	7. 07	7. 75	47. 17	12. 50	122. 72
3. 25	8. 30	8. 00	50. 27	12. 75	127. 68
3. 50	9. 62	8. 25	53. 46	13. 00	132. 73
3. 75	11. 04	8. 50	56. 75	13. 25	137. 89
4. 00	12. 57	8. 75	60. 13	13. 50	143. 14
4. 25	14. 19	9. 00	63. 62	13. 75	148. 49
4. 50	15. 90	9. 25	67. 20	14. 00	153. 94
4. 75	17. 72	9. 50	70. 88	14. 25	159. 48
5. 00	19. 63	9. 75	74. 66	14. 50	165. 13
5. 25	21. 65	10. 00	78. 54	14. 75	170. 87
5. 50	23. 76	10. 25	82. 52	15. 00	176. 71
5. 75	25. 97	10. 50	86. 59	15. 25	182. 65
6. 00	28. 27	10. 75	90. 76	15. 50	188. 69
6. 25	30. 68	11. 00	95. 03	15. 75	194. 83
6. 50	33. 18	11. 25	99. 40	16. 00	201. 06

HERE'S AN ANGLE—Upper left: Here is how you use a carpenter's rule to measure the amount of water flowing through a pipe. Upper right: WATCH THE FREEBOARD! Read how it's done and see figure 3 on the next page.

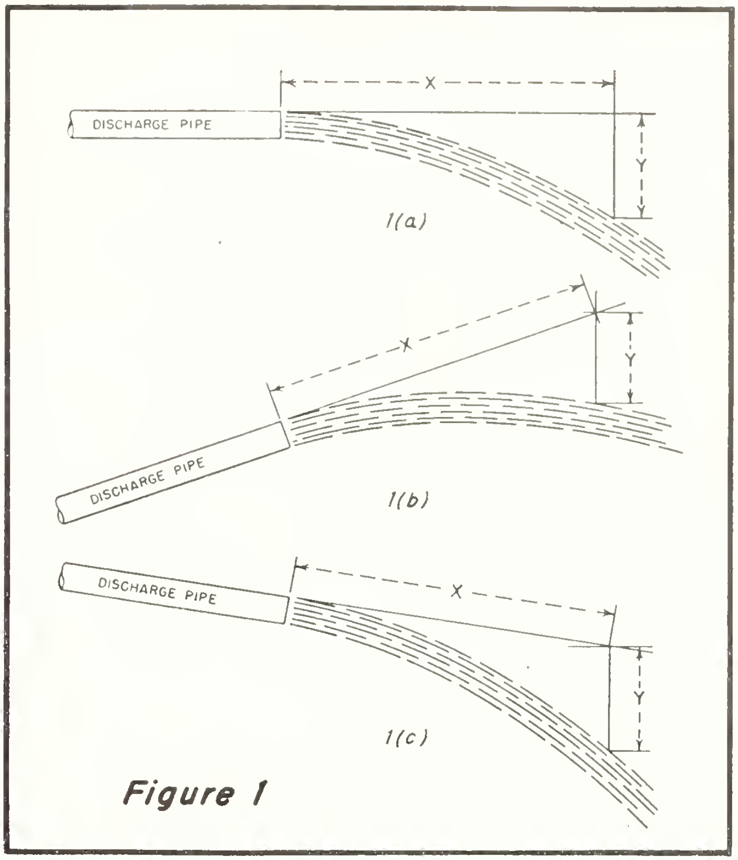


Figure 1

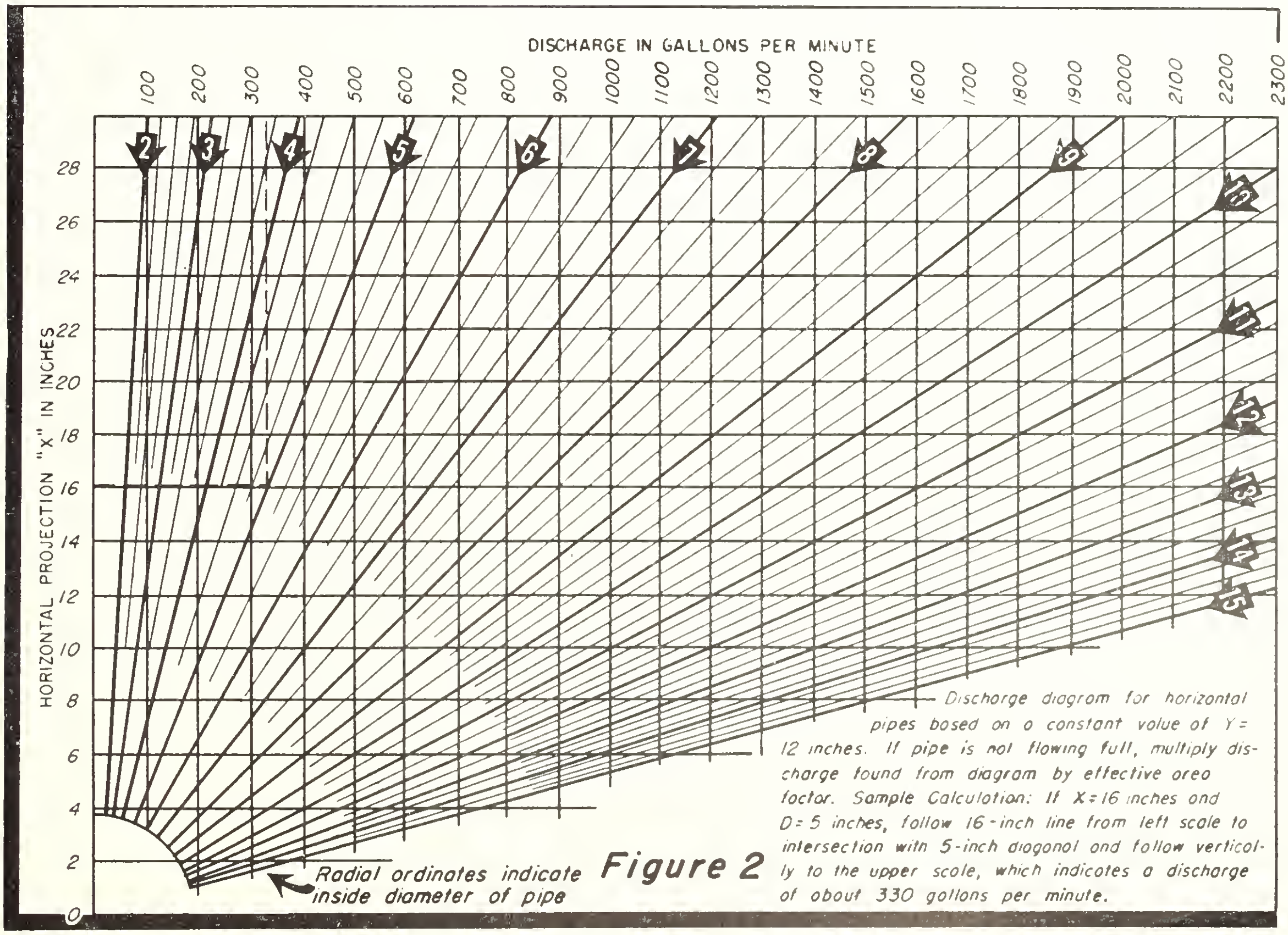


Figure 2

Discharge diagram for horizontal pipes based on a constant value of Y = 12 inches. If pipe is not flowing full, multiply discharge found from diagram by effective area factor. Sample Calculation: If X = 16 inches and D = 5 inches, follow 16-inch line from left scale to intersection with 5-inch diagonal and follow vertically to the upper scale, which indicates a discharge of about 330 gallons per minute.

the square root of Y, unless you are a whiz at mathematics and want to prove it yourself. All you need is the inside area of the pipe in square inches and the number of inches shown on the carpenter's rule as the water projects out of the pipe on measurement X. For practical purposes the measurements of X and Y should be made from the upper water surface rather than in the center of the stream.

If the pipe is not flowing full, you will have to make an allowance for the unfilled portion, and we have prepared table 2 to help you make this correction for the empty space or "freeboard." Column 1 in this table shows the ratio of (1) the vertical distance from the water surface to the inner surface of the top of the pipe—or the freeboard, to (2) the diameter of the pipe. Figure 3 shows a cross-section of pipe with these two dimensions. Column 2 in table 2 shows the "effective area factor" or the actual portion of the area of the pipe which is occupied by water when the well is discharging. Before you work out the formula for calculating the number of gallons per minute discharged, you will have to multiply A (the area of the pipe in square inches) by the "effective area factor." Use table 3 to find the square root of given values of Y or the water drop.

To help you apply the above equation, the following sample problem is given:

If the inside diameter of pipe, D, is 5 inches (see fig. 2), and the freeboard, F, is 2 inches, then $\frac{F}{D}=\frac{2}{5}=0.40$.

From table 1 the effective area factor for $\frac{F}{D}=0.40$ is 0.627.

From table 2 the area of a pipe of 5-inch inside diameter is 19.63 square inches. If $X=16$ inches and $Y=12$ inches, substitution of the values in the equation gives

$$Q=\frac{3.61\times 19.63\times 0.627\times 16}{\sqrt{12}}=\frac{709}{3.46}=2.05 \text{ gallons per minute.}$$

You may use this same formula for pipes discharging at angles inclined less than 90° to the horizontal, if you measure X along the axis of the pipe, and Y vertically as shown in figures 1 (b) and 1 (c) on page 53.

In general, successful measurements cannot be made at times when the wind velocity is great enough to produce turbulence so that successive measurements do not check within reasonable limits. In any event, two or three measurements should be made to minimize errors.

(Continued next month)

TABLE 2.—Ratio of Freeboard to Diameter and Corresponding Effective Area Factor

F/D=R	Effective area factor	F/D=R	Effective area factor	F/D=R	Effective area factor
0.10	0.948	0.24	0.816	0.38	0.651
.11	.939	.25	.805	.39	.639
.12	.931	.26	.793	.40	.627
.13	.922	.27	.782	.41	.614
.14	.914	.28	.770	.42	.602
.15	.905	.29	.759	.43	.589
.16	.896	.30	.747	.44	.577
.17	.886	.31	.735	.45	.564
.18	.877	.32	.723	.46	.551
.19	.867	.33	.712	.47	.538
.20	.858	.34	.700	.48	.526
.21	.847	.35	.688	.49	.513
.22	.837	.36	.676	.50	.500
.23	.826	.37	.664		

TABLE 3—Square Roots of Values of Y

Y	$\sqrt{Y}$	Y	$\sqrt{Y}$	Y	$\sqrt{Y}$
2.0	1.41	7.5	2.74	13.0	3.61
2.5	1.58	8.0	2.83	13.5	3.67
3.0	1.73	8.5	2.92	14.0	3.74
3.5	1.87	9.0	3.00	14.5	3.81
4.0	2.00	9.5	3.08	15.0	3.87
4.5	2.12	10.0	3.16	15.5	3.94
5.0	2.24	10.5	3.24	16.0	4.00
5.5	2.35	11.0	3.32	16.5	4.06
6.0	2.45	11.5	3.39	17.0	4.12
6.5	2.55	12.0	3.46	17.5	4.18
7.0	2.65	12.5	3.54	18.0	4.24

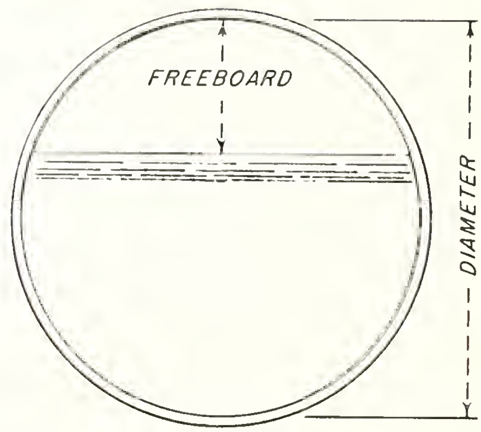


Figure 3

On Looking Back

by the Honorable JEFFERSON CAFFERY
United States Ambassador to Egypt

EDITOR'S NOTE: The Honorable Jefferson Caffery, recently appointed Ambassador to Egypt, toured reclamation projects in our Southwest, before taking over his new post in the Near East as recounted on page 245 of the December 1949 ERA. Here are some impressions he has jotted down since his arrival in Egypt. A similar article was prepared by him for use in a State Department magazine "Today in America," which has a wide distribution in countries of the Near East.

THE AUTHOR appearing rather grim as he addressed a United States audience in the Bureau's Region 3 and outlined the serious problems confronting the world in the areas where water is scarce. *Photo by Harry W. Myers, Region 3 photographer.*

HERE IN THE CRADLE OF CIVILIZATION are millions of acres of land which have lain dusty and idle and unproductive for thousands of years. The sun has baked them to such a hardness that even the occasional downpour during the rainy season can hardly penetrate the earth and most of the water quickly drains away into the rivers, taking with it more of the dwindling supply of topsoil.

Dotting this expanse of sun-baked terrain, which comprises most of the lands of the Near East, are occasional bright spots of green. Most of them are in a narrow belt along the rivers while a few here and there are made verdant by springs and water holes. If only these lands could all be made green and productive!

I have such a vision concerning these lands—a vision inspired by a hurried airplane excursion into the Southwest just before leaving the United States to take over this new post of duty. For five inspirational days I toured reclamation projects in Arizona and California in company with Bureau of Reclamation executives and officers of the water associations. These are groups of people who contract with the Federal Government to make possible reclamation projects now using the limited water resources of California and Arizona.

Ian A. Briggs, the regional head of the division of land use and settlement of the Bureau of Reclamation, was my guide on that trip and a good guide he was, too. On the first day, we were conducted over the Salt River project in Arizona by R. D. Searles, president of the Salt River Water Users Association. The manner in which water is put to work is absolutely astounding. There is hardly a drop that is not used over and over again for power production before it finally pours out on the land for irrigation purposes.

First it is caught during the rainy flood season or as snow is melting in the mountains, and retained in one of several reservoirs constructed in the high canyons surrounding the Salt River Valley, of which Phoenix is the center. Then, as it is needed for irrigation during the dry growing season, it is released, not plunging down uncontrolled into irrigation canals, but harnessed and directed through a series of power plants which also provide electricity, the sale of which helps finance the construction. This electricity is also used to pump water from great natural underground storage reservoirs which underlie the area. The underground water, replenished by the surface water poured on the land from the canals, is one of the principal sources of irrigation and domestic water, particularly during the dry years when there is insufficient precipitation to fill up the reservoirs.

I was much interested, too, in the steam-electric plant the water users have erected. The association can get a much higher price for a larger amount of its power by using this plant to insure a firm supply at times when there is little water being released by hydroelectric power generation.

All this may sound terribly involved to those who are not familiar with it, but there is no question of its success or what it means to the area. The amazing prosperity of evidence of well-being in towns like Phoenix, set in the midst of this blooming, ever-green desert, would convince any doubters.

The same story was repeated on the Yuma and Gila projects in the southwest corner of Arizona where we were accompanied by Marcel Forman, president of the Yuma Valley Water Users' Association. Here, I was particularly interested in the new construction and the young war veteran settlers who are just getting started on farms they are homesteading on the Gila project. I would like to return in a couple or three years and see how they are making out. They gave every evidence of being "on their way" in carving out their own farms from the rough desert land, but they must have boundless energy, enthusiasm and faith if they are to succeed.

En route to California's Imperial Valley early the next morning, we crossed the Colorado River a short distance

(Please turn to page 61)

Reclamation's Hall of Fame

Nomination No. 7

JOHN A. BEEMER

by

U. V. ENGSTROM, Construction Engineer, Enders Dam, Enders, Nebr., Region 7

If construction men, both contractors and engineers, were biographers with propensities for making laudable comments on the accomplishments of their fellow workers, Beemer would receive a deluge of nominations to Reclamation's Hall of Fame. John, as he was commonly known throughout the Bureau, retired from active service early in 1945 after having worked in the field of land development and irrigation for 38 years. His work carried him to many parts of the world although he made his major contributions to the western United States. His work was truly pioneer irrigation development, and it was only through the ingenuity and courage of John and men like him that the enormous developments in his field were made possible.

Teaching in a country school was John's first vocation. This proved extremely dull and too confining for a man of his nature, and early in life he redirected his energies toward the field of science. He obtained a bachelor of science degree in civil engineering from the Case School of Applied Science at Cleveland, Ohio, in 1907, and received his civil engineer degree from the same institution in 1913.

In those days Idaho seemed to be a gathering place or, it could be said, a jumping off place, for outstanding reclamation men. It was here, in 1907, that John first gained employment with the Reclamation Service as a junior engineer. While stationed in Idaho, he worked on the construction of the Arrowrock Dam on the South Fork of the Boise River and later was division engineer on construction of the Nampa division of the Boise project. F. E. Weymouth was supervising engineer at that time.

The wanderlust was always strong in John's young blood and during the period from 1913 to 1916, he managed to wangle an appointment as assistant engineer for the Bureau of Public Works in the Philippine Islands doing investigational and design work on water systems and irrigation works.

During the first World War, he served with the United States Army as a captain in the Engineer Reserve Corps.

After being released from the Army, John again resumed his profession in irrigation work and was associated almost entirely with private irrigation companies. As chief engineer for the Walker River irrigation district of Nevada, Montague water conservation district of California, and Big Springs irrigation district of California, he handled the organization of districts, and then followed through on the financing, investigation, design, contracts, and eventual construction of the projects.

The Montague water conservation district board of directors said this of John—"Although we received about a hundred thousand dollars less for our bonds than expected, his work was so well planned and so economically accomplished that we have money to pay all contractors in full and have funds to pay 3 years interest upon our bonds."

The board of directors of the Walker River irrigation district made this comment on John's work—"He carried all his work to a successful conclusion . . . He has proved himself to be a careful, capable, conscientious, and successful engineer."

The State engineer of California, department of public works, Sacramento, Calif., in referring to John made the following statement in 1929—"He is one of the best known engineers in the western part of the United States on the development of irrigation projects. . . . His experience on dam construction, especially earth and hydraulic-fill types, has been very great, and he is recognized as an authority on this subject."

After having completed his assignments on private irrigation work, John spent 2 years in Russia as a consulting engineer on irrigation, drainage, and river control. He then came back to work for the Bureau of Reclamation. Practically all of his remaining assignments were on construction, being in charge of the work on the Alcova Dam in Wyoming, Deer Creek Dam in Utah, and Anderson Ranch Dam in Idaho. Since retirement, John has been a consultant to the Bureau of Reclamation on dam design and construction.

The project manager for one of the West's largest contractors once said this of John, "If he wants us to put a truck on top of that mountain, by * * * we will do it without a question."

His proteges all say, "He guided us well; his advice was sound; his word was good; I learned a lot and I hope I can pass it on as well as he did."

John started on the Reclamation's Arrowrock Dam, traveled and worked almost around the world, then terminated his career for the Bureau of Reclamation as construction engineer on Anderson Ranch Dam, the highest rolled earth-fill dam in the world, located only a short distance upstream from his starting point, Arrowrock Dam. This assignment as top man on the highest rolled earth-fill dam in the world is a fitting tribute to cap John's professional achievements. His work was always of the highest caliber, his explanations were always simple and plain, although the problems were involved. He commanded the respect and trust of every man he contacted, from subordinates to superiors, serving to make a sound foundation for future work—a priceless contribution to reclamation. THE END

TWO DAMS AND A MAN. Anderson Dam at top of column and Arrowrock Dam below it, stand today as reminders of the work which John A. Beemer put into them. At extreme left, a photo of John taken shortly after he retired in 1945. Inset, as he looked after graduation from the Case School of Applied Science at Cleveland, Ohio. *Photo of Anderson Dam by L. R. Murphy; photo of Arrowrock by Hu Blonk, both of Region 1.*

Three In A Row

(Continued from page 51)

lished farm would necessitate. However, now he has *his* farm and he is well acquainted with the country and the methods.

Banks has already started his plans. During the fall and winter, he will continue with his employment at the post office; but will use every free minute getting his land ready for a crop and a house ready to live in. By spring, he hopes to have the land cleared and ready for crops. The first year he will plant seed peas, oats, and alfalfa. And, on his 101-acre farm, 98 of which are irrigable, he will plan so that he can ultimately have livestock, a practice which has proven a profitable sideline on reclamation projects throughout the Northwest.

Homesteading for Mr. and Mrs. Banks, the parents of three handsome children from 4 months to 9 years, will not carry the hardships that it did for the grandparents. Roads into the area are good and lines carrying electricity are spider-webbing the area.

It is a rosy picture for Laura and Leon Banks. It is an "all this and heaven, too" because they have wanted for several years to take their children to a farm where they could grow in peace and safety.

It is a rosy picture for many others, too. On September 23, 1949, the public drawing at Powell established a priority for the award of 104 irrigable farm units. And, at two previous openings on the Heart Mountain division, the Bureau made available for settlement 114 homesteads. This settlement program, termed by Commissioner of Reclamation Michael W. Straus as "an end objective of the Bureau," is going on throughout the West; giving many World War II veterans the chance to realize their dreams and at the same time make the United States a stronger and better Nation. All made possible by the provision of what nature cannot assure—a stable supply of crop-producing water. THE END

Hungry Horse Dam, Mont., is slated to be 564 feet high. Hoover Dam is 726 feet high, Shasta 602 feet, and Grand Coulee 550 feet.

DIESEL OIL DOES IT—Johnson Grass getting an application of Diesel oil by a member of the Salt River Valley Water Users Association. *Photo by C. W. Bowser of Region 3.*

Getting Rid of JOHNSON GRASS

by H. F. ARLE, Assistant Physiologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture

Johnson grass continues to plague farmers and operations personnel on irrigation projects throughout the Southwestern States from Texas to California. However, complete eradication of that persistent weed from ditchbanks and other areas is now possible on a practical basis. That is the encouraging conclusion from extensive experiments carried on at Phoenix, Ariz., during the past 3 years.

Millions of dollars are being spent annually in the fight against Johnson grass. In the past, we have tried to control rather than eradicate this weed on ditchbanks and other nontillable land. Mowing, burning, and other methods used resulted in only very temporary relief because of the vigorous growth habits and regenerative power of the grass. Now, however, by the use of various aromatic weed oils, we can change our objective. Complete eradication is our goal.

Among the materials we tested in the experiments at Phoenix were various aromatic oils, diesel fuel, oil-water emulsions, diesel fuel fortified with the phenol and dinitro compounds, and fortified oil-water emulsions. Several of the treatments tested completely eradicated Johnson grass in one or two seasons.

Spray applications were made at intervals of 3, 4, 5, and 6 weeks. The tests have repeatedly shown that we got best results from using undiluted aromatic oils, repeating the treatment at intervals of 3 to 4 weeks. We cannot make a general statement regarding the number of treatments necessary to eradicate a stand of grass completely since this is an individual problem depending mainly upon soil moisture, soil fertility, and soil type. In some cases Johnson grass was completely eradicated with only four applications, while in other cases nine treatments were required. The amount of oil necessary for complete eradication has ranged from 500 to 725 gallons per acre.

The cost of spraying with aromatic oils has ranged from $90 to $130.50 per acre for oil alone (Phoenix, Ariz., prices). This is a cost of $109 to $158 per mile of ditch for an average size ditch, the cost per mile ranging upward or downward depending upon the ditchbank area infested. If this appears somewhat extravagant, just consider the costs of neglecting this weed. A heavy growth of Johnson grass along an irrigation canal slows up the water flow, and siphons off large quantities of precious water. Some of the water is gobbled up by the weed to add to its own luxuriant growth but most of it is breathed out and evaporates into the dry air. Eradicating Johnson grass along a canal bank stops these serious water losses and also eliminates the possibility of infesting irrigated land served by that canal. Johnson grass seeds are carried by irrigation water on to the land where they rapidly gain a new foothold, thereby reducing the value of the land, lowering crop yields, and reducing its quality.

The Salt River Valley Water Users' Association at Phoenix used 560,355 gallons of oils in treating Johnson grass on 5,291 miles of ditchbanks in 1948 and expanded this use in 1949.

The late C. L. Williams, for many years superintendent of irrigation, was convinced that proper spraying with oils proved an effective and practical method of eradicating Johnson grass from irrigation ditchbanks.

The many types of petroleum oils being used vary greatly in their weed killing value. Tests have shown that the

HALF AND HALF—A stand of Johnson Grass treated with an emulsion of 50 percent aromatic oil and 50 percent water. Each of the seven applications was made at a rate of 160 gallons per acre, using a total of 560 gallons of aromatic oil per acre. Note heavy growth of grass which remains.

FULL STRENGTH—What was left of Johnson Grass after being treated with undiluted aromatic oil. Each of the first two applications was made at 160 gallons per acre. Five following applications made at continuously decreasing volumes. Total volume of oil used, 585 gallons per acre. Note clean condition.

lethal doses are contained in the unsaturated compounds or unsaturates. How effective an oil is for weed killing depends on the percentage and type of aromatics it contains, and also its gravity. Another thing to consider is the ability of the oil to withstand the flow of water and hold itself together—what we call "oil viscosity." An oil of suitable viscosity spreads readily, but remains on the plant until it is absorbed. Very light oils disperse and break up too rapidly and the resulting weed injury is due to acute, rather than to chronic, toxicity. When a suitable oil is used in sufficient quantity, it not only kills the leaf surface, but by running and creeping down the stems, penetrates the crowns of grasses and kills the tissue from which new shoots might eventually grow. Suitable aromatic oils can now be purchased from several oil companies.

The more effective special weed oils on the market contain from 40 to 65 percent aromatics, and have a specific gravity of from 23° to 26° A. P. I. (American Petroleum Institute specifications), and a viscosity of 35 to 50 seconds. Present-day Diesel fuels are inferior to those of several years ago as weed-killing oils. This is due to increased refining which eliminates the unsaturated hydrocarbons from the oil. The addition of fortifiers has not made them as effective as the aromatic oils.

Because of the low, so-called, "nozzle delivery" costs of oil-water emulsions, these mixes have found favor with many farmers in their attacks upon Johnson grass. In most cases they have not given satisfactory results.

The Salt River Valley Water Users' Association started spraying 50 miles of Johnson grass infested canal banks in 1948 with a fortified 30–70 oil-water emulsion, but had to change to straight oil spray in midseason to regain control of the grass. There are several reasons for these failures. Probably the most important is the fact that insufficient oil is applied to a given area. An attempt to extend the oil by the addition of water is also an effort to extend its toxic properties and increase the area covered by a given unit of oil. When this is carried to extremes, the result is only a top kill with little or no oil reaching the root crown. The regenerative tissue is not killed and no permanent damage is done to the weeds. The use of insufficient quantities of oil on a given area results in nothing more than chemical mowing. If the practice is carried on for long periods with frequent applications, it is possible to eradicate Johnson grass because the root reserves are depleted and the plant dies, but this procedure is a long-time operation and eventually proves more costly than spraying with straight oil, using sufficient oil to penetrate to the root crown.

Start in the Spring

Experience at Phoenix has shown that the first oil application should be made during the early spring. At that season the root reserves are at their lowest point, and the plant is at the weakest stage in its life cycle. It is therefore important that the initial treatment be made during early spring, and preferably before the grass has attained a height of 15 inches. Failure to spray at that time will add to the final cost of eradication. It not only will allow the Johnson grass time to replenish its root reserves, thereby putting it in a stronger position to recover from future applications, but also, because of additional leaf surface, requires greater quantities of oil to do a thorough job. Adequate coverage can be obtained with 160 gallons of oil per acre when the treatment is made at the proper time. This is equal to spraying an area 1 mile long and $8^1/_4$ feet wide. The volume suggested would be necessary for a continuous and unbroken stand of Johnson grass. Where grass occurs in scattered patches, the volume required would be reduced proportionately.

The first application quickly results in complete destruction of all visible growth. However, new growth soon makes its appearance, and in most cases it appears fully as dense as the original stand. This regrowth is discouraging, and only too often spraying is abandoned without further effort. It should be remembered that Johnson grass is a capable competitor. It is antagonistic and fights back in the struggle for survival. This persistence must be met with painstaking patience and a willingness to make well-timed follow-up applications until all rhizomes (creeping underground stems) are eventually killed.

It will be necessary to make the second application about 3 to 4 weeks following the initial treatment, never allowing the grass to grow more than 15 inches tall. If the grass is allowed to grow beyond this stage, it soon develops hard, woody stems. In this condition it is more capable of resisting the oils and the treatment proves less effective.

The second application again requires 160 gallons of oil for each acre of Johnson grass under treatment. The results of this application are more pronounced and a definite reduction in the amount of regrowth will be evident. Additional applications will be necessary, their number varying with the individual situation. The most important factor, in all cases, is the proper timing of retreatments. The grass must never be allowed to grow unchecked for long periods of time. As the grass population decreases, correspondingly lesser oil will be needed. Eventually only spot applications will be necessary with volumes of 20 gallons or less per acre being required for each application in the clean-up work. For spot spraying of Johnson's grass, it is advisable to direct the spray at the base of the plant; top growth will eventually die, provided sufficient oil is applied to kill the root crown.

After all existing Johnson grass rhizomes have been destroyed, the danger of reinfestation from seeds in the soil still remains. Seedlings, however, can be eliminated rapidly and cheaply through the use of oil-water emulsions. If broad-leaved weeds make their appearance, the addition of dinitro or phenol fortifying materials is desirable.

A great variety of spraying equipment is available and most of it is adaptable for ditch bank spraying. However, a small engine equipped with a pump capable of delivering 50 pounds per square inch nozzle pressure is satisfactory. High pressures are not recommended because the oil breaks up into fine particles readily and much of it may be lost through wind drift. Nozzles delivering a flat fan-type spray are preferred, since they allow more uniform coverage than do those delivering a cone-shaped spray. For spot spraying, only a single nozzle should be used, as this prevents needless waste of oil. Cone-type nozzles which deliver a uniform pattern have been developed, and these can be used to advantage in spot spraying.

In conclusion, the necessity of a well-planned program and the importance of carrying it out according to plan are emphasized. A delay in any of the applications or the use of insufficient quantities of oil detracts from the results and adds to the final cost of Johnson grass eradication.

THE END

(The investigations on which this article is based were started in 1947 by L. S. Evans, now research project analyst, Agricultural Research Administration, United States Department of Agriculture, and were continued and expanded by the writer in 1948 and 1949. The weed investigations at Phoenix are in cooperation with the Arizona Agricultural Experiment Station.)

Reclamation Crops Again Top Half-Billion-Dollar Value

For the fourth consecutive year more than one-half billion dollars' worth of crops were produced in 1949 on western irrigated lands served by the Bureau of Reclamation.

The cumulative value of irrigated crops grown on lands furnished with water from works constructed by the Bureau since the completion of the first project in 1906, totals about $6,580,000,000, or more than four times the entire Federal investment in the Reclamation program which includes irrigation, hydroelectric power, flood control, recreational facilities, and other features. The totals do not include the value of livestock which is an important phase of diversified production on irrigated farms.

"Preliminary estimates, indicating a total production valued at $516,974,000 from 4,927,000 acres of land, or a per acre gross crop value of $104.92 in 1949, clearly demonstrates Reclamation's contribution to the economy and buying power of the Nation", said Commissioner of Reclamation Michael W. Strauss in reporting the figures to Secretary of the Interior Oscar L. Chapman.

Irrigated crops were raised in 1949 on 65 regular Federal reclamation storage and other projects comprising more than 65,000 farms and on more than 23,000 farms served under Warren Act or special contracts authorizing the delivery of supplemental water supplies to irrigation water users. This was the fifth year in which the per acre value of reclamation crops was over $100.00.

The report shows an increase of 227,000 acres in cultivation from 1948 to 1949, additional lands being furnished water on the W. C. Austin project in Oklahoma, Boise project in Idaho, Central Valley project in California, Deschutes project, North Unit in Oregon, Gila project in Arizona, and the Tucumcari project in New Mexico.

Crops raised on the Imperial division of the All-American Canal project in California, valued at $76,796,625, took first rank in total value among the Reclamation areas' production; with the $35,086,248 produced on the Rio Grande project in New Mexico and Texas, second, and $30,522,800 worth of crops raised on the Salt River project in Arizona, third.

While prices received for irrigated crops were generally lower in 1949, production costs remained relatively high, resulting in a decline of about 3 percent in the total 1949 crop valuation, as compared with 1948, and an 8 percent reduction in the per acre gross value. The 1948 figures showed a total crop valuation of $534,623,000 and a per acre gross valuation of $113.76. •

CEDAR BLUFF DAM SITE on the Smoky Hill River about 25 miles south of Wakeeney, Kans., as it appeared in October 1949. Mechanization like this astounded visiting engineers. *Photo by G. E. Thomas, Region 7.*

Foreign Engineers Visit Kansas Reclamation Project

Three civil engineers representing their governments and seeking information on construction practices involved in the construction of earth dams by the Bureau of Reclamation visited the Cedar Bluff Dam in Kansas, now being built by the Bureau of Reclamation, during the latter part of November and first of December 1949. They were Ramon R. Ravanzo of the Philippines, Mr. S. Sankarelingam of India, and Fredrico Ortiz de Zarate of the Argentine Republic. All were impressed by the speed at which the work was being accomplished and said that operations of this nature were undreamed of in their countries.

Mr. Ravanzo is a graduate of the University of the Philippines in Manila, Philippine Islands, and has been associated with the National Power Corporation, a Philippine governmental agency, for the past 15 years. He is in this country as a Fellow of the United Nations.

Construction methods such as those on the Cedar Bluff Dam are not likely to be used in the Philippines to any great extent, Mr. Ravanzo believes. The very cheap labor and need for providing employment makes extensive mechanization unpractical. However, engineering practices employed by Bureau engineers on earthwork control and in determining settlement and pore pressures were of particular interest to Mr. Ravanzo.

Mr. Sankarelingam was on the project only one day and there was no opportunity to discuss engineering problems of India.

Mr. Ortiz de Zarate said that climatic and other conditions in Argentina were similar to ours and that irrigation development was badly needed there. Most of the favorable sites for concrete dams have been developed and they are now interested in constructing earth dams at sites where these dams are more practical.

One of the principal difficulties facing Argentina at this time is a severe shortage of foreign exchange. Since Argentina is very poor in natural resources, coal, oil, steel, and other metals must be imported and this takes dollar credits which they do not have. Therefore, Argentine engineers must use only a minimum amount of reinforcing in their concrete design. Construction of government projects is almost entirely by force account. Mr. Ortiz de Zarate was principally interested in obtaining data on the efficiency of earth moving equipment so that the few dollars which are available for purchase of machinery may be spent to best advantage.—By Glenn E. Thomas, Office Engineer, Cedar Bluff Unit, Missouri River Basin Project, Ellis, Kansas, Region 7.

On Looking Back

(Continued from page 55)

below Imperial Dam where water is diverted for use in both Arizona and California. I think of that river when I look at the Nile. Mr. Briggs told me the Colorado used to flow wildly and out of control during the flood season, then dwindle away to a mere muddy trickle just at the time the water was needed to keep growing crops from withering away. He told me about Hoover Dam and great Lake Mead and how they have brought the wild Colorado under control. I found it hard to believe until I visited the dam on the last day of my tour. The sheer magnitude of the dam is breath-taking and when one views Lake Mead from the air, spreading out with a shoreline of more than 550 miles—well, there's no use talking. It simply makes one glad he is living in an age when modern technology can accomplish such things. They tell me a series of dams and reservoirs is planned all along the river, to bring it even further under control and double or triple the power output.

I am indeed indebted to B. A. Weiss and Evan T. Hewes, the latter president of the Imperial irrigation district, for an extended trip over the rich and verdant Imperial Valley, after which we went northward into the Coachella Valley. This valley is fed by water through a branch of the great All-American Canal, a canal bigger than many rivers, which takes off from the Colorado River at Imperial Dam. Coachella is more like most of the land in the Near East than either the Salt River or Imperial Valleys, possibly because of the towering date palms which were waving in the breeze everywhere. I was also much impressed by the small, family-sized farms in the Coachella Valley. I left them with the idea that those bustling farmers and their families, each in his own little dominion, enjoy unusually good living as well as unusually good security.

All these memories are very sharp to me as I take over this new post in Egypt, and I intend to keep them very much to the fore in my relations with the government here. Conservation and wise use of the water resources of these nations in the Middle East may be the key to their prosperity and future success and, in keeping with President Truman's pronouncement, we should be liberal indeed with our knowledge gained in the development of such amazing projects as those in the Lower Colorado River Basin. The End

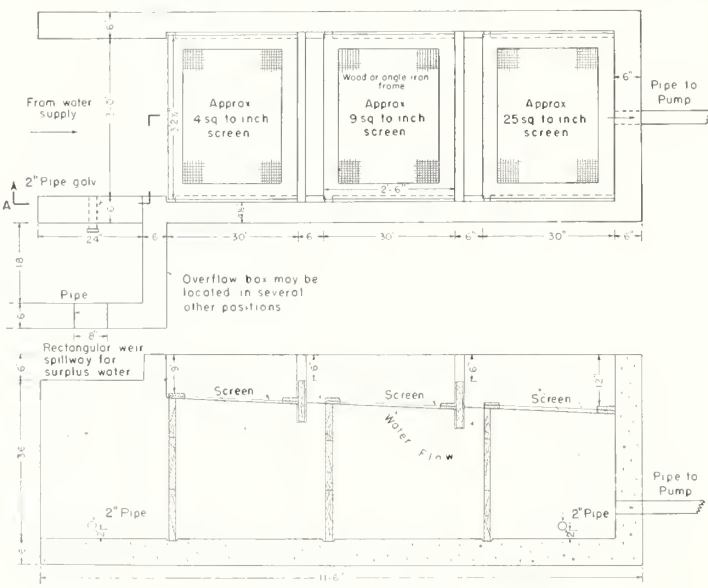
KEEPING TRASH OUT OF SPRINKLER SYSTEMS

THE USE OF SPRINKLERS for irrigation is spreading rapidly throughout the country. Farmers on Bureau of Reclamation projects have found that keeping trash out of their sprinkler systems is difficult. In many instances horizontal screens to catch the floating material, and settling boxes to retain the sediment, have proved useful. Two somewhat similar devices which are in successful use in the Pacific Northwest are described in the following items.

SCREENING AND SETTLING BASINS ON THE COLUMBIA BASIN PROJECT

by MILO W. HOISVEEN, Chief, Land Predevelopment, Unit, Columbia Basin Project, Ephrata, Wash., Region 1 (headquarters at Boise, Idaho)

Several screening and sediment settling basins are in use on the Pasco pumping unit of the Columbia Basin project in eastern Washington. The accompanying drawing shows



SECTION A-A
SCREENING AND DESILTING BOX

FIGURE 7

how the basins are built. The basin on William Lovercheck's farm is shown in the photograph at right with the water just reaching the second screen. This structure performs two jobs. It screens out floating material from the water to prevent plugging of sprinklers, and it removes silt and sand to prevent excess wear of sprinkler head parts. The baffle boards and screens are designed to make the water pass downward through the screen, then over the baffle board to the next screen. Each successive screen is of a smaller mesh, so by the time the water reaches the pump, practically all foreign material that might plug the sprinkler nozzles is screened out. It is recommended, for the best performance, that the first screen have approximately 4 openings per square inch, the second, 9 openings per square inch, and the third, approximately 25 per square inch. At times, it may be advisable to have an extra No. 3 screen to use while a trash-laden screen is being cleaned. Screens can be cleaned best by connecting a garden hose to a tap in the sprinkler line and using the water pressure on the reverse side of the screen. The No. 3 screen usually stops algae and moss effectively.

The basins must be of sufficient size to reduce the velocity of the water enough to permit the sand and much of the silt to settle out before the water reaches the pump. In the right foreground of the photograph an overflow device is seen which functions when the pump is stopped. The overflow provision is necessary on the Pasco unit because of the large number of sprinkler systems being installed. Without the overflow protection, should power failure shut down sprinkler motors, water could be backed into the laterals causing them to overflow. This might occur, also, when a number of sprinkler laterals are shut down at the same time while being moved. The overflow, as designed, permits the operator

SIFTING THE SILT through successive screens of diminishing mesh sizes keeps silt, sand and other floating materials out of the sprinkler line. This photo of the desilting basin on the William Lovercheck farm, Pasco Pumping Unit, Columbia Basin project, was taken by Harold Foss, Region 1 photographer.

to use the excess water on a small area prepared for surface irrigation.

The basins on the Pasco unit are doing their job well. Most of the Bureau of Reclamation laterals, on which these basins are located, were constructed 2 years before settlers moved onto the land. Consequently, large amounts of silt, sand, and other undesirable materials collected in the laterals, and subjected the basins to a rather severe test in their initial period of operation.

One sprinkler operator reported the No. 1 compartment of his basin was filled with sand every 24-hour-period of operation. Little or no silt or sand was found in the No. 3 compartment. Two plugged sprinklers occurred in 72 hours of operation because of pipe scale.

A second farmer also reported heavy collections of silt in the Nos. 1 and 2 compartments. He had but one plugged sprinkler in 100 hours of operation. He believed carelessness in cleaning the No. 3 screen caused the clogging.

For a permanent installation, reinforced concrete should be used. The bars should be three-eighths inch in diameter and placed in 12-inch center-to-center spacing.

Bureau Engineer McFarland's "Public Welfare" Concept Wins A. S. C. E. Prize

Sidney L. McFarland, engineer in the branch of project planning, Region 2, Sacramento, Calif., was awarded the 1949 Daniel W. Mead Prize for Juniors of the American Society of Civil Engineers, by vote of the society's committee on professional conduct meeting in Washington, D. C., in October 1949. The prize-winning paper is entitled "Under what conditions and to what extent is it ethical for an engineering society, such as a local section, A. S. C. E., to make studies and recommendations, without remuneration, on proposed public projects."

According to Mr. McFarland, the determining factor is the public welfare. The society is justified in making detailed studies and investigations on a local engineering project in which the public is clearly concerned if (1) the local section has unsuccessfully exhausted all means in attempting to arouse the effective interest of city officials and civic groups; (2) the local project has been the subject of misrepresentation to the public; or (3) there be an error in the design or accomplishment affecting the safety or welfare of the public.

"Our guide," wrote Mr. McFarland, "cannot be a hard and fast rule which can be applied to all public projects. The measure must be in terms of public welfare. The conditions under which it is ethical to make studies and recommendations on proposed public projects are those conditions where the public will be benefited. The extent to which we are justified in undertaking such studies is the extent necessary to fulfill our moral obligations to our profession and to the community which we serve."

SELF-CLEANING SCREEN

by

A. L. MARBLE, County Extension Agent, Hood River, Oreg.

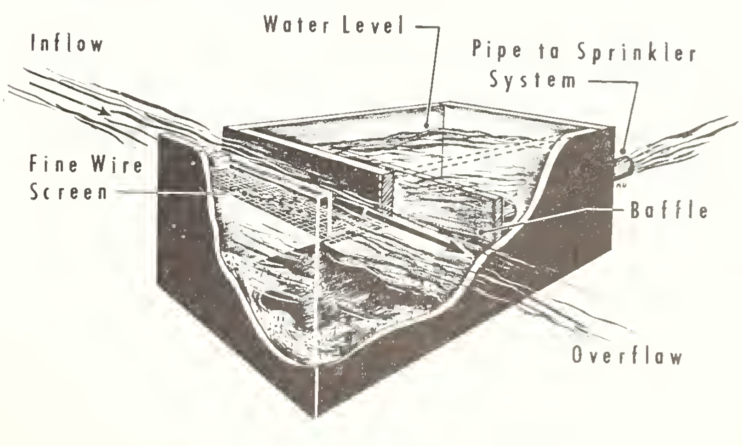
Bob Nunamaker, a Hood River farmer, worked out a method of screening irrigation water for use in sprinklers which has also been installed by several other men with great success.

Heretofore, screening devices have been set up with from two to four or more vertical screens with mesh from one-half inch down to one-eighth inch or less. These screens continually clog with algae and debris carried in the water.

The screen developed by Nunamaker (see photo below) consists of a single fine copper window screen about 15 or 16 inches wide, as long as the settling box (4 feet or more) and placed horizontally. The success of the operation is secured by a continuous overflow from above the screen back into the main irrigation line or into a waste line. In practice, the water level over the screen is held at two to four inches depth by establishing the overflow opening at that height above the screen. The amount of overflow need not be great, probably safely as low as 5 percent, only enough current to carry leaves and sticks. In my own box, the overflow goes back into the main line and no loss is suffered. This was never removed for cleaning or any other purpose through the entire season.

The size of screen required will depend on the quantity of water to be pumped. A screen 15 by 48 inches has been fully adequate for 100 gallons per minute on the writer's installation. We have one screen of this type taking care of 400 acres on about 20 farms in the Hood River Valley.

HOW IT WORKS—Water flows into the box at the upper left-hand corner and flows over and through the fine screen forming the bottom of the shallow channel across the left end of the box. Most of the water flows downward through the screen into the settling basin where sand and silt settle out. It then flows up over the baffle board and out through the pipe to the sprinkler system pump. The excess water flows on across the box and out over a lip 2 to 4 inches above the screen. Drawing by the Graphics Section, based on a design submitted by the author, A. L. Marble.



SELF CLEANING SCREEN

Members of the National Reclamation Association met with Reclamation Commissioner Michael W. Straus on January 17, 1950, to discuss House Bill 1770. Seated clockwise around the table are E. R. Wells, Prosser, Wash.; R. P. Parry, Twin Falls, Idaho; Arvin B. Shaw, Jr., Los Angeles, Calif.; Commissioner Michael W. Straus, Bureau of Reclamation; Clifford E. Fix, Chief Counsel, and Edward W. Fisher, Assistant Chief Counsel on legislative matters, Bureau of Reclamation; J. W. Moeur, Phoenix, Ariz.; Harry E. Polk, Williston, N. D., president, National Reclamation Association; E. E. Tiffany, Billings, Mont.; James A. Howell, Ogden, Utah; Clifford H. Stone, Denver, Colo.; and G. W. Lineweaver, Director of Operations and Maintenance, Bureau of Reclamation. In the left background is Merl B. Peek, assistant secretary-manager, National Reclamation Association.

Members of the legislative committee of the association are Clifford H. Stone, chairman, E. R. Wells, R. P. Parry, Arvin B. Shaw, Jr., J. W. Moeur, E. E. Tiffany, and James A. Howell.

More Homes for Veterans

Public notices for 11 farm units on the Roza division of the Yakima project in the State of Washington and 54 units on the Riverton project in Wyoming are expected to be issued by the Bureau in the near future. The Yakima Roza area embraces 723 acres while the Riverton farms cover an area of approximately 7,000 acres.

As in past postwar land openings, veterans preference will prevail. Information on the Yakima Roza farms may be obtained by writing to the Superintendent, Bureau of Reclamation, Post Office Box 1377, Federal Building, Washington. For information on the Riverton units, inquiries may be addressed to the Superintendent, Operation and Development, Bureau of Reclamation, Riverton, Wyoming.

Phillips to Manage El Paso District

N. B. Phillips has been appointed manager of El Paso County water improvement district No. 1, on the Rio Grande project in New Mexico and Texas, to succeed the late Roland Harwell (see page 20, January 1950 RECLAMATION ERA), according to a recent announcement by P. F. Brinkmann, district president.

Mr. Phillips had served for the last several years as administrative officer with the International Boundary and Water Commission at San Diego, Calif.

A veteran of 30 years' experience in reclamation and irrigation practices, Mr. Phillips is a former employee of the Bureau of Reclamation. For 20 years he was assessor-collector, treasurer and treasurer-manager for the Elephant Butte irrigation district at Las Cruces, N. Mex. During his employment with the Bureau, Mr. Phillips served in various capacities in both operation and maintenance and construction divisions. He served also as a New Mexico member of the Interstate Streams Commission.

Hoover Dam—Top Tourist Attraction

Despite record breaking blizzards in January and February 1948 which paralyzed all forms of travel throughout Western United States, a total of 356,778 persons visited Hoover Dam during 1949, according to a report by C. P. Christensen, director of power, Boulder Canyon project, Nevada.

Only the abnormal travel years of 1947 and 1948, and the peak prewar year of 1941 surpassed the 1949 total. The 1949 daily average of 977 was just a bit above the daily average of 966 since guide facilities were begun.

During 1949 at least two records were established. The 3,658 who visited the dam on Memorial Day set a postwar daily record, and the 53 who braved the snow storm of January 12, 1948, set an all-time low for any one day since guide service facilities were begun in 1937.

Modified Columbia Basin Plan Approved

On February 2, 1950, Secretary of the Interior Oscal L. Chapman was advised by the Bureau of the Budget that President Truman has approved, with some modifications, a plan for the development of the Columbia River Basin as proposed by the Department of the Interior and the Department of the Army, the work to be accomplished by the Bureau of Reclamation and the Army Corps of Engineers.

The Bureau of the Budget requested Secretary Chapman to submit its letter to the Senate at once together with recommendations concerning the Columbia River Basin and other amendments to House bill 5472, now pending in the Senate. These amendments have been approved as being in accord with the program of the President. The President, according to the Bureau of the Budget letter to Secretary Chapman, endorsed the establishment of a basin account which would pool revenues from all of the power plants to pay the costs of these projects, and also to help pay the irrigation costs of the over-all basin development, rather than maintain a separate account for each individual construction unit.

"Such an accounting method," the Bureau of the Budget letter points out, "is obviously necessary to permit efficient management of the Government's power operations in the Columbia Basin and a proper assignment of power revenues to return the costs of irrigation facilities which are beyond the ability of the water users to repay."

"The President's endorsement of the principle of a basin-wide account," Chapman said, "upholds a long-standing policy that power from our western rivers should be developed not only to provide low-cost energy for farms, homes, and industry, but also to help in the further development of the arid lands of the West."

The Bureau of the Budget advised Secretary Chapman that authorization of the program by Congress will make it more important than ever to establish a better organizational framework for the conservation and development of all natural resources in the Pacific Northwest, such as would be provided by the Columbia Valley Administration which the President has previously recommended.

U. S. GOVERNMENT PRINTING OFFICE: 1950

March 1950

Office 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. Moshy; *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 Programs and Finance)*, Archie M. Rankin; *Associate Director of Supply (Office of Supply)*, J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller)*, Wendell Bramwell; *Chief, Personnel Field Office (Office of Personnel)*, Everett K. Gould.

Alaskan Investigations Office, Juneau, Alaska, Joseph M. Morgan, Chief

United Western Investigations Office, 222 South West Temple, Salt Lake City, Utah, Stanford P. McCasland, Engineer in Charge.

REGIONS

REGION 1: Regional Office, P. O, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, H. T. Nelson; *Assistant Regional Director*, J. Lyle Cunningham; *Assistant Regional Director*, F. M. Clinton; *Assistant to the Regional Director*, William F. Rapp; *Regional Engineer (Branch of Design and Construction)*, D. S. Walter; *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.

Operating Offices	Official in charge		Address
	Name	Title	
Anderson Ranch Dam project office	G. A. Swanson	Construction engineer	Anderson Dam, Idaho.
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Boise-Payette construction field office	W. Watson Ketchen	Acting Construction engineer	P. O. Box 172, Caldwell, Idaho.
Boise-Payette O. & M. field office	John V. Walker	Irrigation manager	Notus, Idaho.
Cascade Dam field office	Earl Harmon	Construction engineer	P. O. Box 440, Cascade, Idaho.
Owyhee project field office	Paul L. House	Acting irrigation manager	Nyssa, Oreg.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	P. O. Box 368, Ephrata, Wash.
Deschutes project office	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hungry Horse project office	C. H. Spencer	do	Columbia Falls, Mont.
Kalispell area planning office	Charles S. Hazen	Planning engineer	Ford Bldg., P. O. Box 97, Kalispell, Mont.
Lewiston Orchards project office	Wilfred L. Karrer	Construction engineer	Weisberger Bldg, 5th and Main, P. O. Box 621, Lewiston, Idaho.
Minidoka project office	J. F. Spofford	Superintendent	1359 Hanson Ave., Burley, Idaho.
Palisades project office	I. Donald Jerman	Project engineer	Palisades, Idaho, Mail Address: P. O. Box 1259, Idaho Falls, Idaho.
Salem area planning office	Lee McAllister	Planning engineer	460 N. High St., Salem, Oreg.
Walla Walla area planning office	M. Boyd Austin	do	Bldg. T-208, Walla Walla City-County Airport, P. O. Box 718, Walla Walla, Wash.
Yakima project office [1]	O. W. Lindgren	Superintendent	P. O. Box 1377, Federal Bldg., Yakima, Wash.

[1] Also project office for McKay Reservoir, Umatilla project.

REGION 2: Regional Office, P. O. 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)*, William J. McCrystle; *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 Acquisition 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.

Operating Offices	Official in charge		Address
	Name	Title	
Cachuma Project field office	E. R. Crocker	Project manager	P. O. Box 701, Goleta, Calif.
Delta district	C. H. Kadie, Jr	District manager	P. O. Box 928, Stockton, Calif.
American River construction division	H. F. Bahmeier	Construction engineer	Folsom, Calif.
Canal construction division	O. G. Boden	do	P. O. Box 570, Tracy, Calif.
Electrical construction division	H. W. Thomson	do	Elverta, Calif.
Klamath project field office	E. L. Stephens	Project manager	P. O. Box 312, Klamath Falls, Oreg.
Sacramento Valley district	James K. Carr	District manager	P. O. Box 302, Chico, Calif.
Construction division	Edward Helgren	Construction engineer	Redding, Calif.
Orland field office	R. W. Hollis	Watermaster	Orland, Calif.
Shasta Dam division	George D. Atkinson, Jr	Operations superintendent	Redding, Calif.
San Joaquin Valley district	J. W. Rodner	District manager	318 Patterson Building, Fresno, Calif.
Canal construction division	S. S. Leonard	Acting construction engineer	Friant, Calif.
Construction division (distribution systems)	R. K. Durant	Construction engineer	Lindsay, Calif.
Design division (distribution systems)	Ernest C. Fortier	Design engineer	318 Patterson Building, Fresno, Calif.

REGION 3: Regional Office, 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 Counsel* (*Legal Division, 620 Rowan Bldg., 458 S. Spring St., Los Angeles, Calif.*), R. J. Coffey; *Regional Programs and Finance Officer* (*Programs and Finance Division*), M. E. Rains; *Regional Supply Officer* (*Supply Division*), O. J. Littler; *Regional Personnel Officer* (*Personnel Division*), M. H. Mitchell; *Regional Information Officer* (*Information Division*), W. J. Williams; *Chief, Office of River Control*, C. P. Vetter.

Operating Offices	Official in charge		Address
	Name	Title	
All-American Canal (Coachella division) project office	C. S. Hale	Construction engineer	Coachella, Calif.
Coachella design field station	H. R. Voris	Head, design unit office	P. O. Box 1416, Banning, Calif.
Boulder Canyon project office	C. P. Christensen	Director of power	Boulder City, Nev.
Colorado River front work and levee system project office.	C. P. Vetter	Chief, office of river control	Do.
Blythe field station	B. E. Wilson	Engineer	Office of River Control, General Delivery, Blythe, Calif.
Needles field office	C. H. Gremmels	do	P. O. Box 975, Needles, Calif.
Davis Dam project office	H. F. Bahmeier	Construction engineer	P. O. Box 790, Davis Dam, Nev.
Escondido area planning office	J. D. McCoy	Area planning engineer	P. O. Box 475, Escondido, Calif.
Lower Colorado River district	M. J. Miller	District manager	Yuma, Ariz.
Engineering division	G. E. Tank	Chief, engineering division	Do.
Operations division	J. P. Collopy	Chief, operations division	Do.
Overton area planning office	W. P. Adair	Area planning engineer	Johnson Bldg., Overton, Nev.
Parker Dam power project office (including Davis trans. system const.).	S. A. McWilliams	Project engineer	P. O. Box 392, Phoenix, Ariz.
Blythe construction field office	J. H. Childs	Engineer	Blythe, Calif.
Kingman construction field office	D. F. Murphy	do	Kingman, Ariz.
Parker Dam O&M field office	E. A. Benson	Power operations engineer	Parker Dam, Calif.
Phoenix area planning office	V. E. Larson	Assistant regional planning engineer	P. O. Box 2071, Phoenix, Ariz.

REGION 4: Headquarters, 32 Exchange Place, P. O. 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 Information Officer* (*Information Division*), M. C. Corbett; *Regional Programs and Finance Officer* (*Programs and Finance Division*), F. J. Farrell; *Regional Personnel Officer* (*Personnel Division*), G. A. McDougal; *Regional Counsel* (*Legal Division*), J. S. McMaster; *Regional Supply Officer* (*Supply Division*), E. G. Bywater.

Operating Offices	Official in charge		Address
	Name	Title	
Durango area office	Wm. F. Crabtree	Area engineer	Masonic Bldg., P. O. Box 640, Durango, Colo.
Mancos project office	do	do	Do.
Pine River project office	do	do	Do.
Eden project office	A. H. Peterson	Construction engineer	First Security Bank Bldg., Rock Springs, Wyo.
Fallon area office	W. H. Slattery	Area engineer	Post Office Bldg., P. O. Box 849, Fallon, Nev.
Grand Junction area office	C. H. Jex	do	310 Post Office Bldg., P. O. Box 780, Grand Junction, Colo.
Kemmerer area office	P. B. DeLong	do	Town Hall, P. O. Box 591, Kemmerer, Wyo.
Logan area office	E. K. Thomas	do	46 East Center, P. O. Box 294, Logan, Utah.
Paonia project office	R. W. Jennings	Construction engineer	P. O. Box X, Paonia, Colo.
Provo River project office	L. R. Dunkley	Project engineer	303 Knight Block, P. O. Box 77, Provo, Utah.
Spanish Fork area office	P. R. Neeley	Area engineer	24 N. Main, P. O. Box 71, Spanish Fork, Utah.
Weber Basin area office	F. M. Warnick	do	203 24th Street, Ogden, Utah.

REGION 5: Regional Office, P. O. Box 1609, Old P. O. Building, 7th and Taylor, Amarillo, Tex.

Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *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; *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 Information Officer* (*Information Division*), Garford L. Wilkinson; *Regional Supply Officer* (*Supply Division*), I. G. Campbell; *Regional Safety Adviser*, G. F. Peterson.

Operating Offices	Official in charge		Address
	Name	Title	
Albuquerque area planning office	J. L. Mutz	Area planning engineer	P. O. Box 95, 723 N. 2d St., Albuquerque, N. Mex.
Austin area planning office	H. P. Burleigh	do	P. O. Box 817, Littlefield Bldg., Austin, Tex.
Balmorhea field station	Paul Powell	Irrigation maintenance superintendent	Balmorhea, Tex.
Carlsbad field station	J. J. Broekman	Reservoir superintendent	P. O. Box 512, Fort Sumner, N. Mex.
Fort Sumner project office	W. B. Bierce	Construction engineer	P. O. Box 496, Fort Sumner, N. Mex.
Oklahoma City area planning office	M. G. Barclay	Area planning engineer	P. O. Box 495, 205 Council Bldg., Oklahoma City, Okla.
Rio Grande project office	L. R. Fiock	Project manager	U. S. Courthouse, El Paso, Tex.
Elephant Butte division office	Labon Backer	Division superintendent and acting construction engineer.	Elephant Butte, N. Mex.
Las Cruces division office	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta division office	F. D. Postle	do	Ysleta, Tex.
San Luis Valley project office	W. H. Sweet	Project engineer	117 Jefferson St. Monte Vista, Colo.
Platoro Dam field office	L. F. Wylie	Construction engineer	Do.
Tucumcari project office	R. J. Lyman	Acting project engineer	Tucumcari, N. Mex.
W. C. Austin project office	J. A. Callan	Project engineer	Altus, Okla.

REGION 6: Regional Office, Yale Building, P. O. 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 O. & M. 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; *Chief, Reports Coordination Division*, Edwin E. Wilson; *Regional Information Officer (Information Divison)*, Harold I. Sylten; *Regional Personnel Officer (Personnel Division)*, Howard M. Watts; *Regional Supply Officer (Supply Division)*, Fred W. Gilbert; *Regional Safety Engineer (Safety Division)*, Charles O. Parsons; *Chief, Municipal Water Supply Investigations Unit*, Stanton J. Ware.

Operating Offices	Official in charge		Address
	Name	Title	
Big Horn district	R. H. Workinger	District manager	P. O. Box 839, Cody, Wyo.
Boysen project field office	G. R. Rolin	Project engineer	P. O. Box 1111, Thermopolis, Wyo.
Heart Mountain project field office	Alden S. Ingraham	Project superintendent	P. O. Box 900, Cody, Wyo.
Riverton project field office	T. A. Clark	Project engineer	P. O. Box 71, Riverton, Wyo.
Missouri-Oahe district	Joseph W. Grimes	Acting district manager	P. O. Box 825, Huron, S. Dak.
Angostura construction field office	Norval E. Enger	Acting construction engineer	P. O. Box 812, Hot Springs, S. Dak.
Bixby construction field office	H. M. Crowell	Construction engineer	P. O. Box 326, Newell, S. Dak.
Keyhole construction field office	F. E. Goehring	do	P. O. Box 278, Moorcroft, Wyo.
Shadehill construction field office	D. M. Forester	do	P. O. Box 298, Lemmon, S. Dak.
Missouri-Souris district	Bruce Johnson	District manager	P. O. Box 1050, Bismarck, N. Dak.
Cannonball construction field office	Floyd M. Jensen	Construction engineer	Elgin, N. Dak.
Heart Butte construction field office	Walter W. Brenner	do	Glen Ullin, N. Dak.
Minot investigations field office	George J. Cheney	Engineer	P. O. Box 1869, Minot, N. Dak.
Upper Missouri district	Harold E. Aldrich	Acting district manager	P. O. Box 1629, Great Falls, Mont.
Canyon Ferry construction field office	W. P. Price, Jr	Construction engineer	Canyon Ferry, Mont.
Helena investigations field office	F. V. Munro	Engineer	P. O. Box 1164, Helena, Mont.
Lower Marias investigations field office	T. R. Smith	do	P. O. Box 1729, Great Falls, Mont.
Milk River project field office	Bruce E. Garlinghouse	Acting superintenhent	Malta, Mont.
Sun River project field office	George Ebner	do	Fairfield, Mont.
Tiber Dam construction field office	Walter Sanford	Acting construction engineer	P. O. Box 218, Chester, Mont.
Yellowstone district	Donald C. Ketcham	District manager	P. O. Box 1264, Billings, Mont.
Buford-Trenton project field office	A. H. Whitmore	Construction engineer	P. O. Box 1135, Williston, N. Dak.
Fort Peck project field office	George R. Larson	Acting construction engineer	P. O. Box 1245, Fort Peck, Mont.
Hardin construction field office	R. F. Herdman	Construction engineer	P. O. Box 516, Hardin, Mont.

REGION 7: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director*, E. V. Lindseth; *Regional Administrative Officer (Administrative Division)*, H. S. Varner, Jr.; *Regional Engineer (Branch of Design and Construction)*, Herbert E. Prater; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, John N. Spencer; *Regional Power Manager (Branch of Power Utilization)*, Harold R. Lee; *Regional 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; *Regional Personnel Officer (Personnel Division)*, Albert R. Novak; *Regional Information Officer (Information Division)*, Ralph L. Williams; *Regional Supply Officer (Supply Division)*, William F. Sha; *Regional Safety Engineer (Safety Division)*, Alton T. Cromwell.

Operating Offices	Official in charge		Address
	Name	Title	
Kansas River district	H. E. Robinson	Construction engineer	P. O. Box 737, McCook, Nebr.
Bonny field office	Clifford L. Mntch	do	P. O. Box 67, St. Francis, Kans.
Bostwick field office	Paul E. Strouse	do	P. O. Box 512, Superior, Nebr.
Cambridge distribution system field office.	C. M. Jackson	do	Arapahoe, Nebr.
Cedar Bluff field office	R. J. Walter, Jr	do	P. O. Box T, Ellis, Kans.
Enders field office	U. V. Engstrom	do	P. O. Box 17, Enders, Nebr.
Medicine Creek field office	William J. Quinn	Acting constrnction engineer	P. O. Box 157, Cambridge, Nebr.
Trenton field office	Ellis L. Armstrong	Construction engineer	P. O. Box 63, Trenton, Nebr.
Lower Platte River area office	P. L. Harley	Area engineer	P. O. Box 997, Grand Island, Nebr.
Niobrara River area office	C. E. Burdick	do	Ainsworth, Nebr.
Mirage Flats field office	George T. Kelly	Irrigation superintendent	Hay Springs, Nebr.
North Platte River district	I. J. Matthews	District manager	P. O. Box 280, Casper, Wyo.
Guernsey field office	K. K. Korber	Superintendent	Guernsey, Wyo.
Kortes field office	C. S. Rippon	Construction engineer	P. O. Box 280, Casper, Wyo.
Transmission Lines field office	Othello F. Tucker	do	Do.
Torrington field office	C. M. Rader	Engineer	Torrington, Wyo.
South Platte River district	J. H. Knights	District manager	Bldg. 10, DFC, Denver, Colo.
Fort Collins field office	C. E. Klingensmith	Construction engineer	P. O. Box 551, Fort Collins, Colo.
Fort Morgan field office	Rob Roy Buirgy	Acting construction engineer	P. O. Box 152, Fort Morgan, Colo.
Grand Lake field office	G. R. Highley	Construction engineer	Grand Lake, Colo.
Kremmling field station	B. B. Dawson	Resident engineer	Kremmling, Colo.
Loveland field office	G. A. Sampson	Acting construction engineer	P. O. Box 449, Loveland, Colo.
Upper Arkansas River area office	B. F. Powell	Area engineer	P. O. 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.
Belle Fourche	Belle Fourche irrigation district	Newell, S. Dak.	Oliver G. Rose	do	Vern Hafner	Newell, S. Dak.
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.
Carlsbad	Carlsbad irrigation district	Carlsbad, N. Mex.	J. C. Howard	do		Carlsbad, N. Mex.
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.	Arthur Donlan	President	Ralph P. Scheffer	Huson, Mont.
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo.	Frank Hart	Manager	William Griffith	Cory, Colo.
Grand Valley	Grand Valley Water Users' Association	Grand Junction, Colo.	W. J. Chiesman	do	C.E.Blumenshine	Grand Junction, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo.	Don S. Leslie	Superintendent.	C. J. McCormick	Do.
Grand Valley, Mesa County	Mesa County irrigation district	Clifton, Colo.	Otto Thyret	do	H. B. Smith	Palisade, Colo.
Grand Valley, Palisade	Palisade irrigation district	do	S. F. Patterson	do	W. E. Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev.	Robert S. Leighton	Secretary-manager.	R. S. Leighton	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	A. L. Benton	Chinook, Mont.
	Fort Belknap irrigation district	do	George Niehauer	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	B. W. Powell	do	NancyM.Haddock	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	do	Louis Galloway	Roosevelt, Utah.
Newlands	Truckee-Carson irrigation district	Fallon, Nev.	Phillip Hiibel	Superintendent.	J. R. Hannifan	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	Henry Sutherland	Watermaster	Joseph R. Tuddenham.	Newton, Utah.
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr.	G. H. Storm	Manager	Joe F. Oshack	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.
Post Falls	Post Falls irrigation district	Post Falls, Idaho	Howard McGinley	President	Ben Morehouse	Post Falls, Idaho.
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	A. N. Smith	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.
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.
Umatilla (Warren Act Contractors)	Stanfield irrigation district	Stanfield, Oreg.	Emmett Myers	Superintendent.	Mabel M. Richards.	Stanfield, Oreg.
Umatilla (Warren Act Contractors)	Westland irrigation district	Hermiston, Oreg.	Ed Nunn	Manager	Al Langenwalter	Hermiston, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo.	Jesse R.Thompson	do	H. D. Galloway	Montrose, Colo.
Vale	Vale Oregon irrigation district	Vale, Oreg.	Walter C. White	do	Walter R. Ulrey	Vale, Oreg.
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash.	G. L. Sterling	do	G. L. Sterling	Ellensburg, 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.	Clifford Kail	do	Clifford Kail	Yakima, Wash.

U. S. GOVERNMENT PRINTING OFFICE: 1950

NOTES FOR CONTRACTORS

Contracts Awarded During January 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2800	Central Valley, Calif.	Jan. 18	Spare parts for generators for Keswick power plant	General Electric Co., Denver, Colo	$21,601
2814	Missouri River Basin, Mont	Jan. 10	3 23,500-horsepower vertical-shaft hydraulic turbines for Canyon Ferry power plant.	Newport News Shipbuilding & Dry Dock Co., Newport News, Va.	522,690
2819	Boulder Canyon, Ariz.-Calif.-Nev.	do	1 120-inch butterfly valve and upstream flange for unit A9, Hoover power plant.	United Engineering & Foundry Co., Pittsburgh, Pa.	127,310
2820	Davis Dam and Gila, Ariz.-Nev	Jan. 18	Four supervisory control and telemetering switchboords and 1 lot of carrier-current apparatus for Wellton-Mohawk pumping plants Nos. 1, 2, and 3, and Gila substation, schedule 2.	Control Corp., Minneapolis, Minn.	50,000
2831	Missouri River Basin, Kansas	Jan. 4	Structural steel for spillway bridge at Cedar Bluff Dam	Kansas City Structural Steel Co., Denver, Colo	27,359
2837	do	Jan. 24	1 20,000-kilovolt-ampere voltage-regulating transformer for Shelby substation, schedule 2.	Moloney Electric Co., St. Louis, Mo	33,033
2837	Fort Peek, Mont	Jan. 24	One 115,000-volt and two 34,500-volt circuit breakers for Shelby substation, schedules 5 and 6.	Allis-Chalmers Mfg. Co., Denver, Colo.	31,313
2840	do	do	Circuit breakers, and 24 disconnecting switches for Havre substation, schedules 6 and 7, and items 18 and 18a of schedule 9.	Pacific Electric Mfg. Corp., San Francisco, Calif	101,446
2843	Davis Dam, Ariz.-Nev	Jan. 19	Furnishing and installing heating and ventilating system for system dispatchers building at Phoenix, Ariz.	Newhall-Mason & Co., Phoenix, Ariz.	18,800
2844	Columbia Basin, Wash	Jan. 10	Construction of earthwork and structures for West canal, station 1229+74 to 1992+50, Quincy pump lateral, and excavation for Quincy pumping plant, schedules 1 and 2.	Marshall, Haas & Royce, and Haas & Rothschild, Belmont, Calif.	983,631
2844	do	do	Construction of earthwork and structures for West canal, station 1992+50 to 0241+50, schedule 3.	Minnis & Shilling, Eugene, Oreg	396,961
2845	Shoshone, Wyo	Jan. 5	Construction of earthwork, tunnel, structures, and surfacing for Shoshone power plant access road.	Taggart Construction Co., Cody, Wyo	60,159
2848	Central Valley, Calif	Jan. 25	Constructing 230-kilovolt transmission line, Shasta-Tracy No. 1 and 2, Cottonwood-Artois section.	Don L. Cooney Co., Seattle, Wash	367,691
2849	Davis Dam, Ariz.-Nev	Jan. 19	Construction of all structural work for Coolidge substation, schedule 1.	Arizona Sand & Rock Co., Phoenix, Ariz	344,218
2849	do	Jan. 24	Installation and completion of electrical work for Coolidge substation, schedule 2.	Stolte, Inc, Oakland, Calif	134,191
2851	Santa Barbara, Calif	Jan. 9	Construction of Tecolote tunnel and access road, schedule 3.	Carl M. Halvorson, Inc., and H. Halvorson, Inc., Portland, Oreg.	4,750,155
2852	Boise, Idaho	Jan. 24	Installation of electrical and mechanical equipment for Anderson Ranch power plant, switchyard, and outlet works.	Vernon Bros. Co. and C L Electric Co., Boise, Idaho.	179,644
2855	Colorado-Big Thompson, Colo	do	Construction of earthwork, concrete lining, and structures for 5 miles of Poudre supply canal.	Peter Kiewit Sons' Co., Denver, Colo.	1,216,698
2856	Missouri River Basin, Wyo	do	Construction of 20 miles of Boysen-Thermopolis 115-kilovolt transmission line.	Reither Construction Co., Aitkin, Minn.	154,940
2857	Central Valley, Calif	Jan. 18	Construction of earthwork and structures for Delta-Mendota canal and Firebaugh wasteway.	United Concrete Pipe Corp. and Vinnell Co., Inc., Baldwin Park, Calif.	3,067,484
2859	Colorado-Big Thompson, Colo.	Jan. 25	Completion of Granby pumping plant, schedules 1 and 2	Eichleay Corp., San Francisco, Calif	259,204
2868	Central Valley, Calif	Jan. 26	Completion of Shasta power plant	O'Connor Bros., Red Bluff, Calif.	112,623
2871	Colorado-Big Thompson Colo	do	Construction of Olympus siphon, station 57 + 68.97 to 87 + 40.00, and access road, Estes-Foothills power acqueduct.	Peter Kiewit Sons, Co. Omaha, Nebr.	321,921
2874	Colorado-Big Thompson, Colo	Jan. 19	Construction of 5 miles of Pole Hill-Flatiron 115-kilovolt transmission line.	J & J Construction Co., Oklahoma City, Okla	66,291
R1-HH-11	Hungry Horse, Montana	Jan. 3	Clearing part of Hungry Horse Reservoir site, schedules 1 and 3	Wixson & Crowe, Redding, Calif	2,446,850
R1-HH-11	do	do	Clearing Hungry Horse Reservoir site, schednles 2, 4, and 5	J. G. Trisdale, Redding, Calif	2,484,360
R1-CB-39	Columbia Basin, Washington	Jan. 13	Completion of Central grade school at Grand Coulee Dam	Cherf Bros. Construction Co., Ephrata, Wash	111,530
R2-86	Santa Barbara, Calif	do	Residences for Government camp at Cachuma Dam site, schedule 3.	R. McGray, Santa Maria, Calif.	43,843
R2-86	do	do	Residences for Government camp at Cachuma Dam site, schedule 1.	C. C. Sharps, Arroyo Grande, Calif	103,951

Construction and Supplies for Which Bids Will Be Requested By May 1950

Project	Description of work or material
Boulder Canyon-All-American Canal, Ariz.-Calif.	Construction of 3 steel-beam concrete deck bridges, each with 3 37-foot spans, across the Coachella canal, about 25 miles from Yuma, Ariz.
Boulder Canyon, Ariz.-Nev	3 460-volt unit auxiliary power boards and 2 250-volt battery distribution boards for Units A-3, A-4, and A-9, Hoover power plant.
Do	Main switchboard for Units A-3, A-4, and A-9, Hoover power plant.
Central Valley, Calif	2 60- by 30-foot radial gates and 2 180,000-pound radial-gate hoists for Delta Cross channel
Do	Motor-driven water pumps, 120 cubic feet per second at 180-foot head, for Trauger pumping plant, situated between Lindsay and Strathmore, Calif.
Colorado-Big Thompson, Colo.	Construction of 3 miles of 8-cubic-feet-per-second unlined section of Dixon Feeder canal, including furnishing and laying 1,600-feet of 24-inch diameter precast concrete pipe, 4 miles west of Fort Collins, Colo.
Do	Construction of 1 mile of 7- to 10-foot diameter concrete-lined Carter Lake pressure tunnel with portal structures, about 6 miles west of Berthoud, Colo.
Do	Construction of 72 miles of 115-kilovolt, 3-phase, wood-pole transmission line between Brighton and Brush, Colo.
Do	1 vertical-shaft, Francis-type, 48,000 horsepower at 825-foot head hydraulic turbine for Pole Hill power plant.
Do	Erection of steel warehouse building, consisting of 2 sections, 1 40- by 162-feet and 1 30- by 100-feet, near Loveland, Colo. Work also includes installation of plumbing, fire protection system, and electrical work; grading and gravel surfacing of warehouse area; furnishing and erecting chain-link fence; and construction of septic tank.
Columbia Basin, Wash	Construction of machine shop, central heating plant, and fire station; completion of warehouses A and B; and completion of all industrial area grading, surfacing, underground conduits, and water, sewer, drainage, and heating distribution lines at Grand Coulee Dam.
Do	Miscellaneous handrailing, fabricated steel, and ornamental fabricated aluminum for Grand Coulee pumping plant.
Do	1 150,000-gallon steel plate water storage tank for Grand Coulee Dam.
Fort Peck, Mont	100,000-pounds of galvanized fabricated steel structures for Havre substation.
Hungry Horse, Mont	5 8- by 8-inch cooling water jet pumps for Hungry Horse power plant.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Hanna substation, 34.5-kilovolt high voltage.
Missouri River Basin, Mont	Construction of Missouri diversion dam, with 650-feet-long and 30-feet-high concrete spillway gate structure, concrete headworks structure, 2,600-feet of earth dikes, and access road, on the Missouri River near Fort Peck, Mont.
Do	3 25- by 16-foot radial gates and 3 25,000-pound radial-gate hoists for Missouri diversion dam.
Do	1 375- and 1 65-cubic-feet-per-minute air compressor and 1 8-cubic-feet-per-minute portable air compressor; and 2 42-inch diameter by 10-foot air receivers, and 1 24-inch diameter by 6-foot air receiver for Canyon Ferry power plant.
Do	1 125-ton traveling-bridge type crane and 1 70-ton traveling-gantry type crane for Canyon Ferry Dam and power plant
Missouri River Basin, Nebr	Construction of Cambridge lateral system, requiring 100,000-cubic yards of excavation, 4 miles west of Holbrook, Nebr.
Do	Furnishing and laying 2,600 feet of 8-inch diameter perforated pipe subdrain and 300 feet of corrugated metal pipe on the Cambridge canal.
Do	Construction of 1 3-bedroom conventionally built, insulated, 24- by 12-foot wood-frame caretaker's residence; 1 21- by 48-foot garage and laboratory building; and sewer, water supply, and propane gas systems at Trenton Dam.
Missouri River Basin, N. Dak.	Construction of 65 miles of 230-kilovolt, 3-phase, double-circuit, steel tower Garrison-Bismarck transmission line with overhead ground wires. Goverment will furnish transmission line materials.
Do	Construction of 105 miles of 230-kilovolt, 3-phase, single-circuit, steel tower Bismarck Jamestown transmission line with overhead ground wires. Government will furnish transmission line materials.
Do	Construction of 55 miles of 115-kilovolt, 3-phase, single-circuit, wood-pole H-frame Garrison-Voltaire transmission line with overhead ground wires. Government will furnish transmission line materials.
Missouri River Basin, Wyo	Construction of Anchor Dam, a concrete arch structure 196 feet high and 550 feet long at the crest, on Owl Creek, 10 miles northwest of Thermopolis, Wyo.
Do	Construction of 20,000-kilovolt-ampere Thermopolis substation, 115- to 69-kilovolt to 33-kilovolt.
Do	250,000 pounds of galvanized fabricated steel structures for Thermopolis substation.
Do	Main control board, annunciator relay cabinet, distribution board, 460-volt unit substation, and battery charging motor-generator set for Boysen power plant.
Do	125,000 pounds of fabricated structural steel roof girders for Boysen power plant.
Riverton, Wyo	Construction of 27 miles of partially lined Muddy Ridge canal and laterals, including North Branch, 15 miles north of Riverton, Wyo.

Little Drops of Water

MAY RUIN OR REDEEM your thirsty acres, depending upon what you do to prevent splash erosion, so graphically depicted in these close-ups taken by V. P. Robey of the Naval Research Laboratory and submitted by W. D. Ellison, who will be remembered for his articles on raindrop erosion which appeared in the May and June 1949 issues of the Reclamation Era. These pictures were taken with an 8 by 10 view camera at approximately one-millionth of a second. As a drop fell through a light beam, it would trip a strobe light, automatically taking its own picture.

The Reclamation ERA

April

1950

The Reclamation ERA

April 1950

Volume 36, No. 4

Issued monthly by

The Bureau of Reclamation

United States Department of the Interior, Washington 25, D. C.
Approved by the Bureau of the Budget

CONTENTS

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.
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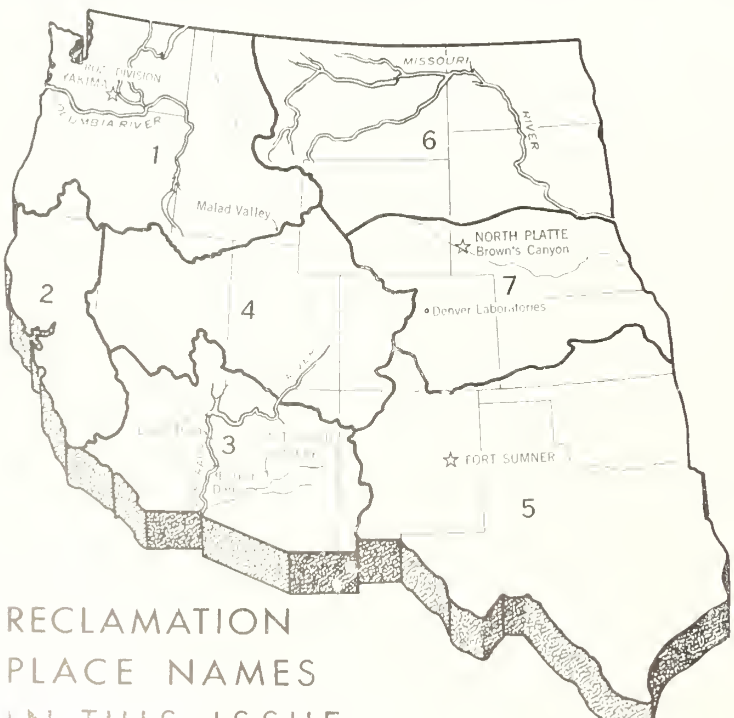

RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO IN THE ERA

Reclamation Abroad

The projects for the regulation of the water of the upper Nile include the construction of irrigation works on the White and Blue Nile and the regulation of the lakes. The improvements are intended to provide the water necessary to enable both Egypt and the Sudan to develop their agricultural possibilities to the utmost. The commission to examine these projects consists of an irrigation engineer nominated by the Indian Government, a British physicist nominated by the University of Cambridge, and an irrigation engineer nominated by the American Government (Mr. H. T. Cory, consulting engineer, United States Reclamation Service). The commission is to report on three heads: (1) After examination, on the physical data involved in these projects: (2) the manner of apportioning water between Egypt and the Sudan; (3) proper apportionment of expense to be borne by Egypt and the Sudan.

(From the April 1920 issue of the Reclamation Record, predecessor to the Reclamation Era, p. 181.)

United States Department of the Interior

Oscar L. Chapman, Secretary

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

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REGION 6: K. F. Vernon, Regional Director, P. O. Box 2130, Billings, Mont.
REGION 7: Avery A. Batson, Regional Director, 318 New Customhouse, Denver, Colo.

Soil Conservation District Supervisors Meet With Federal Representatives

Another step was taken toward an all-out Nation-wide effort to conserve land and water resources when an association of more than 1,000 delegates representing 4½ million farmers active in soil-conservation districts throughout the 48 States invited representatives of the United States Departments of Interior and Agriculture to confer with them at a 3-day session from February 28 to March 2, 1950, at Atlanta, Ga., during the Fourth Annual Convention of the Association of Soil Conservation District Supervisors.

A committee on relations with Federal agencies was formed at the invitation of the president of the association, Kent Leavitt, and met for the first time at this convention, for the purpose of exchanging information and consulting on ways and means of effecting closer coordination among the local, State, and Federal agencies concerned with soil and water conservation, and the soil conservation districts.

These districts, organized under State laws, are somewhat comparable to irrigation districts and are organized for the purpose of carrying out soil conservation programs within the 2,220 soil conservation districts now organized which contain (as of January 1, 1950) approximately 1,207,812,000 acres in the 48 States, Puerto Rico, the Virgin Islands, Hawaii, and Alaska.

The Federal representatives clarified their functions and relationships with State and district groups and a resolution was unanimously adopted to pave the way for mutual support of the soil conservation, reclamation, and related associations of land and water users. Another resolution was passed supporting increased Federal weed-control programs in cooperation with land and water users. The convention went on record expressing appreciation of the interest and helpfulness of the Federal delegates and the members of the association pledged their continued cooperation with the agencies represented.

Harry Polk, president of the National Reclamation Association, was one of the principal speakers and devoted his talk to the theme of the common interests of soil conservation districts and irrigation districts, pointing out their similarities in organization, operation, and problems.

Farrington Carpenter of Hayden, Colo., prominent western livestock man and original director of the Division of Grazing, United States Department of the Interior, outlined the evolution of the soil conservation movement, stressing the fact that it is up to the farmers themselves, in the final analysis, to assume responsibility and leadership in conserving soil and water.

Waters Davis of League City, Tex., active in Texas and Gulf Coast soil conservation and drainage work, was elected to the office of president of the association, succeeding Kent Leavitt.

Georgia Governor Eugene Talmadge and his wife were present, with the Governor making the keynote speech. In addition to the above-mentioned participants, among those in attendance were Congressman Stephen Pace from Georgia, of the House Agriculture Committee; and Sam Broadbent, Assistant Director of the Estimates Division, United States Bureau of the Budget. Representatives of the United States Department of the Interior were Eugene D. Eaton, Assistant Director, Branch of Operation and Maintenance, Bureau of Reclamation; Edward N. Kavanaugh, Director of Soil Conservation, Office of Land Utilization; Evan L. Flory, Chief, Branch of Soil Conservation, Bureau of Indian Affairs; Walter Walker, Area Soil Conservationist, Concho, Okla., Bureau of Indian Affairs; G. M. Kerr, Chief, Division of Range Management, Bureau of Land Management; O. Emil Gianni, Assistant Chief, Soil and Moisture Conservation, Bureau of Land Management; Harold J. Burback, Regional Chief, Soil and Moisture Conservation, region 4, Salt Lake City, Utah, Bureau of Land Management; and James Silver, Regional Director, region 4, Fish and Wildlife Service, Atlanta, Ga.

DON'T FORGET!

HAVE YOU CHANGED YOUR ADDRESS LATELY?

GOING TO MOVE SOON?

Let us know immediately so we can change our mailing list—it takes time, you know.

We'll do our best to deliver the Reclamation Era at your door, but we have to know where it is.

CREDITS AND CORRECTION

The photographs on page 59 of the March 1950 issue showing results achieved by spraying Johnson Grass with aromatic oil, were taken by Harry W. Myers of Region 3. We regret the omission of this credit line, as well as the credit due Glen Peart, Department of the Interior photographer, who took the photo of the National Reclamation Association's legislative committee meeting with Bureau of Reclamation officials, which appeared on page 64 of the March 1950 issue.

On page 54 of the March issue, the value of Q in "Measuring Well Water" should be 205 instead of 2.05 References to table 1 and table 2, lines 27 and 28 should be reversed.

OUR FRONT COVER

Measuring the height of the crown above the top of the 6-inch diameter vertical pipe. Note that the flow is more turbulent than in the photograph on page 76 illustrating part 2 of "Measuring Well Water". The discharge was estimated to be about 420 gallons per minute with a crown height of about 6⅜ inches.

OUR BACK COVER

PREVIEW of next month's issue

Engineer Fred O. Jones was in the midst of this beehive of activity about a year ago. When the Chinese Communists threatened the area where the Upper Tsing Yuan Tung Dam was under construction Mr. Jones returned to this country bringing with him many unusual photos like this. He was also at the site long enough to obtain the material for his interesting and exciting story, "How China Builds a Dam", which appears in next month's issue of the ERA. Make certain your subscription is current so as not to miss this unusual story. Also next month—WATER REPORT!

DAMAGING AS IT DIMINISHES is this cloud of cavitation bubbles, collapsing from right to left. The above photograph, reproduced from high-speed moving pictures, illustrates the collapse of cavitation bubbles as water flows through the cavitation machine. The pictures were taken showing a view into the machine through a Plexiglass window which was substituted for a test specimen. The cloud of troublesome bubbles has reached its maximum size in the right-hand moving-picture frame, and the frames to the left show the successive stages of collapse.

TROUBLESOME BUBBLES

by GEORGE B. WALLACE, Materials Engineer, Branch of Design and Construction, Denver, Colo.

WOULD YOU BELIEVE that bubbles smaller than the soft, sparkling, bubbles that make a hot bath seem so luxurious are capable of damaging concrete and steel hydraulic structures? Well, they are, as exemplified by the damage shown in the pictures on page 67. Such damage frequently occurs where there is turbulence in fast-flowing water because it is here that the bubbles are most apt to form and collapse. The collapse of harmless-looking bubbles in flowing water has damaged the outlet works of many of the Bureau's structures.

Two types of bubbles that look very similar may form where turbulence occurs in fast-flowing water. One type is filled with air and the other with water vapor. The vapor-filled bubbles are the troublesome little spheres that cause the damage. They will form in running water whenever the pressure at a point in the liquid is reduced to its vapor pressure. These bubbles are carried downstream with the flow until they reach an area of sufficiently high pressure to cause the vapor to condense. Condensation is very rapid and the water rushing in to occupy the vacated space produces the destructive forces.

Estimates of the pressure at the point of impact of these bubbles range from about 10,000 pounds per square inch to as much as 100,000 pounds per square inch. Whatever the true pressure, it is sufficient to erode away large quantities of high quality concrete and to penetrate through a 2½-inch-thick steel pipe in a comparatively short time. This phenomenon of vapor bubble formation and collapse has been given the name "cavitation," meaning formation of cavities, because when first observed the bubbles were believed to be cavities devoid of either vapor or gas.

Recently, costly repairs resulting from the damage done by collapsing bubbles indicate the need for understanding and controlling the destructive forces of cavitation. Typical of the damage done to many of our outlet control structures by the cavitation process is the pitting which occurred in the Parker Dam gate piers.

To determine which of various materials used in hydraulic structures could best resist erosion due to cavitation, tests have been performed in the Bureau of Reclamation's Denver laboratories where test specimens were exposed to a standard cavitation attack in a specially designed cavitation machine. Concrete specimens were tested in this machine to determine the effect of water-cement ratio, strength, consistency, entrained-air content, size of aggregates, and age on the resistance of concrete to erosion. The rate of the erosion on these specimens was determined by measuring the volume of material eroded during a standard exposure period.

As shown in the accompanying illustration, water flows through the cavitation machine at sufficiently high velocity to produce vapor bubbles in the low-pressure area of the Venturi throat. The frequent explosions (or, more properly, *im*plosions) due to the collapsing bubbles hammer at the boundary surface. The rate of destruction by this pounding action is dependent upon the resistance of the boundary material and the frequency, pressure, and temperature of bubble collapse.

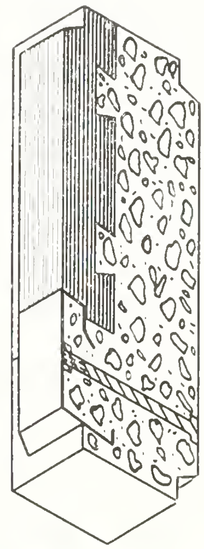
It was found from these laboratory tests that concrete specimens with low water-cement ratios were more resistant to erosion than those with high water-cement ratios. Tests were then undertaken to reduce the water-cement ratio of the exposed surface only by employing a vacuum to the surface of some of the test specimens through a porous mat attached to the forms, and thereby removing excess mixing water needed only to make the concrete placeable. Other specimens were cast against absorptive form lining material for the same reason. Surfaces of some specimens were densified by stoning a rich sand-cement grout into the voids of the concrete surface and grinding the surface to a smooth finish. Results of tests on these specimens showed that through proper proportioning, surface treatment, and curing, the resistance of concrete to cavitation erosion may be extended three or four times. However, these tests indicate that the best concrete will not resist the forces of cavitation for a prolonged period.

Since the cavitation attack consists of numerous impacts due to the collapsing bubbles, it probably causes a fatigue type of failure in concrete specimens. Bureau engineers hypothesized, therefore, that repeated shocks might be absorbed or cushioned by a resilient protective coating placed over the exposed concrete surface. To test this theory, specimens were coated with Amercoat, Neoprene, Thiokol, and rubber, and exposed to the standard cavitation tests.

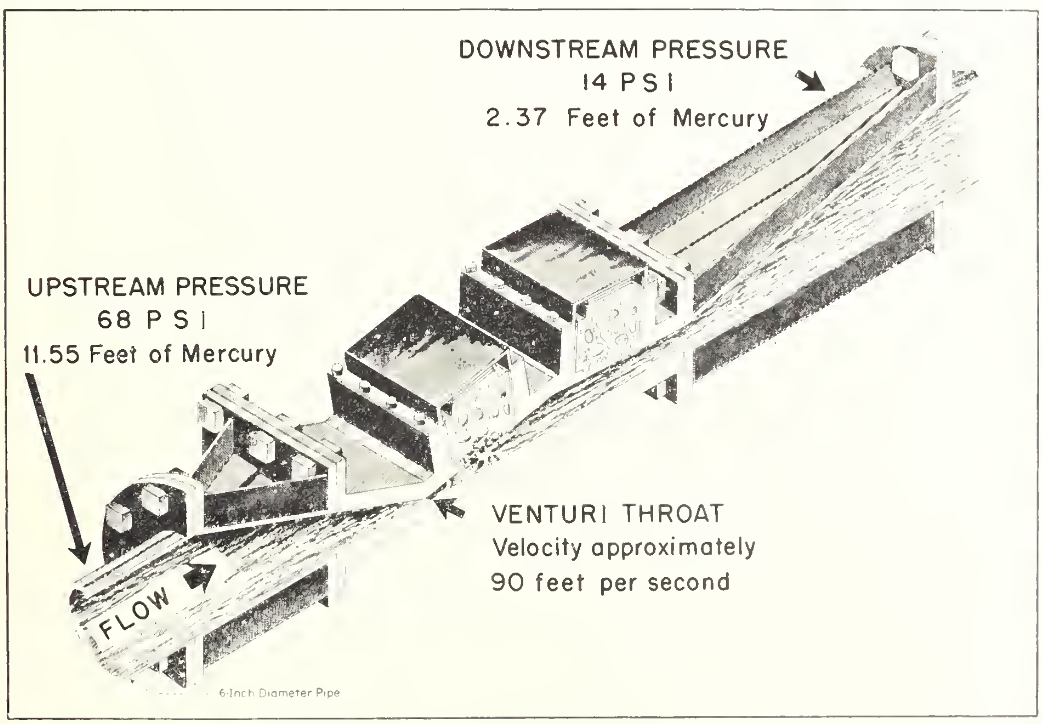
Of these protective coatings only a 1-inch thick rubber plate embedded into the concrete proved to be effective in protecting the concrete from the forces of the cavitation attack. The bond of the other coatings to the concrete surface failed, and the coatings were eroded away. Adequate bond of the rubber slab to the concrete was obtained by fabricating the edges of the slab in the form of a wedge which protruded downward into the concrete. After 50 hours of exposure to the cavitation test this specimen remained undamaged. Additional tests are being made to determine the feasibility of protecting concrete in the field in this manner.

In contrast to vapor-filled bubbles, pressure applied around air bubbles reduces the volume of the bubbles in proportion to the pressure applied, somewhat in the same manner that a rubber chair cushion is compressed. This property of air bubbles proved to be quite useful, for by introducing air into the water containing vapor-filled bubbles, the shock produced by the collapse of the vapor-filled bubbles was cushioned by the compressible air-filled bubbles. Concrete and mortar specimens exposed to the cavitation test with about 3 percent air introduced into the flowing water suffered considerably less damage than specimens exposed to the flow without induced air.

(Please turn to page 69)



AFTER 50 HOURS OF EXPOSURE to the forces of cavitation attack, the 1-inch thick rubber plate embedded in a concrete specimen at right remained undamaged, although the square piece of concrete was worn away, as demonstrated by the central picture. At extreme right is a cross-section showing how the rubber plate was mounted on the concrete. Below is an artist's drawing of the cavitation machine used in the Bureau's Denver research laboratories for evaluating resistance of concrete and protective coatings, while at lower right is a close-up of erosion induced by cavitation on Parker Dam gate piers, Parker Dam Power project, Arizona-California.



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Reclamation's Hall of Fame

Nomination No. 8

GEORGE HEBARD MAXWELL

by

R. O. BAIRD, Branch of Project Planning, Phoenix, Ariz., Region 3 (headquarters at Boulder City, Nev.)

EVERY FAMILY A HOME OWNER was the slogan of George Hebard Maxwell along with many other concepts which since his time have been written into the law of the land and become standard operating procedure for multiple purpose reclamation developments over the world.

George Hebard Maxwell was one of the great American conservationists of the late nineteenth century. With John Muir, Gifford Pinchot, Ernest Seton Thompson, and others of like convictions, he lived to see fulfilled to a large extent the programs which he and his contemporaries urged upon an unsympathetic America.

Each of these men crusaded primarily for the conservation of one particular resource, but their fields overlapped. Together, they reversed completely America's attitude toward utilization of basic resources. George Maxwell chose water as his main interest in conservation.

As a court reporter for the United States district courts in California, and later as a young lawyer, Maxwell became aware of the injustice which State tax laws imposed on the irrigation farmers near his birthplace of Sonoma. Taking up the battle, he stumped California for 5 years, urging a change in tax laws to recognize the inability of farmers to pay as much in years producing no irrigation water as they did in years of plentiful supply. Eventually he won his fight.

During this period Maxwell became thoroughly familiar with the problems of irrigation farmers. From a chance discussion with Brigham Young, Jr., on the train between Tombstone, Ariz., and Los Angeles, Calif., he learned how Mormon farmers stored snow in the canyons near Salt Lake City for a summer water supply. This set him to thinking about methods of stream flow equalization. His previous activities had taught him that tax adjustments were merely a palliative—the disease from which California irrigation farming suffered could be cured only by controlled stream flow. To him his life work was now defined, and until his death in 1946, at the age of 86, he never ceased his efforts.

He realized early that stream control was a problem too large for individual irrigation companies or even individual States. Therefore, he became an uncompromising opponent of the proposal known as cession, still occasionally voiced, which was then being advanced as a cure-all for irrigation project ills. Had the cessionists been successful, the public domain would have been ceded to the various States for disposal, and Federal reclamation would not exist today.

To counteract the cession trend, Maxwell founded the National Irrigation Association, predecessor of the National Reclamation Association, in June 1899. So successful were his efforts and those of his colleagues that in 3 short years their work culminated in the passage of the Reclamation Act of June 17, 1902.

For about 5 years following the passage of the Reclamation Act, Maxwell lent his assistance to potential projects in settling their internal differences and organizing water users' associations. The first of these associations was the Salt River Valley Water Users' Association of Phoenix, Ariz. Judging from existing letters and testimonials, the union of various water companies in this area, and the amalgamation of their divergent demands and views, were due largely to Maxwell's influence.

A conservationist always, Maxwell did not rest on his laurels after the passage of the Reclamation Act. Expanding his field of endeavor, he founded the Homecroft Society in 1907 to promote his philosophy that enduring social stability and preservation of government depended upon rooting every family to the land in a home of its own—city workers as well as country workers.

Maxwell held the conviction that "every family a home owner" could be welded to the conservation of water—not only in the West through irrigation, but throughout the entire country. His Homecroft idea was adopted by Samuel Spencer of the Southern Railroad Co., but Spencer's untimely death in 1909 prevented its full development. Henry Ford adopted an almost identical plan at a much later date, and several other industrialists are now following Maxwell's lead.

George Maxwell anticipated the Hoover Commission by approximately 40 years in recommending that all Federal conservation agencies be united under one head, and he succeeded in his efforts to have the Newlands amendment to the 1917 Rivers and Harbors Act passed. This amendment, establishing a waterways commission for the purpose of coordinating all navigation, reclamation and flood control activities, was, in effect, repealed in 1919 and almost 30 years elapsed before Maxwell's basic beliefs were again recognized.

As executive director of the Pittsburgh Flood Commission and Ohio State Water Conservation Board, Maxwell kept busy demonstrating and expounding his principles of soil and water conservation and upstream engineering. His work at Zanesville, Ohio, on the Muskegan drainage led to the adoption of his program by the newly founded Soil Erosion Service, and in addition formed the basis for much of the work program of the Civilian Conservation Corps.

During all his years in Washington, working for the passage of legislation, Maxwell never had the term "lobbyist" attached to his name. His fellow Cosmos Club members, at a mock trial wherein he was accused of being a lobbyist, described his activities on behalf of conservation legislation very aptly: the court decreed that his activities were those of a "militant evangelist," and he therefore was not guilty of the charge of "lobbyist."

When he was 80 years old, Maxwell settled down to a relatively peaceful, but by no means inactive, life of authorship, dedicated to furthering his conservation and social betterment schemes. He ventured into the public spotlight only once again—that was to receive a testimonial from the National Reclamation Association at their 1941 annual convention, held in Phoenix, Ariz.

The Sonoma (Calif.) Index-Tribune summarized the great conservationist's life work in an article published on April 5, 1940: "Some day grateful generations yet unborn will erect monuments to George H. Maxwell in recognition of what he has done for humanity. He knew he was right and for 40 years preached his doctrine in the face of vicious opposition."

The End

THE BIRTHPLACE OF RECLAMATION—George Maxwell's home at Phoenix, Ariz., with present-day leaders in reclamation discussing current problems: Lloyd Miller, member of the Columbia Basin Commission and president of the board of directors, Roza District, Yakima project, at left, and Commissioner of Reclamation Michael W. Straus. Not shown in this photo are the legends which were painted below the eaves—"Golden Rivers and Treasure Valleys," "National Reclamation Association, organized 1899, George H. Maxwell, Executive Director," and partly visible above, "American Society for National Service—National Educational Memorial Institute." *Photo by Al Olchvary, Jr., submitted through the courtesy of Bryon Akers, editor, The Great Southwest Magazine.*

TROUBLESOME BUBBLES

(Continued from page 67)

High-speed movies of the cavitation action were taken in the laboratory at the rate of 3,000 frames per second through a plexiglass plate installed in place of a specimen. These pictures show that the induced air produces a damping effect upon the collapse of the bubbles. Without air in the flow, the "cloud" of cavitation bubbles was well formed in a definite pattern. With the introduction of air, the "cloud" pattern was not so well defined, and the collapse did not seem as severe.

Studies to date indicate that there are three effective methods that may be used to combat cavitation erosion. The first and most useful method is the proper design technique to avoid conditions favoring vapor bubble formation; second, means for introducing air into the cavitation area to cushion the shock produced by the collapsing vapor bubbles, and third, installation of protective resilient coatings securely bonded to the surfaces exposed to cavitation erosion.

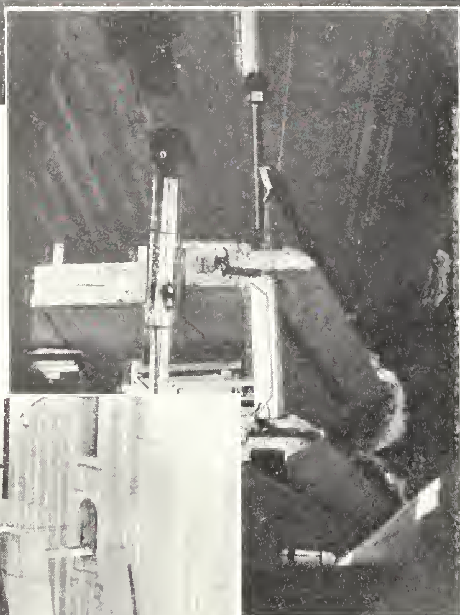
The End

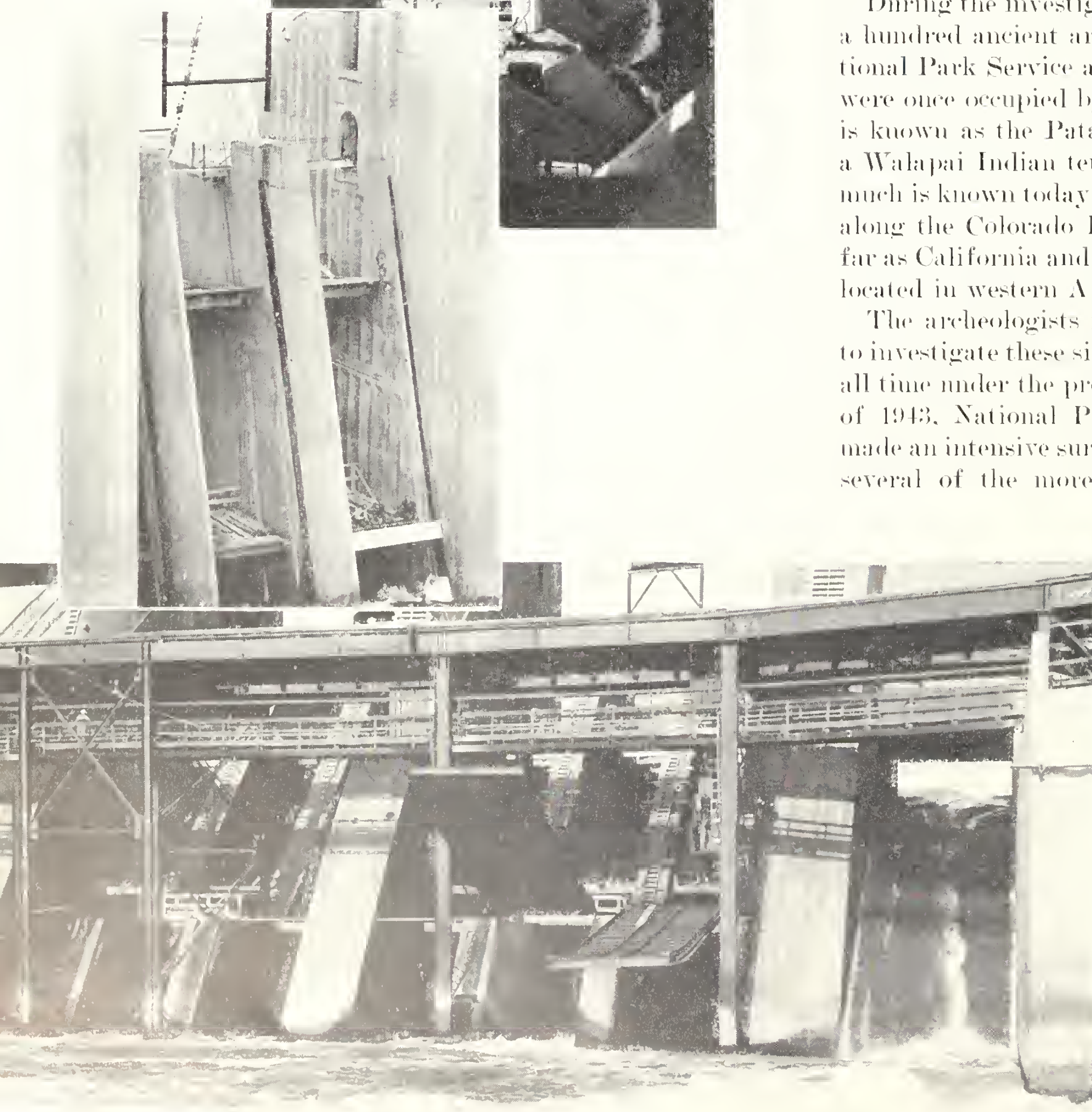
Taliaferro Appointed Region 2 Power Manager

Henry B. Taliaferro of Sacramento was appointed Regional Power Manager of the Bureau of Reclamation's Region 2, on March 3, 1950, to fill a vacancy left when Power Manager Ben W. Creim went to Washington, D. C., to become Administrator of the Southwestern Power Administration.

Since the war Mr. Taliaferro has been Mr. Creim's assistant in Sacramento, Calif. A native of Washington, D. C., he was graduated from the U. S. Naval Academy at Annapolis, worked for the Potomac Electric Power Company in the office of the Vice President and Chief Engineer, then was office engineer to the Chief of Construction at Bonneville Power Administration in Portland, Oreg., and later was assistant in the Washington office of the Bonneville Administration.

During the war Mr. Taliaferro was on active duty in command of a L. S. M. flotilla in the Mediterranean and Pacific theaters, and later Commanding Officer of the *U. S. S. Rolette*, including service preparatory to the atomic bomb test at Bikini. His citations include the Legion of Merit with Combat Clasp from the President, and the Commendation Ribbon from the Commander-in-Chief of the Atlantic Fleet. •





THE CONCRETE STOP LOGS DROPPED into the spillway slots at Davis Dam.

Gradually, water began to rise behind the dam, covering an area which had been combed thoroughly by various members of the National Park Service for several years. Now the archeologists and surveyors could give way to those who develop parks, picnic grounds, bathing, boating, fishing places, and other necessities of a Federal recreation area.

Davis Dam, located between Nevada and Arizona, 67 miles below Hoover Dam, the newest link in the chain of Reclamation structures on the Colorado River, was backing up a lake of cold blue Colorado River water—not the "Muddy Colorado" here—but a startling expanse of bright cobalt blue which makes the traveler rub his eyes in disbelief as he suddenly comes upon this enormous, swiftly flowing, cold, blue river, in the midst of the parched desert.

As the river rises and becomes a 67-mile-long lake (name as yet undecided), the National Park Service's plans for making the most of the recreational possibilities of the reservoir area will be put to good use. Several years before construction work began on the dam, George F. Baggley, superintendent of the Lake Mead Recreation Area (of which the Davis Dam area is a part) set his crews to work investigating the shores of the river-soon-to-be-a-lake, so they could prepare for the time when the new lake would rise and provide a new beauty spot for the Southwest.

During the investigations, survey parties found more than a hundred ancient archeological sites along the river. National Park Service archeologists discovered that these sites were once occupied by early day Indians who gave us what is known as the Patayan Culture. "Patayan" comes from a Walapai Indian term meaning the "Ancient Ones." Not much is known today about these early people, but they lived along the Colorado River Valley south of Hoover Dam as far as California and the Gulf. Large settlements were also located in western Arizona.

The archeologists realized they would have to work fast to investigate these sites thoroughly before they were lost for all time under the proposed man-made lake, so in the spring of 1943, National Park Service archeologists and helpers made an intensive survey of the reservoir area, and excavated several of the more important sites. They unearthed a

THE RIVER IS RISING—but no cause for alarm. A lake 67 miles long is being created behind Davis Dam shown at top with the stop logs in place, raising the water at the dam to a depth of 70 feet. The Arizona end of the dam is at the left. Below is a bird's-eye view of workmen lowering one of the 240 concrete stop logs (each 13½ feet long and weighing 6 tons) into one of the slots in the spillway of the dam. The third photo down shows stop log No. 202 going into place. At immediate left you can see the water flowing through the radial gate outlet at the right of the picture. The other outlet on the opposite side of the spillway is not in the photo. This operation backed up the river 30 miles. *Second photo from the top by E. S. Ensor, others by Phil Blew, both Region 3 photographers.*

EACH ROOM WITH A VIEW like this. The National Park Service photo at right was taken from a spot close to the proposed lodge site at Katherine Wash as the new lake began to form behind Davis Dam. Map below submitted through the courtesy of the National Park Service.

NEW LAKE in the Desert

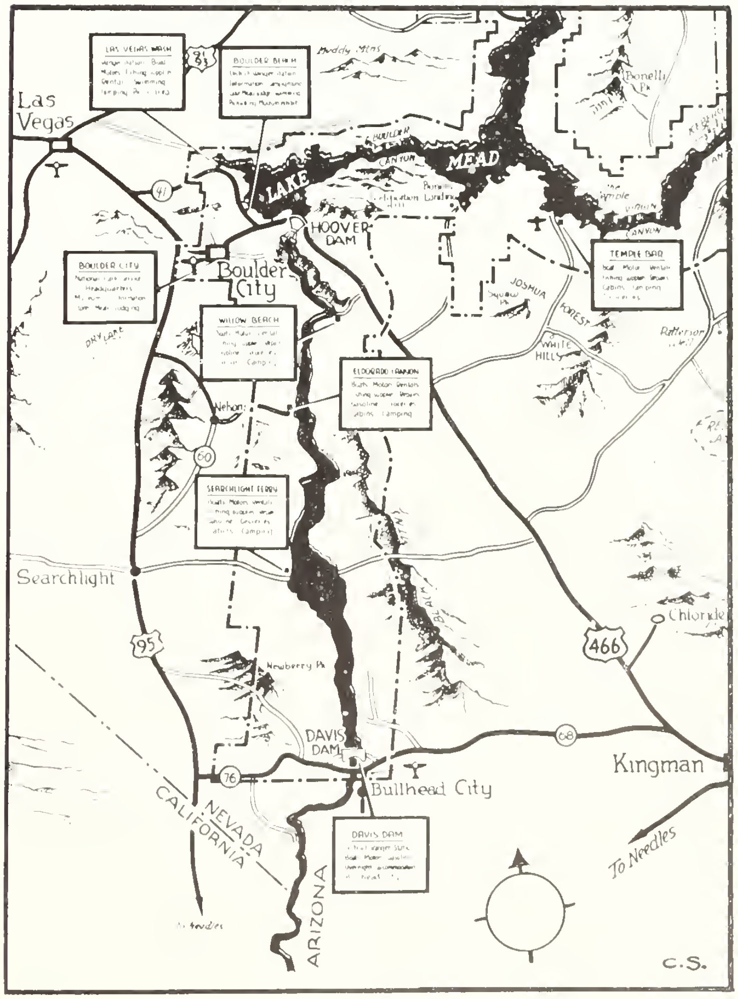
by **RUSSELL K. GRATER**, Park Naturalist, Lake Mead Recreational Area, Arizona and Nevada

wealth of material that is still being studied and cataloged to provide clues to the way of life of the Ancient Ones. Most of these artifacts are stored at Boulder City, Nev., where they make up an extremely interesting and valuable collection. In time, many of them will be available for use in museum displays portraying the daily life of these Indians who lived along the Colorado.

Ring Bolt Rapids is another spot where National Park Service photographers and historians are saving history for posterity. In 1866, a steamboat was brought up the Colorado River as far as old Fort Callville—now deep under the water of Lake Mead. Chugging against the swift rapids was no easy task, so the crews drilled holes into the sheer rock above the stream, and fastened bolted rings at intervals along the canyon wall. They threaded ropes attached to the steamboat through a ring, fastened the ropes to a winch aboard the boat which then literally pulled itself up over the fast water. For several years after 1866, steamboats made regular trips up the river, returning with freight from the settlements in Utah for the outside world. Today, these old rings are still found in place, and all available information and photographs are being obtained before they disappear under the new lake.

A one-time oasis in the desert, richly green with palm and eucalyptus, later a wilderness of mesquite, arrow-wood and quailbrush, is now under many feet of water, but its story, too, has been salvaged by the National Park Service workers. The Tatum Ranch on the Arizona side of the Colorado River, was located a short distance downstream from Searchlight Ferry, and although now only a memory, was well-known throughout the region in the early 1900's. The old ranch lay in a broad flat valley above the river where the extremely fertile soil required only water to produce almost anything desired. The ranchers pumped the water from the river into irrigation canals that transported it to the spots where it was needed. Alfalfa fields dotted the valley, and several crops of hay, furnishing feed for great herds of cattle, were cut each year. Large numbers of melons were also grown in the valley, and the mesquite and cats-claw blossoms produced quantities of honey. The ranch was abandoned and will form the largest part of the new reservoir site.

The National Park Service will preserve the archeological remains, the records of the iron rings along the river, the story of the Tatum Ranch, and other objects of historic interest that have been salvaged so that pages in the history of the Southwest would not be wholly lost. Now that the initial on-the-spot studies have been completed, and the new reservoir is forming, the careful plans for developing the



THE "ANCIENT ONES" will be remembered. At top, Dr. Gordon Baldwin of the National Park Service uncovers one of a number of prehistoric burials at Willow Beach, and below is a typical Indian petroglyph found in the area to be covered by the lake. These relics of the past will be preserved by the National Park Service, which also made these photographs available for publication.

area's recreational resources are being put into action. Roads are to be built along the shore so that visitors can reach the water at various points. A comfortable lodge, picnic area, public campgrounds, a beach, and a public boat landing are to be located a short distance up the lake from Davis Dam on the Arizona side. The boat landing, campground, and beach will be near Katherine Wash, with the lodge and picnic grounds situated above the wash on low mountains overlooking the lake, which is expected to add to the already spectacular and picturesque scenery of the area. There is much to do before this recreation spot becomes a reality, however. New roads must be constructed, sanitation and water systems installed, electricity and other utilities provided, and the million and one details attended to which will protect and assist the future visitors to the area.

Farther up the lake there will be three other vacation spots—near the old Searchlight Ferry crossing, in El Dorado Canyon, and at Willow Beach. Concessioners have already been given authority to build and operate overnight accommodations and to furnish boats for fishing or boating excursions. The fishing should be good. This part of the Colorado is now famous for its trout fishing, and for several years after the reservoir is formed the fish population should multiply rapidly, as the nutritious plant life covered by the reservoir should produce abundant fish food.

Plenty of information will be available for the future tourists and vacationers, due to the long years of planning by the Park Service. Small exhibit structures containing material regarding the lake, local geology and biology and other items of outstanding interest will be located at key points along the highways above the lake shore and around the developed areas to help the visitors to understand and enjoy the region.

Much remains to be done to make the Davis Dam area the outstanding recreational center it is destined to become, but it is now definitely out of the blueprint stage. How fast and how far the National Park Service can go in carrying out its plans depends to a great extent upon the availability of funds. THE END

Secretary Chapman Approves Three-Way Power Deal in Missouri Basin

A wheeling contract insuring service of Federal power to public bodies over private power lines, and an REA cooperative contract which will clear the way for advance construction of a 700-mile backbone transmission grid to supply power to users in North Dakota at the lowest possible cost, were approved on March 10, 1950, by Secretary of the Interior Oscar L. Chapman.

The contracts with the Otter Tail Power Company and the Central Power Electric Cooperative, both operating in North Dakota, were characterized by Secretary Chapman as a major step in three-way cooperation between the Federal Government and public and privately owned utilities.

The contract with the Otter Tail Company of Fergus Falls, Minn., provides for the transmission of federally generated power over the company system to preference customers of the government in North Dakota and for the sale of secondary power generated at Federal plants to the private utility.

The contract with the Central Power Electric Cooperative in central North Dakota will permit transmission over the Government system of power from the 40,000 kilowatt steam-electric plant the cooperative plans to build near Voltaire, N. Dak., in advance of the time the lines will be needed for the transmission of federally generated power from Garrison Dam and other hydroelectric facilities now under construction in the Missouri River Basin. The contract with the cooperative also provides for the sale of secondary power to that group by the Government.

The Bureau of Reclamation, at the request of the cooperatives and with the authorization of the Congress, is completing the contracts and proceeding with construction of the transmission system well in advance of the time it will be energized finally from Garrison and Fort Randall Dams and other hydroelectric facilities which will be a part of the Missouri Basin project. This is being done in order to alleviate North Dakota's present power shortage by cooperation with the Central Power Electric Cooperative. •

ROTATION PROGRAM—At immediate right, Frank Tessitor of the Bureau's materials laboratory (in white shirt) shows Ralph E. Landerholm, mechanical engineer from Washington State College, and Hurlburt Anderson, architectural engineer from the University of Colorado, how to test a concrete cylinder. At extreme right, Engineer A. J. Peterka shows two civil engineering graduates the proper flow measuring technique, using the Felcon Dam model in the hydraulic laboratory. Thomas C. Mosely (Colorado School of Mines) measures, as Rex A. Paschke (University of Colorado) records the data. Below, Electrical Engineers Richard S. Jacobson (University of Wisconsin) and Reed E. Ashton (University of Utah) review a power problem with W. A. Morgan (center), head of the power system analysis section.

Interns in Reclamation

by

L. W. BARTSCH, Head, Administrative Engineering Division, Branch of Design and Construction, Denver, Colo.

Taking a leaf from the book of medicine, the Bureau of Reclamation now has its interns, too—young people in engineering and administrative functions blending schooling with experience.

In the days when Bureau employees numbered a few hundred and the annual program was measured by a few million dollars, a young staff member such as an engineer, or accountant, had no trouble grasping the scope of operations. He had chances to perform various jobs, and to exhibit special talents in technical or administrative work.

The new employee seeking a career in reclamation today, however, might be overwhelmed by the organization required for a 387-million dollar reclamation program. Engineering has become highly specialized, and the youngster may easily get lost or get misplaced. Administration and management also have become more complex.

Chief Engineer L. N. McClellan recognized the importance of the problem and believed it would grow, not diminish, in the years ahead. And last June he did something about it in the engineering work of the Branch of Design and Construction—launching a rotation plan to encourage maximum individual development. He believed that both the Bureau and the men would benefit if the newcomers could get a better understanding of the broad phases of Bureau organization. Further, the tendency to channel beginning engineers immediately into one specialty would be reduced.

Under the Bureau's pilot plan now in full operation with 275 men participating, the recent graduates will move through four to eight differing assignments, a new one coming every 3 months for 1 to 2 years. Other Branch and Regional Directors are watching this system with the idea of adopting it to help out in their staffing problems.

In a way, the engineers are serving an internship, similar in basic purposes to the postgraduate work of a medical doctor. The doctor takes his crackling-new degree into a hospital, where he gets practical experience in diagnosis, internal medicine, surgery, and the other specialties of medicine. The engineer joining the Bureau applies textbook learning and slide rule to the analysis, laboratory study, design, and construction of irrigation and power structures. Both professionals have an opportunity to prove their skills in specialties, while learning more about related fields. Having varied experience at the end of the training periods, both are better able to seek the specialty in which they will be most contented, and therefore are likely to progress fastest.

To illustrate the rotation system, let's follow an engineer who might be considered typical as he moves through the transition from college classroom to the offices of one of the world's great engineering organizations.

First, he's interviewed and is assigned to a "career advisor." The advisor, an experienced engineer, reviews and discusses qualifications and training, and lays out a schedule in accord with current needs of the Branch of Design and Construction.

The initial assignment is, perhaps, to the hydraulic laboratory, where he will help build models of dams in advanced planning stages, and will compile data on models of outlet works. The second three months might find him in a section of the dams division where he will get first-hand knowledge of the many problems encountered in the design of spillways and outlet works.

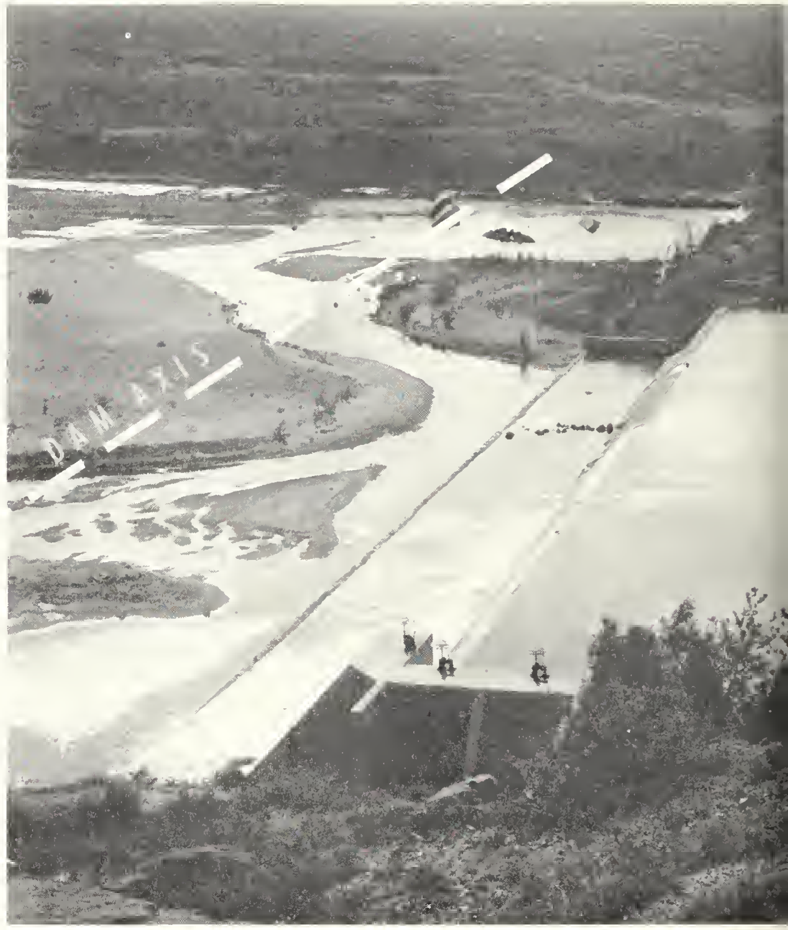
Subsequent assignments in the Branch will take him into the pipe lines and siphons section of the canals division;

(Please turn to page 82)

FORTIFYING FORT SUMNER

by CAROL HITT

a former feature writer for The Amarillo, Tex., News-Globe



IN A PART OF THE SOUTHWEST where not too long ago Billy the Kid practiced murder without warning, the Apache Mescaleros roamed the prairie, raiding settler's outposts and leaving behind only death and destruction, and where an unsuccessful attempt was made to hold the Navajoes on a reservation, a peaceful kind of change will soon begin that will affect the life and productivity of every citizen in central New Mexico.

Last July President Truman signed a bill that will authorize the construction of a new diversion dam on the Pecos River at Fort Sumner, N. Mex. In the following 90 days, the Bureau of Reclamation and more than 200 of the district's water users set a speed record for completing irrigation repayment contract negotiations.

Besides constructing the new dam, the present 15-mile canal will be rehabilitated. New hydraulic pumps will be installed to lift water into the high line canal and the 8-mile high line canal will be put into A-1 operating condition.

These improvements will guarantee a dependable water supply for 150 farms in the 6,500-acre project, representing the latest link in a chain of irrigation activities in the Fort Sumner district.

As long ago as the Civil War, while battles were being fought in the East and South, United States troops, stationed at Fort Sumner to guard Indians confined in the vicinity, constructed an irrigation system for 2,000 acres on which to raise crops for their own use and food for their mounts.

The project was in operation for 5 years, then abandoned. Interest in this type of agriculture was revived in 1903, when two individuals initiated the existing development by filing on the natural stream flow and flood water of the Pecos.

The Fort Sumner Land & Canal Co. acquired the filings in 1906, and the following year started construction of diversion works and other facilities. Irrigation has been practiced continually in this area since 1907.

Irrigation is necessary for profitable farming in this semiarid area, but the project experienced many setbacks. The Fort Sumner Land & Canal Co. went into receivership in 1911.

Charles F. Fishback acquired the works a year later. However, Fishback was unable to finance the project's rehabilitation. He sold the property for $100 to the Fort Sumner irrigation district.

Difficulties continued to beset the development. The newly organized district issued $28,100 in bonds to finance the first unit of a concrete diversion dam, which was undermined and destroyed soon after completion.

The district sold another $122,000 bond issue in 1934 to construct new facilities, including the existing concrete diversion dam, and an additional $18,000 to refinance outstanding indebtedness.

A section of the dam was washed out in 1941, and another bond issue of $40,000 was sold to repair the structure. A year later another section was washed out and replaced only by a dirt fill which can be destroyed by a minor flood.

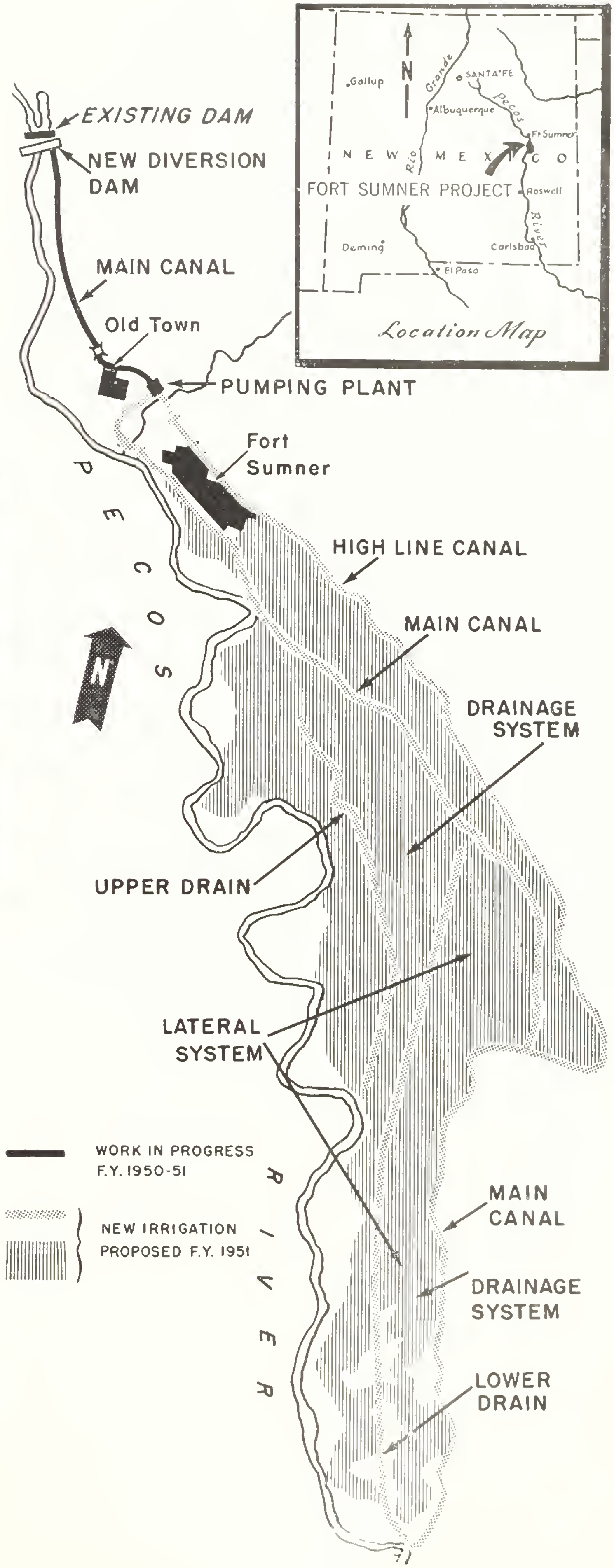
The district contains approximately 8,035 acres of land in a narrow strip 12 miles along the east bank of the Pecos, near the town of Fort Sumner. The surrounding rolling plains are devoted to ranching.

Acreage under irrigation has varied from year to year. In 1937, a total of 6,650 acres was under irrigation. In recent years the acreage has been about 5,000, due to the dwindling efficiency of the irrigation works.

The project's principal source of water supply is that portion of the Pecos River flow contributed by numerous springs in the vicinity of Santa Rosa, N. Mex. No storage is involved, as the water right is for direct diversion only.

The project lands receive water from the springs which passes through the Alamogordo Reservoir built by the Bureau of Reclamation for the Carlsbad project in 1937. The people of the Fort Sumner project are assured of receiving as much water as they are entitled to under their water right.

At left: Close-up of the unstable diversion dam on the historic Fort Sumner project, New Mexico, which will be eliminated after completion of the new dam, as indicated in the photo. The temporary earth-fill section near the center of the present dam was built in 1942 following the destructive Pecos River flood. Inset shows damage to diversion dam on Carlsbad, N. Mex., project caused by this flood. *Left photo by Dale Hovey, formerly of Region 5. Inset photo by David R. Cervin, Region 5.*



Plant growth has cut down the amount of water which can be carried through the canals, laterals, and drains. The upper 3-mile reach of the main canal has a capacity of 100 second-feet, while the lower 12-mile section has a capacity of 70.

Present capacity of the high line canal is only 11 second-feet, and it also contains restrictive cross-sections and structures. Water losses are high in portions of the canal system, and structures generally have deteriorated.

The 1940 population of DeBaca County was 5,726, an increase of 625 over the 1930 figure. This gain occurred almost entirely in the town of Fort Sumner, which had a population of 1,661 in 1930.

A railroad trunk line passes through Fort Sumner, adjacent to the project lands. Highway transportation is excellent. Markets in general are local. Most of the produce not sold to local consumers is purchased at the farms by truckers from other points. Electric service is available.

Climate and soils are favorable for high production with sufficient water, but the productivity of many of the irrigable district lands has and is being gradually lost.

Rehabilitation of the Fort Sumner irrigation district works, including construction of a stable diversion dam, represents a victory over water waste. The End

FIGURE 4 (REFERRED TO IN THE TEXT) appears at upper left, a sketch showing a stream of water from a vertical discharge pipe. The photograph shows how to measure the height of the crown above the top of the 6-inch diameter vertical pipe with a combination square. Note the smooth surface of the water. The discharge was estimated to be about 220 gallons per minute with a crown height of about 2⅝ inches.

Measuring WELL WATER

PART 2

by H. R. McDONALD, Engineer, Hydrology Division, Branch of Project Planning, Denver, Colo.

You can measure the "head" and estimate the number of gallons per minute flowing out of a well which pumps the water straight up in the air, or vertically, by using a small carpenter's combination square or trisquare with a slide and level bubble assembly which can be set with a thumb screw.

However, you must use a different formula than the one for horizontal or diagonal pipes. For those who wish to go into the background more thoroughly, we mention the fact that F. E. Lawrence and P. L. Braunworth verified this in 1906 when they conducted experiments at Cornell University. Their paper, entitled "Fountain Flow of Water in Vertical Pipes," was published in Volume LVII, page 264 of "Transactions of the American Society of Civil Engineers" for 1906.

On the basis of their experiments, we prepared tables and developed the graph shown in figure 5. All you have to do is measure the inside diameter of your pipe in inches. With your combination square, or trisquare plus the level bubble assembly, measure the number of inches the water rises above the top of your pipe, shown as H in figure 4. From these two measurements and by consulting figure 5 you can easily find the number of gallons per minute discharged from a vertical pipe between 2 and 16 inches in diameter.

I made some experiments at the University of Utah a few years ago which indicate that this method assures less than 10 percent margin for error. When you measure a low head, however, a small error in measurement will produce relatively large errors in measurement of discharge. For example, if $H=1$ inch on a pipe 4 inches in diameter, an error of only one-eighth inch will give you an answer in gallons per minute about 15 percent from the actual output. But, if you make the same error when $H=8$ inches, the answer would be only 2 percent out of line.

You may also find it difficult to measure surging flow at high heads with great accuracy.

If your well is cased with pipe which is not of standard diameter, or the ends of the casing are frayed or damaged, you might adopt a method we used on a groundwater investigation in the Malad Valley, in Idaho. We found that many of the flowing wells which we were to measure were either not standard diameter or had been damaged by the driller during construction, making our calculation method impossible. We overcame this difficulty by using lightweight galvanized iron tubes, about 3 feet long, inserted into the pipes. We used tubes a size smaller than the casing, wrapping them with burlap strips to make them fit tight and force all flow through the tubes. We found that the tube, if inserted far enough into the casing so that the top of the tube is not more than a few inches above the top of the casing, will not reduce the amount of flow. We were then able to measure with the trisquare the height of the stream of water above the tube, and, using the diameter of the tube as the other measurement, determined the discharge from the curves in figure 5.

Besides finding out how much water is coming from a well, you may want to know how much energy is expended in pumping a quantity of water for a given period of time. If you are using electric power to operate the pump, first be sure to cut off all other electrical equipment operating on the same meter as your pump, and then apply this formula to compute the power input for your pump:

$$\text{Kilowatt input} = \frac{K_h \times n \times 60 \times 60}{t \times 1{,}000}$$

K_h = disk constant, representing watt hours per revolution of the disk,

n = number of disk revolutions in the observed period,

t = time in seconds of the period of observation.

Your electric company or meter reader will be able to give you the disk constant, K_h, for your meter if it is not stamped on the name plate.

The following is a simple problem using this equation:

If $K_h=2.4$,

$n=20$,

$t=60$,

$$\text{then kilowatt input} = \frac{2.4 \times 20 \times 60 \times 60}{60 \times 1{,}000} = 2.9$$

You can find out how much horsepower is being used for your pump motor at the same time by dividing the kilowatt input by 0.746.

To eliminate errors you may want to check the horsepower input computed in this manner with the horsepower rating of the motor, usually stamped on the name plate. The computed horsepower input should not vary more than about 25 percent from that stamped on the motor name plate and if it does, it would be well for you to repeat the observations. Some difference between the two values may be expected because electric motors are capable of producing more than their rated horsepower for short periods of time, although overheating and subsequent damage to the motor will often result.

We also have another useful equation to help you find out how many kilowatt-hours are consumed in pumping 1 acre-foot of water. Once you know how many gallons per minute are being discharged from your well, you can find out the number of cubic feet per second by dividing the number of gallons per minute by 7.5 to find the number of cubic feet, and by 60 to find the number of cubic feet per second. With this figure, you can then work out the equation: Kilowatt hours consumed in pumping 1 acre-foot of water=

$$\frac{\text{Kilowatts input}}{\text{Discharge in cubic feet per second} \times 0.0825}$$

It should be noted that this equation automatically accounts for the motor and pump efficiency, as the total power input is measured.

In electrical installations involving motors of more than about 25 horsepower, only a fractional part of the total electrical power consumption is usually metered. Ordinarily, meters will not carry more than 5 to 10 amperes, and in large installations, therefore, both a current and voltage transformer are sometimes used. If these transformers are used, you will have to multiply the numerator of the equation for computing kilowatts input by the product of the ratios of these transformers; that is, if C_t (current transformer ratio) = 10 : 1, and V_t (voltage transformer ratio) = 4 : 1, then the numerator of the equation must be multiplied by 40.

As an example, using the assumed values of the previous sample problem:

$$\text{Kilowatts input} = \frac{2.4 \times 20 \times 60 \times 60 \times 40}{60 \times 1{,}000} = 115$$

$$\text{Horsepower input} = \frac{115}{0.746} = 154.$$

The transformer ratio is usually stamped on the name plate or is otherwise indicated on the transformers, but if it is not, this factor may be obtained from your power company or meter reader. The total number of hours operated by the pump or the quantity of water pumped for a month or year may then be computed from meter readings obtained for the period of time desired.

THE END

EDITOR'S NOTE: Last month we published Engineer McDonald's explanation of how to measure water gushing out of horizontal, or diagonal pipes, and find how many gallons were being pumped out per minute. Here are the necessary instructions, formula, graphs, and charts to use in figuring out how many gallons per minute are flowing from artesian wells or pumps with vertical pipes. In addition, we are publishing the formula for checking up on the number of kilowatts used to pump the water. So take an inventory of your well. It will help you to make sure that the water is working and not being wasted.

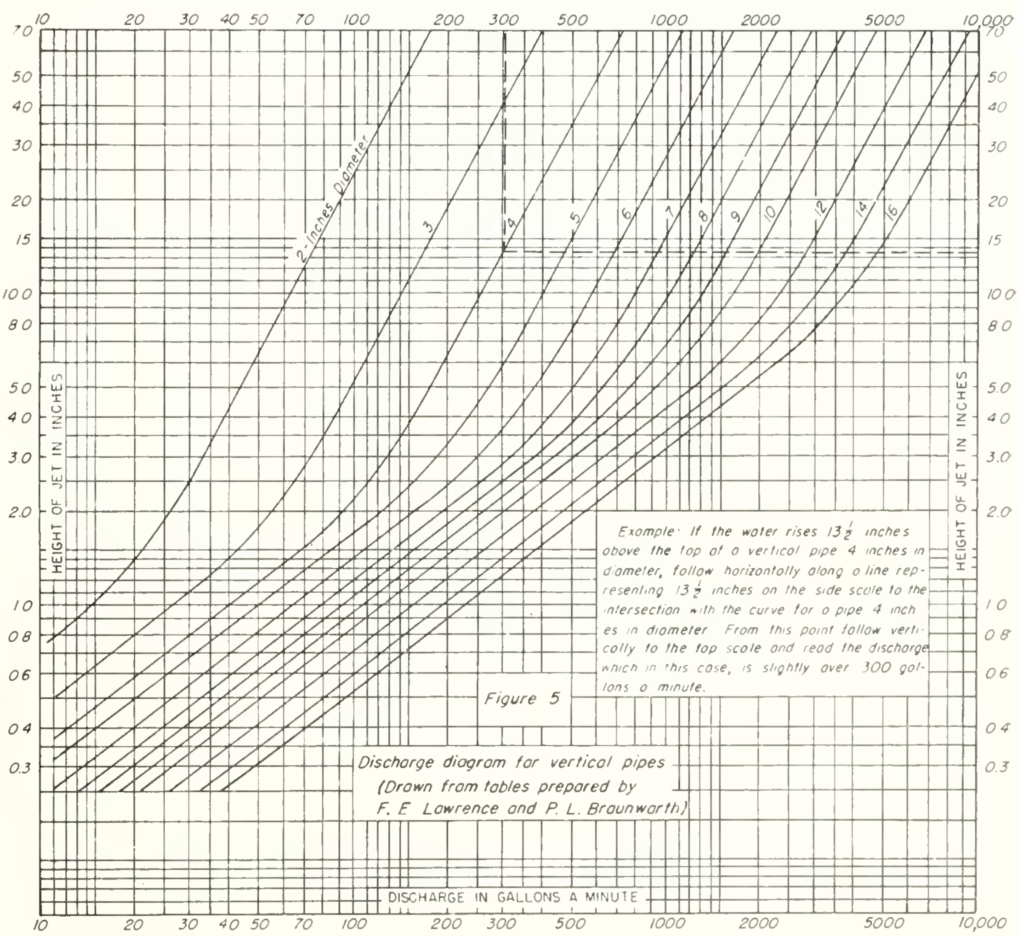
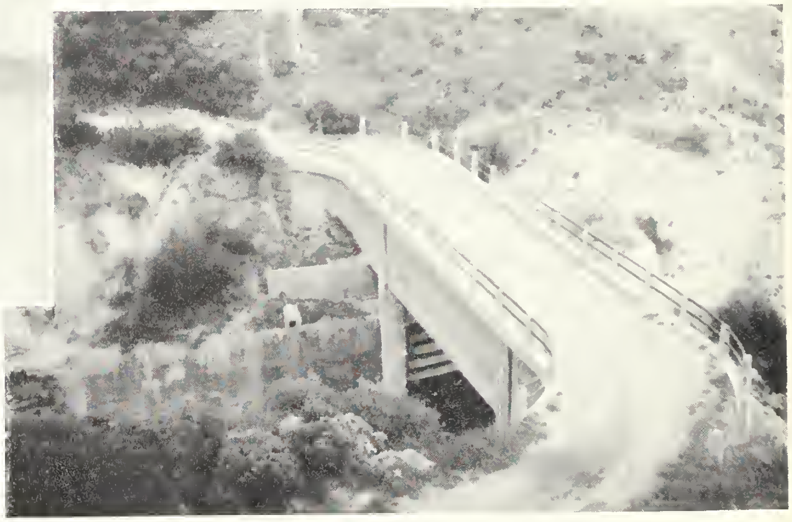


Figure 5

Discharge diagram for vertical pipes (Drawn from tables prepared by F. E. Lawrence and P. L. Braunworth)

AFTER 25 YEARS the intake transition of Brown's Canyon siphon is in excellent condition as indicated by the photo at left. Below is the roadway on top of the siphon barrel. *Both photos submitted by the authors.*



Brown's Canyon Siphon—Designer's Dilemma

by H. P. BUNGER and C. A. PRESCOTT, Branch of Design and Construction, Region 7, Denver, Colo.

OLDTIMERS IN THE BUREAU, observing the extensive recruitment drives to induce college graduates to consider Government service, may well exclaim in amazement, "It wasn't like this in the old days!"

Time was when a youngster fresh out of college approached the engineer in charge of personnel and offered as his chief qualification a college degree in civil engineering. "Well, ain't that just dandy," the discomfitingly unimpressed reply would often be. If a vacancy existed, the youngster was forthwith yanked from his dream world of immense dams and aqueducts and ended up pushing a pen as a tracer or driving stakes with an axe. Those were the enlightened old days. In the real old days, time was when the choice was even less—he was simply handed the axe. Time was, that is.

What has this to do with Brown's Canyon Siphon? Time was when the youngster, ready and anxious to prove his stuff, was allowed to demonstrate his newly acquired knowledge by designing Brown's Canyon Siphon.

Brown's Canyon is located on the south side of the North Platte River about midway between Scottsbluff, Nebr., and the Wyoming State line. It is crossed by the Fort Laramie Canal of the North Platte project. In this vicinity the terrain is composed of level plains dissected by steep narrow canyons. The chief geological formation is brule clay. This is a compact silt, brownish-tan in color. Where the canal crosses, the brule clay has been eroded into almost sheet canyon walls. Anchoring a siphon with a capacity of 900 second-feet in material like this is no easy matter.

Another interesting feature was introduced by the decision to use the top of the siphon as a roadway. The nearest crossing of Brown's Canyon was 2 miles distant. Since the canal must be patrolled regularly, means must be provided for crossing the canyon.

After several years of investigations and preliminary designs, the favored design was to carry the canal across the canyon in a hollow-arch siphon. This plan had two serious disadvantages:

(1) The supports for the arch had to be anchored in brule clay and any settlement of the foundation would cause cracking;

(2) Calculations of stresses were somewhat beyond the ability of a young engineer to cope with.

For these reasons, when the problem of design was turned over to young Howard P. Bunger, he came forth with an alternative design which was eventually adopted. Bunger's design carries the barrel into the canyon so that the roadway slopes are a maximum 7 percent, and then crosses the canyon in a horizontal section supported by columns on continuous footings. The footings are 19 by 6 by 2 feet, the columns 3 feet square and approximately 90 feet high, and the span between columns is 40 feet. The horizontal section of the barrel and the columns are designed to act as cantilevers to the midpoint of the siphon. Contrary to the usual practice of today, this design required the siphon barrel to be a monolith, with no expansion joints.

Another significant deviation from present-day construction methods was the forces used for construction. Time was when the important features of a project, or those involving complex designs, were constructed by Government forces. Contractors were employed where skilled labor was not so important in the days before the construction industry of the West had reached its present high status of competence. Accordingly, Brown's Canyon Siphon was con-

(Please turn to page 84)

DE-WEEDING THE ROZA MAIN CANAL. At left, the waterweeds are receiving a dose of aromatic solvents. Below is a close-up shot of the spray boom nozzles in action.

Aromatic Solvents for Waterweeds

Part I—A Hundred-Mile Victory Over Waterweeds on the Roza Division

by

V. F. BRUNS, Agronomist (General), United States Department of Agriculture, Bureau of Plant Industry, Soils and Agricultural Engineering, cooperating with Washington Agricultural Experiment Station, in charge of Weed Investigations at the Irrigation Experiment Station, Prosser, Wash.

and

W. H. FARMER, Land Use Specialist, located at Yakima, Wash., United States Department of the Interior, Bureau of Reclamation, Region I (headquarters at Boise, Idaho)

Aromatic solvents—petroleum or coal-tar naphthas, mixed with emulsifying agents—are teaming up with 2,4–D for a knock-down, drag-out fight to the death with weeds in irrigated areas in the western United States. Most weeds won't have a chance, now. 2,4–D sprays them to death on the ditchbanks, while the aromatic solvent mixture goes into the irrigation canals, laterals, and drains and kills them under water.

In 1949, a group of men, expert in methods of weed-killing, from the United States Bureau of Plant Industry, Soils and Agricultural Engineering, the Washington State Experiment Station, private irrigation districts, and the Bureau of Reclamation, combined their know-how and equipment to test aromatic solvents on a total of 27 different irrigation channels which spider-webbed a 115-mile stretch of the State of Washington's Yakima Valley. They used 10,000 gallons of these materials to treat 350 miles of weed-choked channels under actual performance conditions.

We must admit that not all aromatic solvent treatments were completely effective, but the experiment produced a high percentage of results which were rated from "satisfactory" to "excellent."

At any rate, this treatment was sufficiently effective and popular with the various irrigation districts to cause them to report that they will double the quantities of material next year and try it out on larger canals.

During the season the waterweed killing crew put 2,600 gallons of aromatic solvents into 100 miles of Roza Division (Yakima project) canals and laterals.

First they treated small laterals to try out different types and concentrations of the mixture. The information and experience they gained from these preliminary experiments proved extremely useful early in July. At that time waterweed growths in the large Roza Main Canal were getting serious. Richardson's pondweed and other species of underwater weeds had taken over, growing as long as 10 feet, and so densely that the mass of stems and leaves covered many sections of the canal from bank to bank. Ditchriders reported that the water surface was rising from 2 to 4 inches a day and getting too close to the tops of the banks.

A SERIOUS SITUATION—And so it is when Richardson's Pondweed (inset), takes control of an irrigation canal. The scene above was taken along a main canal in October 1942 near Toppnish, Wash.

Canal operators went on a 24-hour patrol to keep an eye on softening ditchbanks. They drove trucks to the canal bank, loaded with tons of soil and rock, which the workmen used to plug up the numerous leaks and seepage points. The alert operators of the canal realized that they would have to take drastic measures to protect the main canal. This was the first time waterweeds had been a serious problem on this new project.

On July 20, aromatic solvents streamed into a section of the Roza Main Canal which had a water flow of 75 cubic feet per second. Leaders from other irrigation districts, also plagued with serious waterweed problems, were on hand to watch the operation.

Men from the Wapato irrigation district, the Roza Division, and Prosser irrigation experiment station pooled their efforts and equipment to meet the emergency. They used three small power-spraying units, equipped with spray booms, with their batteries of nozzles to apply the solvents under water.

They took a water pipe 18 feet long, 1 inch in diameter, and drilled into it $\frac{1}{8}$ inch holes, staggered at right angles (45°) 6 inches apart—somewhat like a flute or whistle. This contrivance was patterned after a unit used successfully on the Richland irrigation district main canal with a water flow of 40 cubic feet per second. It became an "agitator boom" when fitted up with a hose, attached to a large air compressor, and placed 3 feet under water a few feet downstream from the applicator boom. As the solvents left the nozzles, the agitator boom churned the water, thus doing the vitally necessary job of mixing the chemical thoroughly with the otherwise smooth flowing water. This method seems to be the answer to the problem of mixing and spreading the chemical in canals with no weirs or other structures to create the water turbulence needed.

The dosage was 6 pints of the new type California Spray Emulsifier No. 5 to every 50 gallons of California Spray Solvent No. 7R. The spray nozzles were placed 3 feet below the water surface and 362 gallons of the emulsified aromatic solvent went into the canal for 30 minutes. This amounted to a concentration of 358 ppm (parts per million) or 4.83 gallons per cubic foot per second.

The crew moved a mile downstream (actually 1.15 miles), set up the equipment, and as the milky, treated water passed by, sprayed booster shots of 200 gallons for 30 minutes. They made a second booster application a little more than a mile downstream (actually 2.7 miles below the original treatment point), using the same amount of solvent during a half-hour period.

Within 24 hours after treatment, the next day, farmers and canal operators saw the results. The waterweeds were limp, most of them had sunk to the bottom of the canal. The water level dropped 12 to 15 inches. Within a week, as the waterweeds continued to disintegrate, the water level dropped another 3 to 6 inches, in spite of the fact that the water flow at the lower end of the canal had increased 20 cubic feet per second, due to much less seepage in the reduced area of the canal now carrying the water.

For a distance of 7 miles below the last booster station the waterweeds had been knocked out by the aromatic solvents, and the inspection crew noticed evidence of chemical injury for an additional 3 miles.

Ten miles above this section in the Roza Main Canal, only 8 days later (July 28) a second emergency treatment was made. The water flow there measured 150 cubic feet per second, and the same compressed air unit was used as an agitator boom. The crew used one $1\frac{1}{2}$- and one 3-horsepower pumping unit complete with 21-foot spray booms and hoses. This equipment is regularly used for spraying 2,4-D on ditchbanks.

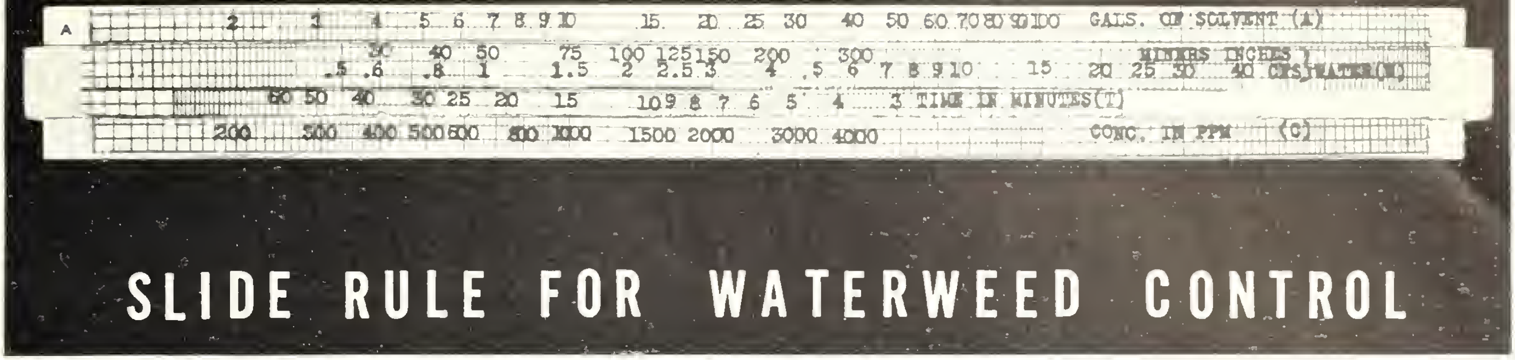
The procedure was the same as before, but the concentrations of aromatic solvent and emulsifier were slightly increased. This time 1 gallon instead of 6 pints of emulsifier No. 5 was added to each 50 gallons of solvent No. 7R. Of this mixture, 750 gallons were applied for 30 minutes (370 ppm or 5 gallons per cubic foot per second. A booster shot of 425 gallons went into the stream 1.2 miles below the initial station.

Most of the waterweeds sank out of sight as far as the previously treated section 10 miles downstream. Ditchriders noticed the treated blanket of water, accompanied by dead bugs and naphtha odor, as far as the lower end of the canal 25 miles distant. Limp waterweeds in midchannel proved that at least part of the emulsion carried for this distance.

Anxious-sounding district people at the lower end of the canal phoned to report a possible canal break, as the water surface had dropped 18 to 24 inches over night. They were quite relieved to learn it was caused by the weed-killing treatment, which they did not know had already been made.

These two series of emergency treatments kept the Main Canal free of water weeds for the irrigation season, and although considerable quantities of chemical were needed for such a large canal, no crop damages were reported.

(Please turn to page 82)



SLIDE RULE FOR WATERWEED CONTROL

FIX UP YOUR SLIDE RULE this way if you want to save time in figuring out how many gallons of aromatic solvent to use, how long to apply it, how much per cubic feet per second, or how many parts per million, or in other words, the concentration of chemical to water.

by JESSE M. HODGSON, Assistant Agronomist, Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, United States Department of Agriculture

Successful control of waterweeds with aromatic solvents or other chemical treatments depends largely upon accurate measurements of water flow and the amount of chemical applied in the desired time. However, the calculation of the necessary chemical and concentration data, often involving unfamiliar units, is rather long, tedious, and very subject to error. A convenient, inexpensive, and accurate computor for calculating the concentrations and dosages in application of aromatic solvents for control of waterweeds can be made easily by attaching the necessary scales to an ordinary slide rule. Slide rules suitable for this purpose usually can be purchased for $0.25 to $0.50 in variety or book stores. A similar modified rule for determining 2,4-D application data was devised by L. S. Evans in 1948. (See p. 236, December 1948 Reclamation Era.)

The above picture shows the arrangement of the four scales on the slide rule. The scales are made on 3-cycle semilog paper and then glued on the slide rule to replace the original scales. Scales A and C are put on the outside and are nonmovable. They should be set so that units 2, 3, etc., on the A scale are opposite 200, 300, etc., respectively, on the C scale. The gallons of solvent and the concentration in parts per million vary in direct proportion, i. e., if we assume a constant time and amount of water, any increase in the amount of chemical will result in a proportional increase in concentration.

The time and water variables are placed on the inner movable scale. As shown in the picture, the water measure used may be miners inches, or, preferably, cubic feet per second. The miners inches on this scale are according to the standard that 50 miners inches equal 1 cubic foot per second. This standard differs among the different States according to statute. The time scale is reversed since any increase in the time of application will result in a lower concentration if the amount of chemical and water remains the same.

In computation, assuming a constant amount of solvent and constant concentration, the point 4.714 is established where scales W and T are equal. These two scales should be attached to the rule so that this point coincides with both of these scales. The accuracy of the rule will depend upon the care in placing the scales upon the slide rule.

Any one of the following variables of chemical, cubic feet per second of water, time, or concentration, can be determined quickly if the other three are known or assumed. These variables can be determined from the following formulae.

$$\text{Gallons of chemical} = \frac{450^{1} \times \text{cfs}^{2} \times \text{time}^{3} \times \text{ppm}^{4}}{1{,}000{,}000}$$

$$\text{Cubic feet per second} = \frac{1{,}000{,}000 \times \text{gal. of chemical}}{450 \times \text{time} \times \text{ppm}}$$

$$\text{Time in minutes} = \frac{1{,}000{,}000 \times \text{gal. of chemical}}{450 \times \text{cfs} \times \text{ppm}}$$

$$\text{Concentration (ppm)} = \frac{1{,}000{,}000 \times \text{gal. of chemical}}{450 \times \text{cfs} \times \text{time}}$$

The following examples are given to show the manipulations of the modified slide rule in solving these problems:

Example No. 1: *To find the gallons of aromatic solvent for a 400-parts-per-million concentration for 30 minutes in a ditch carrying 2 cubic feet per second of water.*

- Set 30 on T scale over 400 on C scale
- Move hairline to 2 on W scale and
- Read A scale under hairline, approximately 10.8 gallons of aromatic solvent.

Example No. 2: *To determine the concentration obtained when 50 gallons of solvent are applied in 9.5 cfs of water, in a 25-minute period.*

- Set 9.5 on W scale under 50 on A scale
- Move hairline to 25 on T scale and
- Read C scale under hairline, 467 ppm (approximately).

Example No. 3: *To determine time in minutes to apply 100 gallons of solvent into 18 cfs of water and obtain a concentration of 400 ppm.*

- Set 18 on W scale under 100 on A scale,
- Move hairline to 400 on C scale and
- Read T scale under hairline, 30.8 minutes (approximately).

The End.

[1] 450 is the number of gallons of water per minute in 1 cubic foot per second.
[2] Cfs is cubic feet per second.
[3] Time is in minutes.
[4] Ppm is parts per million on a volume basis.

Interns in Reclamation

(Continued from page 73)

the pumping plant structural design section of the structural and architectural division; the production planning and control section of the administrative engineering division; and the concrete dams section of the dams division. Nearing the end of his rotation, he is to don a "hard hat" to assist an experienced inspector assigned to a field construction project. His final period could be spent in the contract administration division in the office of the chief construction engineer.

Programs as detailed as the above are now in effect and could be followed by a civil engineer without deviation. Rotating is flexible, however—a man won't be told to leave a job half finished because it's time to move on, and personnel needs of sections expand and contract. In some instances there certainly will be fewer than eight phases.

Many scores of possible assignments exist for civil engineers. Although scope is more limited for mechanical and electrical engineers, there still is plenty of room for rotation. A mechanical engineer might, for example, work on pumps in the hydraulic machinery division, install equipment at a dam, be assigned to field operation and maintenance, and go into various sections of the mechanical division.

A civil engineer could serve in the power utilization office, and the office of project planning, as well as in sections of the electrical division and in the field for installations.

How different it was for the father of the present-day engineer starting with the Bureau! The older man might have been, successively, a surveyman, assistant construction engineer, designer, engineer in charge of irrigation investigations, and project construction engineer. If he had outstanding ability, he rose rapidly.

Commissioner Straus is hoping the special aptitudes of the current crop of youngsters will be brought into the open by the rotation plan. Limits of the plan are not fixed, although the present intention is to bring 260 more men into the program, including those exchanged between branch and field and regional offices. Enrollment in January numbered 275 engineers, who represent 83 universities and colleges.

The Bureau plan parallels orientation programs carried on by many industrial firms. The private companies have realized there is a wide gap between principles absorbed in classrooms and application of principles to daily assignments in industry. Well thought-out and managed rotation programs can bridge the gap, the companies found.

A period of transition for new employees provides guidance in observation and thought processes that speeds individual progress. Also significant is the new engineers' improved understanding of organization and administration, which in turn helps to develop administrative leadership.

Most participants in the Bureau of Reclamation rotation scheme are highly pleased with their internship, their periodic reports indicate. Some have told their supervisors that their fears are gone that they might (as is probable under ordinary placement practices) stay in a specialty for which they're not suited. The supervisors say these recent graduates will make better professional engineers, more capable of completing assignments under the highest engineering standards. THE END

Aromatic Solvents for Waterweeds

(Continued from page 80)

In October, when water was diverted from the canal, the ditchriders reported some regrowth, mostly sago pondweed 8 to 12 inches long.

The cost of the chemicals used was approximately $1,065 at an average of 54 cents a gallon. Labor and equipments costs were estimated at $175. Thus, the total cost for treating this 25-mile section of Roza Main Canal with aromatic solvents was $1,240, or less than $50 per mile.

So far as we know, this represents the first time aromatic solvents have been used to kill waterweeds on such a large scale. We expect that the successful treatment of a canal with a water flow of 75 to 150 cubic feet per second will have far reaching effects upon the future use of aromatic solvents for aquatic weed control.

NEXT MONTH—How aromatic solvents solved waterweed problems in the older irrigation ditches and canals in the Yakima valley.

Frank Banks Honored

District Manager Frank A. Banks of the Columbia Basin district was recently presented with a life membership in the American Society of Civil Engineers in honor of his long and outstanding work in the engineering field. ●

New Mexico Ground-Water Levels Decline

Water levels in most wells in areas in New Mexico where ground water is used for irrigation at the beginning of 1949 reached the lowest wintertime levels on record, according to a report prepared by the U. S. Geological Survey and approved by Secretary of the Interior Oscar L. Chapman.

However, as a result of more favorable precipitation, which reduced the amount of pumpage necessary for irrigation, the net additional decline of ground-water levels in 1948 was somewhat less than that in 1947.

In the Roswell Basin, the High Plains in Lea County, and the Mimbres Valley in Luna County in 1948 the water levels declined significantly.

The decrease in pumping in the Portales Valley in 1948 caused the net decline in water level to be smaller in 1948 than in 1947 and in the Grants-Bluewater area the net declines of water level were decidedly less in 1948 than in the 3 previous years because of the availability of a surface supply from Bluewater Reservoir.

A preliminary report prepared by the U. S. Geological Survey in cooperation with the State Engineer of New Mexico gives the measurements made in January and February 1949 in about 1,200 wells, along with a discussion of changes in level from 1948 to 1949. A limited number of copies of this report are available free from the U. S. Geological Survey, 309 Federal Building, Albuquerque, New Mexico. ●

Connecting Pipe to Concrete

by GENE NICOLAI, Coulee Dam, Wash., Region 1 (headquarters at Boise, Idaho)

R. M. MOORHEAD, MATERIALS ENGINEER for the Bureau of Reclamation, now with the Columbia Basin project at Coulee Dam, Wash., has devised a special form to solve the problem of fitting circular concrete or tile pipe to concrete structures.

Used in more than 1,000 installations in the Roza Division of the Yakima project in eastern Washington, the form holds the pipe rigidly in place as to grade and line, can be used for various-size pipes, and improves the hydraulic properties of pipe attached to the mother structure.

In addition to these advantages, the form saves time and money, particularly if a large number of installations are to be made.

The form consists of a hollow hemisphere, preferably a ¼-inch steel plate, with a steel bar 1½ inches wide across the open face. The bar has a ⅞-inch hole through the center as does the hemisphere. Two ¾-inch eyebolts—one long and one short—are needed, each threaded at the hookless end. The shorter eyebolt extends through the hemisphere, and thence through the steel plate across the open end of the hemisphere and through the outer form of the structure, where it is secured with a nut. (See A in drawing.)

The longer eyebolt hooks to the eyebolt on the convex side of the hemisphere and extends through the concrete or tile pipe to be attached. At the threaded end of the long eyebolt where it extends from the concrete pipe, a common two-by-four, drilled through the center, is mounted. Tightening of a nut against the two-by-four automatically cinches the hemisphere against the other end of the pipe. (See B in the drawing below.) The hemisphere remains solidly in place against the form, insuring a secure connection.

In the Roza work, two sizes of hemispheres were used. A hemisphere 10 inches in diameter was used for 6- and 8-inch pipe; a 14-inch hemisphere was used for 10- and 12-inch pipe.

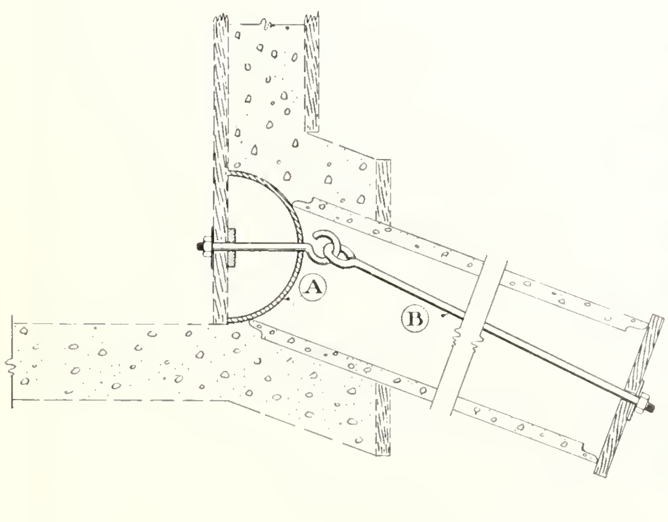
To install the equipment, first secure the hemisphere to the structure form by the short hook bolt with the lower side at the flow line. This will center the pipe in the proper position and permit setting it at any angle, either vertical or horizontal, up to approximately 30°. The long eyebolt then is hooked to the short one, the tile is slipped over this, and the two-by-four mounted on the open end of the pipe to be installed. The nut at the lower end of the longer eyebolt is tightened until the tile fits snugly to the hemisphere at the proper angle. This prevents the tile from becoming displaced while the concrete is being vibrated in the form.

The half sphere enlarges the opening into the tile, improving the hydraulic intake and leaving a smooth finish. Thus, the builder is saved the cost of chipping concrete and grout out of the tile and has no rough edges around the opening to finish.

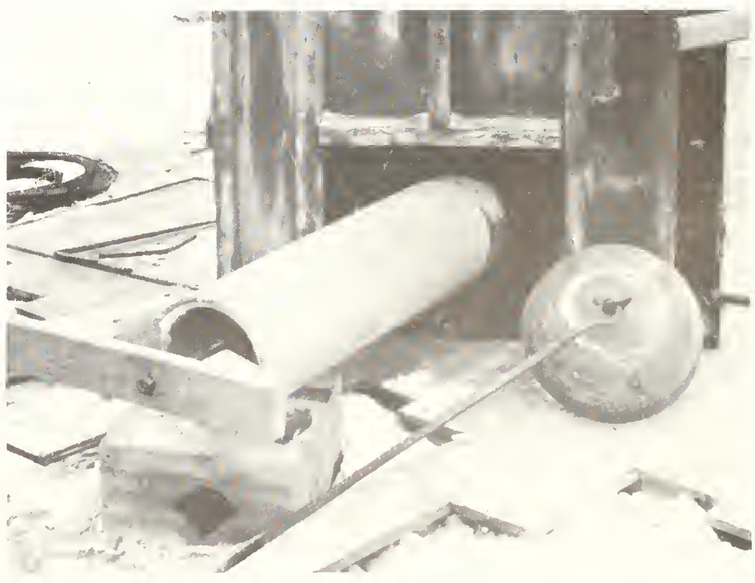
In the Roza job, Moorhead estimated that at least 2 hours' time was saved in each installation by using the special attachment.

Another advantage lies in the fact that it eliminates the practice of having the first piece of tile extend from a structure at a right angle and making the break in grade at the end of the first piece of pipe. By using the equipment described, the correct angle always is maintained at the structure. THE END

DIAGRAM OF THE MOORHEAD DEVICE, showing the few parts needed to provide a quicker and more efficient method for attaching concrete or tile pipe to concrete structures. The two hooked rods are ¾-inch steel. The hemisphere *(A)* is ¼-inch steel plate. The longer rod *(B)* is held against the end of the tile by cinching the bolt against a common two-by-four, across the lower end of the pipe.



MAKING THE RIGHT CONNECTION. Here is the special equipment needed, and a pipe being mounted, showing the rod extending through it, attached to the two-by-four bar. At the right is a spare hemisphere, with its long bolt. The opening in the form will be closed before concrete is poured for the vertical structure.



First Reclamation Power Plant Goes Into Forty-fifth Year of Service

Federal power development on the great rivers of the West began on the Salt River project in Arizona 45 years ago in March 1905. When the Bureau of Reclamation put into operation a 1,000-kilowatt generator in a cave on the project at that time it marked the beginning of the greatest Federal public power program in the world. Today the Bureau is the world's largest single producer of power with an installed capacity of approximately two and three-quarter million kilowatts. •

Favorable Water Supply Anticipated In The West

Heavy snowfalls in the West during the past few months have practically assured an adequate water supply of irrigation water on most Reclamation projects for the coming irrigation system.

Heavy snows in the Sierra Nevadas will aid the supply for Nevada projects and the reservoirs of the Salt River project show an increase in water supply over last year. However, on the Central Valley project despite snow and rain the flow into reservoirs remains below normal. •

A. W. Simonds Aids New Zealand Development

At the expense of the New Zealand Government, A. W. Simonds, Bureau of Reclamation engineer and one of the world's few authorities on grouting of dam foundations, has been sent to that country on an emergency assignment.

He will work with New Zealand engineers on the foundations of the Maraetai Dam, one of a series being built for power development.

Foundation grouting is a highly technical phase of dam construction in which liquid cement mortar is injected into natural fissures in the foundation rock and thus prevent seepage after the structure is in use. •

Brown's Canyon Siphon

(Continued from page 78)

structed largely by Government forces under the direction of Andrew Weiss, at that time manager of the North Platte project. In recognition of his long and illustrious engineering career, Mr. Weiss was recently elected an honorary member of the American Society of Civil Engineers.

Excavation began on May 4, 1923, and the work of backfilling the completed structure was completed in December of the same year. The original estimated cost was $58,000 and the total cost of the completed structure was $54,331.85. Some of the quantities involved were: excavation, 9,000 cubic yards; concrete, 1,255 cubic yards; reinforcing steel, 155,000 pounds; backfill, 5,000 cubic yards. The 11-foot-diameter barrel is encased by 12 inches of reinforced concrete.

Inspection of the structure 25 years after its construction shows the design and construction to be eminently satisfactory. Only four minute cracks have developed in the monolithic barrel, all of which developed soon after water was turned in. Some scour developed around the footings and additional concrete has been added for protection. The roadway on top of the barrel was used for a time as a principal county road but now is primarily a secondary road used by local residents and ditchriders. Brown's Canyon Siphon is nearly forgotten now, being integrated into the smooth-functioning Fort Laramie Canal System. Time was when it held the spotlight briefly in Reclamation history.

Time was, that is. THE END

Jefferson Water Conservancy District Name Changed

On the basis of an election held by the members of the Jefferson County conservancy district in November the Circuit Court of Jefferson County, Oreg., issued an order changing the name of the district (operating agent for the Bureau's Deschutes project in Oregon) to the north unit irrigation district. •

NOTES FOR CONTRACTORS

Contracts Awarded During February 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2820	Davis Dam and Gila, Ariz.-Nev	Feb. 2	Two 150-kilovolt-ampere and one 200-kilovolt-ampere unit substations for Wellton-Mohawk pumping plants Nos. 1, 2, and 3, schedule 4.	Nelson Electric Manufacturing Co., Tulsa, Okla.	$12,780
2824	Central Valley, Calif.	do	Two 230,000/196,000-volt circuit breakers for Tracy switchyard, schedule 1.	Westinghouse Electric Corp., Denver, Colo.	140,440
2824	do	do	Two 196,000-volt disconnecting switches for Tracy switchyard, schedule 2.	Schwager-Wood Corp., Portland, Oreg.	15,040
2835	Missouri River Basin, Mont	Feb. 9	280,000 barrels of bulk portland cement for construction of Canyon Ferry Dam and power plant, schedule 1.	Ideal Cement Co., Denver, Colo.	980,000
2835	do	do	22,600 tons of bulk pozzolan for construction of Canyon Ferry Dam and power plant, schedule 2.	Combustion By-Products Co., Chicago, Ill.	31,640
2837	Fort Peck Mont.	Feb. 3	One 20,000-kilovolt-ampere transformer with three 115,000-volt and three 34,500-volt lightning arresters for Shelby substation, schedule 1.	Gough Industries, Inc., Los Angeles, Calif.	65,998
2862	Boise, Idaho	Feb. 20	One 138-000-volt circuit breaker for Mountain Home substation, schedule 1A.	Pacific Electric Mfg. Corp., San Francisco, Calif.	23,950
2864	Boulder Canyon, Ariz.-Calif.-Nev	Feb. 7	One actuator-type governor with pumping equipment for regulating speed of 70,000-horsepower hydraulic turbine for unit A9, Hoover power plant.	Woodward Governor Co., Rockford, Ill	32,630
2867	Central Valley, Calif	Feb. 21	Construction foundations, erecting steel towers, and stringing conductors and overhead ground wires for 18.3 miles of Elverta-Perkins 230-kilovolt double-circuit transmission line.	Donovan-James, St. Paul, Minn.	243,324

U. S. GOVERNMENT PRINTING OFFICE 1950

NOTES FOR CONTRACTORS—Continued

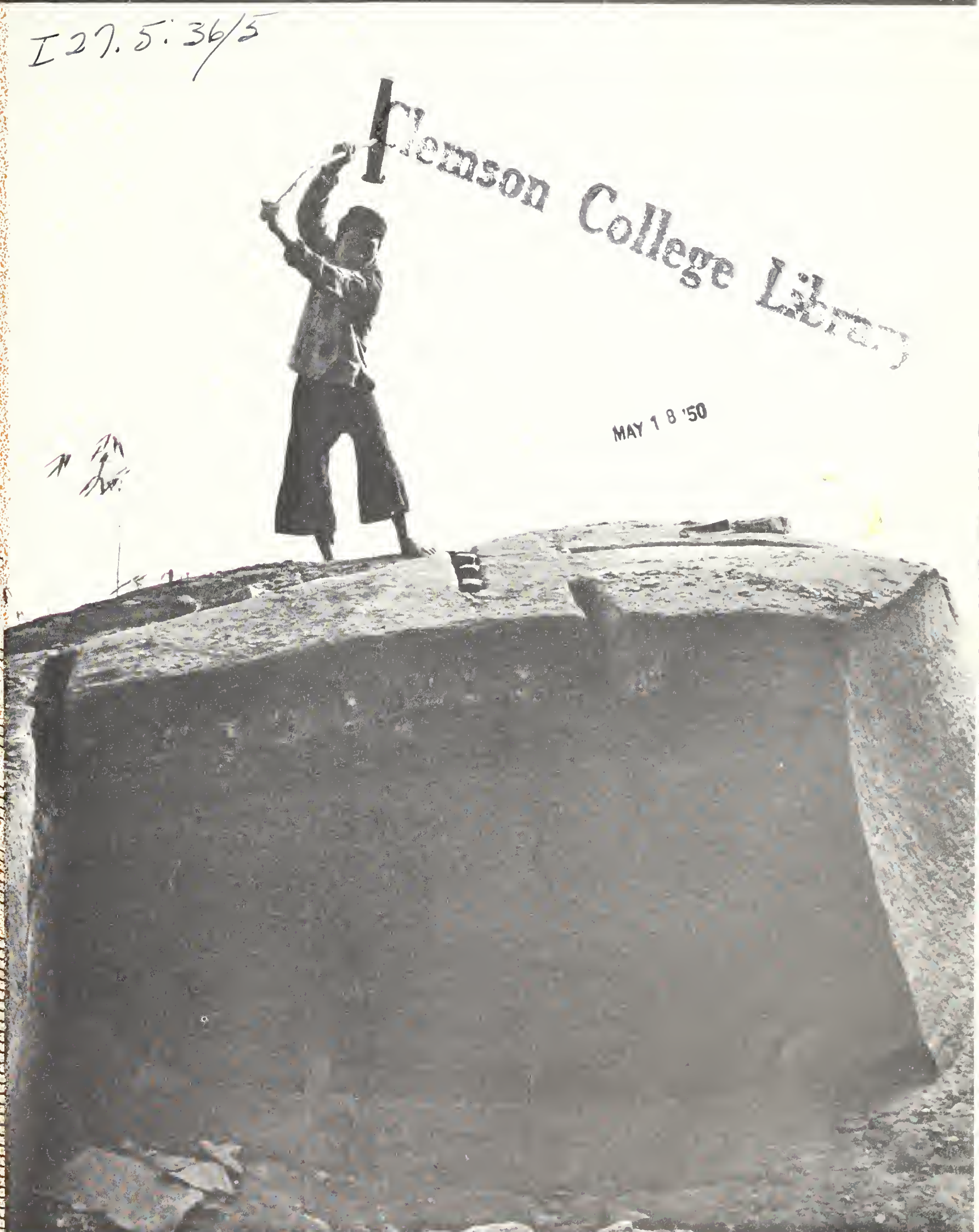
Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2873	Colorado-Big Thompson, Colo.	Feb. 27	Four 115,000-volt circuit breakers and seven 115,000-volt disconnecting switches for Leyner substation, schedules 1 and 2.	General Electric Co., Denver, Colo.	$98,924
2879	Columbia Basin, Wash.	Feb. 21	Construction of earthwork, concrete lining, and structures for East Low canal and Weber wasteway.	Western Contracting Corp., Sioux City, Iowa	1,649,982
2881	Davis Dam, Ariz.-Nev.	Feb. 15	Hollow metal door, metal partitions, and pipe chase closure plate for Davis power plant, item 1.	Grand Metal Products Corp., Portland, Oreg.	21,163
2885	do.	Feb. 24	Completion of utility building, parking area, and forebay channel bridge at Davis Dam.	Superior Construction Co., Las Vegas, Nev.	194,847
2886	Central Valley, Calif.	Feb. 13	Construction of earthwork, pipe lines, and structures for lateral 88.4W and lateral 90.4W, Lindmore irrigation district, Friant-Kern canal distribution system.	Concrete Conduit Co., Colton, Calif.	263,916
2907	do.	Feb. 15	254,000 linear feet of standard concrete irrigation pipe for Ivanhoe irrigation district; Lindmore irrigation district, unit 3; and Southern San Joaquin municipal utility district, unit 3.	Central Valley Concrete Pipe Co., Stockton, Calif.	100,790
2909	Paonia, Colo.	Feb. 28	Construction of earthwork and structures for enlargement of Fire Mountain canal.	Crocker and Ellett, Inc., Denver, Colo.	137,887
2915	Boise, Idaho.	Feb. 7	Repair of penstock header for Anderson Ranch power plant.	J. A. Terteling and Sons, Inc., Boise, Idaho	32,000
R1-64	Yakima, Wash.	Feb. 9	Earthwork, pipe lines, structures, and pumping plant—McCravey and Severyns areas.	Tom McCorkle Construction Co., Boise, Idaho.	23,887
R1-CB-34	Columbia Basin, Wash.	Feb. 2	Clearing of equalizing reservoir between North Coulee dam and South Coulee dam.	J. W. Hardison, Yakima, Wash.	348,962
R1-CB-36	Do.	Feb. 21	Construction of temporary housing for Operation and Maintenance Headquarters at Quincy and Othello, Wash.	Unit Co., Inc., Seattle, Wash.	168,310
R3-B-11	Boulder Canyon, Ariz.-Nev.	Feb. 15	Extension of water distribution system at Boulder City and Lakeview addition.	Nevada Construction Co., Las Vegas, Nev.	13,352
R3-B-12	do.	Feb. 14	Car shelters at Federal garage, Boulder City, Nev.	Lembke Construction Co., Las Vegas, Nev.	13,828
VII-97	North Platte, Nebr.	Feb. 2	Furnishing and erecting Pathfinder Dam elevator walkway.	Northwest Realty Co., Alliance, Nebr.	13,124

Construction and Equipment for Which Bids Will Be Requested by June 1950

Project	Description of work or material
Boulder Canyon-All-American Canal, Ariz.-Calif.	Construction of three 111-foot bridges across the Coachella Canal.
Boulder Canyon, Ariz.-Nev.	Construction of blacksmith shop at Hoover Dam.
Do.	Construction of additional rooms in the present Hoover power plant.
Do.	Generator voltage bus structures for units A-3, A-4, and A-9, Hoover power plant.
Do.	200,000 pounds of galvanized fabricated steel structures for 230-kilovolt Arizona-Nevada switch yard at Hoover power plant.
Central Valley, Calif.	Construction of 66-mile Artois-Madison 230-kilovolt, double-circuit, steel tower transmission line.
Do.	Construction of 26-mile Rio Vista-Tracy 230-kilovolt, double-circuit, steel tower transmission line.
Do.	Rehabilitation of Shasta Dam Government camp.
Do.	Construction of 13-mile, 5,000-cubic-foot per second capacity unlined San Luis wasteway on the Delta-Mendota Canal.
Do.	Construction of 2 ditchriders' residences on the Madera Canal, near Friant, Calif.
Colorado-Big Thompson, Colo.	Construction of Carter Lake Dam, an offstream earthfill structure, west of Berthoud, Colo.
Do.	Construction of Willow Creek storage and diversion dam, an earthfill structure, about 6 miles north of Granby, Colo.
Do.	Construction of 2.8 miles of 250-cubic-foot per second capacity tunnels on the North Poudre supply canal, 6 miles of Berthoud, Colo.
Do.	Construction of 3 miles of 8-cubic-foot per second capacity unlined Dixon feeder canal, 4 miles west of Fort Collins, Colo.
Do.	Construction of 11 miles of 550-cubic foot per second capacity partially concrete lined St. Vrain supply canal, near Loveland, Colo.
Do.	Construction of 72 miles of Brighton-Brush 115-kilovolt, single circuit transmission line.
Columbia Basin, Wash.	Furnishing and installing 1 electric passenger elevator for Ephrata office building.
Do.	Construction of 11.7 miles of 1,800-cubic-foot per second capacity unlined section of Potholes East canal, about 10 miles northeast of Othello, Wash.
Davis Dam, Ariz.-Nev.	Construction of 30,000-kilovolt-ampere Prescott substation.
Do.	Furnishing and installing air conditioning system in Gila substation.
Do.	Construction of 21 miles of 34.5-kilovolt Wellton-Mohawk power supply transmission line near Yuma, Ariz.
Do.	Furnishing and installing underground about 2,300 feet of 5-inch conduit between Phoenix substation and dispatcher's building at Phoenix, Ariz.
Do.	Supervisory control and telemetering equipment for Blythe and Drop. No. 4 substations.
Eden, Wyo.	Construction of Big Sandy Dam, an earthfill structure, near Eden, Wyo.
Do.	Construction of 5 miles of 500-cubic-foot per second capacity, unlined canal near Farson, Wyo.
Fort Sumner, N. Mex.	Construction of 12 miles of 100-cubic-foot per second capacity, concrete-lined Main canal near Fort Sumner, N. Mex.
Do.	Construction of 8 miles of 20-cubic-foot per second capacity, partially lined High Line canal, near Fort Sumner, N. Mex.
Kendrick, Wyo.	Construction of 35 miles of double-circuit telephone line from new Casper substation to Alcova Dam, Wyo.
Missouri River Basin, Kans.	Construction of Republic diversion dam, a reinforced-concrete structure, on the Republican River near Hardy, Kans.
Missouri River Basin, Mont.	Construction of Tiber Dam, an earthfill structure on the Marias River, 13 miles south of Chester, Mont.
Do.	Construction of 60-cubic-foot per second capacity N-Bar-N River pumping plant, 1 relift pumping plant, tapline, substation, and canal and lateral systems along the Missouri River in McCone County, Mont.
Missouri River Basin, Nebr.	Construction of Trenton Dam, an earthfill structure on the Republican River, about 2 miles west of Trenton, Nebr.
Do.	Construction of 66 miles of Sidney-Ogallala 115-kilovolt, wood-pole transmission line.
Do.	Construction of 30 miles of 210-cubic-foot per second capacity, unlined section of Cambridge canal, near Arapahoe, Nebr.
Do.	Relocation of 19 miles of single track C. B. & Q. R. R. at Trenton Dam reservoir area.
Do.	Furnishing and erecting 3 miles of fence at Medicine Creek reservoir near Cambridge, Nebr.
Do.	Furnishing and erecting 2 miles of fence at Enders Reservoir, Nebr.
Do.	Construction of control house and high and low voltage section of 20,000-kilovolt-ampere Sidney substation.
Missouri River Basin, N. Dak.	Construction of 65 miles of Garrison-Bismarck 230-kilovolt double-circuit, steel-tower transmission line.
Do.	Construction of 105 miles of Bismarck-Jamestown 230-kilovolt single-circuit, steel-tower transmission line.
Do.	Construction of 55 miles of Garrison-Voltaire 115-kilovolt, single-circuit, wood-pole transmission line.
Do.	Construction of 42 miles of Bismarck-DeVaul 69-kilovolt, single-circuit wood-pole transmission line.
Do.	Construction of 27 miles of Devils Lake-Lakota 115-kilovolt, single-circuit, wood-pole transmission line.
Do.	Construction of 37 miles of Jamestown-Valley City 115-kilovolt, single-circuit, wood-pole transmission line.
Do.	4,000 tons of galvanized fabricated steel towers for 97 miles of 230-kilvolt single-circuit transmission line, Central North Dakota system.
Do.	3,500 tons of galvanized fabricated steel towers for 60 miles of 230-kilovolt double-circuit transmission line, Central North Dakota system.
Missouri River Basin, Wyo.	Construction of 20,000-kilovolt-ampere Thermopolis substation.
Do.	Construction of 34 miles of Seminoe-Sinclair 115-kilovolt single-circuit, wood-pole transmission line.
Do.	Relocation of U. S. Highway 14 at Keyhole damsite, 15 miles northeast of Moorcroft, Wyo.
Do.	Construction of residences, office building, garage and warehouse, and utilities for Government camp near Anchor damsite, 35 miles west of Thermopolis, Wyo.
Do.	One 20-gpm and one 40-gpm gear-type oil pumps; two 250-gpm, centrifugal pumps, 220-foot head; and two 1,500-gpm, turbine, type deepwell pumps, 18-foot head, for Boysen power plant.
Yakima, Wash.	Construction of 5 two-bedroom residences with garages in Yakima and Benton Counties, Wash.

The Reclamation ERA

May
1950



How China Builds a Dam

The Reclamation ERA

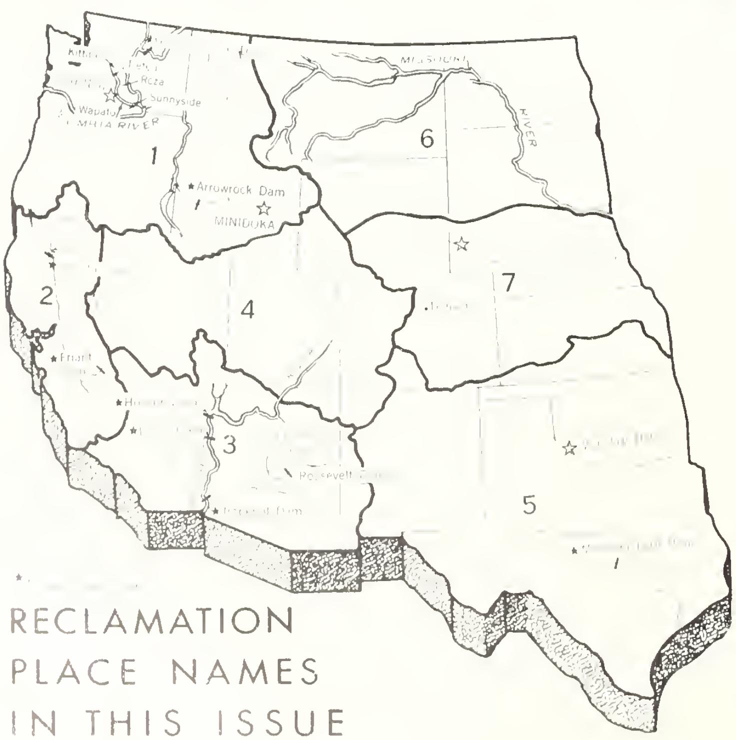
May 1950
Volume 36, No. 5

Issued monthly by
The Bureau of Reclamation
United States Department of the Interior, Washington 25, D. C.
Approved by the Bureau of the Budget

CONTENTS

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.



RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO IN THE ERA

Farm Wages Not Always Understood

Many farmers engage their employees upon a basis somewhat similar to the example given below.

The farmer engages a man who receives—

Monthly wages	*$50.00*
Use of small house, monthly renting value	*10.00*
Firewood, monthly value	*5.00*
Milk, 2 quarts daily, 6 cents a quart	*3.60*
Use of garden lot (1/4 acre), monthly rate	*2.00*
	$70.60

Upon this scale of values, often more, and seldom less, it will be seen that the farm laborer is really receiving $70.60 per month instead of $50. Yet, unless some form of contract is provided which definitely sets forth the values of these "extras," the laborer will fail to give them just consideration. Ask him what he receives and he will name the cash allowance alone.

(From the May 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA, page 212.)

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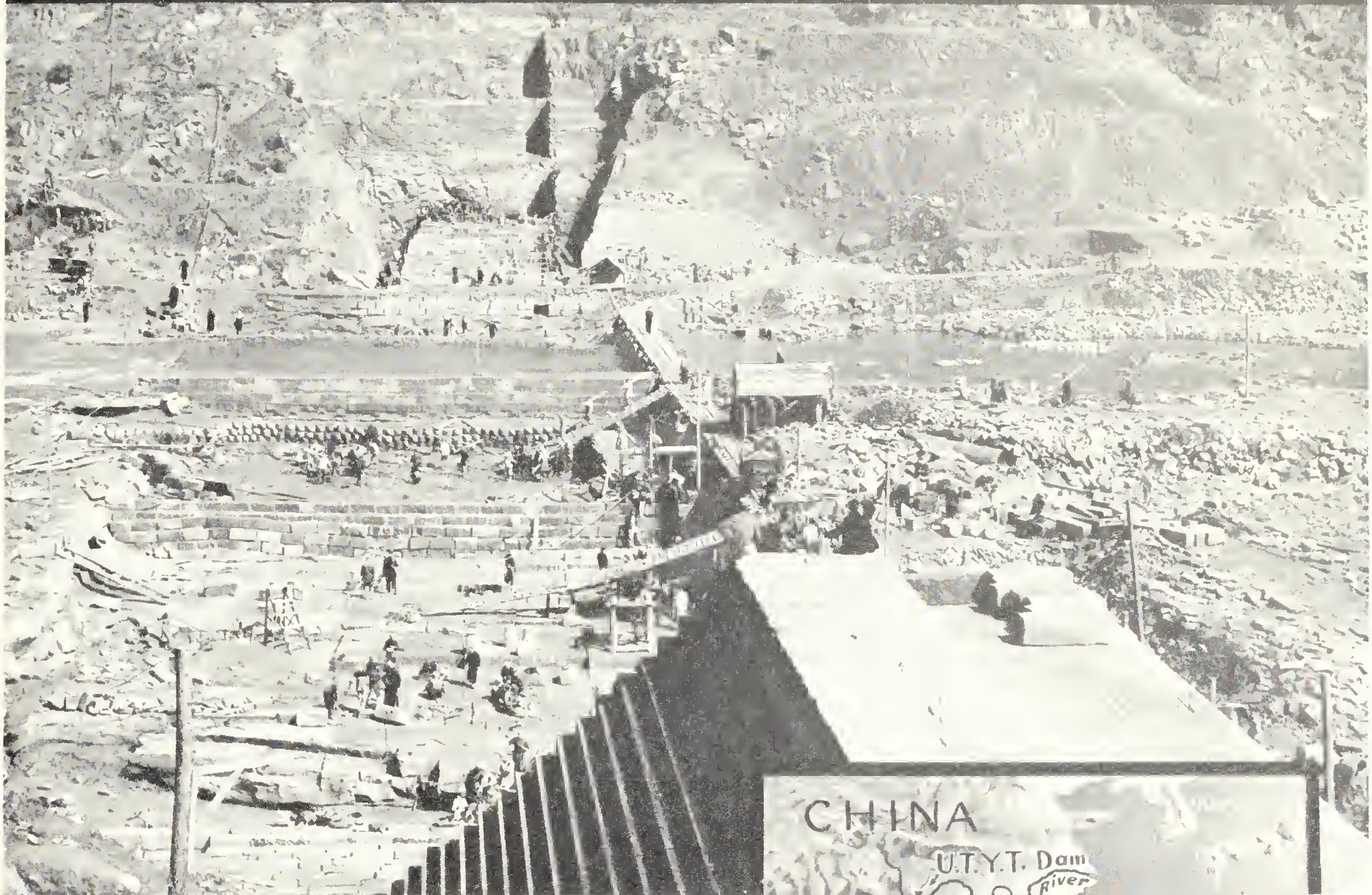
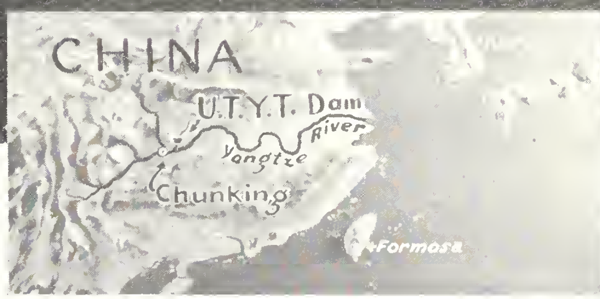
HOW CHINA BUILDS A DAM





by FRED O. JONES, Engineering Geologist
United States Geological Survey
Spokane, Wash.

In the short interval between the Japanese occupation of China and the Communist conquest, a few Chinese engineers struggled in vain to establish multiple-purpose river projects to better the standard of the Chinese people. Their plans included projects both large and small, encompassing the Yellow, the Yangtze, and many other rivers of China.

The U. T. Y. T. (Upper Tsing Yuan Tung) Dam, the first step in this river wealth development, is being constructed by methods as ancient as those used to build the Great Wall and the Pyramids of Egypt. Literally, it is being built stone upon stone by strong Chinese hands and backs.

Located in the great inland province of Szechwan, the dam site spans the valley of the Lung Chi Ho (*Ho* is the Chinese word for "river"), a small tributary of the Yangtze, 25 miles above the place where it enters the Yangtze from the north at the city of Changshow, 50 miles downstream from Chungking and 1,300 miles above Shanghai. The valley of the Lung Chi Ho is a beautifully colored landscape. The rock formations are red and maroon shales and sandstones. The grass is always green in Szechwan, and a few huge old trees dot the tops of the hills and ridges. The rolling hills are

Editor's note:

A little over a year ago Mr. Jones returned from China where he went as a technical adviser and chief geologist of the National Hydroelectric Engineering Bureau of the National Resources Commission. His travels took him to the headwaters of the Yangtze River in the Tibetan Highland, downstream through the Province of Szechwan, through the famous gorges of the Yangtze to the site of the tremendous Yangtze Gorge Dam, and thence to Nanking and Shanghai.

Before going to China, Mr. Jones was project geologist at Grand Coulee Dam, where he directed geological investigations for the Columbia Basin project as well as investigations for the Hungry Horse project in Montana. At present he directs activities of the engineering geology branch of the Federal Geological Survey in the Columbia River Basin.

Mr. Jones returned from China when the Communist forces threatened the area where the Yangtze Gorge dam sites are located and when monetary inflation made the continuation of the project impossible. In this article he describes the methods of construction he witnessed as the first unit of the Yangtze River Basin development got under way.

BY A WATERFALL—From which it gets its name, the Upper Tsing Yuan Tung Dam at left, takes advantage of an almost made-to-order site. At left, the dam as it appeared in March 1947. Note the clean bedrock surface of red sandstone, which eliminated the necessity for much excavation. Below (inset) the Upper Tsing Yuan Tung Falls of the Lung Chi Ho, where a bomb-proof powerhouse has already been excavated. The power unit will discharge into the plungepool at the foot of the falls.

terraced to their tops in gracefully curved rice paddies, and some of the sticky red terraces are covered by shallow lakes.

Upper Tsing Yuan Tung Dam is China's only new dam under construction. It will be 40 feet high, 650 feet long, and will contain 700,000 cubic feet of masonry. This small dam is the first unit in the Yangtze River Basin development—the dream of most young, energetic Chinese engineers. The Yangtze has probably the greatest potential water power of any river on earth. Rising in the Tibetan highland and fed by huge tributaries from Asia's highest mountains, the basin offers the world's greatest opportunities for multiple-purpose projects. Practically all of the work done so far on power, irrigation, navigation, and flood-control projects up and down the Yangtze has been paper engineering, except for the upper Tsing Yuan Tung Dam.

In selecting the site, engineers took advantage of the naturally favorable river physiography at a waterfall in the Lung Chi Ho. The dam is situated a few hundred feet above the waterfall, and the powerplant is located at its toe. A tunnel in the valley-bottom bedrock was to carry water from the reservoir above the dam to a bomb-proof powerhouse excavated in the rock wall beside Upper Tsing Yuan Tung Falls. The power unit was designed to discharge into the plungepool at the foot of the falls.

Although most of the construction methods were extremely primitive, a small amount of power, available from a plant near Changshow, made possible the use of an air compressor, a few jackhammers, a wagon drill, three pumps, a half-yard concrete mixer, and a rock crusher. In addition to these, the project had three worn-out trucks and a narrow gage push-car railroad for transportation. Even this equipment was little used, due to the lack of skilled personnel and to the cost and difficulty of making repairs and getting replacements.

The river has scoured the valley nearly clean of soil materials, and the entire valley floor at the dam site is good,

THE STONE BLOCK SLIDE—Looks like a railroad, but it goes "swish" instead of "chug." Stone blocks are loaded onto sleds at the top of the incline, and shoved off. The sled invariably stops near the center of the stock pile where it is unloaded, carried up the hill, and loaded for another slide. Note the terraces.

hard, maroon sandstone. The stream is small enough during low water season so that diversion for construction has been quite simple. While excavation and construction were in progress along one section of the valley floor, the river was confined in another section by temporary cofferdams of stone blocks or bamboo baskets tamped full of clayey soil.

Overburden and bedrock was excavated by hand. The people dug overburden of soil and earth material with large hoe-like tools and carried it out in baskets. The sandstone bedrock along the valley floor was excavated to a depth of 6 to 10 feet, to remove all the decayed and disintegrated rock. They drilled blast holes for loosening the bedrock with hammers and steel points, and broke the large blocks into pieces small enough to be carried out by "yoyo" sticks or in baskets. They blasted with three kinds of explosives—tung oil yellow powder, black powder (both made locally), and a commercial gelatin from the United States, used in places where it was absolutely essential. Some of the detonators were made in the United States, but most of them were produced in local shops. All of the fuse wires came from the U. S. A. After they removed the overburden and blasted bedrock, they trimmed the foundation rock smooth, carefully cleaning it with brushes in preparation for laying the stone blocks of the dam. Keyways for the dam were excavated for a distance of 30 to 40 feet into the shale abutments on the sides of the valley.

U. T. Y. T. Dam will require 120,000 stone blocks to make up its volume of 700,000 cubic feet, each block measuring approximately 16 by 16 inches by 2 feet 8 inches to 3 feet 10 inches and weighing 600 to 800 pounds. Hundreds of coolie stone masons worked up and down the valley from daylight until dark, cutting blocks from boulders, dislodged chunks and outcropping ledges of bedrock. Each large piece was broken by first chiseling a row of holes and then driving a series of wedges until the rock split. Once in slabs, it worked up more readily into the required sized blocks.

In many places families worked together, the old men and children usually doing the lightest work, which is the final dressing and sizing of the blocks. A few of the blocks were transported to the dam by push-cars on narrow-gage railroads. The railways were usually constructed on a light downgrade from the quarries to the dam site, so that the loaded cars would push easily. Some of the blocks were transported by junks along the river above the dam.

In one place a rock block slide was improvised by using wooden sleds on rails down a steep grade. The sleds hauled two blocks and were carried back up the hill after each load was sent down. Practically all of the blocks, though, were carried from their many places of origin by coolies.

Fifteen hundred workmen were employed on the dam. Most of them were regarded as skilled or semiskilled, and certainly no one who has seen the block carriers bring a stone up a slick, narrow walkway or down a muddy trail would say they are unskillful.

Groups of coolies chanted in rhythm as they worked. The chant of a single coolie was usually answered by other coolies, sometimes nearby, sometimes far away. A group, such as a gang of block carriers, had a leader who began the chant, and the rest answered in unison. The rhythm was timed to their walk and the swinging motion of the load they carried.

(From top to bottom) SUPERVISOR C. H. Hsiao, M. I. T. and Harvard graduate, chosen to head up Lung Chi Ho project, had incredibly small staff of 16 engineers, foreman, and clerks, and directed 1,500 employees. BAMBOO COFFERDAMS—Tamped full of clayey soil for temporary river control. HUMAN STONE BLOCK CARRIERS—Sooner or later coolies transport these 600- to 800-pound blocks around the dam. BLOCK PLACEMENT—After bedrock has been excavated and trimmed, at least 120,000 blocks must be placed to make up the 700,000 cubic foot volume of the completed dam.

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CONCRETE MIXER—One of the few pieces of machinery on the job was handfed. The half-yard mixer gets a charge of crushed rock and cement from a square, four-handled measuring box (seen at right foreground), water is put in with a wooden ladle (operation as shown), and sand is dumped from baskets.

Going downhill the chant was quite rapid and staccato, uphill or along a narrow walkway it was slow and legato. The chant of the rock splitter was the most expressive of all. It started as the heavy hammer on its limber handle was raised off the rock. The chant ran a riot of tones as the hammer went and started falling. The blood-curdling crescendo reached a peak as the hammer hit the wedge, and it seemed as though the sound alone would almost split the rock.

The methods of construction were in amazing contrast to western methods, but the noises of construction were in even greater contrast. To one used to construction jobs with tractors running, cranes screeching, horns tooting, and bells ringing, the chants and songs of the coolies were startling.

The blocks were fitted together closely with thick cement grout. After each layer was placed, the surface was dressed smooth and carefully cleaned before the next layer was placed to minimize the use of cement and insure a good bond between layers. Cement for the grout came from plants near Hankow, 500 miles down the Yangtze. Sand was carried by baskets from sandbars downstream from the falls. The coarser mortar aggregate was crushed from quarried rock and then classified into proper sizes by hand screening. A half yard mixer powered by electricity mixed that part of the grout not prepared by hand. The aggregate was fed in by boxes and baskets of measured sizes, and water was added with a wooden ladle. Open-end scoop-like baskets were used to carry the mortar to all parts of the job.

During the time the dam was under construction, more than 90 separate contracts were let. Even though some of the work was done under contract, the engineering staff actively supervised all work. The contractors usually had neither equipment nor regular personnel, and were actually little more than subforemen, but since they had an opportunity to make a little profit, they tried to keep the work moving. For this reason their employment was apparently justified. Many of the early contractors left in the night just as soon as they felt they were losing money, so the practice was adopted of holding 10 percent of their money back. Thereafter they became more dependable.

The project had a riverside wharf at Changshow with an incline ramp connecting it to a project road higher on the side of the Yangtze valley. The supplies were carried or pulled up the ramp to the narrow, twisting road at the top of the incline where three old trucks transported men, supplies, and mail to the job. Supplies of spare parts were limited, and Mr. Hsiao, the project chief, commented, "No one in the States appreciates as much as we do the problem of standardization of spare parts."

When will the Upper Tsing Yuan Tung Dam be completed? I don't know. THE END

RAIN MAKING *in* ARIZONA

by BEN AVERY, The Arizona Republic, Phoenix, Ariz.

Here in Arizona's Salt River Valley—the cradle of western reclamation where the vision of man-made dams to store flood waters for use during the recurring droughts of the Southwest gave birth to the National Reclamation Act—men have another vision.

They envision filling those reservoirs by man-made rain.

Rain making didn't originate in the Salt River Valley, but the drought-battered farmers of this valley were the first to take it seriously. As far back as 1910 a self-styled rain maker came to the valley, found ready backers for his mystical project, and left in the middle of the night, $3,000 richer.

That unfortunate experience with rain making didn't slow the Arizonians, however, when they first heard about the rain-making experiments of Dr. Irving Langmuir and his protege, Vincent Shaefer, at the General Electric Laboratories in Schenectady, N. Y.

The Arizona Republic sent its managing editor, Harvey L. Mott, and Dr. Amos Hoff, head of the science department of Phoenix College, Ariz., to Schenectady, N. Y., to see if the scientists could be prevailed upon to shift their experiments to Arizona.

As a result, the newspaper itself went into the rain-making experimental work, cooperating closely with Langmuir and Shaefer. A DC–3 was chartered to cast dry ice into cloud formations, and the first artificial rain was made to fall over Roosevelt Dam on July 16, 1947. The newspaper kept its work secret for several months, however, until the results had been closely established.

The next step saw the formation of a corporation, Precipitation Control, Inc., by the newspaper, two large Arizona banks, a copper mining company, and the Salt River Valley Water Users' Association.

Dr. Irving Krick, noted meteorological consultant of Pasadena, Calif., who conducted long-range weather forecasts for the Army during World War II, was employed to assist in directing the cloud seeding and evaluation of the work during the summer of 1948.

By careful measurements of rainfall, comparisons with precipitation measured under similar weather conditions in other years, Dr. Krick estimated that the work that summer placed 11,990 acre-feet of water in Roosevelt Reservoir at an economical cost.

During the summer of 1949 the experimental work was continued. Meantime, the research branched from dry ice to use of silver iodide and other agents. C. S. (Chuck) Barnes, flying president of Precipitation Control, Inc., of Phoenix, developed generators for installation in experimental planes to scatter the silver iodide, and the Salt River Valley Water Users' Association worked on ground generators to be set up on mountain peaks.

The 1949 experimental work led Dr. Krick to make the observation that the ground generators might supplant the seeding of cloud formations from airplanes and greatly re-

TESTING RAIN "SEED"—C. S. (Chuck) Barnes tries out a metallic sodium generator before installing it in the powerful plane used in seeding rain clouds. Barnes is president of Precipitation Control, Inc., of Phoenix, Ariz., and considers this the newest thing in rainmaking.

"SEEDS" AWAY!—Sodium oxide is sprayed out of pipes at the bottom of the plane. The short pipe above sprays silver iodide. Barnes, on ground, watches generator function, while one of his pilots, William G. Walker, watches from the cockpit. *Both photos by Al Leach.*

duce the cost of the work. On his recommendation, the water users last December ordered 7 new ground generators to increase their total to 10, then a month later appropriated $20,000 to continue the airplane seeding work during the summer of 1950. The 1950 program will employ still another rain-making agent, a sodium oxide, which has been used by Barnes with the aid of specially mounted generators in his plane.

It was in dead seriousness that the board of governors voted the additional $20,000. So far this year, natural run-off on the Salt River watershed is the second lowest in 36 years, and less than 500,000 acre-feet of water is stored in the nearly 2,000,000 acre-foot reservoirs.

Arizona has been in the grip of a drought that has been virtually unbroken since 1941, and the State's battle to obtain Colorado River water to supplement its present inadequate supply, even with a quick victory in Congress, could not relieve the situation in less than another 10 years. So it is small wonder rain making is taken seriously in the Salt River Valley with farmers, businessmen, and bankers ready to put up large sums of money to carry on the work.

And the valley's rain-making enterprise, Barnes Precipitation Control, Inc., already is branching out. Last year Barnes was engaged by the Mexican Government to carry on rain making in four areas of Mexico, and he will continue the work there this summer, employing eight airplanes.

Despite all this work and the many developments of the past 3 years, however, all concerned still regard rain making as in the experimental stage. But the results obtained here and by Barnes in Mexico, coupled with other work being done in California, other parts of the continental United States, Hawaii, Canada, and Australia are regarded as definite proof that man can cause the sky to spill its clouds behind his reservoirs and thereby increase the value of his reclamation work. THE END

EDITOR'S NOTE: Legislation now before the Congress would authorize the Department of the Interior, as the primary water resource development agency of the Federal Government, to conduct a program of comprehensive theoretical and applied research in artificial precipitation.

Central Valley's Sky-Scraping Towers

Two of the world's highest electric transmission line towers are scheduled for installation on the Central Valley project in the near future. Reaching skyward almost 440 feet, these "giants" (approximately three-fourths the height of the Washington Monument) will carry Bureau of Reclamation power on a line strung over half a mile across the Sacramento River high above the shipping district near Rio Vista, Calif., thus avoiding interference with navigation in the river below.

Bids for the job, which also provides for two other towers 337 feet high to support a high tension line across the San Joaquin River, and three anchor towers 121 feet high, were opened on March 29. Bureau of Reclamation engineers under the direction of Chief Engineer L. N. McClellan at Denver, furnished designs for the footings of the towers.

When the towers are completed they will support two 231-mile, 230-kilovolt transmission lines from Shasta Dam to the town of Tracy, Calif., bridging the gap across the Sacramento and San Joaquin Rivers.

Construction of these features of the Central Valley project is in line with the Bureau's policy to complete every essential feature of the Central Valley project as rapidly as possible in order to furnish power and water to the greatest number of people. •

Reclamation's Hall of Fame

Nomination No. 9

JOHN LUCIAN SAVAGE

—Engineer to the World

Ben Glaha, region 2, chief photographer, caught the quiet, self-possessed, soaring competence of the ultra-civilized Savage.

By his works, you shall know him.

For the man himself shuns publicity, shrugs off compliments, modestly belittles his accomplishments. Yet, of all the nominations received for Reclamation's Hall of Fame, John Lucian Savage got the most votes.

A photographer for one of the country's leading magazines "gave up" on John Savage one day. It wasn't that the man who has earned the title of "billion dollar engineer," "world trouble shooter," "public servant extraordinary," refused to assume a pose—he just didn't know how. A naturally modest, unassuming, soft-spoken, hard-working engineer, with a quiet, friendly manner, he disarms those who meet him for the first time with his attitude of "it's all in the day's work, and please don't make a fuss about me."

Not that he would be ungracious about accepting an honor once it was given, but he is always surprised. Perhaps the magnitude of the structures he has designed has given him a sense of proportion above that of ordinary mortals. What is a mere man, compared to, for example, the Yangtze Gorge Dam which he designed? As Savage planned it, tall as a skyscraper, reaching higher into the sky than Hoover (designed by Savage), in hulking mass three times greater than Grand Coulee (designed by Savage), dwarfing the largest pyramid, you may be able to catch the sweep of the Savage vision, perhaps responsible for the Savage humility.

At one of the few press conferences held by this man who is hard to locate, due to the fact he may be in China, Egypt, or other points of the compass, Commissioner of Reclamation Michael W. Straus said, "There came walking into this office this morning a man who goes working around over the world." Commissioner Straus pointed to photos of Hoover, Grand Coulee, and other mighty Reclamation-built structures, and continued, "We have Mr. Savage's monuments on all sides. And for many years it has seemed to be illegal for any dam to be built in the world without Mr. Savage's supervision. Largely through Mr. Savage's perambulations, there has been a tremendous interest throughout the world at this time in water use, irrigation, and hydroelectric power, what might be called a renaissance in thinking along those lines, resulting in world demands for services of American technicians for work on water-control engineering—often beyond our ability to meet."

During this accolade, Jack Savage sat quietly, enjoying the rhetoric, and after the Commissioner stopped speaking and the reporters started their barrage of questions, he turned a press conference into a friendly gathering—with his quiet, courteous manner, easy humor, and his ability (shared by all real experts) to present technical data in easily understood terms.

That is Jack Savage—all over the world.

He was born on Christmas Day on a Wisconsin farm near Cooksville, in the year 1879, to Edwin Parker and Mary Therese (Stebbins) Savage. He attended private school at Spring Green, went to high school in Evansville and in Madison, and after graduation earned his bachelor of science degree in civil engineering at the University of Wisconsin in 1903.

There was a new Government agency, the Reclamation Service, only a year old, which was planning big things in the west, and needed young engineers with vision to put the plans on paper and see they were carried out. At that time there was much talk about "making the desert bloom like a rose," giving farmers better than half a chance at success. Jack Savage joined that outfit at Boise, Idaho. He had found his life's work.

His first job was designing irrigation structures for the Minidoka project under the guidance of Chief Engineer

Arthur P. Davis, Project Engineer D. W. Ross, and Consulting Engineer J. A. Wiley. Five years later, when he and J. A. Wiley went into the engineering business for themselves in 1908, at Boise, the Reclamation Service called upon him to design gates for the Arrowrock Dam. The partnership flourished, and Jack Savage designed many important structural works including the Salmon River Dam, the Swan Falls power plant on the Snake River, the Barber power plant on the Boise River, the Oakley Reservoir Dam, and the American Falls power plant.

But after 8 years, when the Office of the Chief Engineer was established at Denver, Colo., and Jack Savage was asked to take charge of all civil engineering designs, he accepted the offer. In 1924, he was placed in charge of all electrical and mechanical designing with the title of chief designing engineer, the position which he held until his retirement from the Bureau of Reclamation on April 30, 1945.

Since that time he has served as a consulting engineer to the Bureau and various foreign governments, which have been calling upon him for the last 25 years. Whenever a question stumped the experts, they would ask for Jack Savage. His first foreign assignment was in 1921, to give advice on the Barahona Dam in Santa Domingo. In those days, Savage says, "They used to have to pass an individual law for each trip." As a matter of fact, he answered at least one of these calls for help by refusing to accept any pay. It happened in 1938 when London cabled for Savage to come at once and do something for the ailing 40-year-old, Burrinjuck Dam in Australia. Savage was ready to go at once, but someone pointed out the law which prohibited citizens of the United States from accepting emoluments from foreign countries. Rather than delay the voyage in this emergency, Savage wired former Commissioner John C. Page of the Bureau of Reclamation: "Any assistance given the Government of New South Wales will be gratis and I shall not accept any fee or other form of compensation or any reimbursement for expenses." He added that he needed a vacation, anyway, but when he was once asked, "Do you always travel on dam business?" he replied, "I don't travel for pleasure."

A list of the dams and irrigation structures which have received the Savage touch would fill pages of manuscript, and nowadays with his duties as consultant to many countries, the number of projects designed by Savage, supervised by Savage, or "saved by Savage" is growing. As of present writing, there have been 19 countries which have called upon this reclamation engineer.

About a year ago he decided he needed a new passport. He was applying for a visa to Turkey and perhaps a stop-over at Palestine, and his old passport had become so heavy with extension upon extension that he claimed the air lines would be charging him for excess baggage. At that time he had had two passport extensions and 57 visas.

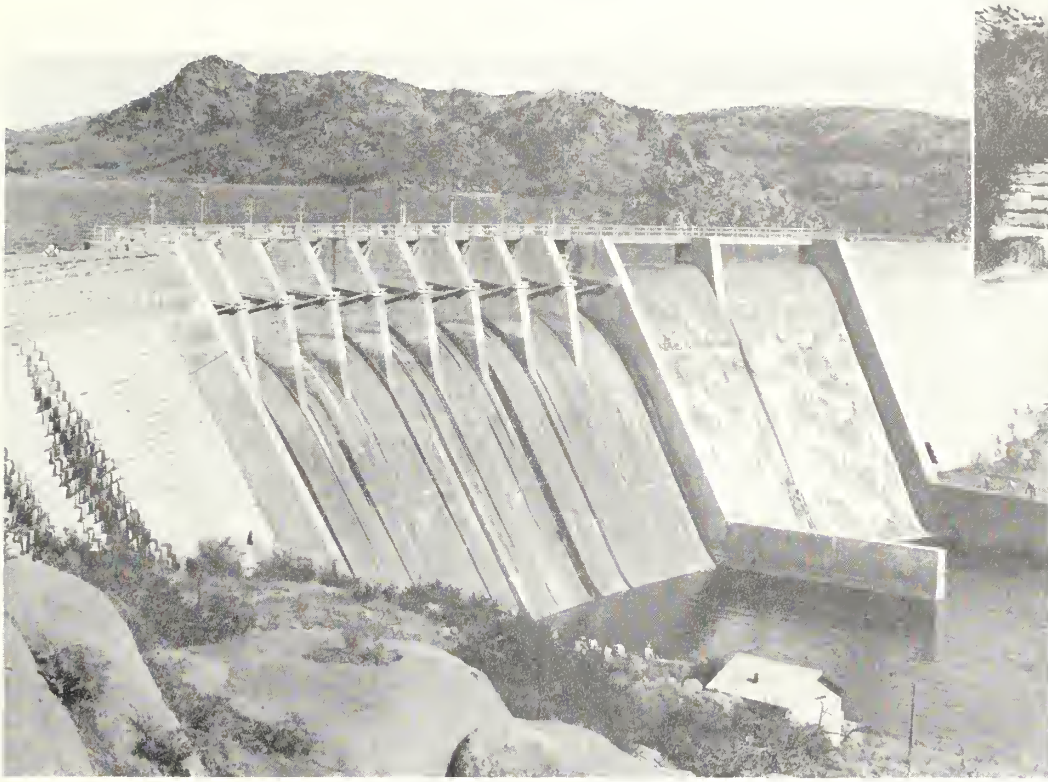
Although he created a great stir in engineering circles with his "giantific" plans for the Yangtze Gorge development in China, what he considers the greatest project in the world is located in what the nonengineering fraternity might consider an unlikely country for a reclamation project—Switzerland. This will be the Superdixence Dam, 900 feet high, which will completely submerge the present Dixence Dam, only 240 feet high. The reservoir will be unusually deep, with only about 1/100th of the surface area of Lake Mead, and every drop of the water will be used. Savage has designed a multiple power drop of 6,000 feet of head, which he says is the highest power drop in the world—so far as he knows.

What he has contributed toward daring, imaginative, utilitarian structures for his own country also comprises an unbelievably long and impressive list: in addition to Hoover and Grand Coulee Dams, add Friant and Shasta Dams of the Central Valley project in California, the Norris and

(Please turn to page 101)

"WE HAVE HIS MONUMENTS ON EVERY SIDE"—At left, Commissioner of Reclamation Straus stands with Savage before an enlarged photograph of Hoover Dam. At lower left, the way the Ichang Dam of the Yangtze Gorge project in China will look from the air. Savage says, "Because of the current situation in China it is doubtful it will be completed for some time."

ARTIST AND MODEL—John Lucian Savage and the working model of Davis Dam at the Denver, Colo., office of the Chief Engineer. This dam is now nearing completion, representing another daring design by Savage.



FROM FISH TO FLOOD CONTROL—The W. C. Austin project has everything. Above is a scene in the Quartz Mountain State Park, with Altus Dam in the background. At left is the dam and reservoir itself.

The W. C. AUSTIN PLAN

Part 1

On a project in Oklahoma, town and country, Federal, State, and county agencies, local people and organizations, demonstrate the true meaning of the word "cooperation."

by WILLIS C. BOEGLI, Branch of Operation and Maintenance, Amarillo, Tex., Region 5

EDITOR'S NOTE:

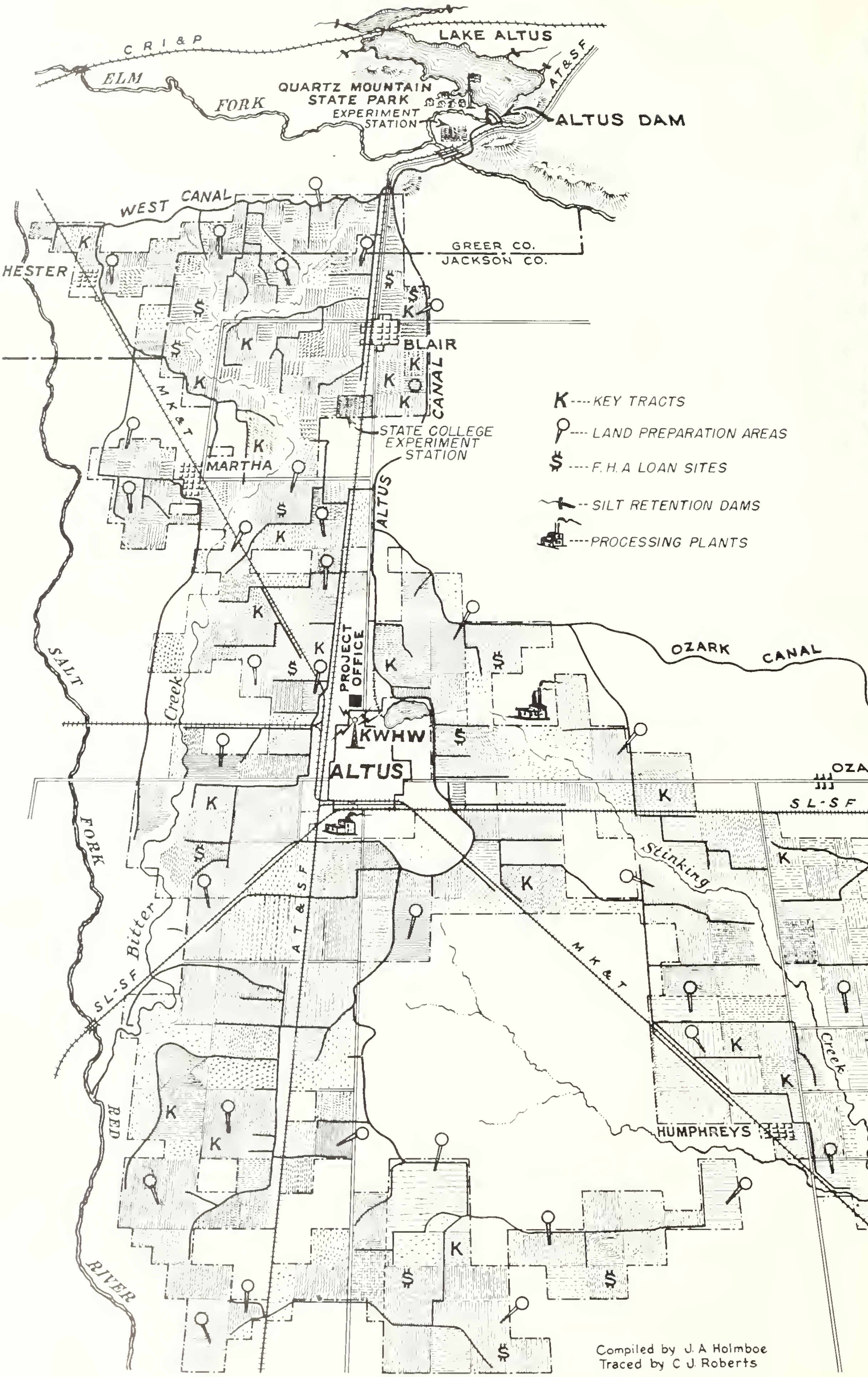
This is the first of a series of articles about the W. C. Austin project in southwestern Oklahoma. Because of its location in a subhumid area, where annual rainfall averages approximately 26 inches, the W. C. Austin project is unique in Bureau of Reclamation history. In this initial article, Mr. Boegli of the Bureau's Regional Office at Amarillo, Tex., discusses the rapid development of the project as a result of cooperative efforts by local, State, and Federal agencies. Other contributions to this series will be made by representatives of the various agencies participating in the project's development.

FROM TIME IMMEMORIAL all thinking people have known the value of cooperation. In fact, civilization's greatest advances have been recorded in times when there was a maximum of coordinated effort by all segments of society. America was pioneered by persons who were compelled to work together in solving problems encountered on every new frontier. When early settlers wished to build a house or harvest a crop, a call for help was sent out over the countryside. Nearly everyone responded.

Today on a reclamation project in southwestern Oklahoma, completed in 1949 by the Bureau of Reclamation, modern pioneers have combined their efforts to explore a new field of irrigation. Here, in this subhumid climate, the trails being blazed by farmers and the representatives of various local, county, State, and Federal agencies may lead to other successful developments and advance the conservation and use of the Nation's resources.

Cooperation has been the guiding principle from the time irrigation was first considered in the W. C. Austin project area. State, Federal, and local agencies have contributed greatly to the planning and development of this project—a pilot project for subhumid areas. Representatives of all interested agencies have considered every phase of the evolutionary transition from dry land to irrigated farming. People in other subhumid areas are studying the united program on the Oklahoma project, for it may provide a pattern for use in other similar climatic areas now seeking irrigation developments.

The project itself was designed to serve many persons and purposes—what the Bureau of Reclamation calls a multiple-purpose development. It provides municipal water for the city of Altus, Okla., recreational facilities, flood control and irrigation water for 50,000 acres of crop lands. The area covered by the project was settled and farmed before Oklahoma became a State in 1907. But the settlers didn't have much luck. Weather is not cooperative. The average annual rainfall of 26 inches sounds good, but although it is


LAKE ALTUS
C R I & P
ELM
FORK
QUARTZ MOUNTAIN
STATE PARK
EXPERIMENT
STATION
AT&SF
ALTUS DAM
WEST CANAL
GREER CO.
JACKSON CO.
HESTER
BLAIR
ALTUS CANAL
M K & T
MARTHA
STATE COLLEGE
EXPERIMENT
STATION
K----KEY TRACTS
----LAND PREPARATION AREAS
$----F. H. A LOAN SITES
----SILT RETENTION DAMS
----PROCESSING PLANTS
OZARK CANAL
PROJECT OFFICE
KWHW
ALTUS
OZARK
SL-SF
SALT
FORK
Creek
Bitter
Stinking
Creek
AT & SF
RED
RIVER
HUMPHREYS
Compiled by J. A Holmboe
Traced by C J. Roberts


FROM LEVELING TO LOADING—Everyone helps. At extreme left the Soil Conservation Service supervising land preparation; at center harvesting combine maize on the three-way cooperative demonstration farm, and at immediate left, the new potato packing house constructed by the Frisco R. R. Co. and the city of Altus to process and ship the produce of the W. C. Austin project.

sufficient for growing wheat and cotton, its erratic distribution and deviation from the average results in extreme variations in crop yields and economic conditions in the area. The annual precipitation records of the last 2 years are typical of the climatic variations. In 1948 the area received 16 inches. The precipitation in 1949 totaled 37 inches. Farmers often experience severe droughts in July and August even though the annual total rainfall approaches or exceeds the average figure. Those who planned the project recognized, early in the game, that irrigation under these climatic conditions would be uncommon in the Bureau of Reclamation's long history and that the work of technicians, representing various governmental agencies, would be desirable.

Construction of Altus Dam began in 1941, but was delayed by the war. The War Production Board later rescinded its 1942 stop construction order and work on the irrigation project was resumed in 1944. In the initial stages of project development the Bureau of Reclamation and the United States Soil Conservation Service reached an informal agreement that the latter agency was primarily responsible for giving technical assistance to project farmers in the preparation of their land for irrigation. Ever since water first became available for the initial unit in the project, the Soil Conservation Service, under the direction of R. H. Gieck, district conservationist, has helped farmers prepare more than 15,000 acres of land for irrigation.

The Oklahoma State College Extension Service, in cooperation with the Bureau, employs an irrigation specialist under the title of associate county agricultural agent, whose services are available to project farmers. Drue Dunn, formerly a county agent in Idaho's reclamation areas, served in this capacity for 2 years. Mr. Dunn was promoted recently to State extension irrigation specialist, and was succeeded by James Howell. Mr. Howell was reared on an irrigation farm in New Mexico, and is a graduate of New Mexico A. & M. College. County Agent D. R. Vaniman is an enthusiastic member of this service organization and in addition to directing the regular extension program he has performed splendid work in connection with the use of fertilizers, crop selections, and soil improvement activities in the irrigated section of Jackson County. About 180 boys and girls in the project area are active in 4–H Club work.

In the initial stage of project operation the Bureau, the Oklahoma Planning and Resources Board and the Lugert-Altus irrigation district pooled finances and personnel to set up a demonstration farm in the area to guide farmers in the change-over from dry land to irrigated farming. Anyone who needed help could actually see how to manage irrigation water, select crops, and perform similar operations which an irrigation farmer should know.

The Bureau and the State College later made a cooperative agreement which resulted in the transfer of the demonstration farm's management to the State. Now the former demonstration farm, and a much larger station in another area in the project, are operated by the experiment station branch of Oklahoma A. & M. College, under the direction of Ernest Williams. These stations are now experimenting in basic soil changes under irrigation, rates of water application, crop variety tests, horticultural crops, and other studies.

Besides the Bureau's annual crop and livestock census, which provides a wealth of information on irrigated farming, key tracts furnish early information on how much water is required by certain crops and how they react to irrigation. Detailed records are analyzed each year and the results are available to all agencies for use in planning their programs. Until experimental data on irrigation practices in this new area become available, the currently analyzed information is helpful.

The Oklahoma State Park Service has improved the beautiful Quartz Mountain State Park in the project's reservoir area. Good roads lead to the various attractive recreational buildings and points along the lake shoreline. Park Superintendent Asa M. Spain estimates that 175,000 persons visited the playground in 1949. In an area that is relatively short of recreational facilities, the park now is increasing in popularity for persons in western Oklahoma.

(Please turn to page 101)

AROMATIC SOLVENTS FOR WATERWEEDS

PART 2

by V. F. BRUNS, Agronomist (General), United States Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, cooperating with Washington Agricultural Experiment Station, in charge of weed investigations at the irrigation experiment station, Prosser, Wash.

and

W. H. FARMER, Land Use Specialist, located at Yakima, Wash., Department of the Interior, Bureau of Reclamation, region I (headquarters at Boise, Idaho)

WAPATO (pronounced *WAH*-pah-to) is switching to aromatic solvents.

This 130,000-acre Indian irrigation project, one of the six irrigation units built by the Bureau of Reclamation in the Yakima Valley of the State of Washington, has a serious waterweed problem in its 900 miles of water distribution and drainage systems. As on the Roza division (see map) about which we wrote last month, the project people have tested aromatic solvents to control the waterweed menace, especially in smaller laterals, and have been convinced of their effectiveness.

During 1949, under the direction of Jim Chamberlain, irrigation engineer of the Wapato irrigation project, weed crews treated 85 miles of the Wapato's channels with about 2,000 gallons of these materials. In general, they introduced the chemicals for 30-minute periods at concentrations ranging from 4.5 gallons per cubic foot per second of water flow (333 to 370 parts per million). Nearly 85 percent of the treatments gave satisfactory results and project personnel planned to double the use of aromatic solvents this year.

Until we prove whether aromatic solvents can be applied economically in the larger channels, the people on the Wapato project will probably continue chaining in channels of over 70 cubic feet per second, wherever the ditchbanks can accommodate the necessary trucks and crew for dragging the channels and forking the loosened weeds downstream.

As the season progressed, the Wapato experiments and field trials became more effective. We attributed the growing success to several facts—the water became warmer, making it easier to mix the chemicals, and the project people were able to get more efficient solvents and emulsifiers. Moreover, progressively less muddy water was carried in the channels. Suspended soil particles in the water not only tended to absorb quantities of chemical materials but also covered plant growth with a protective scum.

Unfortunately, one waterweed, the giant sago pondweed, the predominate species of submersed aquatic weed on the Wapato project, proved to be one of the most difficult species in this region to control with aromatic solvents.

Tieton division weed crews used comparatively more aromatic solvents for its size than for any other irrigation district in the Yakima Valley. During July and August 1949, they treated over 90 miles of laterals on this 25,000-acre project with 2,250 gallons of aromatic solvents.

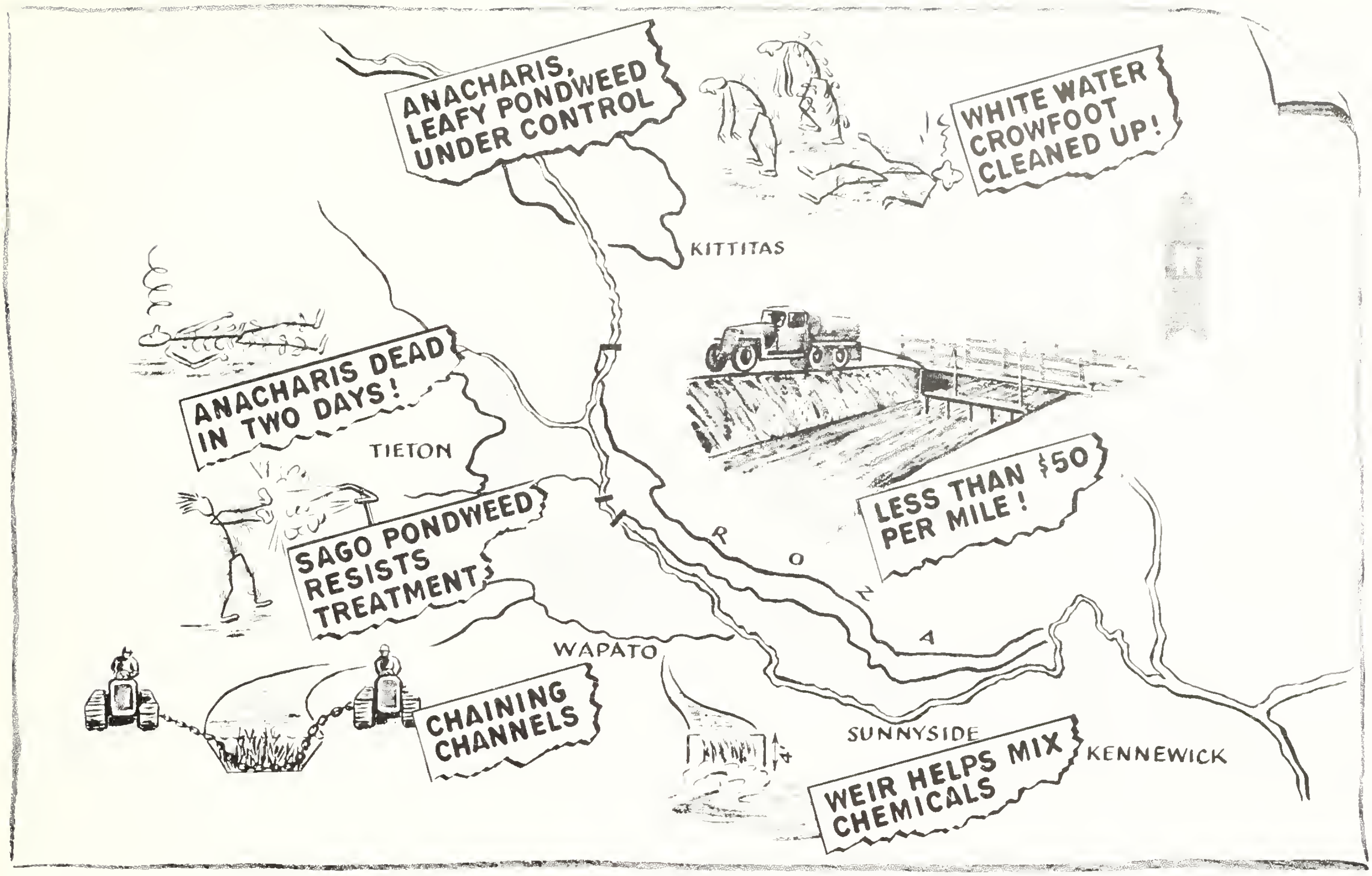
Before the project people started using the chemicals on July 26, the entire maintenance crew was kept busy removing waterweeds from channels in order to maintain continuous water delivery. When they started the field trials, using pick-up trucks, a small spray unit, and aromatic solvents, only two men were needed part-time to control waterweeds, and less water was lost through seepage and breaks. The spray unit consisted of 1½-horsepower engine, ¾-inch gear pump, spray boom, and neoprene hoses.

The laterals treated ranged in capacity from 2 to 40 cubic feet per second. By using a ready-mix material at 56½ cents per gallon, the average chemical cost was $12.89 per mile. The average over-all costs for treating 1 mile of channel were about $16. This may be compared with costs of previous hand-cleaning methods ranging from $80 to $200 per mile.

In general, results from aromatic solvent treatments were reportedly good. However, the waters of this project were relatively cold, and the crews had to use higher concentrations of chemical. As an example, one lateral with a water flow of 10 cubic feet per second was treated with 102 gallons of ready-mix material. Effective control of weed growth was obtained to the end of the channel 5.74 miles below the point of introduction. Waterweeds, mostly Anacharis (which of all the waterweeds has the common name "waterweed") were prostrate 2 days after treatment. Weed growth gradually disintegrated or sloughed away during the following 3 weeks without clogging structures downstream, and it was not necessary to repeat the treatments. Furthermore, treated water was used directly to irrigate field crops and orchards without reported damage.

Some difficulty was experienced during experimental trial runs on the Tieton project when emulsifier was added to a ready-mix material to obtain the desired percentage for low-water temperatures. Those conducting the trials did not know that the new ready-mix material contained a different type emulsifier and the two were not compatible. This resulted in considerable coagulation, clogging of screens and nozzles, and breaking of emulsion.

The water remains relatively cold throughout most of the



HIGH LIGHTS OF THE YAKIMA WEED MANEUVERS: ROZA—The cost for treating two sections of the wide Main Canal (one 75 cubic feet per second, and one carrying 150 cubic feet per second flow) was less than $50 per mile. An agitator boom helped mix the chemicals in water. WAPATO INDIAN—Warm water helped mix the chemicals, and better solvents and emulsifiers proved effective, although Giant Sago Pondweed resisted treatment. Chaining will be continued in channels over 70 cubic feet per second. TIETON—On small laterals ranging from 2 to 40 cubic feet per second the average cost was $16 per mile. Cold water and hard-to-mix emulsifiers caused trouble, one ready-mix solution and emulsifier proving incompatible. Anacharis (pronounced A-*nak*-ăr-is) dead in 2 days. KITTITAS—6 to 8 gallons per cubic feet per second help control Anacharis and leafy pondweed, and White Water Crowfoot cleaned up. SUNNYSIDE—Warm water, 8-inch temporary dam, and 4-foot weir, help mix chemicals. One hundred percent kill below higher weir, 65 percent below small dam.

season in irrigation channels of the Kittitas Division, in the upper reaches of the Yakima Valley. In treating several laterals on this project with aromatic solvents during the season, experimental tests indicated that concentrations of 450 to 600 parts per million (6 to 8 gallons per cubic foot per second) of type A aromatic solvent and oil-soluble petroleum sulfonate emulsifier, introduced over a 30-minute period, were necessary to effectively control infestations of Anacharis and leafy pondweed in this area.

However, weed crews completely cleared a dense growth of white water-crowfoot (often called "water buttercup") out of a ¾-mile section of one channel with a 30-minute introduction of 300 parts per minute (4.05 gallons per cubic foot per second) of the aromatic solvent containing the newer type emulsifier mentioned in treatments of the main Roza Canal (see last month's issue of the Reclamation Era). Apparently, white water-crowfoot was much easier to control with aromatic solvents than Anacharis. However, leafy pondweed was present to some extent in all channels treated, and if this species is used as a criterion the newer type emulsifier showed superiority.

As the initial treatments were completely effective, no additional applications were necessary later in the season as far as water delivery was concerned. Although there has been some indication that yearly treatments with aromatic solvents cut down on waterweed growth we cannot claim that these materials injure the root systems seriously. Some regrowth is normally expected.

Where muddy water was frequently a problem, past experiences have indicated the desirability of repeating the treatments of waterweed regrowth. Even though the weeds grew back to no more than 3 or 4 inches in length, the treatments prevented the collection of silt deposits.

We also obtained some valuable information on the use of aromatic solvents through test runs on the Sunnyside Valley irrigation district. Gallon for gallon the crews achieved better results on this project, perhaps because of warmer water.

One trial run afforded a striking example of the importance of thoroughly dispersing the chemical in the water before it comes in contact with the weeds. After the Sunnyside crew had introduced aromatic solvents above a temporary dam with an eight-inch drop, 65 percent control of aquatic weeds was obtained below this structure. However, after the same treated water passed over a weir, with a 4-foot drop, into a turbulent weir pool farther downstream, the weed growth in the remaining portion of the channel was practically

(Please turn to page 104)

WATER REPORT

West-Wide Forecasts of 1950 Water Supplies Based on Work of the Western Snow Surveys

by PAUL A. EWING, Senior Irrigation Economist; CLYDE E. HOUSTON, Irrigation Engineer; and R. A. WORK, Senior Irrigation Engineer, of the Soil Conservation Service, United States Department of Agriculture

OLD HABITS ARE HARD TO BREAK

It looks like an old, familiar pattern: Plenty of water—maybe more than plenty—in the Northwest: enough in the intermountain area and the Pacific slope; not enough for comfort in the Rio Grande Valley and Arizona. That's the water promise for 1950, as seen by the forecasters of the Soil Conservation service[1] on the basis of April snow-survey measurements throughout the West. As in several years past, the RECLAMATION ERA recites below this year's State-by-State water outlook as it appeared on April 1. This forecast is subject to change, and April storms in several sections—notably the Cascades and Sierra—may result in run-off substantially better than the first-of-the-month measurements could justify. However, April forecasts have developed the habit of reasonable accuracy, and the snow-surveyors do not expect the over-all results of the snow-melt to vary greatly from the April prophesies.

Again there are possibilities of floods in the Northwestern States, while the drought in the Southwest, only slightly abated by the rains of last summer, continues. A slight shortage of snow in places was reported in Columbia Basin in January, when only on the Flathead watershed of Montana and the Willamette of Oregon did the snow cover appear unusually high. Now, however, conditions in the Kootenai and Flathead drainages are such that if cold weather and normal precipitation occur during the next several weeks, damaging high water along the main Columbia River will occur. If normal melting conditions prevail throughout the basin, the southern streams will peak before the northern ones reach a high stage. Therefore, under normal melting conditions, little high-water damage should occur down the lower Columbia. However, should the present heavy snow-pack melt uniformly over the basin, causing the rivers throughout the basin to peak simultaneously, damaging high water should be expected along the main stem.

The extreme dryness of recent years in Arizona has now extended to New Mexico and southern Nevada, and unless benefited by an abrupt change of late-winter precipitation habits, they will be hard-pressed for water, especially toward the end of the irrigation season. Utah and western Colorado have much better prospects, and the slopes east of the Rocky Mountains have good reason to expect a liberal supply of water.

[1] The Division of Irrigation and Water Conservation is the Federal coordinating agency of snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, Forest Service, National Park Service, Geological Survey, various departments of the several Western States, irrigation districts, power companies, and others. The California State Division of Water Resources conducts and coordinates snow surveys in that State, while the British Columbia Department of Lands and Forests, Water Rights Branch, has charge of the snow surveys in that province.

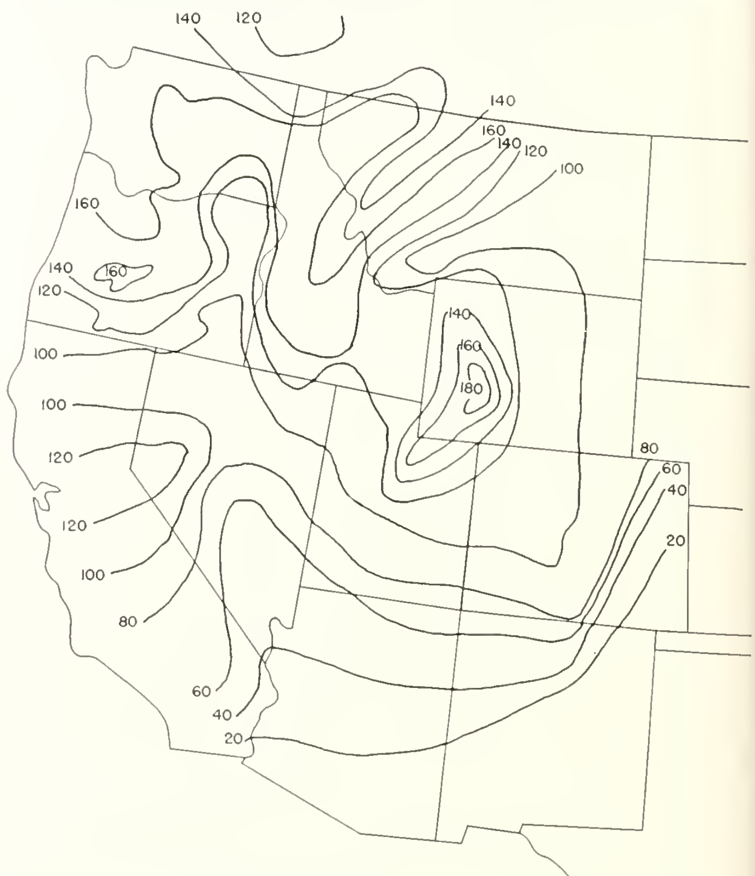
Forecast Summary by States

In the following paragraphs the prospects are described, State by State, as they were viewed on April 1. The two charts illustrate the situation graphically.

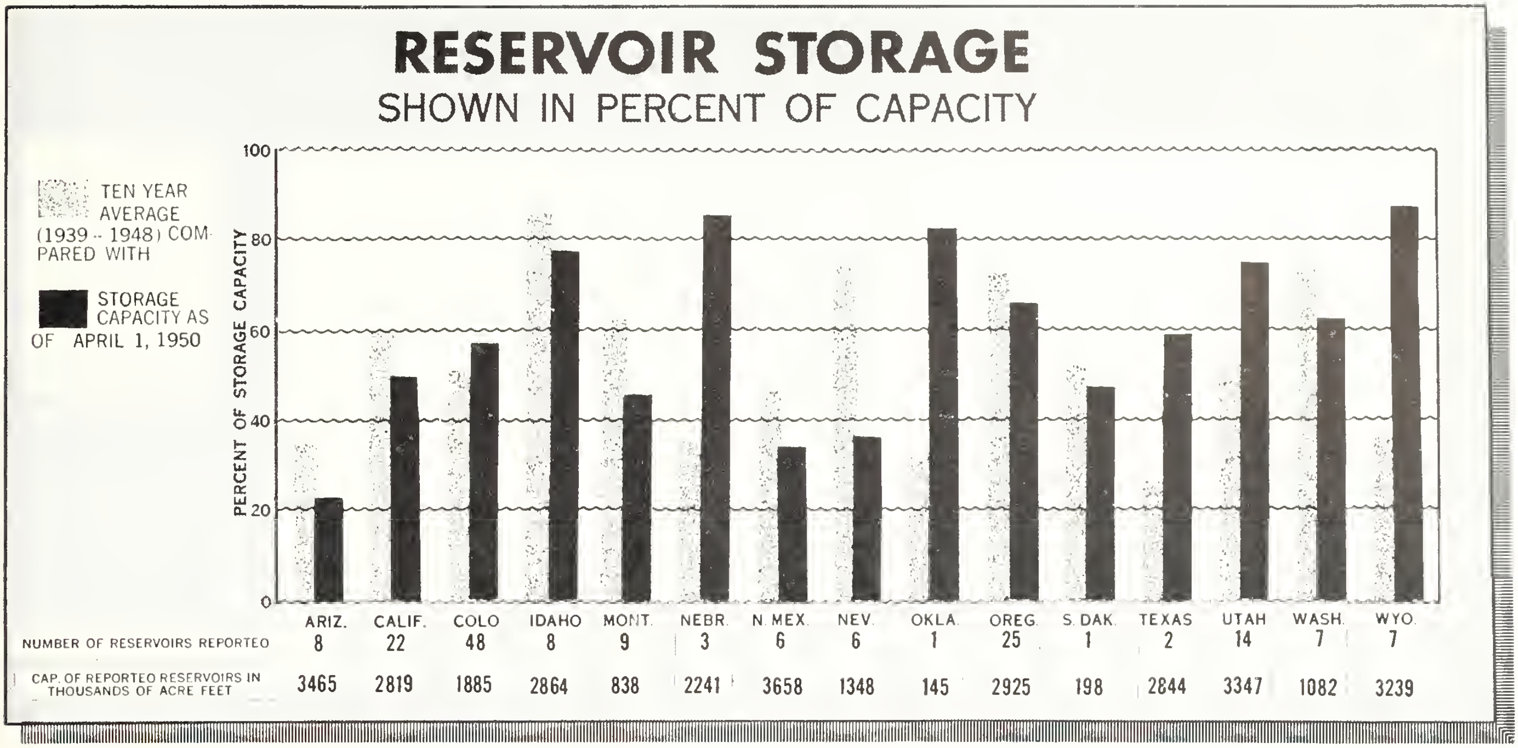
ARIZONA.—Snowfall has been far below normal. Verde and Salt River drainage areas had only about one-third normal snow cover, and Gila River area one-fifth of normal. As of April 1, there is practically no snow remaining on the watersheds of the State. Because of these poor snow conditions, the stream flow into the principal reservoirs has been disappointing. The Verde peaked at about 2,500 cubic feet per second, but only for a couple of days. The Salt never did peak, but has constantly run between 400 and 700 cubic feet per second for about 2 months. The Gila River flow has been so low that water users have been constantly drawing on the San Carlos Reservoir storage.

As of April 1, the reservoir storage in the State is at 20 percent of capacity. It would be far below this amount had there not been a good run-off in 1949.

CALIFORNIA.—Sierra snow pack on the first of April indicates that deficient stream run-off will occur in the San Joaquin River Basin from the Merced River south for the fifth consecutive year. The pack on the Tuolumne, Stanislaus, and Mokelumne watersheds is about normal. Watersheds of the Sacramento indicate conditions are also favorable and snow-melt run-off should be close to normal. In Sacramento-San Joaquin River Basins there should be enough water to fill all reservoirs except Shasta and Millerton, with water spilling at peaks



PROSPECTIVE STREAM FLOW
April-September, 1950
Figures are percent of 1939-1948 Average



Most State averages for reported reservoirs are for full 10-year period, but in a few cases reservoirs having shorter records are included. COLORADO—Does not include John Martin Reservoir (capacity 655,000 acre feet). April 1 storage 150,200 acre feet. CALIFORNIA—Does not include Friant or Shasta reservoirs. April 1 storage in these two reservoirs combined is 3,670,700 acre feet, which is 73 percent of their capacity. MONTANA—Does not include Fort Peck reservoir (capacity 19,000,000 acre feet). April 1 storage 11,932,000 acre feet. NEVADA—Does not include Lake Mead (capacity 27,217,000 acre feet). April 1 storage 17,686,000 acre feet. OKLAHOMA—Average is for 1945—49 inclusive.

of the snow-melt run-off. Lake Tahoe is expected to reach 6,226.65 level. (Prospects as of April 1 were somewhat improved by storms early in the month which precipitated rain in the valleys and snow in the mountains, in substantial amounts.)

Colorado.—Snow cover is near normal in most sections. Full precipitation in the mountains was deficient, and the soil under the snow is dry. Summer run-off is expected to be slightly less than the current snow cover would indicate. On the Sangre de Cristo Range, between the Rio Grande and Arkansas watersheds, the snow cover is very low. The snow-melt season flow of these streams will reflect this condition.

The soil moisture in irrigated areas east of the Continental Divide is low, owing to a lack of snow on the plains and in the valleys during the past winter. On the western slope, valley precipitation has been below average, but soil conditions are good. Reservoir storage is above average on the South Platte and Rio Grande watersheds and slightly below average on the Arkansas.

Idaho.—The present snow pack appears to assure adequate water for all requirements of irrigation and power throughout Idaho. April 1 snow surveys show the snow cover to be above normal, heavy snowfall having occurred since the surveys of January, which showed a snow pack of less than normal in more than half of Columbia Basin.

Montana.—The outlook for the upper Missouri River Basin is good. Snow measurements in the Jefferson and Gallatin Basins show conditions slightly below average, but those for the Madison are above average. Storage is generally good, and with the proper operation of reservoirs, there should be ample water even for late irrigation. Although there are some deficiencies at low elevations, the bulk of the snow appears to be high in the mountains, for late release if the melt season is normal. The Upper Columbia River Basin also appears to be in excellent condition. Many snow courses in this basin have a record high-water equivalent, the measurements being higher than either 1948 or 1943. Once again, for the third consecutive year, a flood potential exists in the upper basin, particularly on the Flathead and Kootenai watersheds. The main stem of the Yellowstone River in southeastern Montana is in only fair condition. The snow pack in the tributary basins to this stream indicate about 80 to 106 percent of average snow pack. Although the conditions are not as critical as those farther south, water will not be plentiful for irrigation.

Nevada.—Snow-water run-off in Nevada will vary from about 80 to 115 percent of normal in the eastern Sierra, while Humboldt Basin streams will flow from 65 to 115 percent. The southern two-thirds of the State can expect very little water from snow-melt, as the snow surveys indicate that during the past winter many areas received their lowest recorded snowfall. Ground-water storage is better than at this time last year but still below normal, while early-season stream flow has been normal or above. Reservoir storage, while better than last year, is only 40 percent of capacity and 50 percent of the past 10-year average. Lake Mead contains about the same amount of stored water as at this time last year, and about 90 percent of normal for this date.

New Mexico.—The snow cover in northern New Mexico is very low, many snow courses producing the lowest snow measurements since surveys were started in 1937. With only normal snow cover on the upper Rio Grande in Colorado, the summer flow of the Rio Grande and its tributaries is expected to be from one-fourth to one-third that of the past 10-year average. Storage in Elephant Butte and Caballo reservoirs is about 30 percent above April 1, 1949, but below the 10-year average. On the basis of current outlook for the flow of the Rio Grande, there will be a substantial drop in storage during the next year. Soil moisture in all irrigated areas is reported as dry.

Oregon.—The outlook is universally favorable, with prospects of supplies nearly equal to those of 1943 and 1946 and better than those of last year in some areas. Deficiencies are not expected anywhere if the snow-melt and run-off take a normal course. New run-off records will be established in the Deschutes watersheds, and unusually high flows are expected in Willamette River tribuatries draining the western Cascade slope from the Coast Fork and Row River northward to and including Santiam River. The condition of storage is generally satisfactory, although below the average of the past 10 years.

Utah.—Wide variation appears in the water-supply prospects. The water supply is excellent in the northern and northeastern part of the State, good in the central part, and fair in the southern part, except for the East Fork of Sevier River, where the expected water supply is poor. The snow blanket in the Cache-Wasatch-Ashley forests has a considerably higher than normal water content and could produce heavy spring stream flows if combined with heavy rains and or above-normal temperatures. Reservoir-storage supplies are near or considerably above the past 10-year average.

Washington.—Prospects already summarized for Columbia River Basin are those of Washington. They are generally favorable, though holding some possibility of high run-off if climatic conditions are not in normal adjustment during the melting period.

Wyoming.—In northern Wyoming, the snow pack of the Wind River Basin above Riverton appears to be in excellent condition as does the Popo Agie River Basin above Lander. The Big Horn watershed below Riverton also has a fair snow pack and the river will carry about the average volume for the run-off season. However, in northeastern Wyoming, the Tongue and Powder Basins do not share in this prosperous snow pack. The eastern slope of the Big Horn Mountains has only about 60 to 80 percent of average snow pack, and that section is likely to feel an irrigation shortage before the summer is over. Late spring or summer rains may help, but a rather critical condition exists.

The outlook for the Green and North Platte watersheds is excellent.

(Please turn to page 103)

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre-feet)		
			Active capacity [1]	Mar. 31, 1949	Mar. 31, 1950
Region 1	Baker	Thief Valley	17, 400	6, 900	11, 000
	Bitterroot	Lake Como	34, 700	8, 200	20, 000
	Boise	Anderson Ranch	464, 200	12, 500	133, 000
		Arrowrock	286, 600	113, 100	172, 100
		Deadwood	161, 900	94, 000	107, 300
		Lake Lowell	169, 000	149, 800	152, 400
	Burnt River	Unity	24, 600	13, 100	6, 500
	Columbia Basin	F. D. Roosevelt	5, 220, 000	4, 875, 000	4, 555, 000
	Deschutes	Crane Prairie	50, 000	37, 500	47, 000
		Wickiup	187, 000	188, 800	185, 300
	Minidoka	American Falls	1, 700, 000	1, 075, 400	1, 527, 800
		Jackson Lake	847, 000	370, 300	449, 600
		Lake Walcott	95, 200	74, 300	87, 000
		Grassy Lake	15, 200	13, 000	13, 200
		Island Park	127, 300	102, 700	127, 800
	Okanogan	Conconully	13, 000	10, 700	7, 500
		Salmon Lake	10, 500	8, 200	6, 600
	Owyhee	Owyhee	715, 000	354, 400	526, 500
	Umatilla	Cold Springs	50, 000	45, 700	45, 400
		McKay	73, 800	59, 900	66, 400
	Vale	Agency Valley	60, 000	53, 500	33, 200
		Warm Springs	170, 000	63, 900	48, 200
	Yakima	Bumping Lake	33, 800	7, 400	11, 700
		Cle Elum	435, 700	177, 400	267, 700
		Kachess	239, 000	175, 000	187, 600
		Keechelus	153, 000	63, 600	71, 500
		Tieton	197, 000	78, 800	110, 200
Region 2	Central Valley	Millerton Lake	503, 100	209, 300	184, 500
		Shasta	4, 389, 100	3, 192, 900	3, 339, 800
	Klamath	Clear Lake	437, 500	172, 300	149, 300
		Gerber	94, 300	32, 800	42, 000
		Upper Klamath Lake	524, 800	376, 000	415, 900
	Orland	East Park	47, 900	48, 200	49, 200
		Stony Gorge	50, 000	45, 100	42, 500
Region 3	Boulder Canyon	Lake Mead	27, 207, 000	17, 735, 000	17, 686, 000
	Parker	Havasu	688, 000	605, 300	664, 000
	Salt River	Bartlett	179, 500	117, 600	59, 700
		Horse Mesa	245, 100	140, 700	227, 100
		Horseshoe	67, 000	62, 700	2, 300
		Mormon Flat	57, 900	35, 100	51, 200
		Roosevelt	1, 398, 400	331, 300	276, 100
		Stewart Mountain	69, 800	37, 200	48, 800
Region 4	Fruit Growers	Fruit Growers	4, 500	4, 100	4, 200
	Humbolt	Rye Patch	179, 000	65, 400	55, 400
	Hyrum	Hyrum	15, 300	10, 800	10, 600
	Moon Lake	Moon Lake	35, 800	10, 200	20, 800
	Newlands	Lahontan	273, 600	192, 400	185, 700
		Lake Tahoe	732, 000	180, 000	228, 000
	Newton	Newton	5, 300	3, 500	4, 900
	Ogden River	Pine View	44, 200	4, 200	5, 800
	Pine River	Vallecito	126, 300	33, 500	55, 100
	Provo River	Deer Creek	146, 800	102, 300	117, 800
	Scofield	Scofield	65, 800	6, 500	25, 200
	Strawberry Valley	Strawberry	270, 000	100, 200	119, 500
	Truckee River Storage	Boca	40, 900	400	16, 100
	Uncompahgre	Taylor Park	106, 200	65, 000	72, 600
	Weber River	Echo	73, 900	14, 000	43, 900
Region 5	W. C. Austin	Altus	140, 000	85, 300	119, 900
	Balmorhea	Lower Parks	6, 000	5, 900	6, 500
	Carlsbad	Alamogordo	128, 300	32, 700	102, 000
		Avalon	6, 000	5, 400	3, 200
	Rio Grande	Caballo	345, 900	162, 300	221, 300
		Elephant Butte	1, 817, 000	530, 700	656, 100
	Tucumcari	Conchas	300, 000	206, 500	208, 400
Region 6	Belle Fourche	Belle Fourche	177, 500	132, 000	93, 000
	Milk River	Fresno	127, 200	74, 500	17, 700
		Nelson	66, 800	33, 500	5, 700
		Sherburne Lakes	66, 100	13, 200	39, 000
	Riverton	Bull Lake	152, 000	40, 000	6, 200
		Pilot Butte	31, 500	13, 200	13, 600
	Shoshone	Buffalo Bill	456, 600	172, 900	169, 400
	Sun River	Gibson	105, 000	76, 100	46, 600
		Pishkun	32, 100	15, 900	18, 800
		Willow Creek	32, 400	19, 400	3, 800
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	53, 800	68, 400
	Kendrick	Alcova	190, 500	129, 300	154, 300
		Seminoe	970, 000	467, 400	518, 800
	Mirage Flats	Box Butte	31, 700	29, 900	26, 400
	North Platte	Guernsey	41, 100	42, 900	25, 100
		Lake Alice	11, 000	0	3, 500
		Lake Minatare	57, 000	15, 100	24, 200
		Pathfinder	1, 040, 500	538, 600	915, 000

[1] Available for irrigation

JOHN LUCIAN SAVAGE

(Continued from page 92)

Wheeler Dams and power plants of the Tennessee Valley Authority, the Madden Dam and power plant which serves the Panama Canal, the Marshall Ford Dam in Texas, the Davis Dam on the border of Arizona and Nevada, and many others too numerous to mention.

However, Jack Savage points out, he cannot claim total credit for any of these structures, insisting on giving credit to all his associates—a clue to his success as an administrator, engineer, and unofficial roving ambassador.

When Savage decided to retire from his full-time duties at the Bureau of Reclamation, former Commissioner of Reclamation Harry W. Bashore said, "Jack Savage in a very real sense has epitomized the Bureau of Reclamation. He grew up with the organization. His extraordinary gift is the ability to bring a fresh mind to new problems in engineering. His approach is daring, but his plans are sound. Neither the necessity of building the highest dam in the world (Hoover Dam) . . . nor the requirement for the construction of the most massive concrete dam so far conceived at Grand Coulee on the Columbia River dismayed Jack Savage. He simply proceeded to design the dams, and they now are the pride of the engineering world."

Savage has left his mark on more than the paper plans of the structures he has designed. He has influenced the lives of many people throughout the world, and legends have grown up around his name. Here are two utterly dissimilar anecdotes which illustrate the high regard which people have for his opinions and ability.

Forty-three years ago a young man named Harry Smith left his mining job in western Idaho for a job at the St. Louis World's Fair. On the train he met a young engineer who was most enthusiastic over the Minidoka tract near Twin Falls, Idaho, which he had just helped survey. Smith was so impressed, he returned to Idaho and took up farming near the Snake River at Heyburn, where he has continued to be thankful for the advice of the younger engineer who was (you guessed it) John L. Savage.

About 13 or 14 years ago an earnest Cornell student named Mohammad Kabir Ludin, from mid-Asia, worked for Savage in the Denver office. After completing his work, he vanished from the Bureau's sight for about 10 years, reappearing as His Excellency, Minister of Public Works of Afghanistan, whose first mission on returning to the United States was to get in touch with Jack Savage, so they could plan together a $17,000,000 reclamation program for his country—a country which, as Jack Savage says reminiscently, "is a country without a railroad." Six large irrigation dam projects are now under way, with many Americans now employed in building roads as well as water projects.

From urging a young miner to take up farming, and causing a future Minister of Public Works to travel half around the world to find a man to save his country from the economic doldrums, the Savage influence is widespread and varied.

Although he states he couldn't even make a guess on the total cost of all the projects for which he has served as a consulting engineer and designer, continually emphasizing the brilliance and competence of other engineers whom he has known in our country, as well as China, India, and Afghanistan, he states unequivocally, "Every country I have been in has been very enthusiastic about developing its water resources. Irrigation is one of the big hopes to lift the standard of living of the countries I have visited—and I have yet to find a place in the world where they produce more power and conserve more water than they can use."

That's John Lucian Savage. He loses himself in his prime objective—designs for better living all over the world.

We hope he will receive his nomination to Reclamation's hall of fame with the same surprised and gracious attitude which has characterized his acceptance of similar tokens of recognition. For example, he received the Colorado Engineering Council's gold medal award for distinguished service in engineering in 1937, the John Fritz medal award for notable scientific or industrial achievement by four American National engineering societies, the Henry C. Turner gold medal award of the American Concrete Institute for notable achievement in, or services to, the concrete industry in 1946, a national honorary membership in Chi Epsilon in 1946, was appointed the American vice president of the International Commission on Large Dams of the World Power Conference for 1937–39 and 1946–47. He has been a member since 1916, an honorary member since 1941, and a life member since 1942 of the American Society of Civil Engineers. Space does not permit a complete listing.

With all these honors, and an enviable record of having designed and put his stamp of approval on the mightiest reclamation structures all over the world, John Lucian Savage, like all great men, is humble, self-effacing, and self-dedicated to his task. Although he refuses to take himself too seriously, he is in dead earnest about his work. Once he was asked if he spoke many of the foreign languages used in the countries he visited. With a chuckle he said, "I don't even speak English very well—but, lucky for me, it is becoming almost a universal language."

Welcome to Reclamation's hall of fame, Jack Savage!

THE END.

The W. C. AUSTIN PLAN

(Continued from page 95)

The Bureau and the Greer and Kiowa County soil conservation districts recently started a program to protect the reservoir storage capacity by constructing silt retention dams in the reservoir area. The Soil Conservation Service, through the districts, has carried on an erosion-control program on farms in the Altus reservoir water shed. (See "Combined Attack on Erosion," page 213, November 1949 RECLAMATION ERA.) This program is being intensified by an over-all plan for erosion control on the entire North Fork of the Red River above the Altus Reservoir.

Recognizing the importance of conservation under irrigation, the county committee of the Production and Marketing Administration, headed by Chairman Forest Schnorrenberg, includes special payments for practices beneficial to project lands in the county agricultural conservation program.

The transition from dryland to irrigation farming to date has been favored by good crops and high prices, and thus the need for an increased farm credit program has been practically negative. George McKeagg, county supervisor for the Farmers Home Administration, reports only 14 operating loans on the project that has 389 individual farm operators. Local banks have been extremely helpful in other cases where farmers desired credit financing.

From the time of the very first publicly expressed desire for a reclamation project in the area, the citizens of Altus and other communities in the valley have been most cooperative. The Chamber of Commerce in Altus (the largest community in the project area, with an estimated population of 14,000 persons) is noted for its intensive and continuing program of service to project farmers, various agencies working in the project area, and all new industries. This civic body, headed by President Robert B. Harbison, and served by Mrs. Mattye Wilson Williams, secretary-manager, is an important factor in adjusting merchandising and processing activities in the city of Altus to meet the needs of the irrigated section in the community's trade territory.

In addition to the grain elevators, cotton gins, and similar marketing establishments that were available prior to project construction, the Frisco Railway Co. and the city of Altus have constructed processing sheds to aid shippers of irrigated produce. These facilities are leased to experienced operators who prepare the farm products for shipment.

KWHW, the voice of the Mutual radio outlet in Altus, is readily available for programs by the representatives of all agencies working in the project area. Station Manager Frank Wimberly, formerly an employee of the New Mexico State Extension Service, with headquarters on the Bureau's Rio Grande project, is one of reclamation's greatest friends.

Three newspapers in the project area—the Daily Altus Times-Democrat, the Southwest News at Altus and the Enterprise at Blair—are alert to the educational values of the printed word and no request for cooperation is ever denied by them.

Further manifestation of the unselfish, cooperative attitude that prevails throughout the W. C. Austin project area is that of the housing arrangement between the Bureau's project office, under project engineer J. A. Callan, and the Lugert-Altus irrigation district, managed by Merle W. Wilkerson. One modern building, remodeled especially for this purpose, houses employees of the Federal agency and the irrigation district. Parking space for cars and trucks and conference rooms are no problem when project farmers and others visit the attractive and practical office building.

The programs of all agencies working in the project area are coordinated by a U. S. D. A. council. The council is composed of the heads of Department of Agriculture and State college agencies, which maintain offices in the county. Members meet each month to discuss their problems and plans for action. This committee serves the entire county, but it devotes as much time as may be required to project matters. Another committee, designed primarily as a coordinating unit, is known as the Agricultural Advisory Committee to the Extension Service. Membership of this committee is composed of agricultural technicians from all agencies that work with project farmers.

Although 1949 rainfall was unusually favorable for nonirrigated crops on the W. C. Austin project, 75 percent of the area was irrigated last year. In view of the fact that almost 50 percent of the farms received water for the first time in 1949, this percentage of irrigation activity is little short of phenomenal.

The W. C. Austin project rapidly is becoming a model of interagency and rural-urban cooperation. Here, on this agricultural frontier, the resources of men and women are being combined to conserve and use to the maximum extent possible those natural resources which nature has placed within their hands.

NEXT MONTH—How the people of the W. C. Austin project worked out a cooperative plan to convert to crop production under irrigation.

Aspinall Commends Bureau on Emergency Action at Grand Valley

On March 8, while tunnel workers were trying to make emergency repairs to tunnel No. 3 on the Grand Valley project, Colo., the hill slipped, causing a slide which completely blocked the tunnel and threatened the farmers on the project with a total loss of crops. Swiftly cutting red tape to clear the way for action, the Bureau of Reclamation drew up plans and specifications, asked for bids and had hired a contractor to drill a new section of tunnel in solid rock on March 17. The appreciation of the water users is well expressed by Congressman Wayne N. Aspinall of Colorado in the following letter to Commissioner of Reclamation Michael W. Straus. Congressman Aspinall also sent a letter to Secretary of the Interior Oscar L. Chapman, praising the prompt action taken by the Bureau.

Congress of the United States,
House of Representatives,
March 23, 1950.

Dear Commissioner Straus: Now that all of the preparatory work has been done by the Bureau under your fine and capable leadership on the repair of tunnel No. 3 of the Grand Valley Water Users project and the contractors are in the process of getting set up for the work ahead of them, I wish to thank you sincerely for the outstanding work which the Bureau has performed in this instance. Never in my knowledge (and as far as I know, this goes for war days, too) has a Department and Bureau of the Government proceeded as swiftly and ably as have you in this particular. I shall never let go unchallenged any criticism by a citizen of that area concerning the inability to cut red tape when it is absolutely imperative. I think that I appreciate the necessity of thorough study and the following of prescribed rules in dealing with public matters and public moneys as much as anyone. On the other hand, when an emergency demands the other course of action, it is not only heartening but also enlightening to know that speedy action may be obtained.

I shall be glad to assume some of the responsibility (if such is necessary) in advising the constituency that such emergency action must, of necessity, be a little more expensive than it would be otherwise. I do not think this task will be a very difficult one. As far as I can determine from letters and through publicity channels, the people of that district are universally pleased with your help and services.

I wish to take this opportunity of expressing to you my pleasure in having a gentleman like Goodrich Lineweaver in your Bureau. He is most thoughtful, cooperative, conscientious, and able in the discharge of the duties of his office. I certainly enjoy working with him.

Again expressing my appreciation and with kindest regards to you, I am

Sincerely,

(Sgd.) Wayne N. Aspinall, M. C.

AWAY WITH DUST—The air cleaner designed by Kyllo and Day is shown at left with the pencil pointing to the clean area of the oil bath filter. The standard air cleaner at right permitted a noticeably larger amount of dirt to collect in the oil at the bottom of its oil bath filter. Both air cleaners were operated under similar conditions for the same period of time.

SUPER AIR-CLEANER

by

E. C. KEELER, Mechanical Engineer
Yakima project, Yakima, Wash., Region 1

Dust is a nuisance on most new irrigation developments, not only for the new settlers but for Bureau of Reclamation engineers and equipment engaged on construction.

So it has been on the Roza division of the Yakima project in eastern Washington.

The light volcanic soil in this area, very fine and flourlike when dry, produces clouds of gritty dust when disturbed or driven through by an automobile. Operating cars under this condition was costly in wear and tear and in maintenance. The carburetor air cleaner, if not cleaned frequently (sometimes daily), would permit the dust to enter the motor and cause excessive wear.

Two Bureau men, however, solved the problem. They are Lloyd Kyllo, chief of party, and Frank Day, property clerk. They invented what is called a "super air-cleaner."

The men got the inspiration for their invention from the extremely dusty conditions under which they worked. Dust was sometimes a foot deep on roads along the Roza Canal construction. They noticed that the dust would boil up under the hood of the car or truck, with the blast of air from the fan driving it back into the old-type cleaner, down through the carburetor and into the cylinders, with resultant severe wear.

They knew, too, that an almost new motor in one of the vehicles had to be replaced because the dust had caused it to wear so badly. A new jeep station wagon had to have a complete motor overhaul at 1,500 miles.

Even though the old-type cleaners were serviced two or three times a week to keep them open, and worn parts were replaced, the wear continued.

Then came the Kyllo-Day invention.

The "super air-cleaner" consists of an old-type oil bath air cleaner, with an air-tight hood which has a 5-inch pipe in the back, connecting to the opening in the dash with a 5-inch hose. The air is taken from inside the car. This eliminates 90 percent of the dust. When entering a dusty area, all windows are shut and the cowl ventilator opened. The reason for opening the ventilator is to create an air pressure inside the car, which will keep dust from sifting in through loose windows or cracks.

A comparison test was made. A car with the "super air cleaner" and one with the old-type cleaner were used in the same area for 1 week. At the end of that time, both air cleaners were taken off and cleaned. The "super air cleaner" showed only a very small trace of dust in the oil, while about three tablespoonfuls of dust were taken from the old-type cleaner.

The inventors feel their device is a real improvement in air cleaners, and it will save the Government many large repair bills and costs of new motors wherever this "super air cleaner" is used.

During the cold and wet seasons the hose connected to the dash should be removed, so warm air from the heater will not be dragged from inside the car. (All surveying crews will testify to the fact that any station wagon is never too warm in the winter.)

To date nine of the "super air cleaners" have been installed on cars subject to very dusty service on the Roza division. The cost of $9 for installation of each will be more than repaid by fewer cleanings of the oil bath air cleaner and longer life of the motor. A test by a mechanical analyzer shows a very slight increase in the richness of combustion when a five-inch hose intake to the "super air cleaner" is used. A 6-inch hose will be tested soon. Very little effect is apparent on the response of the engine. The End

WATER REPORT

(Continued from page 99)

On the headwaters of the North Platte and Laramie Rivers the snow cover is slightly above normal. West of the Continental Divide on the Green, the high-mountain snow cover is 50 percent above normal and well above that of April 1, 1949. Soil moisture on the range and meadow lands of the Upper Green is excellent.

On the North Platte, the irrigation supply for eastern Wyoming and western Nebraska is assured, owing to a record carry-over. Storage in the four major reservoirs now totals 1,675,000 acre-feet, or 73 percent of capacity. However, soil moisture is very low.

British Columbia. The April 1 snow survey showed no indication of general thawing. There has been little run-off, as the weather continued cool and cloudy. The snow is deep, and of low density. About half the results indicate the greatest measured snow-water content on record. The water-supply picture for the Columbia River Basin in British Columbia is therefore very good, with all prospects well above normal, provided normal temperatures and precipitation prevail until and during the run-off period. If the weather during April and early May continues cloudy, cool, and with even normal precipitation, a definite flood potential will exist. The End

OUR FRONT AND BACK COVERS

THE STONE CUTTER swings his heavy hammer on a limber handle and splits irregular rocks into regular shapes. The chant of the rock cutter reaches a crescendo as the hammer hits the wedge, and his chants are answered by other black cutters across and up and down the valley.

THE CITY OF CHANGSHOW BY THE YANGTZE is the river port city for the U T Y T Dam. The ancient city is situated on the north bank of the Yangtze, just above the world-famous gorges. Changshow's largest temple stands guard on a rock hill overlooking the river. It was built in the shape of a dragon, and the rock ridge stretching down to the river is said to be the dragon's tongue as he drinks from the muddy water. Changshow means "long life" a name derived from a well 20 kilometers from the city which is purported to have extended the lives of those who have drunk of its waters. Nowadays it is not necessary to drink the charmed water of the well to receive its benefits. The official seal or "chop" of the magistrate of Changshow, which can be purchased singly or in sheets of 100 from almost any shop in the city, will do the trick. These and all other photographs used to illustrate "How China Builds a Dam" were taken and submitted by the author, Fred O. Jones.

Aromatic Solvents for Waterweeds

(Continued from page 97)

eliminated. Aromatic solvents are lighter than water and unless thoroughly dispersed do not penetrate to the bottom of the channel and the emulsion tends to rise to the surface and break more rapidly.

Other interesting notations were made in this channel which in 1948 had been treated with aromatic solvents. On our year-later trials we used a comparatively high concentration of 900 parts per minute (1.05 gallons per cubic foot per second for only a 10 minute period). Results from the 1949 treatment were far more effective on giant sago pondweed than the year before. In 1948 the same channel had received a concentration of 181 parts per minute (7.5 gallons per cubic foot per second for more than an hour and a half—92 minutes). Undoubtedly the higher concentration used in 1949, coupled with the relatively slow linear velocity (0.4 foot per second) of the water flow in this channel were responsible for our success.

Two weeks after treatment with aromatic solvents the channel was chained to release silt collected on the bottom. Strangely enough, the pondweeds grew back rapidly. Upon checking, we found the regrowth occurred in a portion of the channel where the initial chemical treatment didn't "take" or was less satisfactory.

This indicates that channels should not be chained soon after aromatic solvents have been applied, if such treatments have not been completely effective.

We encountered many problems as various groups tested and used aromatic solvents on such a wide scale to control aquatic weeds throughout the Yakima Valley during 1949. And we have a great deal of research and practical work ahead of us before we are able to obtain the most efficient use of these materials. Nevertheless, rapid progress has been made toward solving waterweed problems with aromatic solvents. Project operators responsible for keeping water channels clear in this area are highly optimistic and hail aromatic solvents as one of the most effective weapons yet developed in the battle against submersed aquatic weeds.

THE END

NOTES FOR CONTRACTORS

Contracts Awarded During March 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2810	Missouri River Basin, N. Dak	Mar. 16	Two 15,000-kilovolt-ampere, two 10,000-kilovolt-ampere, two 7,500-kilovolt-ampere, one 5,000-kilovolt-ampere, and one 3,000-kilovolt-ampere transformers; and two 15,000-kilovolt-ampere autotransformers for substations, advance power system, REA Cooperatives, items 1, 3, 5, 7, 10, 13, 16, 19, 22, and 29	Moloney Electric Co., St. Louis, Mo	$519,419
2810	do	do	Two 15,000-kilovolt-ampere autotransformers for Edgeley and Leeds substations, advance power system, REA Cooperatives, items 15 and 21.	Pennsylvania Transformer Co., Pittsburgh, Pa.	70,877
2810	do	do	Five 1,500-kilovolt-ampere and two 2,000-kilovolt-ampere transformers for substations, advance power system, REA Cooperatives, items 8, 11, 17, 20, 25, 27, and 30.	Larkin Lectro Products Corp., Pine Bluff, Ark.	72,318
2859	Hungry Horse, Mont	Mar. 14	Two 230/196-kilovolt and one 115-kilovolt circuit breakers for Hungry Horse switchyard, schedules 2 and 3.	Pacific Electric Mfg. Corp., San Francisco, Calif	145,620
2859	do	do	Six 230,000-volt lightning arresters for Hungry Horse switchyard, schedule 5.	Westinghouse Electric Corp, Denver, Colo.	17,852
2863	Missouri River Basin, Nebr	Mar. 21	Construction of earthwork and structures for Superior canal, and drains and channel changes.	Ace Construction Co., Omaha, Nebr	227,073
2865	Columbia Basin, Wash	Mar. 22	One 5,300/6,625-kilovolt-ampere transformer for Quincy pumping plant switchyard.	Gough Industries, Inc., Los Angeles, Calif	28,715
2866	Boulder Canyon, Ariz.-Calif.-Nev.	Mar. 16	Two 69,000-volt circuit breakers for Nevada State 69-kilovolt switchyard, schedule 1.	Pacific Electric Mfg. Corp., San Francisco, Calif.	20,549
2869	Davis Dam, Ariz.-Nev	Mar. 7	3 complete sets of forced-air cooling equipment for 30,000 kilovolt-ampere transformers for Parker switchyards	Allis-Chalmers Mfg. Co., Denver, Colo	15,900
2876	Columbia Basin, Wash	do	Construction of earthwork, structures, and surfacing, and construction of Lind Coulee Bridge for relocation of 6 miles of county roads in vicinity of O'Sullivan Dam.	David Nygren, Seattle, Wash	151,691
2880	do	Mar. 9	Construction of earthwork, asphaltic membrane lining, pipe lines, and structures for area W3, laterals and sublaterals, except station 0+00 to 164+70 of lateral W22 and station 0+00 to 8+60 of sublateral W22E, West canal laterals.	J. A. Terteling and Sons, Inc., Boise, Idaho	461,139
2882	Central Valley, Calif	Mar. 8	Constructing foundations and erecting steel towers for 42 miles of Shasta-Tracy Nos. one and two 230-kilovolt double-circuit transmission line, Madison-Rio Vista section, schedule 1.	James H. McFarland, San Francisco, Calif.	263,591
2884	Missouri River Basin, N. Dak	Mar. 21	Construction of 28 miles of Jamestown-Edgeley 115-kilovolt transmission line, schedule 1	Hallett Construction Co., Crosby, Minn	229,820
2884	do	do	Construction of 70 miles of Edgeley-Forman 69-kilovolt transmission line, schedule 2	Delta Construction Co., Clarksdale, Miss	303,919
2889	Davis Dam, Ariz.-Nev	Mar. 6	Construction of Mesa substation, structural work, schedule 1	Arizona Sand & Rock Co., Phoenix, Ariz	198,920
2889	do	do	Construction of Mesa substation, electrical work, schedule 2	J. M. Montgomery & Co., Inc., Los Angeles, Calif.	114,988
2891	Central Valley, Calif	Mar. 17	Construction of earthwork, pipe lines, and structures for laterals 124.5W, 126.7W, 128.3W, and 129.8W, and sublaterals, unit 2, Southern San Joaquin municipal utility district, Friant-Kern Canal distribution system	United Concrete Pipe Corp., Baldwin Park, Calif.	1,572,639
2896	do	Mar. 16	15 traveling water screens for Friant-Kern Canal distribution system	Link-Belt Co., San Francisco, Calif	91,690

NOTES FOR CONTRACTORS—Contracts Awarded During March 1950—Continued

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2901	Missouri River Basin, Nebr	Mar. 17	Construction of 52 miles of Alliance-Chadron 115-kilovolt transmission line.	I. O. Teigen Construction Co., St. Paul, Minn.	$312,739
2903	Hungry Horse, Mont	do	Miscellaneous structural steel, aluminum, and rails for Hungry Horse power plant.	Union Iron Works, Spokane, Wash	19,237
2905	Central Valley, Calif	Mar. 14	Three 115,000 volt circuit breakers and nine 115,000-volt disconnecting switches for Tracy switchyard.	Pacific Electric Mfg Corp., San Francisco, Calif.	96,399
2906	Fort Sumner, N. Mex	Mar. 17	Construction of concrete-gravity Fort Sumner diversion dam	A. L. Murphy and Nathan A. Moore Los Angeles, Calif.	457,760
2908	Central Valley, Calif	Mar. 7	205,670 linear feet of 12- to 72-inch reinforced-concrete pipe for Ivanhoe irrigation district; Lindmore irrigation district, unit 3; and Southern San Joaquin municipal utility district, unit 3, Friant-Kern canal distribution system.	Central Valley Concrete Pipe Co, Stockton, Calif.	768,076
2913	Missouri River Basin, Nebr	Mar. 16	Two 4-foot by 4-foot high-pressure gates with two 85,000-pound hydraulic hoists and 2 gate hangers for canal outlet works at Trenton Dam.	Westinghouse Electric Corp, Denver, Colo.	20,720
2919	Missouri River Basin, Mont	Mar. 24	Miscellaneous structural steel for roof framing and crane runway at Canyon Ferry power plant.	American Bridge Co, Denver, Colo	35,829
2921	Davis Dam, Ariz.-Nev	Mar. 27	Telephone switchboard equipment for Davis power plant	Kellogg Switchboard & Supply Co, Chicago, Ill.	10,021
2922	Colorado-Big Thompson, Kendrick, and Missouri River Basin, Colo.-Nebr.-Wyo.	Mar 31	Carrier-current and relaying equipment for Alcova, Beaver Creek, Casper, Cheyenne, Gering, and Greeley substations, and Estes, Flatiron, Kortes, and Seminoe power plants, schedules 1 and 3.	Westinghouse Electric Corp., Denver, Colo.	79,555
2922	do	do	Carrier-current and relaying equipment for Seminoe and Kortes power plants and Cheyenne and Alcova substations, schedule 2A.	General Electric Co., Denver, Colo	11,080
2925	Fort Peck, Mont	Mar. 30	Construction of 30,000 kilovolt ampere Havre substation	Valley Engineering & Construction Co., Grand Forks, N. Dak.	87,586
2927	Riverton, Wyo	Mar. 24	Construction of buried asphaltic membrane lining between station 1117+00 and 1359+83 of Pilot canal.	Lighty Construction Co. and Brasel and Whitehead, Riverton, Wyo.	96,290
2930	Fort Peck, Mont	Mar. 23	Fabricated structural steel for Havre substation	Puget Sound Bridge & Dredging Co., Seattle, Wash.	13,564
2936	Colorado-Big Thompson, Colo	Mar. 22	120,000 barrels of portland cement for construction of Olympus and Pole Hill tunnels and Olympus siphon, Estes Park-Foothills power aqueduct; and Poudre supply canal.	Ideal Cement Co., Denver, Colo.	390,000
2952	Grand Valley, Colo	Mar. 16	Reconstruction of tunnel No. 3	Grafe-Callahan Construction Co., and Rhoades-Shofner Construction Co., Inc., Dallas, Tex.	609,800
R2-90	Central Valley, Calif	Mar. 13.	Office building, warehouse and garage at Delano Government Camp	Cannon Construction Co., Stockton, Calif.	56,720
R2-93	do	Mar. 24.	Construction of timber operating bridges, Station 3769+68.60 and Station 5165+80, Friant-Kern Canal.	Anderson Co., Visalia, Calif	32,243
R3-PX-32	Parker Dam power, Arizona-Calif	Mar. 14.	Townsite improvements at Parker Dam, Calif	Frontier Construction Co., Tucson, Ariz	97,500
R4-20	Provo River, Utah	Mar. 7	Construction of earth work, pipe lines and structures, sublaterals 1, 2, 2A, 3, and 4; and wasteway, station 452+38.9, south lateral, Utah Lake Distribution Co. canal, Deer Creek division.	Emmett D. Ford, Contractor, Inc., Provo, Utah.	15,522

Construction and Equipment for Which Bids Will Be Requested by July 1950

Project	Description of work or material
Boise Project, Idaho	Erection of 10,000-kilovolt-ampere Mountain Home substation.
Boulder Canyon, Ariz.-Nev	Construction of additional rooms in the Hoover power plant.
Do	Generator voltage bus structures for units A-3, A-4, and A-9, Hoover power plant.
Cachuma Project, Calif. (formerly Santa Barbara Project).	Construction of Cachuma Dam, an earthfill structure located on the Santa Ynez River about 7 miles southeast of Santa Ynez, Calif.
Central Valley, Calif	Construction of a 23-mile long, 2,500-cubic foot per second capacity, concrete-lined section of Friant-Kern canal.
Do	Construction of a concrete gate structure for two 60- by 30-foot radial gates; and construction of a 30-foot long steel and concrete railroad bridge, and a 300-foot long steel and concrete highway bridge, on the Sacramento River, for the Delta cross channel, near Walnut Grove, Calif.
Do	Motor-driven water pumps with total capacity of 120 cubic foot per second at 180-foot head for Trauger pumping plant.
Colorado-Big Thompson, Colo	Construction of 1 mile of 7- to 10-foot diameter concrete-lined Carter Lake pressure tunnel, 6 miles west of Berthoud, Colo.
Do	30,000 pounds of miscellaneous galvanized fabricated steel structures for Beaver Creek substation.
Do	One 30,000/37,500-kilovolt-ampere, 6.9/115-kilovolt, 3-phase transformer for Pole Hill power plant.
Do	Main control board for Pole Hill power plant.
Columbia Basin, Wash	Construction of the 350-cubic foot per second capacity Quincy pumping plant about 1 mile from Winchester, Wash.
Do	Construction of about 60 miles of laterals, sublaterals and appurtenant structures in the M1, W1, W2, and W2A areas extending from Adrian to Ephrata, Wash.
Do	Construction of about 55 miles of laterals, sublaterals, pumping plants and appurtenant structures in the W4 area adjacent to Quincy, Wash.
Do	Construction of about 50 miles of laterals, sublaterals, pumping plants, and appurtenant structures in the E2 area adjacent to Moses Lake, Wash.
Do	Construction of a 17-mile section of the 1,800-cubic foot per second capacity Potholes East canal, about 10 miles northwest of Othello, Wash.
Do	Construction of the Potholes East canal headworks, 3,900-cubic foot per second ultimate capacity, at O'Sullivan Dam, about 8 miles west of Warden, Wash.
Do	Continuation of repairs to Grand Coulee Dam spillway bucket and spillway face.
Do	Construction of 8 permanent wood-frame houses with garages and 20 temporary houses and utilities at Warden, Wash.
Do	Construction of 2 residences, pump house, machine shed miscellaneous farm buildings, and water and sewer systems at the Burke development farm near Burke, Wash.
Do	Construction of a 40- by 70-foot 1 story, concrete block building for divisional office at Othello, Wash.
Davis Dam, Ariz.-Nev	Construction of the 20,000-kilovolt-ampere ED-2 and ED-4 substations near Casa Grande and Eloy, Ariz.
Do	Construction of residences at Mesa, Coolidge, and Tucson, Ariz.
Davis Dam, Ariz.-Nev	Construction of switchyards at Wellton-Mohawk pumping plants No. 1, 2, and 3, east of Yuma, Ariz.
Do	Furnishing and installing pumps for 6 water supply wells at Tucson, Coolidge, Phoenix, and Mesa, Ariz.; and furnishing and laying pipe lines at Mesa and Coolidge.
Do	Furnishing and erecting prefabricated steel warehouse at Parker Dam, Calif.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Hanna substation.
Do	Construction of about 35 miles of 2-circuit, 4-pin on cross-arm, open wire telephone line from new Casper substation to Alcova Dam, Alcova, Wyo.
Missouri River Basin, Mont	One 125-ton bridge-type traveling crane with 20-ton auxiliary hook for Canyon Ferry dam and power plant.
Do	One 375 cubic foot per minute and one 65 cubic foot per minute air compressor, one 8 cubic foot per minute portable air compressor, two 42-inch diameter by 10-foot air receivers and one 24-inch diameter by 6-foot air receiver for Canyon Ferry power plant.
Missouri River Basin, Nebr	Construction of the 1,300-foot long Superior siphon, a 4.5-foot diameter precast concrete pipe line, in the town of Superior, Nebr., on the Superior Canal.
Missouri River Basin, N. Dak	Constructing foundations and installing equipment for 15,000 kilovolt-ampere Rugby substation.
Do	Construction of the 15,000 kilovolt-ampere Devils Lake substation.
Do	Construction of the 7,500 kilovolt-ampere Jamestown substation.
Do	Construction of Fort Clark River and relift pumping plants, substations for the pumping plants, and canal, lateral, and drainage systems; and installation of pumping plant and substation equipment.
Do	Construction of 21 of the Heart Butte pumping plants, including installation of 23 pumping units ranging in capacity from 3 to 10 cfs, and construction of discharge lines and lateral systems.
Do	400,000 pounds of galvanized fabricated steel structures for Rugby, Devils Lake, Jamestown, and Washburn substations.
Missouri River Basin, Wyo	Construction of Anchor Dam, a concrete arch structure, about 40 miles northwest of Thermopolis, Wyo.
Do	Clearing about 3,600 acres of the Boysen reservoir site, about 18 miles south of Thermopolis, Wyo.
Do	Relocation of 3¾ miles of single track C&NW railroad at Boysen Dam.
North Platte, Wyo.-Nebr	Concrete lining for 12,400 feet of Fort Laramie canal, lateral 29.4, 3 miles south of Lingle, Wyo., and lateral 45.1, 3 miles northwest of Veteran, Wyo.; and 10,000 feet of laterals 98.1 and 98.1B, 6 miles southeast of Lyman, Nebr. Asphalt lining of 12,000 feet of lateral 58.7 and a portion of Horse Creek lateral, totaling 12,000 feet, near Veteran and Lyman, Nebr.
Yakima, Wash	Repairs to Kachess Dam, about 3 miles northeast of Easton, Wash.
Do	Repairs to Bumping Lake Dam spillway, 50 miles north west of Yakima, Wash.
Do	Construction of 9 two-bedroom, wood-frame residences with garages in Yakima and Benton Counties, Wash.

The Reclamation ERA

JUNE
1950

Official Publication of the Bureau of Reclamation

The Reclamation ERA

June 1950

Volume 36, No. 6

Issued monthly by

The Bureau of Reclamation

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

Approved by the Bureau of the Budget

CONTENTS

FEATURE ARTICLES

SHORT FEATURES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

OUR FRONT COVER

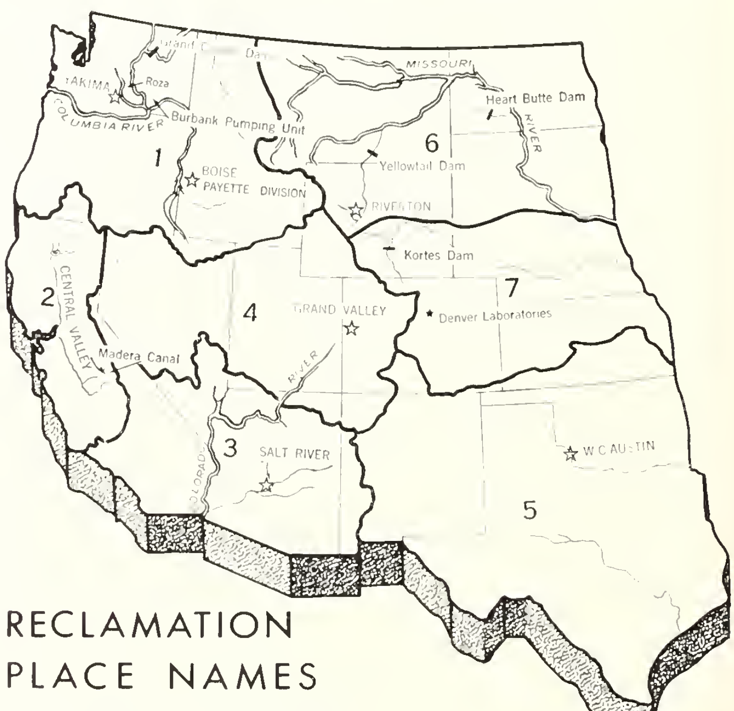
Four-year-old Cherrie McLaughlin, pulling cotton bolls on the J. Davis farm at Altus, Okla. Cotton remains a popular crop on the W. C. Austin project where farmers are gradually learning the advantages of irrigation farming. See part two of "The W. C. Austin Plan" on page 117. Front cover photo by F. S. Finch, Region 5 photographer.

30 YEARS AGO IN THE ERA

Utilizing Waste Places and Products

The irrigation farmer should remember that not all the profits in farming are made from the open fields. Often the proportion of the farm not well utilized is surprisingly large. Interest and taxes run against all the land, and if only 80 percent of it is producing, that part must carry the heavier burden in consequence. But it is not only the utilization of waste places that is important. Each crop has its by-products, its stubble, stover, or aftermath that ought not to rot, burn, or wither because the means for making use of it are not at hand.

(From p. 259, June 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)



RECLAMATION PLACE NAMES IN THIS ISSUE

THE GRAND VALLEY RESCUE

The farmers of Grand Valley Project, Colo., have won their $2,000,000 battle against landslide and drought!

At 12 minutes past noon, on April 27, 1950, some 200 tunnel workers—toiling around the clock and pitted against a May 28 deadline—"holed through" a 2,240-foot detour around a landslide that had wrecked the project's No. 3 tunnel. On May 4, the job was completed.

As a result of this achievement—boring a 12-foot hole nearly a half mile through solid rock—life-giving water flowed to 29,000 acres of peach orchards and farms comprising Garfield Gravity Division, and the Mesa County and Palisade irrigation districts near Grand Junction, Colo.

The tunnel reconstruction was accomplished in about 68 percent of the time allotted for the entire job and 24 precious days earlier than the most optimistic orchardist had dared to hope.

Each day shaved off the 72-day construction schedule was worth thousands of dollars in crops saved. Experts estimated only a $200,000 crop loss if water could be delivered by June 1, and approximately $50,000 if delivered by May 1.

In beating the deadline by such a wide margin, men and machines more than won a race that had enough drama, suspense, and excitement to intrigue the whole Nation. Since Wednesday, March 8, when a southern extremity of the Little Book Cliff mountains near Cameo, Colo., gave way, crushing 500 feet of old No. 3 tunnel like a soda straw, competitive-minded America had been pulling for the water users to avert what could have been a $2,000,000 total loss of 1950 crops.

Newsweek magazine commented:

"Engineers reported that the tunnel would never again be able to carry water. Faced by this catastrophe, the Reclamation Bureau moved with unbureaucratic speed. On the day the tunnel collapsed, the Bureau authorized its field official in Denver to negotiate a contract to get water through to Grand Valley. With $500,000 in emergency funds at hand, and $1,000,000 more available as needed, specifications were drawn up for a 2,240-foot horse-shoe shaped tunnel."

On March 16 the $609,800 contract was awarded to the Grafe-Callahan Construction Co. of Dallas, Tex., and the Rhoades-Shafner Construction Co., Inc., of Los Angeles, Calif.

Three days later, on March 20, the contractor was on the job with truckloads of equipment, and the job got going full swing on a three-shift basis with crews divided for simultaneous digging at both ends of the new tunnel under the direction of Construction Engineer Ross D. Billings, veteran Bureau tunnel man.

Within a week's time the contractor's project manager, B. A. Peters, and his men had built a shop to house jumbo drill rigs, battery chargers, supplies; laid a 24-gauge rail track to the tunnel access; piped in water; found housing for 200 men, and put them to work.

With Billings and his inspectors showing them where to drill, blast, and shovel, the hardrock "moles" cut 100 feet into the mountainside and hammered another 30 feet beyond that in the same first week, while crews at the other end of the tunnel strived to match this progress. Jumbo drill rigs were trundled to the headings by electric locomotives. Five sets of drills bit into the rock face in short rounds of 7 to 8 feet. In the early stages, delay detonators set off gelatin charges a milli-second apart to reduce shock wave to a minimum in the landslide area—a development studied and assisted in by a special agent of the Atlas Powder Co. from the East. Rocker shovels removed the blasted rock in quarter-yard takes, depositing it in the hoppers of mucking machines for speedy removal to the spoils dump by narrow-gage dump cars. At maximum production, the crews at one of the headings approached the national record of 104 feet in 24 hours.

And that is the way it went, only at steadily increasing tempo and efficiency, for the whole 48 days and nights. On the holing-through operations, they had beaten by 30 days the best time that engineering judgment could reasonably expect, and in so doing set two unbelievable records: 752 feet of hard-rock tunnel drilled within a month after the bid call, and 1,324 feet drilled by April 17—a month after contract award.

Back of the actual construction achievement is another "how" story that is less dramatic but equally as important in the great demonstration of teamwork by all concerned.

HURRY-UP CALL FOR THE MASTER PLUMBER

Typical of the reactions to the Grand Valley tunnel episode is the above cartoon made available to the Reclamation Era through the courtesy of the publishers of the Denver Post, who also printed an editorial dealing with the record-breaking operation entitled, "A Big Job—And No Boondoggling."

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It accounts in part for the speed with which Uncle Sam came to the water users' rescue.

A hint of what lay behind the swift action in getting a contractor on the job is contained in another excerpt from Newsweek:

"As in most regions west of the Continental Divide, water means wealth to the Grand Valley. For 33 years, the Grand Valley Diversion Dam near Cameo has been diverting this precious water from the Colorado River into a highline canal—an artery skirting the cliffs and diving through a series of tunnels (Ed. note: of which the No. 3 is the last) on its way to the orchards and truck farms below.

"For well over a year . . . the Grand Valley Water Users Association worried about a 500-foot sector of tunnel 3, a concrete-lined 7,300-foot bore. Hairline cracks widened dangerously, indicating an under-ground landslide which could crush the artery and cut off the flow of water."

Even though the Grand Valley project was turned over to the water users last year upon repayment of their construction charges, the Bureau continues to have an interest in the projects it has built, and is ready at all times to help in an emergency.

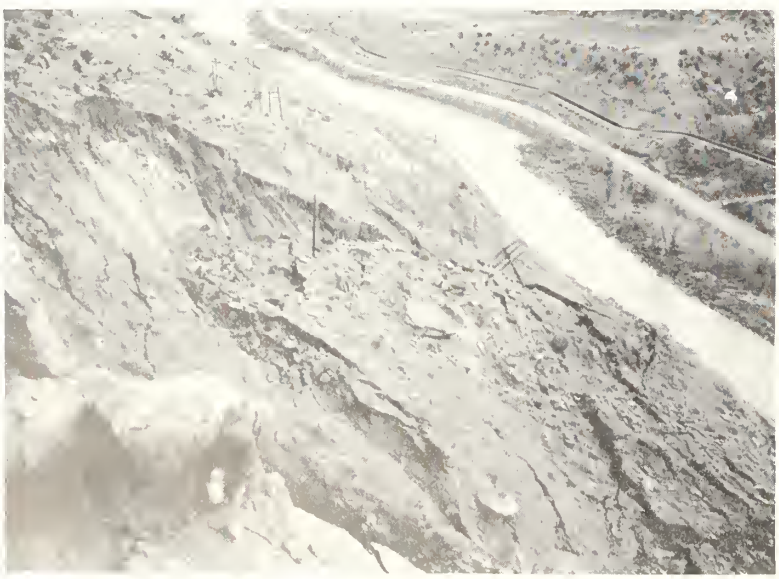
Upon learning of the threatened bottle-neck at the No. 3 tunnel, the Bureau of Reclamation's director for the region in which the Grand Valley project is located, E. O. Larson, sent a diamond drill crew over to the tunnel to see what could be done.

The crew located a route through the solid rock where a tunnel could be bored safely to by-pass the danger spot, and at that time (December 8, 1949) the people hoped emergency repairs might make the old tunnel serviceable for another season. But they did not let it go at that. Just in case the tunnel did not hold, they started the ball rolling for full-scale rebuilding and repairs, and thus had a 3 month "head start." There was a great deal of paper work and negotiations involved in working out a contract with the Grand Valley Water Users Association to pay for the job. The Legal Division and the Branch of Operation and Maintenance, spurred on by the tunnel inspection report which said, "there is no assurance that the tunnel will not fail completely before the 1950 irrigation season," drafted the repayment terms and were so successful with their negotiations that a contract, already approved by the water users, the Commissioner of Reclamation, and the Secretary of the Interior, was in the hands of the House Committee on Public Lands by March 8—the fatal day the tunnel collapsed. The next day the House Committee approved the rehabilitation and betterment funds for the Garfield Gravity division of the Grand Valley project.

While this work was going on to finance the full operation, Commissioner of Reclamation Michael W. Straus released $150,000 for emergency repairs and Area Engineer C. H. Jex recruited foremen and laborers to start work on February 13. They tried to shore up 600 feet of the tunnel with timber supports, but by March 1, after placing the emergency timbers for about 400 feet, it began to look hopeless. A few days later when Engineer A. B. Reeves of the Chief Engineer's office and representatives from the regional office inspected the tunnel, everyone present agreed that no time should be lost in preparing specifications and awarding a contract to construct a new tunnel around the slide area.

Thus it was that the Office of the Chief Engineer was forewarned and forearmed when the news of the March 8 collapse reached him. The next day he wired 25 leading contractors to inspect the scene of the disaster. The regional director forwarded a geological report of tunnel No. 3 to Denver, and on March 13 and 14 representatives of 10 contractors made an on-the-spot check of the tunnel site. On March 15 the contractors held a pre-bidding conference in the Chief Engineer's Office. The following day the negotiating committee opened the six bids submitted, and the Chief Engineer awarded the contract. Thus were two contract records broken—one for negotiating a repayment contract, and one for a construction award.

THE CAUSE OF IT ALL—Where the mountain slipped, the tunnel underneath couldn't stand up against the shock of tons of earth crushing against it. This general view of the landslide area is directly above Tunnel No. 3. *Photo by G. T. Finlinson, of Region 4.*



THE RESULTS—After the landslide. Here is the upstream face of the tunnel, showing a chunk of concrete fallen from the top of the arch, and the buckled and splintered timbers which vainly tried to support the tunnel. *Photo by M. M. Scott, of Region 4.*

The near catastrophe is all history now—one more chapter in the life of a great reclamation project. Veteran farmers of the Garfield Gravity division, and the Mesa County and Palisade irrigation districts, regard their narrow escape as just another vicissitude of the many that have marked the project's 33-year history. True, the water users must repay the cost of reconstructing the tunnel, but this was a rehabilitation and betterment need that had been programed for the next year in any case.

Some 1,000 acres usually planted to sugar beets probably can still be used this year for that purpose since this high-paying crop requires early irrigation. Such early crops as tomatoes and early potatoes may be saved. Any anticipated losses may be recouped by switching to pinto beans, corn, small grains, or other crops that mature quickly.

Since peach irrigation usually starts by June 1, the peach growers came through unscathed. And that is something, for about one-third of Grand Valley's nationally famous peach crop—normaly totalling more than a million and a quarter bushels—is grown each year on the acres served by the No. 3 tunnel.

Among the happiest over the reprieve from drought were the hundreds of families who trek annually from their homes in Oklahoma, Texas, and other States to harvest the peach and vegetable crops. In addition to the employment derived, many bring fruit jars and put up their year's supply of peaches and tomatoes from over-ripe fruit furnished free by the growers.

In addition to the influx from other States, the small armies of high school students can also look forward to their usual summer employment in the peach orchards now that the drought specter is routed.

The project as a whole has been one of the most successful of the federally constructed reclamation projects in creation of wealth. Costs of construction, which commenced in September 1912, totaled $5,667,500. First irrigation water was delivered in June 1915. The first crop record of 1916 reported a total cash return of $54,692 from 1,561 acres or an average of $35.04 per acre.

In 1945, the cropped acreage had increased to 28,247—yielding crops valued at $3,418,833, an average of $121.03 per acre. In 1949, total crop values were $2,108,579 or $73.64 an acre (reflecting no doubt the peach crop damage from hail last year).

A more startling indication of the impact of the Grand Valley project on the economy of the area is found in the assessed valuation figures for Mesa County. The highest assessed valuation prior to the project was $5,762,969 in 1908. By 1916 it had jumped to $26,530,372, and in 1949 the assessed valuation of Mesa County was $29,908,935.

Those who met the emergency of the No. 3 tunnel had a cause worth fighting for. THE END

Lineweaver Now Assistant Reclamation Commissioner

Secretary of the Interior Oscar L. Chapman, on April 28, 1950, announced the promotion of Goodrich W. Lineweaver to the position of Assistant Commissioner of the Bureau of Reclamation. Mr. Lineweaver has been director of the Bureau's Branch of Operation and Maintenance for the last 5 years. E. D. Eaton, who has been assistant director of Operation and Maintenance, was named acting director.


Goodrich W. Lineweaver

Lineweaver was responsible, through the seven regional directors, for the operation and maintenance of more than 50 Reclamation projects which provide irrigation water for about 5,000,000 acres of Western land served by Federal facilities. On these lands crops with a cash value of more than half a billion dollars are produced annually.

Since the war, the Operation and Maintenance Branch has spearheaded a program for financial adjustments of repayment contracts with water users' organizations on older projects. More than a score of amendatory contracts have been negotiated and approved by Congress which have been designed to place them on a firm, financial footing based on repayment ability of the land. The Branch is also engaged in an extensive rehabilitation and betterment program initiated by Mr. Lineweaver to improve project facilities which had deteriorated during the war years.

The appointments were recommended by Commissioner Straus who said an additional Assistant Commissioner is urgently needed to handle the expanding administrative burden of a water resources development program. As the new Assistant Commissioner, Mr. Lineweaver will have immediate supervision of program and finance operations of the Bureau of Reclamation, including appropriation presentations before the Bureau of the Budget and the Congress in addition to special assignments.

Other Assistant Commissioners are Kenneth Markwell and Wesley R. Nelson. Both continue their present positions within the Bureau with specific responsibilities little changed, Commissioner Straus said.

Mr. Lineweaver has been with the Bureau of Reclamation since 1937 in various capacities and has been Director of the Branch of Operation and Maintenance since 1945. In this position he has supervised the opening to homestead entry, by war veterans, of more than 50,000 acres of public lands comprising about 500 irrigated farms.

Mr. Lineweaver first served the Federal Government as Secretary of the Federal Power Commission from 1934 to 1936, and has been associated with Western resources development constantly since that time. He is a native of Harrisonburg, Va., and served as an officer in the United States Army during the First World War.

Mr. Eaton, the new acting head of the Operation and Maintenance Branch, has been with the Bureau of Reclamation since 1943. Prior to the war, he was with the Soil Conservation Service in Albuquerque, N. Mex., and elsewhere in the West. He is a graduate of Cornell University.

CONTROLLING CATTAIL WITH 2,4-D

by MAX WILSON, Superintendent, Madera Canal, and G. M. FINNEY, Weed Specialist, San Joaquin Valley District, both of Region 2, headquarters at Sacramento, Calif.

Cattail is a triple threat to irrigation farmers.

It stops water, drinks water, and collects silt. It spreads rapidly and stubbornly resists efforts to keep it under control.

This decorative, but damaging, weed grows (in water 2½ or 3 feet deep) to man-dwarfing heights, in close formation, shooting up to 7 feet or more. It is quite capable of snarling up a water distribution and drainage system completely. When it retards, or stops, the flow of water in drains or unlined canals, it can be held responsible for damaging crops, seeping the fields and cutting down the profits of the farmers.

You could justify controlling cattails on their water drinking habits alone. An acre of cattail may consume 10 acre-feet of water a year. At a sale value of $3.50 per acre-foot of water, this represents a substantial loss to irrigators.

As a silt-catcher, dense stands of cattail cause silt to settle and require periodic and costly ditch cleaning.

Up to now, irrigation farmers have accepted cattail as a necessary evil, to be endured until the weed got completely out of hand, and then temporarily, and at considerable expense, to be dredged, cut, disked, or chained out of the trouble spot. Cattail relinquishes its ground reluctantly. It persists and spreads, as its extensive root system serves as a vegetative reproducing organ as well as a food reservoir. The large amount of food stored permits the plant to survive periodic top removal and live through the winter. But that is not all. It is a prolific seeder and thrives vigorously throughout the growing season with a discouraging rate of recovery following cutting. Recent developments in burning methods are encouraging, and chaining also works well in some irrigation districts.

After 3 years of tests on the Madera Canal in California's Central Valley project we believe that cattail (which previously resisted all forms of chemical control) has met its match in 2,4-D ("D" for dichlorophenoxyacetic acid).

The Madera Canal began operation in July 1944 and within 3 months cattail began to appear along the waterline of the canal in the unlined section—the last 30 miles or so of the 37 mile-long canal which flows in a northwesterly direction beginning at Friant Dam. Twenty-two culverts carry storm water under the canal into drainage ditches which have very flat bottom slopes. Storm water and seepage around the structures, and through shrinkage cracks, keep water standing in most of the drains throughout the year. Natural springs plus the natural drainage ditches, used to transport water to irrigated lands 10 miles away, supplement this condition. This sluggish drainage situation provides ideal conditions for cattail growth.

Cattail, like many perennial weeds making their first invasion on a new canal, sneak up in a deceptive and rather unspectacular manner but once established, seem to be there to stay.

First, an attempt was made to remove the plants by hand. But cattail, like all other perennial weeds, is kept alive by its invisible roots. Remove the tops and the roots will continue to send up more plants. After the canal had been in operation for 3 years, many of the drains had become choked with tall, dense cattail growth.

In 1946 and 1947 we started experimenting with the then relatively new 2,4-D—a "translocated" herbicide, one which is taken in by the leaves of the plants, and travels to the roots. In the case of cattail, this was the vital (in fact, the only vulnerable) spot to attack.

In order to overlook no possibility for control we tried sterilizing the soil by using carbon bisulphide and a sodium chlorate-borax combination in selected areas. The carbon bisulphide injections into mud or moist ground were very effective for small areas, but the cost, about $2 per square rod, ruled out this method except for the elimination of isolated cattail patches. The sodium chlorate-borax, which was sprinkled on the ground, to be seeped in with water and sterilize the soil, could not be used, either, as most areas were so wet the concentration became too diluted to be effective.

General contact sprays effectively killed the tops but did not reach the roots of cattail, which promptly grew back again—too expensive as a long-run proposition.

In 1947 we began to spray cattails with a salt of 2,4-D. We also tested several concentrations of salt, and ester, of the acid with oils as a spray. From the results of these tests, we planned an all-out assault during the 1948 season, using the ester form. The results have proved the wisdom of this choice. In 3 years, the cattail in the drains has been pushed 500 or 600 feet from the canal, and new growth is now readily controlled, as far as the hoses can reach.

After our second spraying in 1949, no further work was needed on three drains which previously required periodic spraying—they were free of any new growth.

Now, where the cattail used to bloom, grass is flourishing. And grass is an ideal cover for ditchbanks. It controls erosion, keeps out the weeds, does not interfere with the flow of water, and uses much less water than weeds.

For an effective cattail control program, proper timing, the right spraying method, and correct rate of applying 2,4-D are most important. For each acre, we used 3 pounds acid equivalent 2,4-D, 5 gallons of Diesel oil, and enough water to form an emulsion of 240 gallons. We maintained a spray pressure of 90 pounds per square inch for most of the treatments, raising the pressure to 120 pounds for heavier growths. The leaf surface must be thoroughly covered. Wherever the crews did not completely wet the foliage, a few cattails would remain standing, ready to infiltrate and consolidate their forces again.

The first year we sprayed at intervals of every 6 weeks, keeping the new growth from reaching more than 24 inches in height and preventing larger cattails from going to seed. In this manner the old established stands were not given a chance to go to seed the first year. By the second year, we sprayed more often to keep the cattail under control. The new growth during the third year was easily controlled with one or two applications.

If you use a hand boom, you should take special care to prevent the hose from dragging over sprayed foliage, as any movement of the plants may cause some of the spray material to roll off.

Larger plants are more resistant to 2,4-D treatment, and before starting to spray with this solution, large growths should be removed by burning, dredging or cutting with knives or brush hooks. We always sprayed the plants when they were between 10 and 18 inches high. Leaves of plants less than 6 inches tall evidently do not hold enough chemical to permit it to travel to the root system.

The costs for the Madera Canal control program are less and less as cattail succumbs to 2,4-D. In 1947 the cost was $1,014.96, and in 1949 the cost was only $459.14.

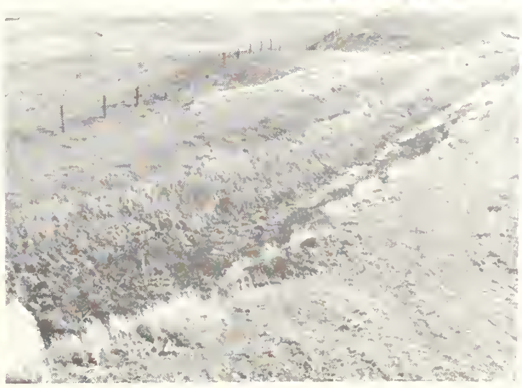
The Madera Canal is at least 10 miles from irrigated crops, reducing danger of drifting fumes from the highly volatile esters. However, where crops are adjacent, the danger of drift of this extremely potent chemical is a real problem. In many States there are laws regulating the use of 2,4-D and copies of these laws are usually available at the county agricultural office. Extreme caution must be exercised in its use in any form to reduce the danger of drift. Simple precautions include:

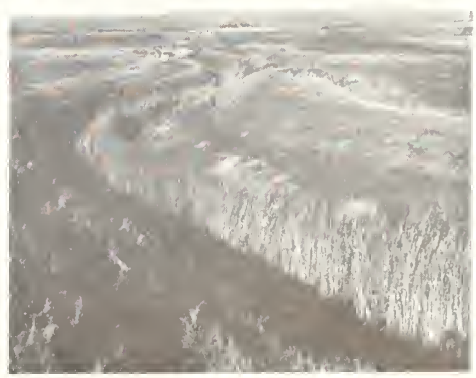
(*a*) Do not spray during windy conditions.
(*b*) Keep the booms close to the plants during operation.
(*c*) Close the spray outlets before the booms are raised.
(*d*) Use less volatile salts, if susceptible crops are near.
(*e*) Apply large volumes (100 gallons or more) per acre.
(*f*) Use lower pressures and coarser droplets.

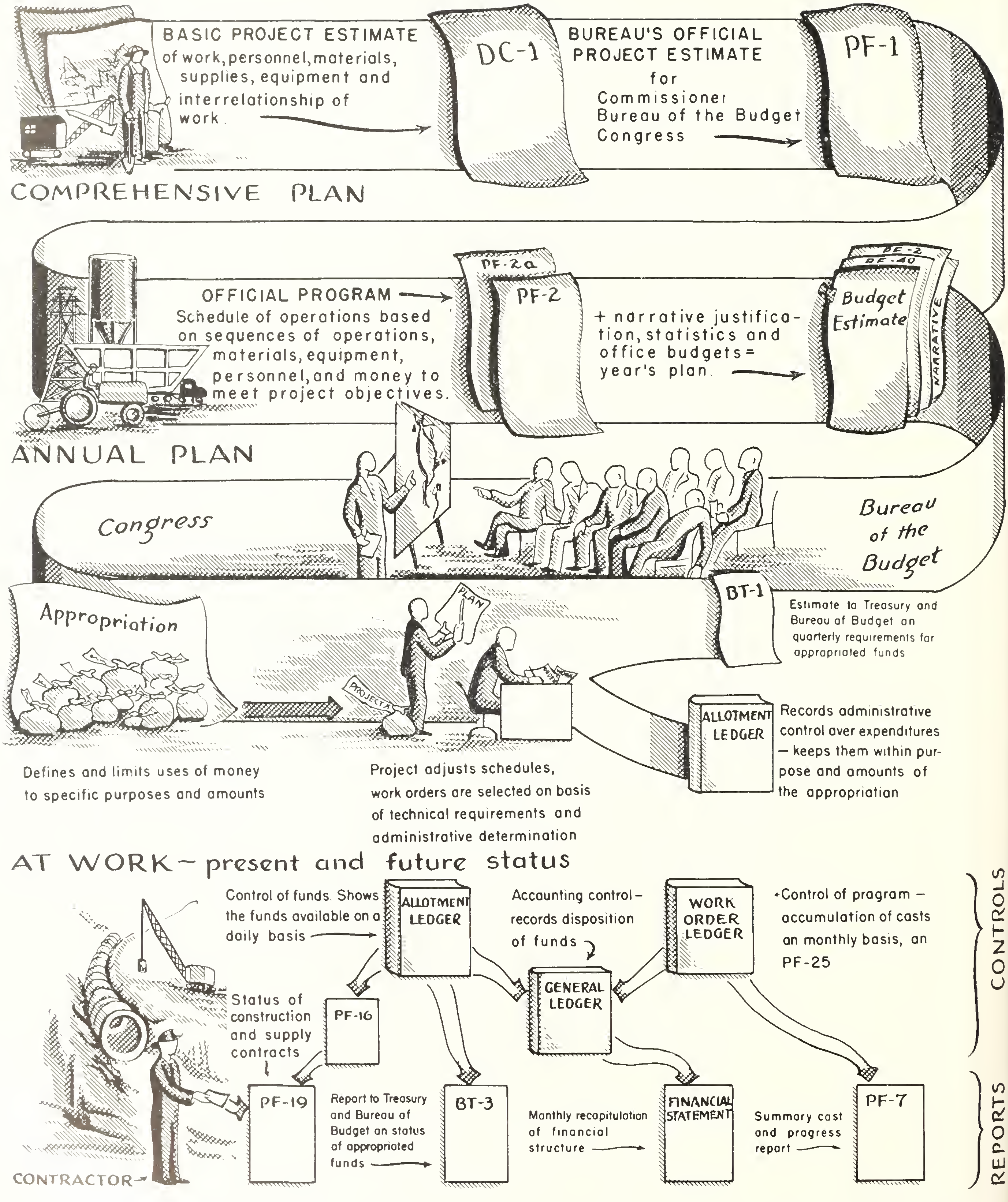
The relative susceptibility of agricultural crops and ornamental shrubs should be known and considered before any spraying is actually done. Cotton, melons, vines, tomatoes, and black-eyed peas are among the most susceptible crops in the San Joaquin Valley.

For best results remember: spray when the cattail is growing vigorously, spray at regular intervals so regrowth will not get too tall, spray thoroughly, and prevent drift. Cattail will not be blitzed but, through a planned program, its roots can be so weakened that routine treatment becomes effective and economical. At least, that is our conclusion based upon 3 years of working to control cattail on the Madera Canal. THE END

AROUND THE DRAIN—At upper right, cattail grows to a height which dwarfs the man standing beside it. Spraying equipment could not reach this far, but in the foreground 2,4–D cleaned it out. This is a drainage channel of the Madera Canal. IN SEEPAGE AREAS—Spraying equipment couldn't get to this growth of cattail around the Madera Canal, in the photo at right. CATTAIL CAN BE ELIMINATED—As demonstrated at extreme left below. At center, how a drainage channel of the Madera Canal looked after a 2-year program of spraying cattail with 2,4–D. Below, right, looking upstream from the same spot showing untreated (and flowering) growth in the foreground. Halfway up the channel, cattail is a little discouraged by a year's 2,4–D treatment. The cleaned canal in the background shows the results of 2 years of spraying. *All photos by Herbert Huffman, of Region 2.*







SIMPLIFYING A COMPLICATED PROGRAM TO SAVE THE TAXPAYERS MONEY—In Government they call it "red tape" and in private industry they call it "system"—but in the Bureau of Reclamation, no matter what they call it, they try to find the best way to get the job done at the least possible cost and to the greatest benefit of the public. As the program gets bigger, they want the paper work to get smaller.

PROGRAMING FOR RECLAMATION

by D. A. DEDEL, Chief of Programs Section, Division of Programs and Finance, Region 3, Boulder City, Nev.

How would you program and direct the expenditure of some $350 million of the taxpayer's money annually to get the most in Reclamation projects in the shortest time?

The Bureau of Reclamation's Office of Programs and Finance believes it has the answer to that question in its revised and improved system of accounting and programing procedures which is now in operation.

Reclamation Era readers are familiar with stories regarding present and future construction of many Reclamation projects, as well as benefits derived from existing projects, and hopes and plans for future Reclamation development. But comparatively few people are aware of the care and effort that go into time and budget tables to propel the Reclamation program smoothly along.

The writer invites you to see how the money appropriated for western development is transformed into operating projects. Congress has rightfully insisted that this money be spent in an orderly and economical manner, and the revised programs and control system is designed to accomplish that end.

Having established accurate and comprehensive accounting, the Bureau must have a system of programing equally as comprehensive so that both the financial and physical progress can be charted with the exactness necessary for controlling the expenditure of large sums of public money.

The Office of Programs and Finance has the responsibility of administering and controlling this work. The Commissioner's office in Washington, as well as each of the seven regional offices, has a program and finance office as part of its organization. Each operating office located on the site of the work has a programs engineer. The programs engineer, under the direction of the head of the operating office responsible for the Bureau's program in that area, originally schedules the work at the project based on construction schedules prepared by the Bureau construction engineer or the contractor. The Regional Director, in turn, supervises and controls the program for all the projects within his particular region, and the Commissioner's office directs and coordinates the entire Bureau program. The branch and regional offices assist in formulating the program.

The operating office, where the initial programing is done, is responsible for the preparation of the form designated as DC–1. This form lists, in extensive detail, each item of labor and material required to produce the completed project and constitutes the basis of the official project estimate. Principal features are listed as main items of the program; under each of these main items, subitems indicate the amount of labor and material required to produce the main feature. The cost of materials, engineering and inspection, investigations, administrative and general expenses, is listed against each item where applicable.

Thus is produced a document which shows the cost of the proposed work in substantial detail and provides the foundation upon which further programing during the present and future years can be based. It also becomes the basis of a time schedule of orderly progress and a source of budgetary information used in the preparation of appropriation estimates for the Bureau of the Budget and the Congress. For an average size project, the DC–1 form may list as many as 200 to 300 individual items.

The PF–2, called the "control schedule," again lists the principal features as in the DC–1 form but omits the subfeatures. It is a timetable showing when the work is to be started and completed. A series of seven vertical columns continues across the sheet, each column representing a fiscal year. Opposite each feature a horizontal bar extends across the yearly columns, indicating in what year the work will be done. Above the bar, the estimated cost of the work for each year is shown. Totaling the appropriate yearly column gives the dollar value of the work for the entire project for any particular year, and summarizing all the yearly columns gives a total project cost which is identical with the cost estimate initially computed and shown, in total, on the DC–1 form. Additionally, such "milestones" (as when first generation of power can be expected from the powerplant or when initial delivery of water to certain acres of land can be made) are indicated on the chart. Thus, the PF–2 form gives a concise but complete program of the work both from a physical and financial standpoint for the current and future years.

A separate schedule called the "detail control schedule," form PF–2a, was devised to show in detail the work currently programed. In order to make this schedule useful to all offices of the Bureau from the Commissioner's office down to the smallest operating office, all detailed information must be presented as shown so that an orderly construction program can be maintained.

The schedule lists in the left-hand column the same main features as shown on the control schedule and, under each of these feature headings, all the major construction and material contracts active during the current fiscal year and the following fiscal year, called the "budget year." It also lists for each feature the sum of all minor contracts as a single line entry, together with the programed cost of engineering and administration, the purchase of land and land rights, construction work performed by Government forces, and other small miscellaneous items.

Each major contract is identified by a physical description of the property and, when awarded, by the name of the contractor performing the work. Additional columns to the right of the feature and contract listing show a contract identification number, the total cost of the contract, and prior years' earnings. To the right of these columns showing the estimated expenditure for each contract in total and by quarter years for the current and budget year and, where applicable, for 5 successive years. Thus, the summation of any column on the schedule will furnish the total expenditure for each year or part of a year as desired, while the summation of any horizontal line on the schedule will

(Please turn to next page)

HEART BUTTE DAM SAVES MANDAN

STRONG HEART Butte—A newcomer to the Missouri River Basin project had an opportunity to test its strength during the week of April 15 to 21, 1950, as can be seen by this aerial shot. Note water released from the outlet of the "glory hole" spillway.

HEART BUTTE DAM SEEMS ON THE WAY to becoming a record-breaker.

Completed a year ahead of schedule, at the end of 1949, the second major dam to be completed by the Bureau of Reclamation as a part of the Missouri River Basin project, it won the distinction of being the first Bureau reservoir in the vast project to fill to its designed operating capacity, and during the week of April 15 to 21, the dam was acclaimed for holding in check a record flood flow on the Heart River and saving the town of Mandan, N. Dak., from inundation.

Typical of many of the Missouri River Basin project units, the Heart Butte Dam and Reservoir on the Heart River south of Glen Ullin, N. Dak., was designed to serve multiple purposes. The unit will hold back and conserve flood flows which can be used for irrigating more than 13,000 acres of land. It will also retain silt, afford recreational facilities, and provide a habitat for fish and wildlife. Its value as a flood control unit has now been proven.

Flood conditions began April 15, when melted snows began pouring into Heart River and its tributaries. River and stream levels continued to rise until April 19, when the peak of the flood passed out of the Heart River Valley into the Missouri River.

Heart Butte Dam formed a barrier to stop a large portion of the tremendous flow. At the peak of the flood, the dam reduced the passage of water by about 24,000 cubic feet a second and allowed only about 3,500 cubic feet, or about 15 percent of the inflow, to pass into the river channel.

From the dam downstream to the mouth of Muddy Creek, Heart River remained within its banks. Muddy Creek carried an unprecedented amount of water. For the first time the town of Almont, N. Dak., was under water. Further downstream, Heart River picks up Sweetbriar Creek, which also ran at record capacity. Heart River, burdened with the heavy inflows from the two creeks and other tributary streams, spilled over its banks in the lower areas, flooding nearby river flats in its course to the Missouri. By the time the flood reached Mandan, the river flow was reported to be about 28,000 cubic feet a second, exceeding the 21,700 second foot flood of 1943 by nearly 30 percent. An ice jam downstream from Mandan blocked the passage of water and it dumped over the river banks on to the flats south and east of Mandan. The flood did not reach the town, however, being held in check by dikes recently constructed around the city area.

Without the protection of Heart Butte Dam, it is believed that the flood flows at Mandan would have reached more than 40,000 cubic feet a second, or about double the disastrous record flood of 1943.

The peak water storage at Heart Butte Reservoir during the flood was 148,500 acre-feet. The maximum capacity of the reservoir is about 428,000 acre-feet or about three times the amount stored during the flood. The dam operates with a "glory hole" type spillway. This tunneled spillway, which takes the water from the reservoir through a stack rising into the reservoir, begins to allow the passage of water when the reservoir has reached a capacity of 75,500 acre-feet. The dam is a rolled earthfill structure 124 feet high above stream bed and has a crest length of 1,850 feet. THE END

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give full programed data for any feature, subfeature, or specific contract listed.

In addition to the financial data shown on the schedule, a system of notes, flags, and bars indicates the scheduled physical program of the work—for example, the date specifications for a certain contract will be issued for the purpose of receiving bids, the award date of the contract, the start of construction, and the estimated completion date of the work scheduled. The schedule also shows to what extent the Commissioner's office, the region, or the operating office will participate in the scheduled action, both from a financial and physical standpoint.

Summarizing: The DC-1 schedule providing a detail cost estimate, the PF-2, giving a condensed financial and physical view of the project, and the PF-2a, showing all the necessary details, provide a convenient means of supervising and controlling the transformation of available funds into useful structures in an orderly planned series of events. A system of monthly reports showing physical and financial progress provides important information to all offices responsible for the prompt and efficient execution of the work scheduled. THE END

Largest Water Contract Signed for Central Valley

A proposed water service contract with the Madera irrigation district of the Central Valley project in California was recently approved by Secretary of the Interior Oscar L. Chapman. This is the largest single water service contract, both from the standpoint of acreage and volume of water involved, ever negotiated by the Bureau. It provides for furnishing 345,000 acre-feet of water annually from Millerton Lake, behind Friant Dam through the Bureau-constructed 459-mile lateral distribution system, to more than 100,000 acres of land.

Water service rates under the contract would not exceed $3.50 per acre-foot for class I "dependable supply" water or $1.50 per acre-foot for class II "uncertain supply" water from the Bureau's Madera Canal, key feature of the huge distribution system. Under the contract provisions, the Madera irrigation district would repay the Bureau for the $9,500,000 distribution system over a period of 40 years and would also assume annual operation and maintenance costs of the system.

The terms of this contract were arrived at after thorough investigations and analyses of the prevailing economic conditions of the area and its agricultural potentialities indicated that the farmers would be able to meet their obligations successfully. The contract has been returned to the district for a vote and final acceptance by the water users.

Another water service contract, for Millerton Lake water, with the Chowchilla irrigation district was also approved at the same time. Under this contract the district receives 190,000 acre-feet of water for approximately 54,000 acres of land. The water service charges are similar to those in the Madera contract.

These contracts bring the Bureau to the half-way mark in its long-range program for allocating irrigation water to Central Valley lands from Millerton Lake and Friant Dam. Thirteen contracts are already in force with other districts in the Central Valley project. •

New Reclamation Map Available

A new Reclamation map showing water conservation projects either completed or under construction is now available to the public.

The 84 projects spotted on the map, including 24 units of the Missouri River Basin project, will ultimately provide irrigation water for more than 12 million acres of land and more than seven and one-half kilowatts of hydroelectric power for communities and industries in the 17 Western States. For copies write to your nearest Regional Director or the Commissioner's Office in Washington, D. C. See Office and Project Directory for addresses. •

Reclamation Engineering Center To Be Dedicated

JUST TESTING!—This is the "small" 4,000,000-pound capacity testing machine shattering a concrete core at the Denver Engineering Center. At the dedication ceremonies on July 20, the new 5,000,000-pound capacity testing machine—the last word in machinery for testing concrete and steel—will be shown, ready for use. It took a year to install the jumbo-size equipment.

On July 20, 1950, the Reclamation engineering center at Denver, Colo., will be formally dedicated to the task of speeding up progress in western water conservation.

Announcing the dedication, Secretary of the Interior Oscar L. Chapman said, "To the western economy, the Denver center is contributing concentrated knowledge and skill in designing reclamation works, a highly specialized field of engineering. It represents an unsurpassed combination of human training, experience and technical ability with the most modern of scientific tools. These resources unite with the planning and construction functions of the Bureau's field offices, and the effects may be seen in all 17 Western States in the form of new farms, homes and industries, more economic opportunity, better living standards, due to new availability of additional water and power. The entire West is the beneficiary, and therefore the entire United States." •

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Twelve issues for $1.00 per year

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(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 ☐

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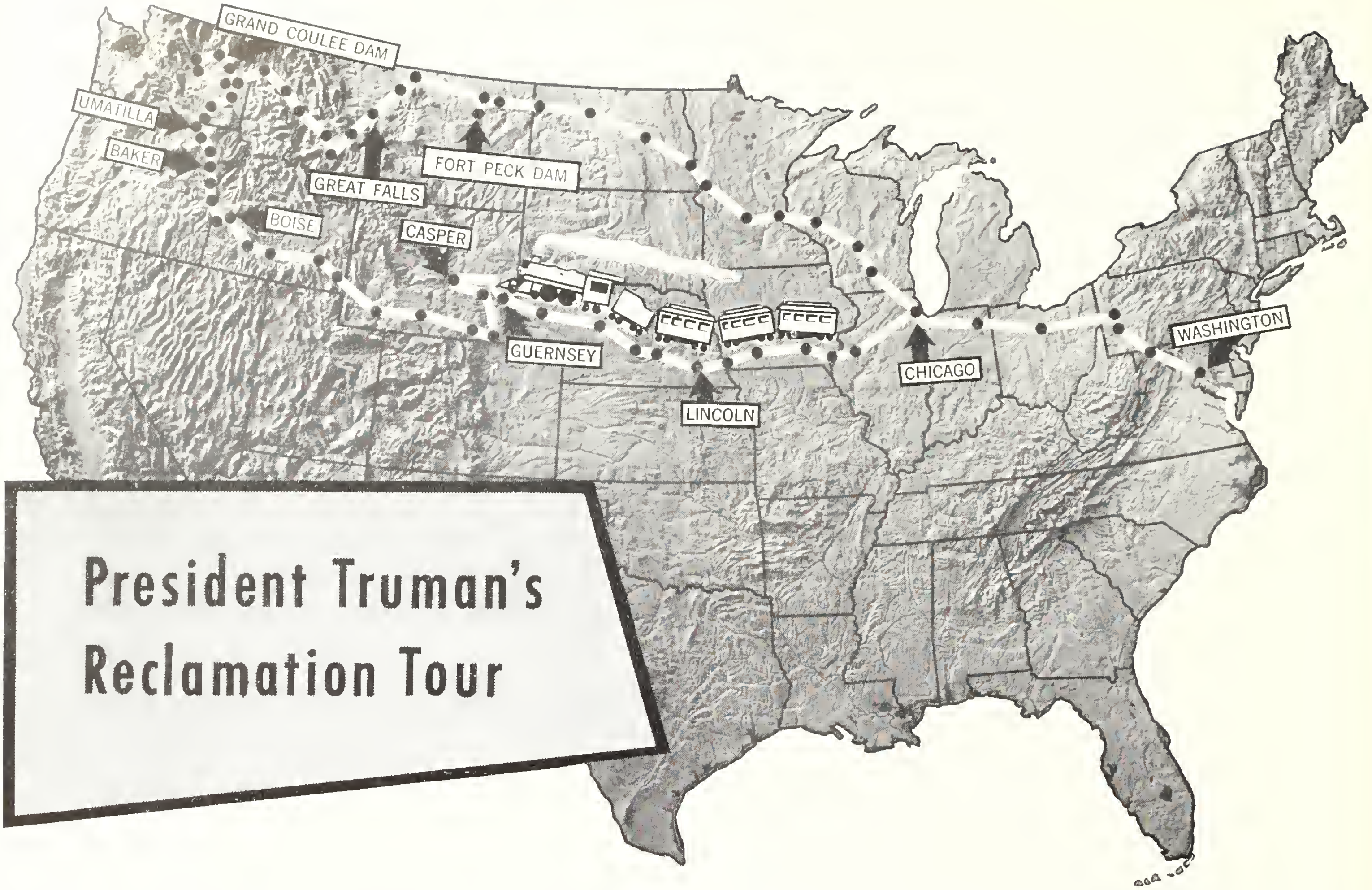


President Truman's Reclamation Tour

When President of the United States Harry S. Truman made a recent tour which included much of Reclamation's area, he showed great familiarity with the problems of water conservation and Reclamation of the West.

Of his ten-day swing through the country (from Sunday May 7 through Tuesday, May 16) seven days were spent in the Reclamation area. Many of his talks from the train and his major speeches at flag-bedecked stands were devoted to topics affecting the Reclamation program.

As he entered the Missouri Basin area, the President made his first speech on Reclamation and flood control at Creston, Iowa, on May 8. At this, and several other spots along the way, he consistently affirmed the administration's support of basin-wide resource development programs. Particularly within the Missouri River Basin area, the President emphasized that all the natural resource programs must be tackled and solved together, including extensive development of flood control, irrigation and power works, as well as increased conservation of crop and range land.

In many informal talks, he pointed out the benefits of Reclamation development to the Nation's economy, and the need for resource development as a means of solving international problems.

At Lincoln, Nebr., on May 8, his sixty-sixth birthday, and also the fifth anniversary of VE-day, he reaffirmed the "family size farm" principle, stating that he recognized the place of the large farms which contribute importantly to agricultural production and income, but that it was only sensible, where public funds are involved, to provide a higher degree of protection for the family farm, so fundamental to our democracy.

At Casper, Wyo., on Tuesday afternoon, May 9, President Truman paid tribute to Kortes Dam, 60 miles southwest on the North Platte River, calling the dam—the first power facility of the Missouri River Basin Project nearing completion—a new source of wealth and strength for the people of the West, and an example of the right way to use natural resources for the benefit of all the people.

He stressed the fact that Kortes Dam is a part of the Reclamation program of the Federal Government, and is built as part of a project which will bring more water to irrigated lands. He also said the income from the power produced at Kortes will help repay the investment in irrigation work, and that the completion of Kortes Dam, besides being a step toward developing natural resources for the welfare of the people, is significant because it demonstrates that water and land and forest must be treated together.

In the forest, he said, we need to build more roads so that we can reach the timber and use it. Along the rivers, we need more sound irrigation projects, and we need to go ahead rapidly to conserve our limited water supplies, he affirmed. Not the least part of the success of irrigation farming, according to statements made by the President, is due to the national investment in irrigation and power facilities by the Federal Government.

At Cheyenne, Wyo., the President mentioned how population and small businesses had increased along with irrigation development.

During the night of May 9, the President's train passed through three river basins—from the Missouri River Basin, which drains into the Gulf of Mexico, into the Colorado River Basin, which discharges through Mexico into the Gulf of California, and then into the drainage area of the Columbia River, which flows into the Pacific Ocean.

As he neared the crest of his westward trip, the Grand Coulee Dam, the President's references to Columbia Basin development became more and more extensive, climaxing with the dedication ceremonies at the dam on May 11.

Secretary of the Interior Oscar L. Chapman and Commissioner of Reclamation Michael W. Straus were present at the dedication ceremonies, as were Secretary of Agriculture Charles F. Brannan, Governor Arthur B. Langlie of the State of Washington, and Governor John W. Bonner of Montana.

After a tour of the Grand Coulee Dam spillway and power house, the President was introduced by Senator Warren G. Magnuson to the crowd of 15,000 who heard the President say that the benefits of public investment must be passed on to the people whose tax money is being used. He said he would fight to the finish with all those who oppose public power, recalling to his listeners the statements of former opponents of Grand Coulee who claimed the power produced at the dam could not be sold, that it would be a "white elephant," and would be of no more value than the pyramids.

Grand Coulee's power facilities now, he said, are repaying the Government's investment with interest and the irrigation developments now under way would provide family size farms for thousands of settlers.

President Truman voiced his preference for a Columbia Valley Authority as a necessary next step in the sensible democratic development of the resources of the Northwest, and said similar resources throughout the Nation must be developed for all the people.

He told the crowd that the country was engaged in a great struggle to achieve peace in a world beset with danger and threatened by Communist imperialism, and that in the struggle for peace the American people must display the adventurous spirit and the firm courage of their pioneering fathers. In fact, the President asserted, the people would need the same kind of vision that saw Grand Coulee Dam when there was nothing but desert, and the same kind of steady perserverance that built the mighty dam. With that kind of vision and determination, according to President Truman, the American people can build a world in which men can be free under laws of their own making and can live at peace with one another.

After his speech President Truman unveiled a tablet to the memory of Franklin D. Roosevelt, for whom the lake behind Grand Coulee Dam was named, and who, in the words of President Truman, had transformed "vision into reality" in the Columbia Basin project.

President Truman also presented a distinguished service award to District Manager Frank A. Banks, who supervised the construction of the dam (see next issue of the Era).

THE END

Kortes Adds Another "First" to Record

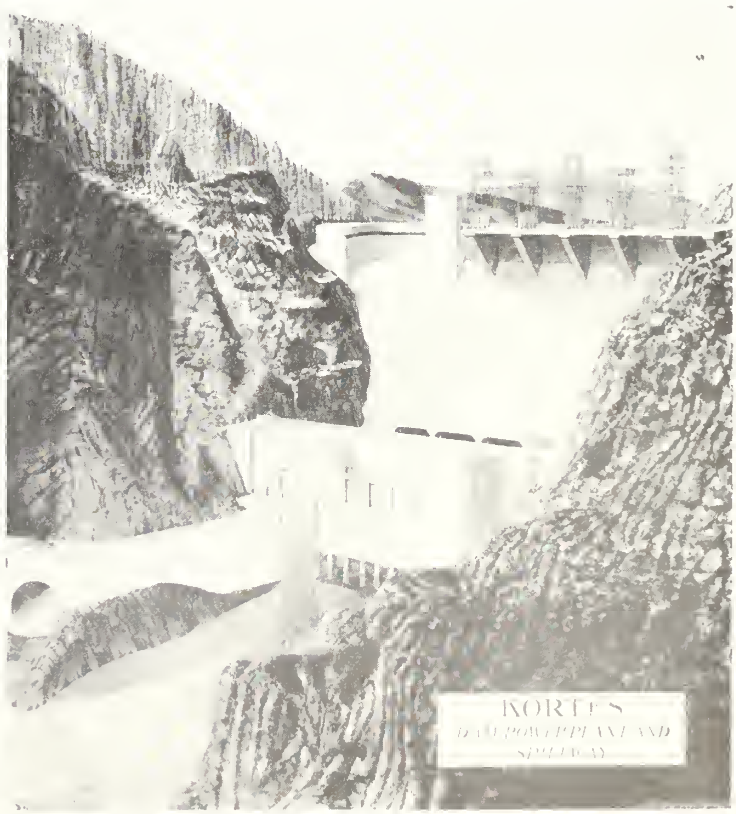
Kortes Dam in Wyoming, the first structure to be started by the Bureau of Reclamation as a part of the Missouri River Basin project, is the first power producer of the vast Missouri River Basin development to near completion.

Located on the North Platte River, about 60 miles southwest of Casper, Wyo., the Kortes Unit was begun May 25, 1946, and initial power generation will start June 15, when the first of three 12,000-kilowatt generators will go on the line. The second generator will be brought in on July 15 and the third in September. The Kortes power plant will have a capactiy of 36,000 kilowatts and provide sufficient electric energy to serve 5 cities the size of Casper, Wyo., which a population of 35,000. The total estimated cost of building Kortes Dam and power plant is $13,162,000. Power sales will return approximately $750,000 a year to the Federal Treasury.

The area to be served by the Kortes plant and other interconnected power producing units of the Missouri River Basin project, abounds in undeveloped natural resources but lacks the power necessary to develop them. In addition, the Kortes unit will supplement existing generating facilities within the area and furnish power where it is now urgently needed for new industries, and the development of agriculture.

The dam will be 240 feet high and have a crest length of 440 feet. The estimated 270,000 tons of concrete used in the Kortes Dam spillway and powerhouse would make a modern highway strip nearly 75 miles long.

The Kortes Dam and power plant is named for the Andrew H. Kortes family, pioneers of Wyoming. ●



Artist M. H. Willson's perspective drawing of the completed structure.

Government Agencies Meet at Western Weed Conference

Increasing interest by western farmers and ranchers in weed control on federally-administered lands was evidenced by an invitation to several Government agencies from the Western Weed Conference to participate in its twelfth annual meeting held January 30-February 1 in Denver, Colo.

Department of the Interior agencies represented were Bureau of Reclamation, Bureau of Land Management, Office of Land Utilization, National Park Service, Fish and Wildlife Service, and Bureau of Indian Affairs. The Forest Service and Soil Conservation Service of the Department of Agriculture as well as the Departments of the Army and Navy also participated.

The entire afternoon of the first day was devoted to a panel discussion titled "Weed control on Federal lands" which was led by Robert B. Balcom, the Bureau of Reclamation's agronomist from the Commissioner's office, Washington, D. C. Each agency presented its weed problems, methods used for weed control, and its plans for future weed programs for increasing the economic use of the lands under its administration and preventing weeds spreading to adjacent agricultural areas. John T. Maletic, Soils Scientist, in charge of the weed control program of Region 7, represented the Bureau of Reclamation on the panel.

Many of the previous misunderstandings concerning weed control programs of the Government's land management agencies were cleared up by the panel speakers, and it was evident that much more weed-control work is being conducted by these agencies than was generally realized before the meeting was held. •

Fifth Annual Weed Control Conference

The Fifth Annual Weed Control Conference held jointly by the Bureau of Reclamation, United States Department of the Interior, and the Bureau of Plant Industry, Soils and Agricultural Engineering of the United States Department of Agriculture, was held at Denver, Colo., February 2–6, 1950.

The conference, considered by many as the most successful held to date, was attended by 47 representatives of these two agencies and guests of other agencies having weed problems. One of the highlights of the conference, which was conducted by Robert B. Balcom, Agronomist of the Commissioner of Reclamation's office and Dr. Karl S. Quisenberry of the Bureau of Plant Industry, Beltsville, Md., was a guided tour through the Chief Engineer's laboratories including the weed research laboratory and greenhouse.

One day of the conference was devoted to discussions on recent weed-control research being conducted by the Chief Engineer's office and the four field stations operated by the BPI for developing more permanent and economical methods of weed control in the irrigated west.

More efficient emulsifiers and application techniques for aromatic solvents were described for use in controlling submersed waterweeds. Aromatic oils and TCA (trichloroacetate) have shown good results in controlling grassy weeds. The use of 2,4-D and 2,4-T alone or in various combinations have proved effective in eliminating willow, wild rose, and blackberry as well as annual broadleaf growths from ditchbanks, thereby reducing the costs considerably over hand and mechanical methods.

Of particular interest to the project operators present were the discussions of the practical applications of the research findings to weed-control problems on irrigation systems.

F. L. Timmons, coordinator of the work in the four BPI field stations at Logan, Utah, Prosser, Wash., Phoenix, Ariz., and Meridian, Idaho, and W. T. Moran and John S. Shaw from the Denver laboratory outlined the research program planned for 1950. The group met for the first time, Dr. Roy L. Lovvorn, Chief of the United States Department of Agriculture's new division of weed-control investigations, to whom it pledged its support in the cooperative weed-control project. Dr. Lovvorn also stated that his division would aid, insofar as possible, in the search for more economical methods of weed control on both irrigation systems and irrigated crop lands. •

Three Reclamationists Receive Interior's Distinguished Service Medal

Three former Reclamation officials recently were awarded the Department of the Interior Gold Medal for Distinguished Service. They are former Commissioners Harry W. Bashore and John C. Page, and Regional Planning Engineer Stanley A. Kerr of the Sacramento Regional Office.

Bashore who worked for the Bureau from 1906 until his retirement as Commissioner in 1946 is an authority on the Colorado River Basin and still serves as consultant for the Bureau from time to time. In addition, he was appointed by President Truman to serve as official representative of the United States in the negotiation of a compact among the Upper Colorado River Basin States of Arizona, Colorado, New Mexico, Utah, and Wyoming.

John C. Page, whose first job with the Bureau in 1909 was on the Grand Valley project in Colorado, became noted for his work as office engineer for Hoover Dam, a position he held until the structure was completed. In 1935 he was called to Washington to head up the Engineering Division and was appointed Commissioner shortly thereafter. Ill health forced his retirement in 1943. However, because of his vast experience, he was retained as a full-time consultant and was able to serve in this capacity periodically until 1947 at which time he suffered a relapse, forcing him to limit his duties to that of a part-time consultant.

Stanley Kerr was one of the men largely responsible for the basin-wide multiple purpose use of water resources in the Central Valley of California. It was largely through his investigations and reports that the master plan for the over-all development of the Valley was laid.

Between 1908 and the time of his retirement March 1950 he spent 29 years with the Bureau. The balance of the time was spent with private engineering concerns. In addition to the Central Valley studies Mr. Kerr conducted many other outstanding investigations which included the Cachuma project, the American River Development and the Solano project, all in California. •

The W. C. Austin Plan, Part 2

CROP DEVELOPMENT UNDER IRRIGATION

IRRIGATED ALFALFA is coming into its own at the W. C. Austin project as a seed crop, soil builder, and livestock feed. Above is a typical scene on Murel W. Kelly's farm just north of Hester, Okla. *Photo by Preston W. George, of Region 5.*

by DRUE DUNN, Oklahoma State Irrigation Specialist

MAKE HASTE SLOWLY.

That seems to be the secret of the success of the farmers on the W. C. Austin project—at least so far as changing crops, cropping practices and soil management are concerned.

When it comes to putting irrigation water to work right away, however, the W. C. Austin farmers lost no time. This is the fifth year that irrigation water has been available to farm land on the irrigation project, and in comparison with some other irrigation developments in the western States, the Austin farmers have put the water to good use rapidly.

The Bureau of Reclamation completed the first section of canal reaching into the project area on April 30, 1946, and on May 27, 1946, sent public notices to the farmers telling them they could irrigate the 1,300 acres of land on the sides of the canal, notifying them of the water charges, methods of distribution and other necessary information. On June 19, the first water was delivered. That year, the farmers irrigated about 500 acres. But in 1947 the comparatively recent innovation of irrigation began to catch on, and 3,000 acres of land went under the ditch. As the canals reached through the project and were completed, the irrigated acres increased to 17,500 in 1948, and in 1949 water was available to the entire 50,000 acre tract on the W. C. Austin project. In spite of the fact that rainfall exceeded the normal supply by 10 inches, 75 percent of the lands were irrigated.

During the first year of irrigation, and through 1949, the farmers made only minor changes in the types of crops seeded. For the most part, they continued to plant the cotton, wheat and grain sorghums which have been their principal cash crops. Their reluctance to change can be easily understood. They had the equipment for raising these crops, they knew how to grow them, and they had the marketing outlets. Having irrigation water available was like having money in the bank to tide them over a rainless season, and while they were trying out this new method of agriculture, they could also bank on their dry land farming experience. They had to find out how the crops they already knew how to grow would respond to irrigation, eliminate those which would do just as well under dry farming, substitute those which would do better, and plant those which would increase their yields and cash value under irrigation methods.

Thus the project farmers are gradually converting to irrigated crops, in a safe and sure method, rather than immediately abandoning their past crop varieties and cultivation methods.

Cotton, for example, an old favorite in this section of Oklahoma, remains popular with the farmers, who are averaging half a bale of cotton more per acre under irrigation. Some farmers boast of their extremely high yield of three bales of cotton from an irrigated acre.

Wheat, although it grows well and furnishes good pasture for livestock, does not respond to irrigation as well as other crops being grown in this area. The farmers doubt that wheat can be produced economically on irrigated land, due to the increased costs of production under the irrigation program. Winter wheat production under irrigation has not continued as an important crop in any of the irrigated areas of the southwest. Around the Austin project they are thinking of replacing wheat with spring grains or other productive crops.

Farmers in the area used to get from 15 to 20 bushels of sorghums per acre under dry land methods. With irrigation, although the average yield has not been particularly high, some farms have produced 100 bushels to the acre. In 1949 the farmers planted 5,000 acres to sorghum, and are continuing to test new varieties. Combine Kafir, Hegari, Plainsman and Martin Milo are the principal varieties grown in this area under irrigation.

For many years a limited acreage in the project area has been developed to nonirrigated alfalfa. However, yields varied greatly along with the amount of rainfall, and the average hay crop was less than 2 tons per acre. Under irrigation the farmers are getting an average of 3 tons per acre on most farms and some farmers have reported 8 tons per acre in five cuttings on their irrigated tracts. Austinites are going into alfalfa seed production and last year got up to 600 pounds of seed per acre.

This year the farmers have reached the point where they are diverting approximately 15,000 acres of irrigable land from cotton and wheat to more diversified crops. Of this, they will plant about 8,000 acres to hay and pasture crops.

During the first 3 years, in addition to their major crops, project farmers planted limited areas to popcorn, green corn, tomatoes and other truck and vegetable crops. These all show definite possibilities as new agricultural ventures. In 1949, for the first time, they tried out Irish potatoes on a commercial scale—900 acres planted from certified seed stock shipped from North Dakota and Nebraska.

Although there were heavy rains just before harvest time which reduced the yields on some farms, this crop also showed considerable promise, and several hundred acres were planted in the late winter of 1950.

Before the irrigation system was completed, some sweetpotatoes were grown in the sandy soil sections of the project. Now that they have an assured supply of moisture, farmers may plant more sweetpotatoes, but—and this factor may also affect other crop changes—more adequate processing and marketing facilities are needed.

This year, the project farmers have a contract with a castor oil company and will plant 1,000 acres to castor beans. There is no limit, so far as soil moisture is concerned, to the type of crops which can be produced. The W. C. Austin area has an average of 223 days of frost-free weather, and the winter is mild enough to grow winter legumes and grasses.

One thing that is limiting high production is soil fertility. For this reason the farmers are giving considerable attention to commercial fertilizers, primarily phosphate, and are plowing under legume crops or legume stubble. Where wheat and cotton were grown exclusively before irrigation, the farmers are planting several varieties of clovers, vetches and peas to rebuild the soil. In addition, they find Madrid sweet clover and hubam clover to be well adapted for this purpose as well as for pasture and seed crops, and see soil improvement and seed production possibilities for blackeyed peas, mung beans, and other summer legumes.

For the last several years the farmers in the project have concentrated on producing cash crops, and the number of livestock on the farms has been comparatively low. However, now that they are growing more forage and pasture crops under irrigation, and in the face of acreage controls for wheat and cotton, they look forward to an increase in the livestock industry in the area. The project is in a good location—right in the in-transit feeding region between the ranges of West Texas and the corn belt feedlots and mid-States' markets.

The Production and Marketing Administration lists grasses and legumes approved for practice payments under their program for the establishment of permanent pastures. The Associate County Agent and landowners on the project have recommended to the Production and Marketing Ad-

(Please turn to page 120)

TO MARKET, TO MARKET—Mrs. O. W. Roberts takes a load of cotton to the gin. Daughter Barbara D. Anne, 3 years old, helps. Marketing and processing are two of the main problems for people on the W. C. Austin project. *Both photos below by F. S. Finch, Region 5 photographer.*

THE SHEEP'S IN THE MEADOW—But grazing livestock on the W. C. Austin irrigated farms, contrary to the old nursery rhyme, means that the project farmers are wide awake to the commercial possibilities of this industry. This is B. Earle Cole's farm, near Altus.

FEDERAL POWER AND RESOURCE DEVELOPMENT

by WILLIAM E. WARNE
Assistant Secretary of the Interior

IT'S WARM INSIDE these houses at Grand Coulee Dam, even though the thermometer registers zero weather. The homes are heated by electric power from Grand Coulee Dam, dedicated on May 11, 1950, by President of the United States Harry S. Truman. *Photo by F. B. Pomeroy, Region I photographer.*

It takes more than power to make a satisfactory base for the kind of agricultural-industrial civilization that is being created in America. On the other hand, our economy cannot be expanded, our wealth cannot be increased, and our level of living cannot be raised without an ever-increasing supply of energy.

The American people have never hesitated to use their Government to overcome obstacles placed by nature in the way of their advance. One example that comes quickly to mind was the use of subsidies and grants of public land to build the railroads that opened the West and bound the country together. Since power is one of the essentials and also is the key to other essential elements of our continued economic growth, the people again and again have demanded that their Federal, State, or municipal Governments do something about providing the needed electricity and making it available for wide use.

The Federal power program is an integral, indispensable part of the over-all reclamation program. The reclamation program could not exist without the power aspect. Power revenues pay an essential part, varying from project to project, of the costs of reclamation. But sometimes it is forgotten that land reclamation and water conservation benefits are also basic purposes.

Everyone knows how Grand Coulee Dam is building a whole new industrial area in the Pacific Northwest. During the war, with fewer than half of its 18 generators installed, this giant produced power equal to the labor of 78 million men working an 8-hour day for a whole year. It made ships, planes, tanks and aluminum and the atom bomb.

These spectacular achievements have led some to overlook the fact that this dam is about to give us an agricultural realm three-fourths the size of Delaware.

Reclamation projects in 1948 purchased an estimated $1,500,000,000 worth of products from other sections. Since 1916, people living in the project areas have paid in Federal taxes an amount nearly as great as the investment that has been made in all the reclamation engineering works that have been built since 1902.

The Federal power policy is aimed at making the public's power as widely available as possible, and at the lowest economically feasible cost. Certain criteria have been set forth by the Congress. One is that power disposal shall be such as to encourage widespread use and prevent monopolization. Another, often repeated in enactments, is that it shall be for the particular benefit of domestic and rural consumers. A third is that power shall be sold at the lowest rates consistent with sound business principles. One of the oldest is that preference shall be given in meeting the requirements of public agencies and cooperatives.

These are the guideposts by which the Interior Department conducts its business through the Reclamation Bureau, the Bonneville Power Administration, the Southwestern Power Administration, and the newly established Southeastern Power Administration. Under these principles the program is carried out not just to produce kilowatt hours of energy, or to make the Treasury whole (important as these objectives may be) but, in addition, to aid the general economic development of the regions where the power is produced and benefit as directly as possible the people.

Satisfying the requirements of the law has involved the construction of Federal transmission lines. None of the purposes could be so well served, if the power were simply generated, and control then relinquished at the point of generation.

WHEELING

Much has been heard this year of wheeling contracts. These are arrangements by which utilities agree to deliver project power over their lines to distributors for the project account. An REA project 50 miles distant from a Federal dam might deal directly with the Government but have its power delivered by a wheeling arrangement over a power company line. We believe that such wheeling contracts must contain provisions that are consonant with the criteria that have been laid down by the Congress, and those that have been signed, a half dozen or more, do have such provisions. They make unnecessary the investment of Federal funds in transmission facilities, and they give the power company a part in the continuing effort to serve the region.

We foresee no substitute for the building by the Government of the main backbone transmission lines, especially those that interconnect large Federal dams. These have no counterpart in any private construction and they provide the means actually to produce substantially more usable energy from the same facilities.

POOLING

One of the most promising developments of recent years is the so-called pooling concept, which is already being applied in the Missouri Basin project. Here all units are considered parts of one great project, as in the TVA, and their costs are lumped together and are paid through uniform, postage-stamp power rates and similar water charges for irrigators and domestic water users. Through this method, various irrigation projects are not forced to depend upon the physical accident of geographical connection with a power plant, and the power customer is not penalized by the distance between him and the generator, or the physical characteristics of the power plant that may be nearest to his meter. Similar arrangements are being considered for the Columbia Basin area and the Colorado River basins. Through this method, the benefits of integration can be obtained and passed along to the people. THE END

(Extracts from an address by Assistant Secretary of the Interior William E. Warne, before the American Public Power Association, Shoreham Hotel, Washington, D. C., 1:00 p. m., March 28, 1950.)

The W. C. Austin Plan—Part 2

(Continued from page 118)

ministration approval of alta fescue, meadow fescue, smooth brome grass, perennial rye grass, and alfalfa to supplement the list already approved. These varieties will be necessary for establishing high yielding irrigated pastures.

Last year, due to early seeding of pastures, livestock was moved into the county for winter feeding—about 10,000 lambs and 1,000 head of beef cattle were reported pasturing at the end of 1949.

The cooperative spirit which has been in evidence on the W. C. Austin project from its very beginning has helped in the business of converting to the best possible crops for irrigation farming.

The irrigation district board of directors, Joe Zinn, chairman, Carthal Mock, and Robert Minor, have held monthly meetings to help work out these and other irrigation problems. Many people are watching this project with interest as a proving ground for similar areas where irrigation is being considered as a means of stabilizing and improving agricultural production. Therefore a great deal of expert advice and assistance has been made available to the people of the project. Oklahoma A. & M. College, the Oklahoma experiment stations, agricultural county agents, Soil Conservation Service officials, representatives of the Bureau of Reclamation, and commercial companies have met with the farmers periodically to discuss ways and means of making the most of the new opportunities available to the farmers due to the irrigation facilities on hand.

In January 1949 a Farm and Home Institute was held to promote balanced farming. Specialists of the agricultural college, extension service, and local representatives of business and farm organizations were featured on the first day. In the evening a program was held in the banquet room of the Orient Hotel in Altus where agricultural economist P. K. Norris, of the United States Department of Agriculture's Foreign Relations Branch, discussed cotton in world affairs. His talk was broadcast over Station KWHW. On the second day irrigation meetings were held at Martha and Blair (see map in the May 1950 issue of the RECLAMATION ERA). At the meeting H. G. Ware, extension poultryman, E. L. Whitehead, extension horticulturist, P. K. Norris, agricultural economist, Wesley Chaggin, extension agronomist, Fred Ahrberg, extension animal husbandman, J. R. Enix, extension economist, C. V. Phagan, extension agricultural engineer and L. H. Stinnett, extension dairy specialist, brought the people up to date on the latest developments in their particular specialties. Through similar exchanges of information and experiences, the W. C. Austin farmers are learning more than the value of cooperation. They are learning about the people who can help them in their new venture, and how they themselves can add to the wealth of information on irrigation farming through recounting their own successes and failures.

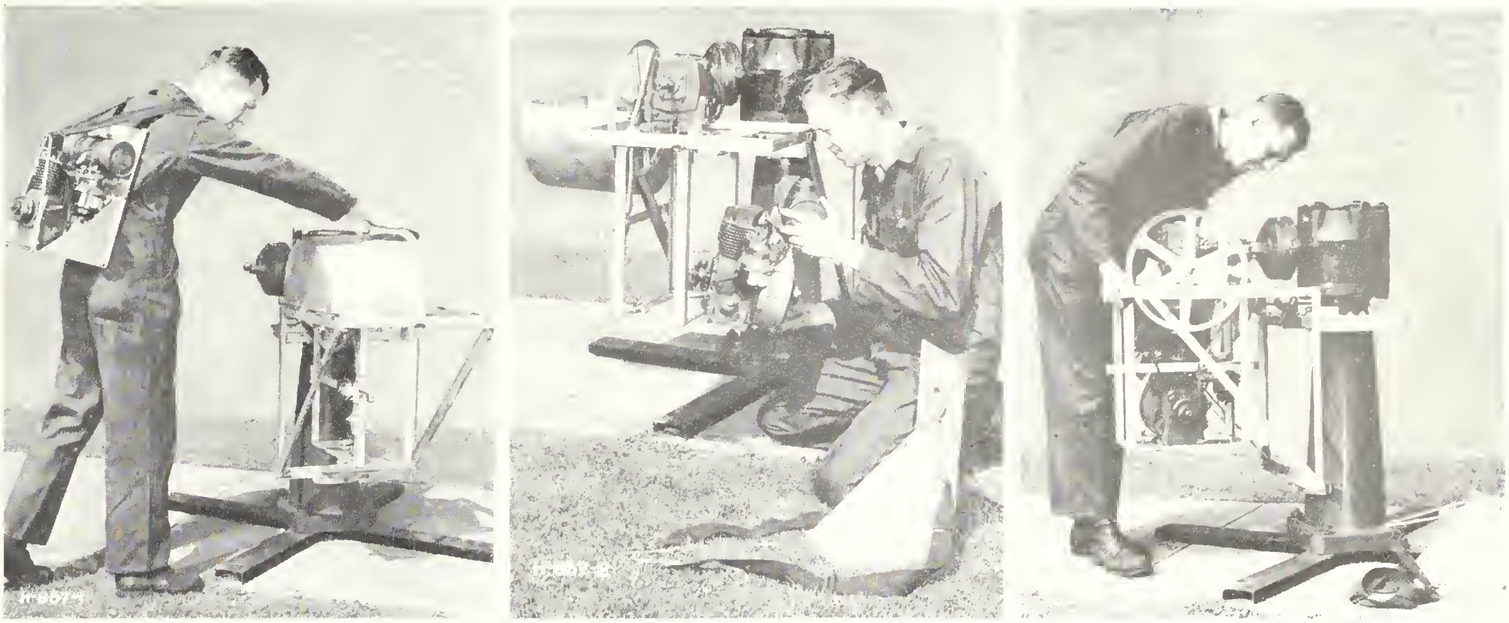
For various reasons not all dry land farmers quickly become successful irrigation farmers. It is not always a simple process to reorganize a dry land farm and re-equip it for irrigation farming. To know what adjustments are needed, and how and when to make them, requires time, patience and skill in farm management as well as in soil and water management.

Another thing which slows up the change-over from dry land to irrigation farming is the fact that 75 percent of the owners do not live on, nor operate, the farms. Of these, fifty percent of the absentee owners are businessmen and farmers who live in town and operate their places with resident tenants or share croppers, and 25 percent of the area's farm owners live outside of the county. When only 25 percent of the land is cultivated by farmers who own, operate and live on their farms, representatives of agricultural, community, and commercial agencies are faced with obvious difficulties in promoting efficient soil and farm management programs.

However, the people on the W. C. Austin project have made a good start. They are receiving splendid support and help from town, country, county, State and Federal agencies, and are practical and realistic in their approach to new methods of labor and production.

What crops to plant, how to plant them, how to harvest and market them, will be problems for the W. C. Austin farmers for several years to come. Peak crop production will depend, in the final analysis, upon the efforts of the landowners themselves.

NEXT MONTH—Preston George, Irrigation Operations Supervisor of the W. C. Austin project, writes about the problems of operating an irrigation project in a subhumid area.



PORTABLE POWER UNIT

For Gate Lifts

STEP ONE: Operator approaches lift, prepared to use power unit which has been swung around for previous crank operation. STEP TWO: Operator installs 1½-horsepower gasoline engine before using power lift. STEP THREE: Operator installs wrench connecting the gear reducer to the permanent gate hoist. The unit is now ready for operation.

by Engineer DALE M. LANCASTER, Research and Geology Division, Office of the Chief Engineer, Denver, Colorado

Anyone who has raised or lowered a sizable gate in an irrigation system with a hand crank will welcome the advent of a portable power gate hoist which has recently been developed and placed on the market by a commercial firm in Denver, Colo.

Originally, this gadget was designed for the Navy, so that members of the crew could strap the power units to their back, leaving both hands free for climbing or combat.

The unit consists, essentially, of a small 1½-horsepower gasoline engine with a V-belt drive to a geared speed reducer which connects to the shaft of the permanent gate hoist. The speed reducer is mounted on a movable base which operates like a drawer, so that the operator can aline it with either of the two crank shafts provided on a two-speed gate hoist. The entire unit is mounted on a welded steel frame in such a manner that you may swing it aside to attach the crank if you find it necessary to switch to a manual operation. The gear reducer has a metal hood which can be fitted with a lock to protect it from the destructive elements of weather and vandalism. The equipment includes a shoulder-strap pack for carrying the engine from one location to another with ease, thus retaining the Navy's wartime advantage of leaving the operator's hands free for climbing. The weight of the pack, including the engine, is 45 pounds. The accompanying photographs show the details of the portable apparatus mounted on a gate pedestal.

Although the equipment is specifically designed for attachment to pedestals manufactured by the commercial firm, you can easily modify it to fit other pedestals by making a minor revision to the framework. Considerable modification would be necessary to apply this particular device to the Bureau's standard design of radial gate hoist, but the problem would not be difficult.

To lift a single gate you need the complete unit, including the adapter bracket, or welded steel frame, power drawer with the speed reducers and portable engine. For lifting multiple gates at the same structure, you install the complete unit at the first lift only, using the adapter bracket for each of the other pedestals since you can move the power drawer from one lift to another.

Where several separate installations are served by one tender, or operator, an adapter bracket and power drawer are mounted on each structure, permitting the use of a single engine for operating several structures. At the gate site the operator simply unlocks and swings the hinged hood out of the way, inserts the engine into the power drawer, and secures it with thumb screws. He places the V-belt on the sheave, fits the socket wrench on the lift shaft, and starts the motor. The lever-operated idler pulley is engaged to tighten the belt, causing the gate to be quickly raised or lowered. The direction of movement of the gate is reversed simply by turning the power drawer 180° utilizing a different shaft from the speed reducer.

The unit develops a speed at the crank shaft of 50 revolutions per minute. The speed reducer has a ratio of 13.67 : 1 and is rated at 1.08 horsepower with a maximum speed of 1,800 revolutions per minute. The drive pulley of the gaso-

(Please turn to next page)

line engine is 5 inches in diameter while the one on the gear box is 11 inches in diameter.

The fact that gates may be lifted in a much shorter time with the power lift than by hand is a definite advantage in operating sluice gates and similar structures where speed of opening the gates is essential in order to free the canal or reservoir of excess water. It is believed that the portable power unit should have definite application to some of the Bureau structures, and particularly in isolated localities where power is not available for electric lifting devices. Conceivably, the gasoline engine powered lift could be installed at new installations where the cost of running a powerline to the structure would be excessive.

Additional information may be obtained from the Hardesty Division of the Armco Drainage and Metal Products, Inc., Denver, Colo. THE END

Publication of the above information does not constitute an endorsement of the commercial product, but is furnished to our readers as an item of interest to them in operation and maintenance of their reclamation farms.—Ed.

Three June Deadlines for Reclamation Farm Applications

THEY WERE LUCKY—Mr. and Mrs. Paul E. Stockard and their son Patrick pick out the place where they will build their new home on the 75-acre farm won in the land drawing at Caldwell, Idaho, March 25, 1950. Mr. Stockard says, "Being the number one winner in this land drawing is the break of my lifetime." The Caldwell land drawing was for 50 units, comprising about 4,489 irrigable acres of the Payette Division of the Boise Project. *Photo by Phil Merritt, Region 1 photographer.*

This month applicants for an opportunity to gain a Bureau of Reclamation irrigation farm face three deadlines. June 17 is the last day for applicants to submit their papers for buying land on the Burbank Pumping Unit about 5 miles southeast of Pasco in the southern part of the Columbia Basin project in the State of Washington. The announcement of the sale of these lands and the opening date for the acceptance of applications was May 3, 1950. These lands, comprising 13 units, totaling an irrigable 678 acres, were purchased by the Government and will be sold at appraised dry land values to applicants meeting the same requirements as for other lands opened to entry by the Bureau of Reclamation. Veterans preference prevails. Those who are interested should write to the Bureau of Reclamation at Ephrata, Wash.

June 19 is the closing date for applicants seeking one of the 11 farm units, comprising approximately 723 acres of irrigated public land, on the Roza Division of the Yakima project in south central Washington. This is the second homestead opening to be held on the Roza Division. The first one was held in 1947, with the drawing on April 25th of that year. To qualify for these farm units, applicants must meet certain minimum requirements including two years of farm experience, $3,500 in liquid capital or assets useful in development of an irrigated farm, good character and industry, and the physical ability to do the required farm work. Applicants must also meet the principal qualifications of Federal homestead laws. After their homestead entry has been approved, successful applicants will have six months in which to establish residence on their land. They will be required to cultivate at least half the irrigable acreage in their farm unit for two years before being given full title to the land. For further information, write to the Superintendent, Yakima Project, Bureau of Reclamation, Yakima, Wash.

June 26 is the closing date for applicants for the 54 units, amounting to about 6,940 irrigable acres on the Riverton, Wyo., project. Requirements are similar to those mentioned above for the Yakima-Roza opening, except that here only $3,000 capital is required. Write to the Superintendent, Operation and Development, Bureau of Reclamation, Riverton, Wyo., on this one. ●

FHA Loans Available to Homesteaders

Settlers on public land farm homesteads on reclamation projects, and elsewhere on the public domain, may obtain Farmers Home Administration loans in advance of securing Government patents on the land, by means of a procedure announced on April 26, 1950 by the United States Agriculture and Interior Departments. The regulations are based on Public Law 361, 81st Congress.

The departments pointed out that homestead entrymen cannot establish title to the land until they have lived on it and accomplished a certain amount of work, and until the new procedure was worked out, could not mortgage the land to provide development funds.

The Department of Agriculture explained that loans to entrymen, like all FHA credit, are limited to farmers unable to get necessary credit from private or cooperative lending sources on reasonable rates and terms. Water facilities loans, for land leveling, construction of ponds, windmills, wells, sprinkler systems and similiar water or irrigation facilities are repayable over periods up to 20 years, at 3 percent interest. Farm development loans, for buildings, fencing and similar farm and home improvements are amortized on a 40-year basis at 4 percent interest. For more information contact your local FHA office. ●

Expedition to Korea

On many occasions during its 48 years of existence, the Bureau of Reclamation has been asked to aid in planning and constructing water-resource developments in foreign countries. Its engineers, recognized as leaders in their field, have participated in the planning, designing and constructing of many of the world's largest and most complex water control, conservation, and use structures.

Now, for the first time, the Bureau has been asked to assume full responsibility for the study of the feasibility of of proposed water-resource developments in a foreign country. The call for help, directed to the Economic Cooperation Administration, came from the Republic of Korea which is planning three hydroelectric projects and one combination hydroelectric and irrigation project. To answer the call, the ECA asked the Bureau of Reclamation to take full charge, using its own methods and personnel, in the basic studies and surveys of the proposed developments in order to determine their feasibility and practicability.

The Bureau plans two separate stages. The first—a general reconnaissance—will require about two months to complete. During this time Bureau engineers and specialists will inspect the sites of the proposed developments, review available data and evaluate the usefulness of this data, determine the amount and nature of work necessary before construction work can start, and ascertain the type and number of personnel required to make additional studies leading to the preparation of a report on the merits of the proposed projects.

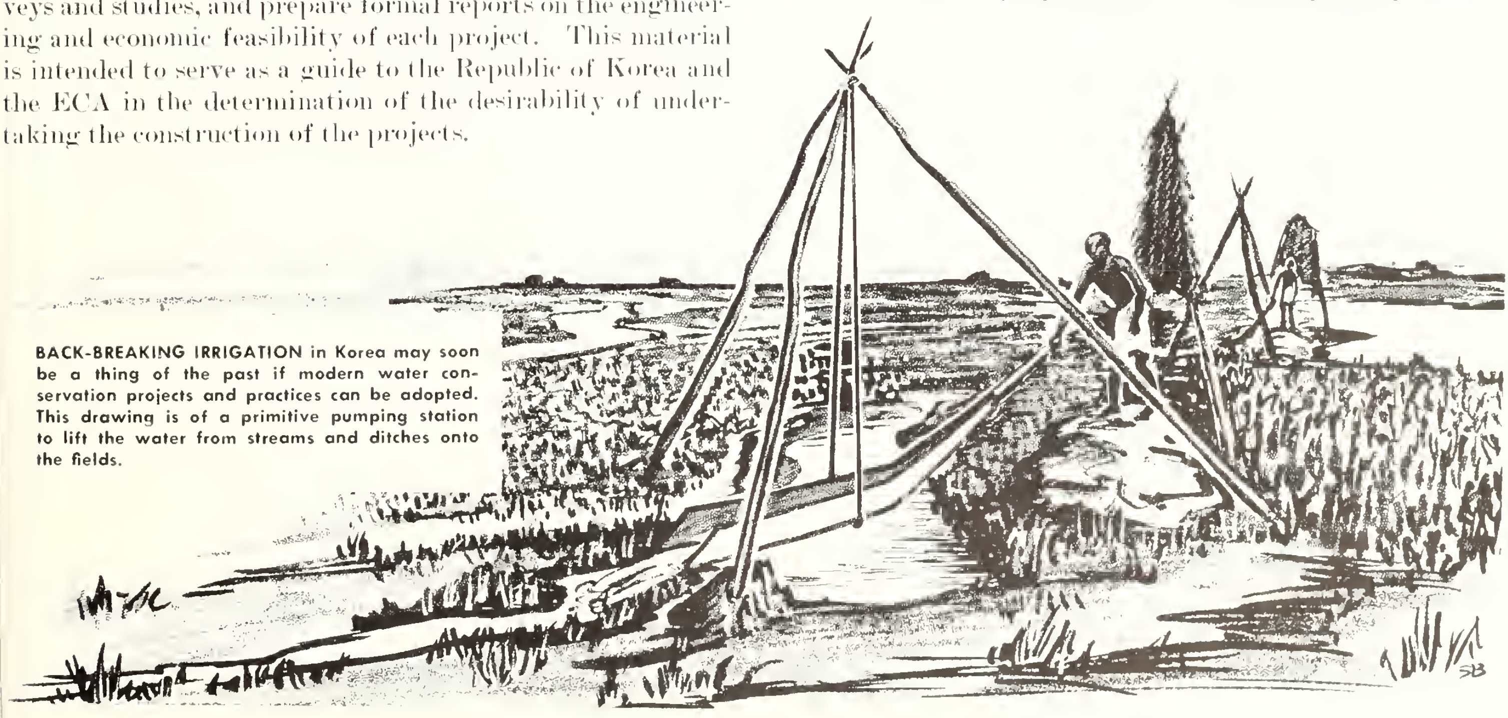
The second stage, planned for completion by about September, calls for a more intensive study of the proposed developments. The party of Bureau engineers and aides selected for this stage will examine the data collected by the advance group, conduct necessary detailed inspections, surveys and studies, and prepare formal reports on the engineering and economic feasibility of each project. This material is intended to serve as a guide to the Republic of Korea and the ECA in the determination of the desirability of undertaking the construction of the projects.

To carry out the work of the first stage, which was initiated in April, the Bureau of Reclamation selected seven persons from among its ranks. The roster forms a body of specialists in the fields of hydroelectric development, geology, hydrology, dam design, irrigation, and the marketing and transmission of power. Heading the groups for the first and second stages is R. F. Herdman of Hardin, Mont., construction engineer for the Bureau's Yellowtail Unit of the Missouri River Basin project, which features the proposed Yellowtail Dam, designed to rise about 500 feet above stream bed in the historic Big Horn Canyon southwest of Hardin, making it one of the highest concrete dams in the world. Herdman, an engineer with 37 years of experience in the engineering design and construction fields on hydroelectric power development, irrigation, flood control, railway and waterway works, and general construction, first became employed by the Bureau of Reclamation in 1913. He served in both world wars and is a colonel in the Army reserve.

Other members of the party are W. H. Irwin, an engineering geologist with the research and geology divisions of the Office of the Chief Engineer at Denver, Colo.; M. H. Fresen, a hydraulic engineer with the Branch of Power Utilization at Washington, D. C.; G. A. Fleming, an electrical engineer with the power marketing division of the Branch of Power Utilization for Region 2 at Sacramento, Calif.; W. D. Romig, a hydrologist with the Branch of Project Planning at Washington, D. C.; William Gorton, an irrigation economist with Region 1 at Boise, Idaho, and Ralph Winchell, an administrative assistant with the Branch of Operation and Maintenance at Washington, D. C.

Some preliminary work on the proposed developments was done before World War II by the Japanese and a general description of the projects was compiled.

One of the proposed hydroelectric power developments calls for the construction of a concrete gravity dam about 160 feet high on the Hongchun River. This dam would store water for a proposed 18,000-kilowatt power plant and



BACK-BREAKING IRRIGATION in Korea may soon be a thing of the past if modern water conservation projects and practices can be adopted. This drawing is of a primitive pumping station to lift the water from streams and ditches onto the fields.

William F. Kubach Succeeded by W. Darlington Denit

Consultant William F. Kubach. New Comptroller W. Darlington Denit.

It was with regret that Secretary of the Interior Oscar L. Chapman and Reclamation Commissioner Michael W. Straus announced the retirement of Comptroller William F. Kubach on April 30 after he had served almost 40 years with the Bureau.

In commenting on Mr. Kubach, Commissioner Straus said, "his experience and skill will be preserved to Reclamation by simultaneous appointment as a consultant on special problems which he has handled and with which he is so familiar."

He earned outstanding recognition for his long and faithful public service in handling the financing and accounting of Reclamation's multimillion-dollar construction contracts. He was also the spark plug for setting the complicated power rates, and negotiating sales and contracts which were among the most difficult confronting any Federal agency.

He joined the Bureau staff in 1912 when he was 23 and as a result had a first-hand working knowledge of the transformation of Reclamation from a single project agency to multiple-purpose project construction and in recent years basin development of the Nation's western resources.

On April 26, at a ceremony in the Interior Department Auditorium in Washington, D. C., Mr. Kubach was presented with the Interior Gold Medal for Distinguished Service, the highest honor the Department can bestow. In reading the citation from Secretary of the Interior Oscar L. Chapman, Assistant Secretary William E. Warne said, "Mr. Kubach's record of 40 years in Government service—38 of them in the Bureau of Reclamation—is an outstanding example of unremitting loyalty to the high traditions of the true civil servant and an enduring challenge to millions of career workers in Government."

He was born in Sandusky, Ohio, in 1889 and with the exception of 2 years in the Post Office Department and 2 with the Alaskan Engineering Commission, has been with the Bureau of Reclamation throughout his entire working career.

He proposed to make his home in the Southwest and indulge in several of his favorite hobbies when not employed as a consultant.

Mr. Kubach will be succeeded by W. Darlington Denit who has served as assistant comptroller for the Bureau during the past 2 years.

Mr. Denit has held numerous executive positions in and out of Government during the past 17 years. Among these assignments he served as head regulatory accountant for the Marketing Administration in the Department of Agriculture; as Administrative Analyst for the Office of Production Management; Director of Finance and Management for the Smaller War Plants Corporation; and was vice president and general manager of Lights, Inc., a war plant which was twice awarded the Army-Navy E.

He is an author and lecturer on finance, administration, and management. He is a member of the Society for the Advancement of Management, American Public Administration Society, Los Angeles Chamber of Commerce, Washington Board of Trade, Sigma Delta Kappa Legal Fraternity and also served as a member of the President's Committee on Cost Principles for Contract Termination.

He is a native of Washington, D. C., where he received his elementary and college education. He now makes his home in Silver Spring, Md. •

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provide additional water storage to increase the output of the existing Chung Pyung power plant.

The third project is extensive and is planned for gradual construction over a period of years. The Japanese had made plans for the development but much study and investigation remains to be done. There are three general proposals for the development of this project.

The first proposal calls for two separate systems. One is known locally as the "Imkei" system with one reservoir on the upper Han River, a water tunnel through the coastal divide, and two power plants on the Japan Sea slope developing 60,600 kilowatts of power. The other, known as the "Kangnung" system, would have three reservoirs on the Han River tributaries, two tunnels through the coastal divide and four power plants on the Japan Sea slope developing 92,200 kilowatts of power.

The second proposal calls for the combining of the two systems to develop 165,600 kilowatts of power through the construction of five interconnected reservoirs, a small pump station, a single tunnel through the coastal divide, two large power plants on the Japan Sea slope and a smaller plant between two of the reservoirs.

The third plan calls for the construction of two large reservoirs on the upper Han River, pumping water from the lower to the upper reservoir with a 20,000-kilowatt pumping station and the developing of 78,000 kilowatts on the Japan Sea slope.

The fourth project was approved for construction under the Japanese program and some lands had been purchased by the Japanese Government from the Korean farmers. When Korea was liberated these lands were transferred to the Korean Government. The dam, as proposed, would be 234 feet high and would make possible irrigation and power production. The planned power plant would have a capacity of 39,000 kilowatts. THE END

U. S. GOVERNMENT PRINTING OFFICE: 1950

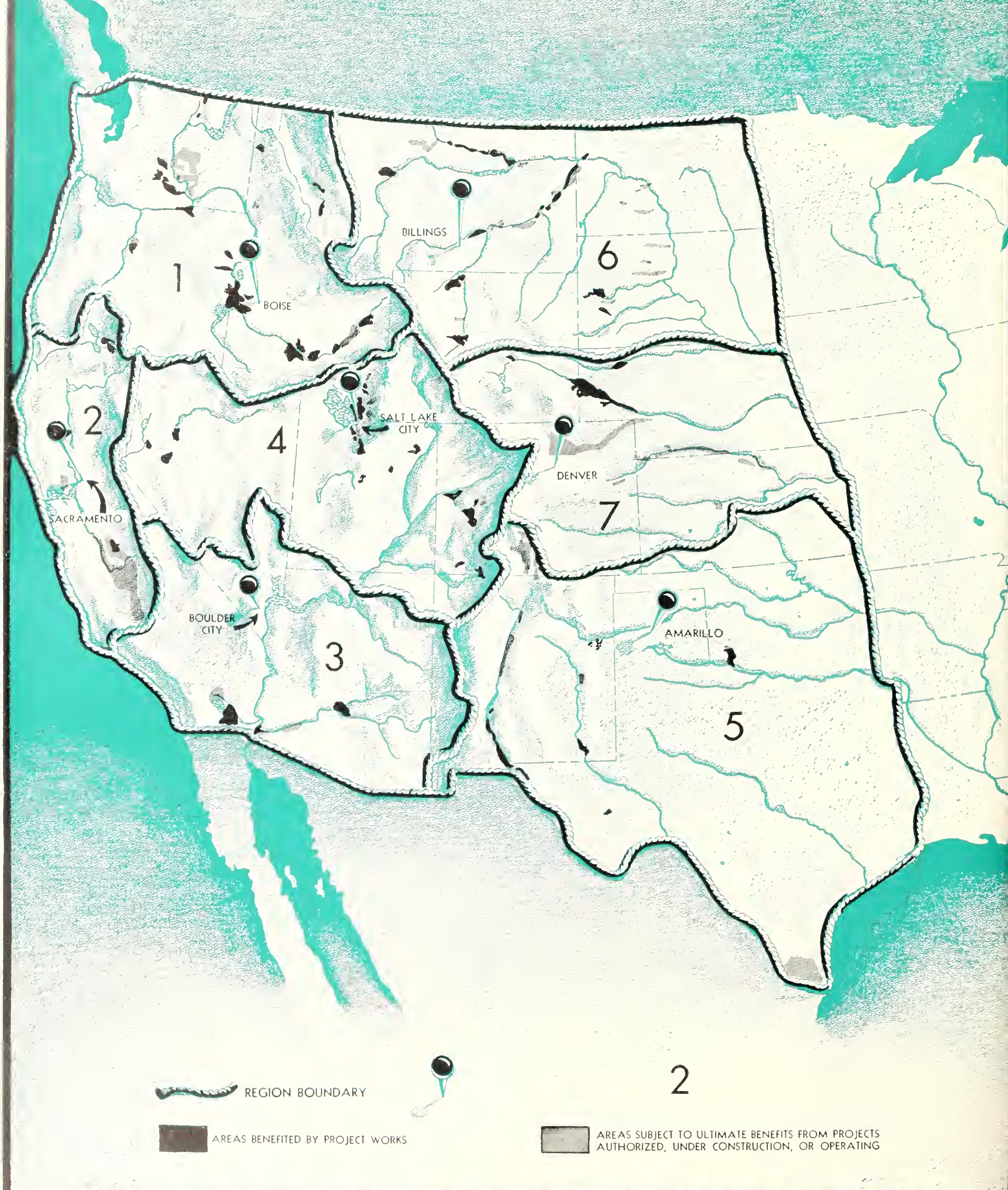
NOTES FOR CONTRACTORS

Contracts Awarded During April 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2883	Central Valley, Calif	Apr. 11	Stringing conductors and overhead ground wires for 42 miles of Shasta-Tracy Nos. 1 and 2 230-kilovolt double-circuit transmission line, Madison-Rio Vista section, schedule 2.	A. S. Schulman Electric Co., Los Angeles, Calif.	$170,320
2895	Missouri River Basin, Nebr.-Kans.	Apr. 7	Construction of earthwork and structures for Superior canal, drains, channel changes, and terminal wasteway.	Dobson Bros. Construction Co., Lincoln, Nebr.	182,680
2898	Davis Dam, Ariz.-Nev	Apr. 6	One 75-kilovolt-ampere transformer, one 65-kilowatt resistor, and one neutral grounding equipment cubicle for Mesa and Coolidge substations.	General Electric Co., Denver, Colo	10,817
2914	Missouri River Basin, Wyo	Apr. 13	Three 115,000-volt circuit breakers for Alcova switchyard, schedule 1	Westinghouse Electric Corp., Denver, Colo.	55,240
2914	do	do	Six 115,000-volt disconnecting switches for Alcova switchyard, schedule 2	Pacific Electric Manufacturing Corp., San Francisco, Calif.	11,063
2916	Colorado-Big Thompson, Colo	Apr. 11	Clearing right-of-way and constructing 50 miles of Green Mountain (Kremmling tap)-Oak Creek 115-kilovolt transmission line.	Smith Construction Co., Nashville, Tenn.	415,235
2918	do	Apr. 28	Six 115,000-volt, one 69,000-volt, and two 14,400-volt circuit breakers for Beaver Creek substation, schedules 2, 3, and 4.	Westinghouse Electric Corp., Denver, Colo.	134,820
2918	do	do	Five 115,000-volt selector switches; eight 115,000-volt, six 69,000-volt, and nine 15,000-volt disconnecting switches; and one 69,000-volt horn-gap switch for Beaver Creek substation, schedule 5.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	25,885
2923	Central Valley, Calif.	Apr. 25	Construction of Sacramento and San Joaquin River crossing towers for 230-kilovolt Shasta-Tracy transmission lines Nos. 1 and 2 (West Side lines).	Macco Corp., Paramount, Calif	432,990
2926	Columbia Basin, Wash.	Apr. 12	Construction of Ephrata office building	Walter W. Harfst Co., Inc., Seattle, Wash	472,192
2932	Central Valley, Calif.	Apr. 20	Two 18-foot by 19-foot 6-inch and three 14-foot by 20-foot radial gates for White River check and equalizing reservoir control structure, Friant-Kern canal, items 1 and 3.	Ransome Co., Oakland, Calif.	12,046
2933	Columbia Basin, Wash.	Apr. 7	Construction of extension of right switchyard for Grand Coulee power plant	Morrison-Knudsen Co., Inc., and Peter Kiewit Sons' Co., Seattle, Wash.	97,864
2934	Davis Dam, Ariz.-Nev	Apr. 25	Furnishing and erecting one 75,000-gallon elevated water storage tank for fire protection and domestic water system at Coolidge substation.	W. E. Caldwell Co., Louisville, Ky	24,976
2935	Missouri River Basin, N. Dak	Apr. 20	Construction of 219 miles of Voltaire-Rugby-Devils Lake-Carrington-Jamestown 115-kilovolt transmission lines.	Western Contracting Corp. and Philard, Inc., Sioux Falls, S. Dak.	1,335,000
2945	Missouri River Basin, Mont	Apr. 24	Two 9.04-foot by 9.04-foot double fixed-wheel gate frame assemblies for river outlets at Canyon Ferry Dam.	Lakeside Bridge & Steel Co., Milwaukee, Wis.	23,764
2948	Kendrick, Wyo	Apr. 20	Tailrace repairs at Seminoe Dam	Sharrock and Pursel, Casper, Wyo	234,900
2949	do	Apr. 7	Construction of control house for New Casper substation.	Dean Construction Co., Casper, Wyo	34,997
2954	Gila, Ariz	Apr. 18	Reconstruction of Gila Valley canal desilting basin	Macco Corp., Paramount, Calif	178,728
2956	Hungry Horse, Mont.	Apr. 13	Structural-steel columns, crane runway girders, and related miscellaneous structural steel for Hungry Horse power plant.	Virginia Bridge Co., Denver, Colo	118,224
2959	Fort Sumner, N. Mex	Apr. 18	50,000 barrels of portland cement for construction of Fort Sumner diversion dam.	Ideal Cement Co., Denver, Colo.	162,500
2963	Colorado-Big Thompson, Colo	Apr. 25	Contraction joint grouting of Olympus Dam	C. M. Hanes Construction Co., Denver, Colo.	4,350
2964	Missouri River Basin, S. Dak	do	Contraction joint grouting of Angostura Dam	do	9,095
R2-99	Central Valley, Calif	Apr. 11	Four-3-bedroom residences for Government Camp at Delano	da Roze-Ribal, Inc., Monterey, Calif	24,912
R3-PX-27	Davis Dam, Ariz-Nev	Apr. 14	Construction of six 5-room and twelve 6-room residences at Parker Dam Government Camp.	Diana & Landi Const. Co., Inc., Phoenix, Arizona.	151,058

Construction and Equipment for Which Bids Will Be Requested by August 1950

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	250-volt direct current 20-kilowatt motor-generator battery charging set for Los Angeles switchyard at Hoover power plant
Do	150,000 pounds of miscellaneous galvanized fabricated steel structures for Boulder Canyon switchyard at Hoover power plant.
Central Valley, Calif	Motor-driven water pumps for Tranger pumping plant, total capacity of 120 cfs at 180-foot head.
Colorado-Big Thompson, Colo.	30,000 pounds of miscellaneous galvanized fabricated steel structures for Beaver Creek substation.
Do	Main control board for Pole Hill power plant.
Columbia Basin, Wash.	Continuation of repairs to Grand Coulee Dam spillway bucket and spillway face.
Do	1 oil purifier, 300-gallon per hour capacity, and 1 oil purifier, 1,200 gallon per hour capacity, for Grand Coulee power plant.
Davis Dam, Ariz.-Nev	Furnishing and installing pumps for 6 water supply wells at Tucson, Coolidge, Phoenix, and Mesa, Ariz.; and furnishing and laying pipe lines for domestic water supply and fire protection system at Mesa and Coolidge.
Do	Furnishing and installing underground about 2,300 feet of 5-inch conduit between Phoenix substation and dispatcher's building at Phoenix, Ariz.
Do	Erection of 230-kilovolt steel structures and installation of high-voltage section disconnecting switches and circuit breakers at Prescott substation site.
Do	Construction of 6,000-, 7,500-, and 15,000-kilovolt-ampere, 34.5-kilovolt switchyards at Wellton-Mohawk pumping plants Nos. 1, 2, and 3, east of Yuma, Ariz.
Do	Supervisory control and telemetering equipment for Blythe and drop No. 4 substations.
Do	Six 69-kilovolt oil circuit breakers and twelve 69-kilovolt disconnecting switches for Phoenix switchyard.
Do	Supervisory control and telemetering equipment for Maricopa substation.
Eden, Wyo	Construction of 4 three-bedroom and 8 two-bedroom duplex units, dormitory, laboratory, office building, garage, and utilities for Government camp at Farson, Wyo.
Fort Peck, Mont	Construction of 20,000-kilovolt-ampere Shelby substation.
Do	Construction of 1,500-kilovolt-ampere Rudyard substation.
Fort Sumner, N. Mex.	Construction of 12 miles of 100-cubic-feet-per-second capacity, concrete-lined Main canal near Fort Sumner, N. Mex.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Hanna substation, including constructing foundations, furnishing and erecting prefabricated control building and chain link fence, and erecting all structural steel and installing electrical equipment.
Do	Construction of about 35 miles of double-circuit, open-wire telephone line from New Casper substation to Alcova Dam.
Missouri River Basin, Mont.	15,100 pounds of miscellaneous steel and brass piping for Canyon Ferry Dam ice prevention system.
Missouri River Basin, Nebr.	Construction of 66 miles of Sidney-Ogallala 115-kilovolt, single-circuit, wood-pole transmission line.
Do	Construction of 10-mile unlined section of 210-cubic-feet-per-second Cambridge canal near Oxford, Nebr.
Missouri River Basin, N. Dak.	Construction of 41 miles of Bismarck-DeVaul 69-kilovolt, single-circuit, wood-pole transmission line.
Do	Construction of 10,000-kilovolt-ampere Carrington substation.
Do	Cubicle-type main control switchboards for Jamestown, Devils Lake, and Rugby substations.
Do	Galvanized fabricated steel structures for Rugby, Devils Lake, Jamestown, and Bismarck substations.
Do	Construction of Fort Clark River and relift pumping plants, substations for the pumping plants, and canal, lateral, and drainage systems; and installation of pumping plant and substation equipment on the Missouri River in Mercer County, N. Dak.
Missouri River Basin, Wyo.	Construction of 34 miles of Seminoe-Sinclair 115-kilovolt, single-circuit, wood-pole transmission line with overhead ground wires.
Do	Construction of Anchor Dam, a concrete arch structure on Owl Creek, about 40 miles northwest of Thermopolis, Wyo.
Do	Construction of residences, office building, garage and warehouse, utilities and reconditioning 6 trailer units for Government camp near Anchor dam site, 35 miles west of Thermopolis, Wyo.
Do	10,000 pounds of miscellaneous galvanized fabricated steel structures for Alcova substation.
North Platte, Wyo.-Nebr	Concrete lining for 22,400 feet of Fort Laramie canal laterals and asphalt lining for 12,000 feet of Lateral 58.7 and portion of Horse Creek lateral near Lingle and Veteran, Wyo., and Lyman, Nebr.
Do	Concrete lining of laterals 24 A and 24 D on the Interstate canal, 2 miles south of Lake Alice, Nebr.
Rio Grande, N. Mex.-Tex	Construction of foundation and erection of steel structures at the site of 2,000-kilovolt-ampere Hollywood substation, Hollywood, N. Mex.



THE RECLAMATION AREA

The Reclamation ERA

July

1950

Official Publication of the Bureau of Reclamation

The Reclamation ERA

July 1950

Volume 36, No. 7

Issued monthly by

The Bureau of Reclamation

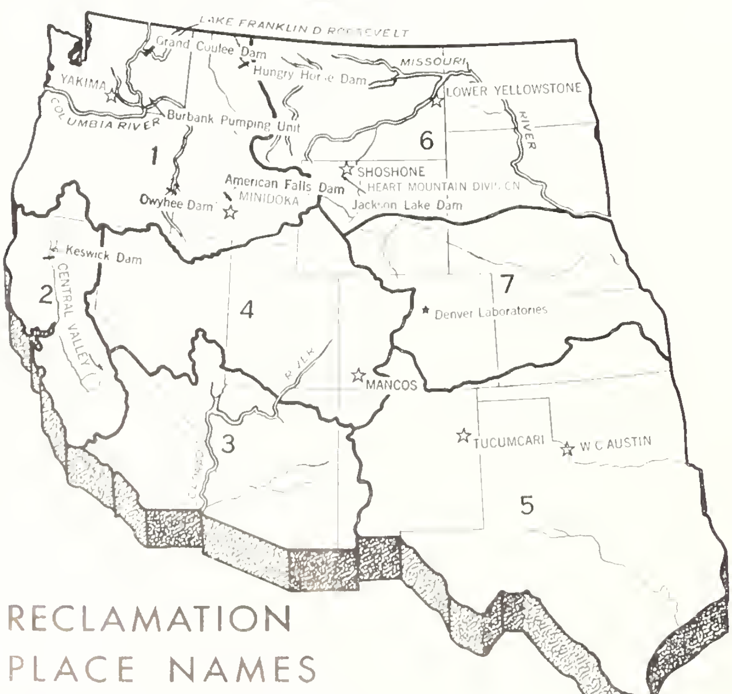
United States Department of the Interior, Washington 25, D. C.

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

CONTENTS

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.



RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO IN THE ERA

Ex-President on Minidoka Project

Former President William H. Taft visited the Minidoka project on June 4. He made a tour of the south side pumping unit, visiting the pumping stations. He expressed great interest in the signs of progress and prosperity that were evident on every side. Much of the construction work on the pumping unit was done during the Taft Administration. In the evening Mr. Taft talked to the people of Burley in the new Latter Day Saints Tabernacle, on the subject of Americanism versus Bolshevism.

(From p. 302, July 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)

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Oscar L. Chapman, Secretary

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HOWDY, STRANGER!

by

JOHN K. BLACK, Settlement Specialist, Bureau of Reclamation, Heart Mountain, Wyo., Region 6 (headquarters at Billings, Mont.)

EDITOR'S NOTE: In Powell, Wyo., the townspeople's welcome to new settlers serves as an example of the truly American spirit. Helpfulness, respect, and consideration for the welfare and rights of each individual, demonstrate the real meaning of democracy. Their plan of action and cordial program are well worth imitating.

MOST WORLD WAR II VETERANS spent long hours on troop trains traveling across the United States. They formed an impression of Wyoming as a wide-open country where one rode over seemingly endless miles of desolate looking "bad lands." Cowboys, Indians, and small settlements typified the State. Winters were cold and summers were hot—everything seemed out of control. When the Bureau of Reclamation announced homesteads available in Wyoming, GI's from coast to coast revived their old impressions of wild and wooly Wyoming.

A farm boy's desire to obtain a farm on his own is strong, however, and applications poured in when 104 farm units were opened in 1949 on the Heart Mountain division of the Shoshone project. Over 20,000 copies of the notice were mailed out and 1,839 farm applications were returned by July 12, 1949, the closing date for simultaneous filing.

The lure of Yellowstone Park nearby influenced many to go west, so a stop-off at Heart Mountain, Wyo., where the settlement office is located, was included in their itinerary. One young veteran, upon seeing the broad expanse of the Ralston bench where 100 farm units lay waiting for the plow remarked, "I never dreamed there was land like this in Wyoming."

As plans were made to call in successful applicants to select their homesteads and be interviewed by the Shoshone project examining board, old timers at Powell, Wyo., a thriving modern community in the heart of the settled portion of the Shoshone project, remembered the many distorted impressions they too once had of Wyoming. They decided these newcomers should be given a welcome that they would remember, and that Wyoming would be praised for its greatness, its opportunities, and placed in its true light before these strangers.

A plan was devised whereby the successful applicants were called to appear in groups of 10 on Tuesdays and Thursdays, the day's program beginning at 10 a. m. The examining board began the orientation by talking to each group about the project generally: how the land development program operates, the construction costs of the project, future responsibilities of water users in taking over operation and maintenance of the irrigation system, homestead laws, and many other related subjects.

A list of questions most frequently asked by new settlers had been compiled and each meeting added a few new ones. "How

AN OPEN LETTER TO OUR NEW NEIGHBORS

We welcome you as fellow citizens of the extensive Powell Valley community.

We know that many of you have already proven-up on your homelands and have made a success of your farming operations in a few short years. For others, new to the area, we know that a lot of hard work is ahead of you on the beautiful Heart Mountain Division.

Others of us who live in the valley and have been here longer realize the hardships you face and the ultimate rewards. We are proud to have you share experiences with us in this desirable area of the Rocky Mountain Empire. We offer you any help that is within our power to give. Our years of experience in this locality and our familiarity with its problems enable us to feel competent to help you.

We encourage you to visit Powell, a typical FARMER'S TOWN. Here are located the finest marketing outlets in the Big Horn Basin. Powell's merchants cater to the supply needs of all farmers, ranchers, and oilmen.

We hope you'll soon enthusiastically agree with us that "your home town," POWELL, has "IT."

The Undersigned Business Houses.

TEN POWELL MERCHANTS got together and paid for a full-page spread in the Powell Tribune which included this letter. The "undersigned merchants" were Bean Dealers E. H. Walrath & Sons, Knutson Implement Co., Samsel's Department Store, Gambles Store, Modern Electric, Big Horn Co-op Marketing Assn., Big Horn Co-op Service Station, Powell Valley Implement Co., J. C. Penney Co., and Roger Bros. Seed Co.

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is irrigation water measured to a unit?" was a perplexing one raised by many. The project superintendent explained that when the settler is ready for a stream of water he should fill out a water request card (he exhibited a sample) 24 hours ahead of the time water is desired, and leave it in the glass jar fastened to a post near his turn-out where the ditch-rider can plainly see it every day as he drives down the ditch bank road. Seeing the card, the ditch rider will pick it up, make a record of the request, and make plans to deliver the water as requested the next day. The superintendent explained the principle of the Cipolletti weir so that its use in measuring the flow of water onto the farm unit could be understood. A table was handed to each settler to enable him to compute the cubic feet per second of water passing over the weir, and from that arrive at the amount in acre-feet of water he is using and paying for. This orientation was always enlightening and of real interest to the whole group, most of whom came from dry land farms where nature measured out water as she saw fit without the use of any intricate devices.

"How in the world can I tell where to put my fence?" was a frequent question. Here again the superintendent told about the galvanized pipe monuments on the corners supplemented with steel posts which are clearly marked to tell the homesteader where his land lies.

The Farmers Home Administration supervisor who attended the meetings was queried as to "When can I get a loan?" and "How much can I borrow?" He explained that funds are available for loans up to $3,500 the first year to purchase livestock and machinery and to pay general farming expenses. He mentioned that a borrower could take 5 years to repay loan money used to buy machinery or livestock but money used to pay annual operating expense must be paid back the first year.

The Rural Electrification Association representative was asked "When will I get electricity?" The group was told that work had been started on the loan to make extension of present lines possible, and that there should be electric lights shining from the windows by Christmas eve of 1950 if the entrymen would join the local cooperative association, and give the planned location of their farmsteads. Questions from the group often came thick and fast, and though many were difficult, honest answers were always given. This group meeting lasted until noon.

As the lunch hour approached, a member of the Chamber of Commerce extended an invitation to the applicants, their wives, parents and friends who came with them, to be guests of the Chamber at a noon luncheon. The Women's Auxiliary of the American Legion served a sumptuous meal, family style, and guests were made to feel perfectly at home. A representative of the Chamber of Commerce was called on to extend greetings to the group and tell about the schools, churches, civic and fraternal organizations in the community, its hospital facilities and other institutions available to fill the needs of the new settlers.

After the luncheon there was time for just plain visiting, Wyoming style. Many interesting facts came to light. One member of the Chamber of Commerce soon learned that the homesteader seated next to him was from his old home town in North Dakota and that their fathers had taken up adjoining dry land farms. It was discovered that one newcomer had brought his father and grandfather with him, representing three generations of homesteaders: grandfather in Colorado, father on the North Platte in Nebraska, and son at Heart Mountain.

The father of one settler said he had crossed through the project area on horseback in 1898. It seemed like a miracle to him to come back and see a prosperous farming community where there had been only salt sage and sagebrush before the Federal Government developed an irrigation system to bring water to the land.

When the president of the Chamber of Commerce first asked the members how many wanted to attend the luncheons, there was scattered response from businessmen who already ate too many meals away from home. After the first luncheon, however, the president had to limit the number who were to attend, as the luncheon room would only hold

(Please turn to page 141)

EXAMINATION TIME is not too hard to take in such an informal and friendly setting. Here is the Shoshone Project Examining Board interviewing Donald K. Miller, who was later awarded Unit 206. Seated from left to right are: A. S. Ingraham, Shoshone project's operation and development supervisor; George L. Gibson and Fred O. Arnold, both members of the examining board; Donald's parents, Mr. and Mrs. Miller, and Donald himself, ready to ask and answer questions.

HONEYMOON TIME was homestead time for Mr. and Mrs. Vincent Schlitz, one couple of the many Heart Mountain settlers with a real pioneer spirit. When Vincent, from La Crosse, Wis., learned his name had been drawn, and he was called for an interview and unit selection at Heart Mountain, he telephoned Betty, who was employed as a stenographer in New York City. They moved up their wedding plans, and hurried to select their new home in the West together. Photo, courtesy of the Powell Tribune.

SCIENCE CENTER

MICROSCOPES, MACHINES, AND MODELS will be on display at the Center's "Open House." At extreme left, Vladimir Walkodoff of the petrographic laboratory uses a radiometer to find out the size, distribution, and shape of air voids in a concrete specimen—an important factor in determining its durability. At center, the huge 5-million-pound testing machine with W. H. Dee manipulating the controls, and Earl Newton and Robert Wells on top of the massive machine's movable head. Above, E. J. Rusho, hydraulic engineer, checks Tiber Dam's model.

Visitors are welcome at the ceremonies dedicating the Reclamation Engineering Center at Denver, Colo., where schemes for saving and using soil and water resources are developed, tested and proven feasible, economical, and beneficial to the welfare of the Nation.

Matchless engineering resources that the Bureau of Reclamation is applying to alleviate western water shortages will be on display this month.

The Reclamation Engineering Center at Denver, Colo., an intricate mechanism which is the mainspring for designing and constructing Bureau projects, will be formally dedicated July 20. During "open house" both on that day and on July 21, contractors, suppliers, leaders in government and the public at large will be welcome to see what makes the works tick.

Engineers, public and private, domestic and foreign, have trodden paths to the doors, recognizing the Center for what it is—a great installation. Even including these, comparatively few individuals outside the Bureau know the quality, extensiveness and variety of Reclamation's engineering offices and laboratories, which are so thoroughly in keeping with the dimensions of the present-day construction program and with the host of technical problems the specialized experts must solve.

Immediate occasion of the dedication is the installation of a huge testing machine signaling the virtual completion of the Center. Fifty feet high and weighing 750,000 pounds, the machine has a capacity of 5 million pounds; with it, concrete can be crushed to powder, or steel bars pulled apart.

Not only is this the most dramatic single piece of equipment at the Reclamation Engineering Center, but it is also symbolical—it represents the tools of science which have become so important to reclaiming land and water.

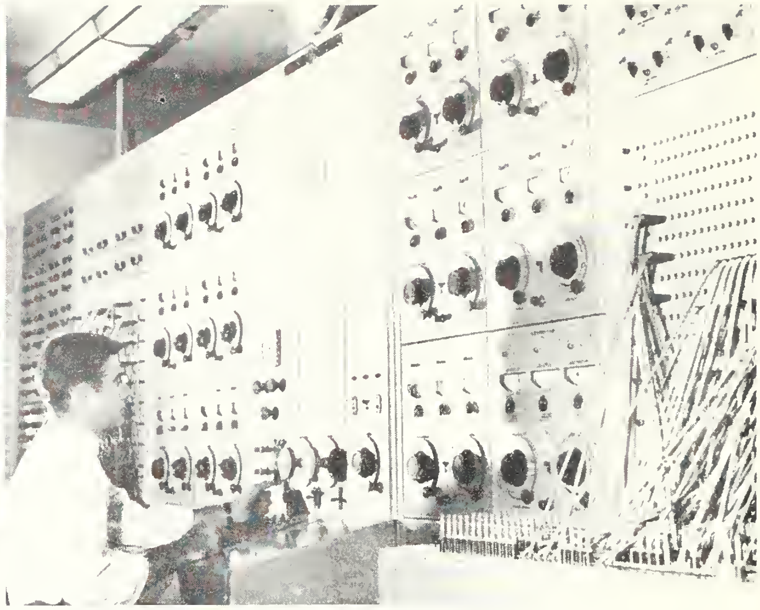
The offices of the Bureau's chief engineer have for many years been the source of the designs, each necessarily different from all others preceding it, for western water development. Here were born the ideas that went into the building of Hoover and Grand Coulee and Shasta Dams, and many other lesser structures before and after them.

The wartime westward shifting of population and industry gave penetrating point to the need for a Bureau construction program much larger after the war than it had been before.

In 1943, at the same time that the Bureau's organization into regions was accomplished, the chief engineer's offices became also the Branch of Design and Construction, and the chief engineer as director of this branch is the only staff officer of the Commissioner not located in Washington, D. C. Quarters occupied in the New Customhouse in Denver were inadequate for the enlarged program, and the branch moved to the Denver Federal Center, a former small-arms plant nine miles from the city's main business district. There, it took over two sprawling buildings, each 300 yards long, one for the design divisions and the other for the laboratories.

During the 3 years since that time, the Reclamation Engineering Center has "shaken down" into an organization unequalled, in its specialized qualifications, anywhere on the face of the globe. Superlative designing engineers work in tandem with the experts in the research and geology labora-

ESSENTIAL DESIGNS, without which neither the mightiest nor the most minute of Reclamation's intricate structures can be created. Structural engineers J. W. Fabry, at left, and W. M. Saunderson, nearest the camera, are completing designs of the new Falcon power plant, to be constructed by the International Boundary and Water Commission on the Rio Grande. Bureau of Reclamation engineers' design work is world famous.



TECHNICAL ANALYSIS is also necessary to insure efficient operation of Reclamation's projects. W. H. Hinch, electrical engineer in the power system technical section, is studying the master instrument panel of the Center's network analyzer, which is used to study in detail all aspects of transmission line network systems. Data on voltage, current, and power conditions on various points of the network are represented in miniature on the analyzer.

tories, and together they evolve the wonderful works of concrete, earth, and steel that enrich western river basins.

The brains of men are, of course, the all-important part of this process of creation. Laboratory experimentation helps men to put their conceptions to test. The big testing machine and scores of other tools they use simply enable Bureau engineers to do their work better—to find the strongest, safest, and most economical ways to build.

The combination of men and laboratory equipment is paying huge dividends to the public. Water and power users, who ultimately pay for Reclamation projects, pay for the work of the Branch of Design and Construction. They should be reassured to know that economies in construction discovered at the Center have more than paid for its total operating costs, as well as the entire cost of establishing and equipping it. Many of the money-saving techniques and materials conceived in connection with specific construction works will apply as well to later works, thus compounding the monetary economies.

Reclamation Engineering Center employees are conscious that the plant is aimed at the goal of building to benefit the largest number of westerners, for the longest time, at the lowest possible cost.

They and the Bureau at large are proud of the Center, serving all the West and indirectly the entire Nation. They therefore welcome the opportunity accorded by the dedication to open its facilities to general public inspection.

Bigness, alone, is no measure of greatness. But vision, backed by solid economics and the welfare of the public, meets that criterion. The pioneers of reclamation had it, and courage and daring too; they met the challenge of their times.

Now the "easy" projects have been built. The task that remains is no more difficult than the work done during the last half century, if the relative differences in knowledge and equipment are taken into account. It is only more intensive. The Staff of the Reclamation Engineering Center at Denver is hopeful that farsightedness today will equal the farsightedness of yesterday, and that its contribution to western development will continue to be an important one.

To this goal is the Reclamation Engineering Center dedicated.

THE END

OUR FRONT COVER

SCIENTIST AT WORK.—Barry Hoag, chemist, is shown at work in the chemical laboratory of the Reclamation Engineering Center. (See above.) Hoag is determining the sulfate content of a paint pigment by filtering out precipitated barium sulfate. By blowing on the tube in his mouth, water from the flask is forced up into the beaker in his left hand and flushes the precipitate of barium sulfate onto the filter paper in the glass funnel. The precipitate on the filter paper can then be ignited and weighed, making it possible to analyze different types of paints to get the best for each particular purpose.

Doty and Northrup Named Assistant Secretaries

Dale E. Doty of Pasadena, Calif., and Vernon D. Northrup of Scranton, Pa., were appointed Assistant Secretary and Administrative Assistant Secretary of the Interior Department, respectively, on June 9, 1950.

Both are veteran career employees in the service of the Department. Mr. Doty joined the Department in 1939 as a field aide in the Indian Service at Albuquerque, N. Mex. He subsequently served as a research assistant in the General Land Office obtaining broad experience in the administration of public land laws. At the time of his appointment he was assistant to Secretary of the Interior Oscar L. Chapman.

Mr. Northrup served as Director of Administrative Planning and Personnel during the war for the War Manpower Commission. In 1943 he became Director of Interior's Division of Budget and Administrative Management. When the Department's new Office of Administrative Management was created in 1949, Mr. Northrup was appointed to the top position as Administrative Officer. He held this post at the time of his appointment to the position of Administrative Assistant Secretary. ●

The Passing of
WILLIAM LEMKE

WITH THE UNEXPECTED DEATH of Representative William Lemke at Fargo, N. Dak., on May 30, the Reclamation program lost a staunch supporter and good friend.

Mr. Lemke served continuously in the House of Representatives since 1933, with the exception of the Seventy-seventh Congress, and was a member of the Public Lands Committee.

He was an ardent supporter of the Reclamation program and was continuously working for the various legislative proposals which would enable the Bureau to develop the natural resources of the West in the fastest and most economical manner which would provide the greatest benefits for the greatest number of people and simultaneously contribute to the wealth of the Nation. His deep interest in this great program may well be attributed to his early life back in Albany, Minn. It was here that he was born in 1878, on a small homestead, to Fred and Julia Kleir Lemke. As a youth in Albany he helped work the farm and through his experiences learned of the need for the measures he was later to promote in the House of Representatives.

During his long career, both before and after becoming a Member of Congress, he was always known as "the farmers' friend."

Before his election to the House, he had been connected with practically every farmers' organization in the Northern Great Plains, either in the capacity of an attorney or as an active member. Among these groups were the Farmers' Union and Cooperative Exchange. After his entry into Congress he continued to fight for the interests of the farmers especially during periods of depression and drought. The Lemke-Frazier moratorium bill earned him the undying gratitude of depression-hit farmers, as well as a national reputation for progressive legislation.

The so-called Lemke-Frazier Act enabled farmers who were victims of the depression to consolidate their debts and extend their payments through the assistance of conciliation commissions which were established throughout the country. This type of financial assistance helped many farmers to save their land and yet placed a premium on diligence and honesty as farmers who did not live up to the various agreements were subject to the National Bankruptcy law.

William Lemke was graduated from the University of North Dakota, studied law at Georgetown University in Washington, D. C., and at Yale University, where he received his law degree in 1905. He began law practice that year in Fargo, N. Dak., and became State Attorney General in 1921, charged with drafting laws for establishing the industrial program for the State. While a member of Congress he ran for the office of President of the United States on the Union ticket. He ran for reelection to the House at the same time and was successful in returning to Washington, D. C., as a Congressman. He was married to Isabelle McIntire in 1910 and had three children.

His passing was deeply mourned by his colleagues in the House and Members of the Senate with whom he had occasion to work on various bills for the development of the West.

Congressman William Lemke "friend of the farmer." *Photo by Harris & Ewing.*

Congressman Mike Mansfield, Democrat of Montana, said, "When I read of the passing of Bill Lemke this morning I knew that I had lost a real friend. Bill was not only interested in irrigation, reclamation, and agriculture in general, but more important, he was interested in the people and their welfare. I appeared before him many times on the various committees on which he served so ably and so well. On every occasion Bill Lemke gave me every possible consideration on bills affecting the welfare of my State, Montana. I know that were my colleague Mr. D'Ewart present he would join me in this eulogy."

Congressman John R. Murdock, Democrat of Arizona, and Chairman of the Public Lands Committee said, "It was only a few days ago, when the Alaska homestead bill was being considered by the House, that our colleague Mr. Lemke from North Dakota took the floor favoring his legislation. That day I had a great many thoughts running through my mind because I have been working with Congressman Lemke on this and many other bills on the Public Lands Committee. I had little time to do more than praise him for his energetic persistence in trying to pave the way for a new commonwealth to be settled by veterans. I am glad now I said to him even a few of the kindly thoughts I had for him * * * We have lost a valuable Member in this versatile and many-sided Congressman."

Congressman Paul Cunningham, Republican of Iowa, said, "Bill Lemke was an able and fearless legislator. He was primarily interested in all those less fortunate than

(Please turn to page 142)

Reclamation's Hall of Fame

Nomination No. 10

FRANK ARTHUR BANKS—

Builder of Grand Coulee Dam

FRANK ARTHUR BANKS—Backdrop by Grand Coulee Dam, the structure Banks refused to leave, even for better-paying jobs.

by RAY J. SCHRICK, Assistant Information Officer, Coulee Dam, Wash., Region 1 (headquarters at Boise, Idaho)

In 1906, a young man of 23 and a young Federal bureau 4 years old struck up a working acquaintance that has grown into fame for both in the past 44 years.

For Frank Arthur Banks, the young man, that association came to a new high Thursday, May 11, 1950, when the President of the United States presented him with the Award for Distinguished Service, highest honor of the United States Department of the Interior. The Bureau of Reclamation (the Federal bureau which Banks joined) is also at the pinnacle of its achievements, the greatest of which is the development of the water and land resources of the great Columbia River system, in which engineer Banks played a starring role. It has been said that no one man has done more to force a river to do its work for the public good.

Banks is a gentle, soft-spoken, white-haired, erudite man who still speaks with the trace of a Down East accent which he brought West from Maine. While he has Bar Harbor in his voice, he has the Wild West in his heart.

There is a fable of a raven who would drink water from a pitcher, but he could not reach the water in the bottom. By carrying pebbles one by one, and dropping them in the pitcher, he raised the water level until he could drink his fill. The Columbia River Basin is the second largest in the United States, and Banks is the engineer who figuratively dropped the pebbles, in the forms of half a dozen dams, to raise the water level for the benefit of several million people and the Nation as a whole.

The Columbia River winds 1,210 miles from the mountains of British Columbia to the Pacific Ocean. It was 158 years to the day of Bank's citation—May 11, 1792—that Capt. Robert Gray sailed his ship, the *Columbia*, into the mouth of this great river, giving it its name. Starting more than a century after these early explorers, engineer Banks outpioneered the early pioneers. He has not only worked the Columbia, but a half dozen major tributaries whose combined reach is wider than the United States.

If it is legend that the doctor "wears three faces," the Reclamation pioneer Banks has worn a dozen:

He crossed the high Teton Pass of Wyoming in a covered wagon, "with snow up to the horse's belly," bearing his wife "Dode" and his month-old daughter to the site of the great Jackson Lake Dam, in its day creating the fourth largest reservoir in the United States.

He contributed to the construction of two dams which, in their day, were the highest in the world—Arrowrock on the Boise River, for which he prepared preliminary designs, and Owyhee on the Owyhee River or Oregon, where he was Construction Engineer.

He owned one of the first "motorbikes" in Montana, where he worked on the Lower Yellowstone project from 1906 to 1909. One of the favorite quotes of that day was, "Here comes * * * I mean, there goes * * * that young Mr. Banks feller with his new motorbike." On occasion, he also rode his cow pony 33 miles to town on Saturday night and danced till dawn.

As recently as the great depression, he hauled makeshift furniture by mule to the Owyhee Dam site and threw up a one-room tar-paper shanty on a gravel bar for himself and his wife. His two children lived in a tent.

For the last 17 years, he has been engaged on the greatest job of all—the mighty Grand Coulee Dam, in the sagebrush country of central Washington—largest man-made structure in the world, three times the volume of the largest pyramid.

Banks was a $65-a-month rodman for a survey gang when he joined the Bureau in 1906. Today, he earns $10,000 a year. He could have earned many times that amount as a private engineer. In 1930, he passed up an offer to design dams in Russia, at a figure considerably in excess of his salary in the United States.

The dams which Banks built in the great basin made a full or supplemental supply of water available for approximately 1 million acres, and within the next 50 years the water from the Grand Coulee will add another million. The 30,000 farms, for which the dams he erected provide or will provide water, cover an area of 3,120 square miles—almost three "new" States the size of Rhode Island.

Banks has helped produce wild hay, alfalfa, barley, and oats for the tiny Powder River Valley, near Baker, Oreg., with his Thief Valley Dam.

The Owyhee Dam pours water through the weirs for 100,000 acres of corn, seed, onions, clover, watermelons and other eastern Oregon crops.

His dams also feed the sandy loam of the Snake River Valley, where the river cuts a horseshoe swath almost 1,000 miles long. The American Falls and Jackson Lake Dams, which Banks helped build on this largest tributary of the Columbia, store water for sugar beets, potatoes, alfalfa, fruits, and dozens of other crops.

The chronology of engineer Banks' 44-year career, except for a short period in another basin, has taken him steadily downstream, from the headwaters more than a mile high to the lower reaches of Oregon and Washington a few hundred feet from sea level. Here is the Reclamation history he has written in concrete:

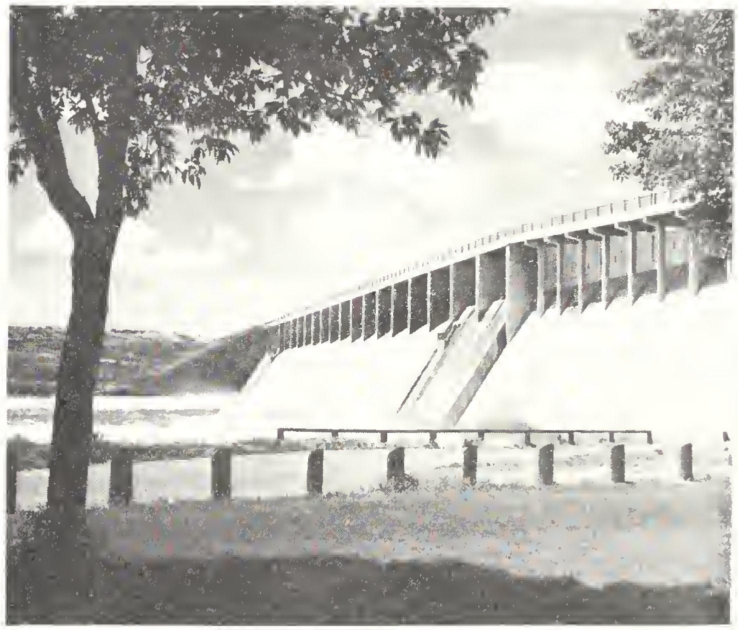
1906–09: Lower Yellowstone Project, Mont., starting as a survey gang rodman and working up to assistant engineer.

1909–13: Designing engineer for the Division Headquarters in Boise, Idaho. It was in this period that Banks designed the preliminary plans for the Arrowrock Dam on the Boise River in Idaho.

1913–17: Construction engineer, Jackson Lake Dam, Wyo., on the South Fork of the Snake River, 6,776.8 feet above sea level.

1917–20: Engineer, Minidoka Project, Idaho, on the Snake River, of which the Jackson Lake enlargement was one part.

1920–27: Construction engineer, American Falls Dam. It was here that Banks moved the entire town of American



THREE BANKS' JOBS—at top, the Jackson Lake Dam on the South Fork of the Snake River in Wyoming. In its day, the reservoir was the 4th largest in the United States and the fifth largest in the world. Frank A. Banks was construction engineer from 1913 to 1917. ***Photo is by Ben Glaha, now Chief Photographer, Region 2.*** **At center, American Falls Dam. Engineer Banks was charged with the job of moving the entire town of American Falls, Idaho, to construct this one. At bottom, Owyhee Dam, on the Owyhee River in eastern Oregon, was the highest dam in the world before the construction of Hoover Dam. Frank Banks headed the construction of the Owyhee Dam from 1927 to 1933.** ***Photos of American Falls and Owyhee Dams by Phil Merritt, of Region 1.***

Falls, a feat which had the help of his colorful wife, the former Theodora Drummond of Boise. There was objection among the citizens of American Falls to the move. One day, Mrs. Banks invited the prominent ladies of town to tea. The Banks home was mounted on rollers. No sooner had the ladies been seated, than the house started to move to its new location. The opposition to moving the town dissolved.

1927–33: Headed construction of Owyhee Dam, Oreg., on the Owyhee River. Until Hoover Dam, this was the highest dam in the world. Banks was considered for the Boulder job, but because Owyhee was not yet finished, it was deemed advisable not to leave the project.

When Grand Coulee Dam got the green light in 1933, Banks declared, "That's the job I want." He was named to head the project on August 1, 1933, and he has been at Coulee Dam ever since. He is now district manager, Columbia River District.

Grand Coulee ultimately will turn the barren sagebrush country of central Washington into a grand, green land of 1 million irrigable acres. Where deserted farmhouses stand as grave markers to attempts at dry farming, new towns already are on the drawing boards. The first water from the dam will flow onto the land in 1952.

The dam already is the largest power-producing unit in the world—and only 13 of the ultimate 18 generators are in production. By the end of 1951, both the left and right powerhouses will be completed. Its power helped make possible the production of atomic fission material at Hanford, and the establishment of aluminum plants which produce about half of the Nation's output of this important metal.

As a scenic attraction, Grand Coulee Dam draws one-third of a million visitors each year. Its waterfall is more than twice the height of Niagara Falls.

Banks distinguished himself in four additional capacities of high executive calibre, while the building of Grand Coulee Dam was underway. These include a period as Acting Administrator for the Bonneville Power Administration, as Regional Director of Reclamation for the Pacific Northwest, as United States member of the International Committee on High Dams, and as United States representative on the International Columbia River Engineering Committee. The respect he commands is one of his outstanding attributes.

Banks chose to complete the Grand Coulee Dam as the culmination of his life's ambition, over a number of offers to move away to regional or high Washington, D. C., offices.

The pioneer blood in him belies his birthright in the staid New England setting. Born in Saco, Maine, on December 4, 1883, he was the descendant of two centuries of Yankee forebears—merchants, lumbermen, and fishermen.

He learned his love of water tending the knock-about sailboats of wealthy Easterners, and he has never lost it—either sailing his own 34-foot cruiser, the largest private boat on Grand Coulee's 151-mile reservoir, Franklin D. Roosevelt Lake, or building dams.

Banks' citation reads, in summing his 44-year career for Reclamation:

"While little the Department of the Interior does can add to or detract from the autobiography that Frank Banks wrote in steel and concrete and dams across the valley of the Columbia, which will aid the Nation as long as water runs downhill, this citation is tendered in recognition of his service to all the people."

Streams of the great Columbia empire are dotted with dams, like the footsteps of a towering Bunyan who strode across the basin. Engineer Banks, who contributed more than any one man to any one water system in the history of the world, declares:

"There is only one feeling comparable to the thrill of seeing these great dams rise in the mountains and on the plains. That is the thrill of watching the thousands of people fulfill an American dream, as they move into their new homes on the soil." THE END

FRIEND OF PRESIDENTS—Engineer F. A. Banks with President Franklin D. Roosevelt on October 2, 1937, as the President inspected the progress of the Grand Coulee Dam which he had visited on August 4, 1934, to mark the start of construction. President Truman visited the Dam on June 9, 1948, and again on May 11, this year, which marked the formal dedication ceremonies. Above, President Truman and Frank Banks, inspecting the plaque which the President has unveiled in honor of Franklin D. Roosevelt during the dedication ceremonies held on May 11, 1950. With this visit, Banks played the role of Presidential host for the fourth time, during his 17 years at the Dam. *Photo by J. D. Roderick, Region 1 photographer.*

Watch Hungry Horse Grow

AT THE VISTA POINT last year's visitors crowded the shelter built on the side of the canyon to "superintend" the construction of the world's fourth largest concrete dam. This year, the scene should be even more interesting. *Photo by A. E. McCloud, Region 1 photographer.*

by

JACK CRISWELL, Chief, Special Services Division, Hungry Horse project, Mont., Region 1 (headquarters at Boise, Idaho)

In 1950, Hungry Horse begins to take shape.

Construction of this big multiple-purpose Bureau of Reclamation project on the South Fork of the Flathead River in northwestern Montana, featuring the biggest concrete dam now being built in the world, has swung into high gear after the winter shut-down.

In the two construction seasons that have passed since the first construction blast reverberated between the steep canyon walls on July 10, 1948, General-Shea-Morrison, prime contractor, has completed the big job of excavating more than 1,000,000 cubic yards of earth and rock in preparing bedrock foundations for the dam and powerplant, and has erected one of the most efficient and up-to-date concrete production plants ever developed.

Climax of this first phase of the tremendous job of constructing the world's third highest (564 feet) and fourth largest (3,000,000 cubic yards) concrete dam came on September 7, 1949, when the first bucket of concrete was placed in the base of the dam. Racing against time, G-S-M placed a total of 59,554 cubic yards of concrete last fall before cold weather halted concrete operations for the winter.

But all of this work was preliminary to the main job. Even the concrete placed last year was considered more in the nature of a test run to work the "bugs" out of the plant facilities and operating procedures.

This year, however, is different. The preliminaries are over; the main event is underway. Mix and pour, mix and pour—day and night, 24 hours a day, 7 days a week, the big 8-cubic yard buckets swing out over the canyon and deposit their loads of concrete in the dam rising in the river chasm. Goal for the year is 1,000,000 cubic yards of concrete. With the construction schedule calling for placement of 5,000 to 6,000 cubic yards each day, the dam will rise approximately a foot a day and will reach a height of about 270 feet above lowest bedrock by the end of the 1950 construction season.

Heart of the big construction job is the 139-foot high, 10-sided concrete mixing plant anchored 350 feet above the river on the right canyon wall just downstream from the dam. To this hub of operations endless streams of sand, gravel, cement and pozzolan flow on belt conveyors to be mixed into concrete. The mixing plant incorporates the most automatic equipment and is so arranged that one operator controls the entire sequence of operations from automatic weigh batching of the raw materials through dumping of the mixed concrete from the plant's five 4-cubic-yard mixers. Maximum capacity of the plant is 400 cubic yards per hour.

Upstream from the site of the big multiple-purpose dam, logging and clearing contractors are driving hard to finish the gigantic task of clearing the 23,500 acres that will be flooded by the Hungry Horse Reservoir. Of the original estimated 70,000,000 board feet of timber in the reservoir area, approximately 23,000,000 board feet remained by March of this year.

More than 570,000 ties, enough to build 180 miles of main line railroad, have been cut from timber removed from the reservoir. If all of the 70,000,000 board feet of timber being removed from the reservoir were processed into lumber, there would be enough to build 14,000 five-room houses.

When the dam is completed, it will back the waters of the South Fork into a 34-mile-long lake, 3½ miles wide at the widest point, with a storage capacity of 3,500,000 acre-feet.

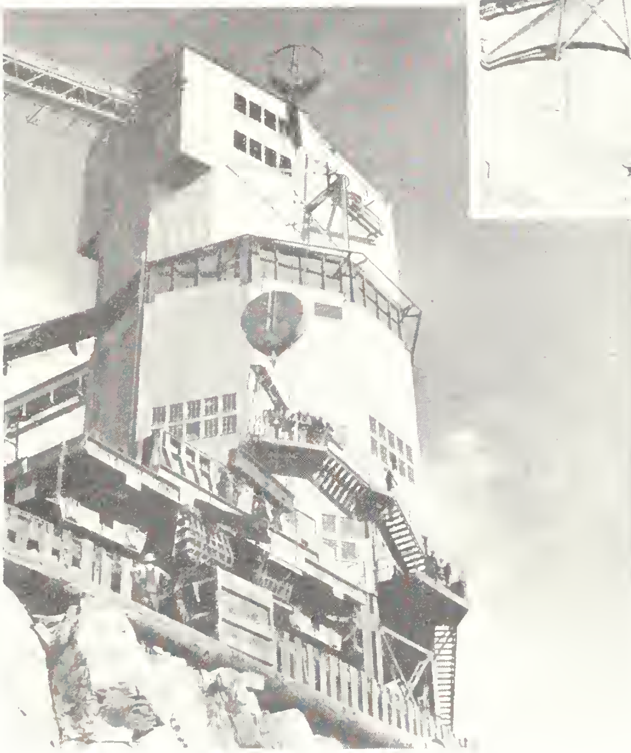
By the time the Hungry Horse project is completed in November 1953, the mixing plant will have turned out enough concrete to build a 20-foot highway from Seattle to San Francisco and back—the equivalent of an 80-pound piece of concrete for every man, woman, and child in the United States.

Deep in the bottom of the canyon a short distance downstream from the dam is a thundering bedlam of construction clatter and other noises. Here, in the five-story aggregate processing plant, pit-run material, hauled by truck from the 110-acre aggregate site at the junction of the South Fork and main stem of the Flathead River 5 miles from the dam, is washed and screened into four sizes of gravel and three sizes of sand. A model of efficient, automatic operation, the aggregate screening plant is one of the most flexible ever built. Arrangement of the plant makes it possible to divert any size aggregate through either a jaw crusher, a cone crusher, or a rod mill for reduction to smaller size to correct deficiencies in the pit-run material.

Sharing the spotlight with concrete placing work this spring is another important construction operation—installation of the first sections of the huge penstocks which will feed the four 105,000-horsepower turbines to be installed in the Hungry Horse power plant. Approximately 1,800 feet of heavy steel pipe up to 13½ feet in diameter will be embedded in the dam to form the four penstocks.

Since the Hungry Horse power plant will supply the first large source of new hydroelectric capacity for the power-hungry Pacific Northwest, construction of the dam and power plant has been set up on the tightest possible schedule.

MIX AND POUR, mix and pour—24 hours a day, 7 days a week. The big 8-cubic-yard buckets swing out from the 139-foot-high concrete mixing plant anchored high on the canyon wall to drop their 16-ton loads of concrete into the dam. At the right can be seen stockpiles of graded sand and gravel, which are located over recovery tunnels. Below is the "heart" of Hungry Horse construction—the ten-sided concrete mixing plant.



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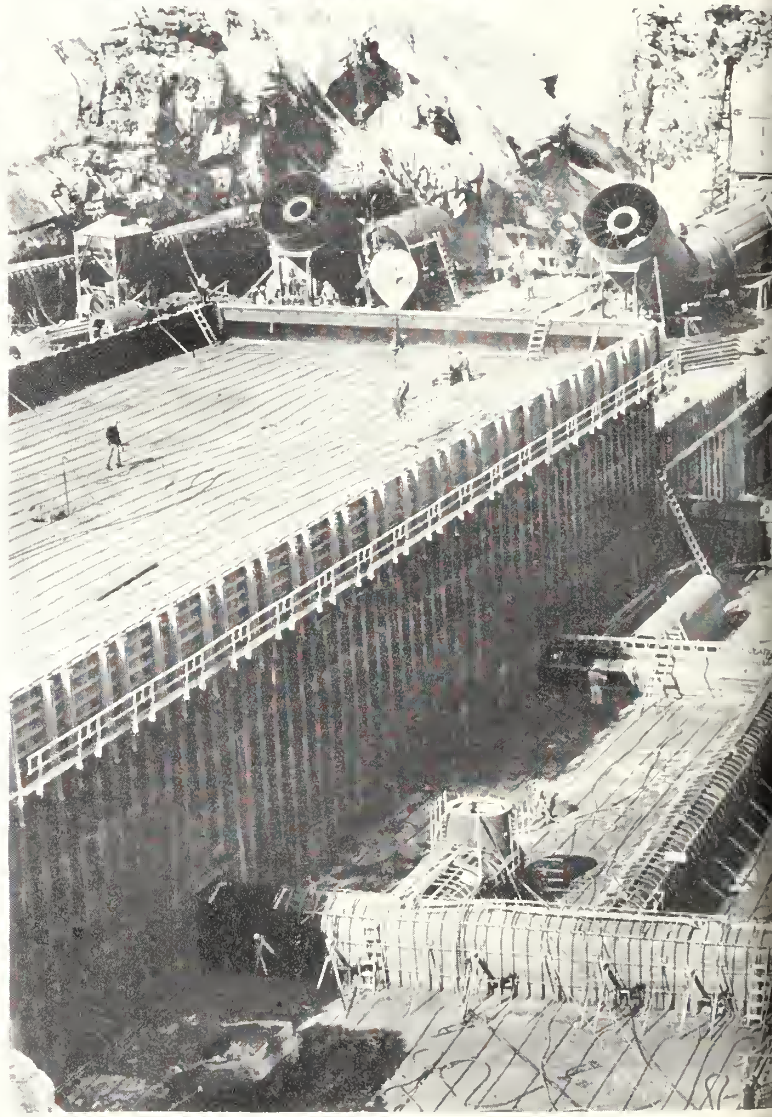


Present plans call for storage of 1,000,000 acre-feet of water by the spring of 1952, with the first 71,250-kilowatt generator to go on the line in October 1952. The plant's four generators with a combined capacity of 285,000 kilowatts are scheduled to be available by November 1953.

Complicating factor in the tight schedule set for construction of the Hungry Horse project is the bitterly cold winter weather which cuts the construction season to 7 to 8 months. During the past winter, temperatures at the project dropped as low as 40° below zero, and 2 to 3 feet of snow blanketed the dam for much of the winter season. Construction activity during the winter months was limited to excavation of two fault-zone-treatment shafts under the base of the dam, calyx hole drilling and repair and maintenance of equipment and plant facilities.

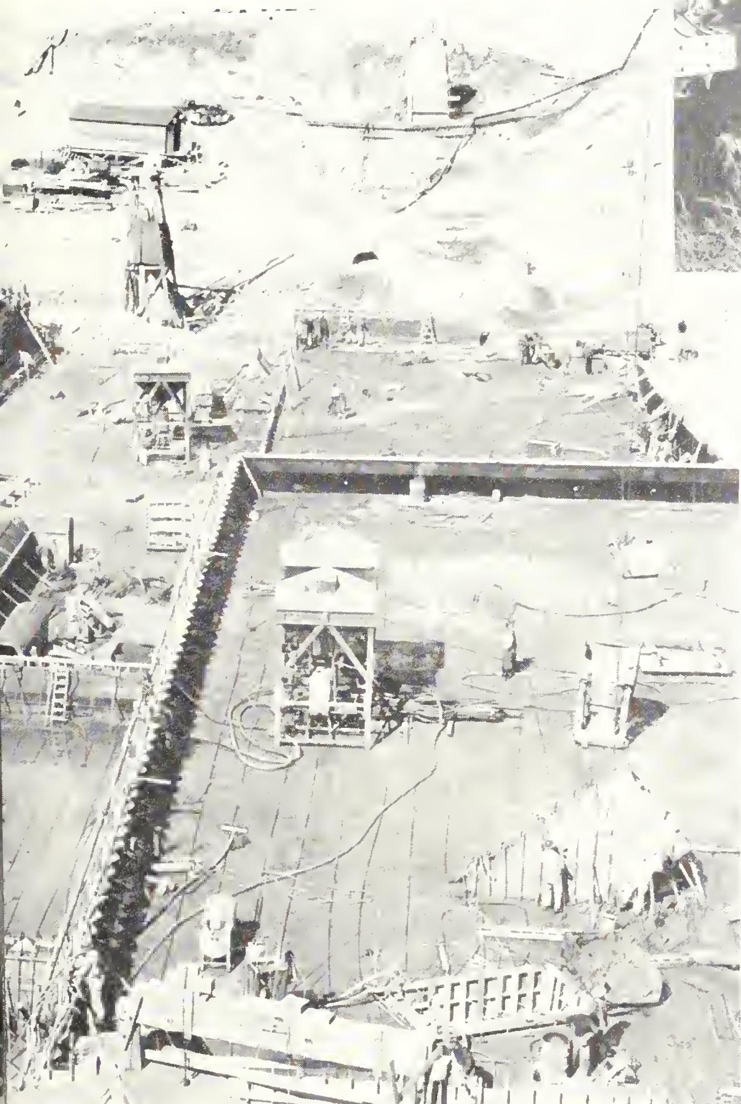
But as soon as spring came again to northwestern Montana, a small army of workmen once more began turning the quiet wilderness canyon into a seething cauldron of activity. Block on block the huge concrete barrier that will harness the South Fork of the Flathead River is rising between the steep canyon walls. Yes, this is the year. Watch Hungry Horse Dam grow.

In charge of operations at the project for the Bureau of Reclamation is Construction Engineer Clyde H. Spencer, a veteran of more than 30 years of service with the Bureau. Spencer came to Hungry Horse from the Deschutes project at Bend, Oreg., where he was resident engineer and construction engineer for 9 years. Assisting him at Hungry Horse are David S. Culver, assistant construction engineer; E. J. "Jake" Niemen, field engineer; and Charles F. Palmetier, office engineer.

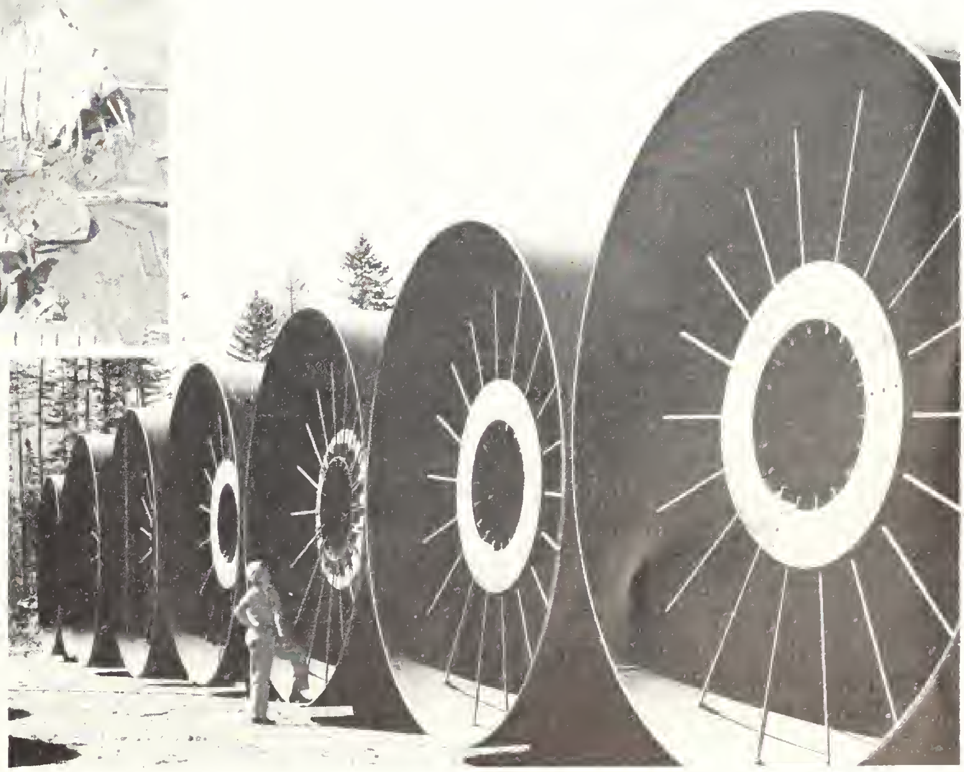
C. W. "Smoky" Wood is project manager for General-Shea-Morrison. Mel Hord is assistant to "Smoky." R. W. "Dick" Jones is chief engineer, and Dave Henderson is office manager.

THE END

OF CONCRETE during the 1950 construction season is the scene below, taken this spring, the snow has not completely could not be poured until April 8, and then only by using to 18 inches thick from the blocks poured last fall. When ed, late in 1953, nearly 1½ miles of galleries will be buried ord structure. The photo below shows forms in place for the of the dam. Shown in the background are the first sections iameter penstocks.



FOR FUTURE IRRIGATION of the Flathead Valley where farmers are progressive, as indicated by the photo above, showing modern farm equipment used to dig and sack potatoes, now one of the major crops of this area. Specialty crops would be possible through irrigation, and preliminary studies indicate that it may be economically feasible to irrigate approximately 43,000 acres of land near the city of Kalispell. Low-cost power from Hungry Horse Dam will be available for pumping water to the land, and excess revenues from the sale of power can be used to assist the farmers in repaying to the Federal Government that portion of the cost of bringing water to the land which is beyond their financial ability to repay.



FOR LOW-COST POWER these big 13½-foot-diameter penstock pipes are now being installed to carry water from the reservoir to the four 105,000-horsepower turbines to be placed in the powerhouse. Each penstock will be 426 feet long, and with the generators operating at maximum capacity and penstock gates wide open, 80 tons of water will pass through each turbine every second.

All photographs by A. E. McCloud
Region 1 photographer

THE W. C. AUSTIN PLAN — PART 3

PROBLEMS OF OPERATING AN IRRIGATION PROJECT IN A SUB-HUMID AREA

by PRESTON GEORGE, Irrigation Operations Supervisor W. C. Austin project, Region 5 (headquarters at Amarillo, Tex.)

ACE IN THE HOLE is the pull-type ditching machine (top left), when weeds and rank-growing grasses get out of hand in the ditch channels. Above, weed burners made in the Bureau of Reclamation shops also are used to keep weeds under control. Note "C"-shaped pipes which serve as runners and nozzle outlets. Both photos by F. S. Finch, Region 5 photographer.

Farmers on the W. C. Austin project keep an eye on the weather.

On this 5-year-old irrigation development, in southwest Oklahoma, an average of 26 inches of rain falls each year. When you figure that 14 inches or less is the annual average for about two-thirds of the irrigation projects built by the Bureau of Reclamation, you can see why the operation and maintenance methods which we have developed over a long period of years to fit drier climates, must be revised considerably to suit Oklahoma's 50,000-acre project.

However, this 26 inches of rain cannot be depended upon to fall when it is needed. The summers are generally long and hot, with drying winds, and occasional, but infrequent, cool periods. The winters are short and mild, with brief cold snaps common.

There is a comparatively long growing season, due to the rather low altitude of the project—from 1,250 to 1,500 feet above sea level. This is higher than the Yuma and Gila projects in Arizona, but much lower than most Reclamation developments. Generally speaking, the lower the altitude, the longer the growing season.

Spreading a supply of water over a project like this during the irrigation season to fill in the gaps left by delinquent rainfall, is no easy matter.

Fortunately, the W. C. Austin project's storage reservoir is relatively close to the irrigated land—unlike the situation at the Tucumcari project in New Mexico where the water is carried 40 miles before it gets to the fields. At Austin the headgates of the dam are only about 4 miles from the first division structure. When the gatetender reduces, increases, or shuts off the flow of water, the farmers don't have to wait long to see the results. With this advantage in being able to adjust the flow of water quickly to meet the frequent changes in the farmers' demands, a great deal of waste is avoided.

Another advantage which the W. C. Austin farmers have over older projects is the modern design and construction of the distribution system. A majority of the structures are of concrete and steel, long lasting and economical to maintain. The system was purposely designed so the canals and laterals could carry a larger per-acre supply of water than most other reclamation projects. This feature also makes it possible to deliver water immediately when the farmers, vainly pinning their hopes on a rain that doesn't fall, delay irrigating until crops definitely need water, and in a hurry.

Drue W. Dunn, extension irrigation specialist for the State of Oklahoma, a native of the irrigated section of Idaho, paid this tribute to the design and execution of the engineering features of the distribution facilities: "From a practical standpoint, the W. C. Austin project is well designed and constructed. The structures, measuring devices, operating roads and canals are of the most advanced design that I have ever seen; this makes for easier and cheaper maintenance than those constructed on older projects."

The distribution system consists of the Main Canal, with a capacity of 1,000 cubic feet per second, leading from the storage dam to a point 4.2 miles distant where the Lugert-Altus irrigation district begins. A total of 52 miles of canals and 218 miles of laterals carries the water from the reservoir to the individual farm units, and measuring devices have been installed so the water going to each farm can be measured at or near the point of delivery.

In spite of advance knowledge of the unusual problems which would likely be encountered, and notwithstanding the design of the irrigation system to aid in the solution of those problems, several situations have been difficult and vexing, and sometimes expensive to solve.

Establishing and training an operation and maintenance organization, composed largely of local persons unfamiliar with irrigation, was quite a problem in itself, and the farmers served with water were, almost without exception, inexperienced in irrigation farming. However, with all of these initial handicaps the use of irrigation water to supplement nature's rains has mushroomed like an Oklahoma oil boom. It is a tribute to the hard work, determination and cooperation of all concerned that the land actually irrigated jumped from nothing to 35,000 acres in only 4 years.

One of the first problems we tackled was a natural conflict between the desire of all concerned to hold waste and loss in the distribution system to a minimum, and the desire of each farmer to receive a rate of flow and time of starting delivery which best suited his convenience. Complete fulfillment of either desire would work a hardship on the other; therefore the solution of the problem can only be a compromise.

The need for irrigation water is very sensitive to weather changes. Strong hot winds following a cloudy period produce a marked increase in the number of irrigation requests, while cloudy skies with a rainy appearance make a noticeable reduction in the number of requests. Sometimes the rain starts to pour down suddenly while the irrigation water is being delivered. When that happens, farmers, ditchriders, and crewmen rush to close the headgates, and the gatetender at the dam shuts off the flow.

The wide variation in demand from week to week is not well-adapted to continuous delivery, and it is difficult to maintain the canals and larger laterals at their normal operating levels under such conditions without wasting large quantities of water when the demand is light.

The available supply is sufficient to allow an average of about one acre-foot of supplemental water per acre per year. Capacity of the distribution system is such that continuous operation of the Main Canal at only one-half of capacity would use up the average year's water supply in less than three months.

This is the operating procedure we developed. Water runs are made, when needed, at weekly intervals in the summer, and at intervals of two weeks in the spring and fall. Between runs, the check structures are adjusted to maintain the water level in the canals at the proper height for the next run. Farmers are required to make their water requests in advance of each run so that the flow in the various canals can be predetermined. This method has proven workable but a search for a better method is continuing. It seems likely that continuous operation may be used during periods of heavy demand after the project is more fully developed.

Hard rains cause problems other than the need to halt irrigation runs immediately. Silt, dead weeds, and trash come into the canals through many of the drainage inlets. Gullies are washed in the slopes of the ditch banks. Sometimes water is trapped on the uphill side of a canal. This floods a farmer's field, and the water must be drained away. In a subhumid climate all fertile land is farmed, even when it is too high to irrigate. To add to these difficulties, a good soaking rain makes the operating roads so muddy that ditchriders find it difficult to get about during these crucial times.

The immediate treatment for canal banks, which are subject to gullying by rains, is to make sure that the bank tops slope to the outside. Thus water falling on top of the banks will cut gullies in the outer slopes of the canal banks. The outside slopes can be built up and reshaped easier than the inside of the canal prism. Long range treatment indicates the need to seed the slopes to low growing native grasses.

The biggest maintenance problem in a subhumid climate probably is keeping rank weed growth out of lateral channels. On projects where ditches are kept full of water during most of the irrigation season, land weeds do not get a chance to grow below the water line. But as cited previously, the laterals on this project often are not in use. Plenty of moisture from rain and occasional irrigation runs, plus warm temperatures, can soon produce a growth of weeds which could cut the capacity of a small lateral to almost nothing, and reduce the capacity of a large lateral by as much as 75 percent.

We fought weeds inside the ditch channels with truck-mounted weed burners, using Diesel oil as fuel, although we believe that a clean high-gravity crude oil, if available, would be cheaper and possibly more effective. Burning units are of conventional design, consisting essentially of a fuel tank, an engine and pump for propelling the fuel to the burner nozzles, and a pivoted boom equipped with nozzles at

(Please turn to page 142)

MODERN DESIGN AND CONSTRUCTION reduce the extent of some of the operating problems on the W. C. Austin project. The photo at right shows a radial gate as it was being installed in 1946 at the West Canal Check. Photo by R. M. Reynolds, Region 5 photographer.

TRAPPED! Tumbleweeds are sliding down the wires, forced to make a detour into the weed trap "basket" on the main Conchas Canal.

TUCUMCARI TUMBLEWEED TRAP

by RAY J. LYMAN, Project Manager, Tucumari Project, Tucumcari, New Mexico, Region 5 (headquarters in Amarillo, Tex.).

EDITOR'S NOTE: Any reader who is interested in receiving complete drawings of this weed trap, showing details of installation, may obtain them by sending a request to the Project Manager, Tucumcari Project, Tucumcari, N. Mex.

FOR MANY IRRIGATION FARMERS and project maintenance crews, Russian thistles, often glorified by radio crooners as "tumbling tumbleweeds," are a pain in the back—and pocketbook.

Although the growing thistle is a pestiferous enemy of farmers and their crops, its troublesome ways survive the killing frosts of autumn. When fall comes upon the land, the thistle is released from the soil that nurtured it. Propelled by wind, the thistle travels many miles back and forth across the countryside, distributing its seed with every bounce until it becomes trapped before some insurmountable object. There it remains until it, too, returns to the soil from whence it came or is burned by an irate farmer.

In many western areas, these obnoxious, spherical-like itinerants each winter clog irrigation check structures, culverts, siphons, spillways and delivery gates, and frequently obstruct straight sections of canals.

Removing multiple tons of thistles from irrigation structures before they cause damage to the water delivery system or interfere with normal operations is a costly process. On the Tucumcari, N. Mex., irrigation project, it is estimated that the annual cost of combating accumulations of tumbleweeds averages $25,000 for the 300 miles of main canals and laterals.

In the enduring struggle to thwart the thistle menace on irrigation systems, both from weeds lodging in the canals during the winter, ready to ride down with the first run of water, and also from those blown in during the irrigation season, several types of weed traps have been designed and constructed on Bureau of Reclamation operated projects, with varying degrees of cost and success. A trap designed and constructed on the Tucumcari project has proved so beneficial that additional ones are now under construction.

During a severe windstorm on the Tucumcari project in 1947, a huge quantity of thistles, estimated at several boxcar loads, became jammed in an 11-foot diameter siphon on the main canal. This created a serious situation. A break in the canal at this particular point might have resulted in damages amounting to as much as $50,000, including erosion of farm lands, roadways, and the cost of repairs to the irrigation system. Fortunately, however, to avoid the possibility of a costly break in the irrigation ditch above the siphon, design and construction engineers had previously installed an automatic spillway immediately above the siphon. Thus, on that spring day in 1947, when the tumbleweeds blocked the canal, a break in the system was avoided. The dammed-up water was released as it reached the danger point.

Although this particular weed invasion did no damage to the irrigation system, the thistles had to be removed from 800 feet of siphon. In this instance, water service was delayed 10 days. A delay like this during the regular irrigation season could be very costly for project water users.

No feasible method has been devised to completely prevent a project invasion by tumbleweeds despite the fact that maintenance crews do make every effort to keep them under control. A completely cleared ditch system may become filled with the weeds in a matter of hours, for the windblown thistles travel great distances, across roadways, and over fences.

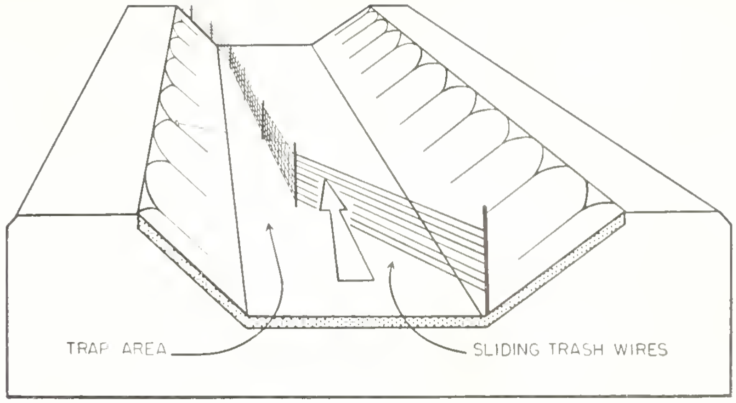
When the tumbling thistles strike water, they become half submerged and float along with the current until they reach some obstacle in the irrigation system. Then they brew real trouble for maintenance crewmen.

Faced by this problem, Tucumcari project engineers devised a weed trap in 1948 that caught the thistle but was not completely successful. This trap contributed to canal bank erosion—a hazard almost equal to the problem it was expected to eliminate. Moreover, three shifts, each of eight men, were required to operate the trap for several days and nights at the beginning of the irrigation season. Additional help was required to dispose of the accumulated weeds.

But project engineers were undaunted. They developed a new type weed trap in 1949. Victory appears to be in sight. This latter model has been so effective in controlling floating weeds that several more traps of the same design have been installed for use in the 1950 season.

The trap is very simple and relatively inexpensive, consisting of straight, smooth wires strung four inches apart across the ditch at an angle of not greater than 20° with the embankment. These are stretched taut and held parallel in a vertical plane from a few inches above the water surface to half the depth of the water. Iron posts or piling securely anchored sustain these wires at either end. The lower end is located at the inside toe of the embankment several feet out in the water from the bank. From this lower end, a mesh or hogwire enclosure extends parallel to the embankment downstream any desired distance, providing a pocket or trap for the weeds. They glide along the wires into this trap and are carried to the lower portion of the trap by the current.

To remove the accumulation, the project engineers have constructed a wide fork with tines a foot apart and about 18 inches long which can be operated from a dragline boom somewhat like a clamshell bucket. Or the fork can be mounted on a "dipper stick" type boom. In this manner the weed accumulation is quickly removed at one-tenth the cost of hand labor. Project personnel believe weed-control costs may be reduced as much as 50 percent on their main canals and 15 percent on the lateral system by general use of this type of weed trap. The cost of installation for labor and material is estimated at $175 per trap on a 24-foot canal and as low as $50 for a 10-foot ditch. THE END



TRAP—as designed and constructed on the Tucumcari project in New Mexico. Drawing by Graphics Section based on project's design.

Part-Time Columbia Basin Farms Available

Fifty-six part-time farming units totaling 138 acres, in the Burbank pumping unit of the Columbia Basin project, Wash., will be made available for purchase by the Bureau of Reclamation in the next few months. This is the first time in the Bureau's history that part-time farms have been offered for sale.

These units will range in size from 1½ to 5½ acres and are intended to provide part-time farming opportunities and suitable homesites at moderate costs for purchasers who have other means of employment in the area. Each small unit can be used for a home site and a small garden, while the larger units offer opportunity for a little more extensive farming. None of these units afford a livelihood in themselves.

A special irrigation water distribution system, constructed of concrete pipe laid under ground with valve-type turnouts for each part-time unit, assures a steady water supply. Complete details will be available in the public announcements. For information write to the Supervising Engineer, Bureau of Reclamation, P. O. Box 308, Ephrata, Wash.

Applications for purchasing the first block of Burbank pumping units, all full-time farms, comprising 13 units and totaling 678 acres, were closed on June 17. ●

E. J. Utz Becomes Assistant Commissioner of Indian Affairs

Ervin J. Utz, former Bureau of Reclamation Chief of the Land Use and Settlement Division of the Branch of Operation and Maintenance, was appointed Assistant Commissioner of the Bureau of Indian Affairs, United States Department of the Interior, on June 15.

Prior to his association with Reclamation in 1946 he served as a county agricultural agent and held important positions with the War Relocation Authority and the Soil Conservation Service.

As Chief of the Land Use and Settlement Division in the Bureau of Reclamation, Mr. Utz spearheaded the greatest postwar land opening program in the Bureau's history. Among some of the land openings conducted under his guidance were Tulelake in Oregon and California; Shoshone—Heart Mountain, and Riverton in Wyoming; and the Yakima-Roza in Washington. Over 800 farms, representing more than 75,000 acres, have been made available to veterans through this program. ●

How Much Is Your Farm Land Worth?

Karl Harris, an irrigation engineer with the Soil Conservation Service and the Arizona Agricultural Experiment Station has written a booklet called "Factors That Give Value to Land or Basic Land Values." E. S. Turville and Charles Hobart, soils specialists for the Agricultural Extension Service, in a recent issue of "Arizona Farmer" said, "Karl has given the matter of soil physics a really practical farm application * * * nothing like it has ever come along before."

In next month's issue, the ERA *hits the high spots* of his new, and distinctly different, method of how to judge the value of land.

First Year at Mancos

JACKSON GULCH RESERVOIR, looking southeast from the north side of the reservoir. Outlet Canal at far right. *Photo by Lyle Eldredge, Region 4.*

JACKSON GULCH DAM IS BEGINNING TO PAY OFF.

Increase in all 1949 crop yields—ranging from 16 percent for barley to 300 percent for corn fodder—attributable to first storage water from the newly completed Mancos project in Southwestern Colorado, have greatly encouraged project farmers confronted with the task of repaying nearly 1 million dollars of construction costs.

Approximately 9 years in the building, Jackson Gulch Dam was completed late in 1948 and dedicated July 3, 1949.

In his dedicatory address, Clifford H. Stone, director of the Colorado Water Conservation Board, touched on the concern of the Mancos Water Conservancy District regarding project benefits versus costs.

"No doubt," he said, "most of those who will benefit from this project will have the burden of paying for it. Many have doubted the need and wondered whether it was worth the high cost. You may have seen these costs soar and wondered whether, after all, it justified such trouble and expense. I think that there is little chance that it will not pay out."

Judge Stone then rationalized some difficulties (since taken care of satisfactorily) encountered by the Bureau of Reclamation in patching a leak in one abutment of the dam foundation, and warned the farmers, "We cannot take this year as typical of the service which this project will give. We must remember that a project is not just built for this generation. It is built to be the bulwark of sound economy in this community. The cost of it cannot be counted in dollars, for its benefits cannot be counted in dollars. There will be benefits which our children's children will enjoy."

In spite of the leaking abutment, first irrigation water was delivered to the farms in July shortly after the dedication, and judging from results recorded in the 1949 official crop report, Judge Stone's fears for the first year of service by the project were unfounded.

Here are some of the figures:

12 percent increase in total crop value.

12 percent increase in crop values per acre.

33 percent increase in oats yield per acre.

45 percent increase in wheat yield per acre.

109 percent increase in corn fodder yield per acre.

Per acre crop values jumped from $28.74 to $32.25 during the first year storage water from Jackson Gulch Reservoir was available.

Total crop values on comparable acreages gained from $185,574 to $208,248.

A comparison of the various crop yields on Mancos project lands for 1948, the last year prior to availability of project water, and for 1949, the first year with project water, follows:

Per-acre crop yields with and without Mancos project

Crop	1948	1949
Barley	33.2 bushels	38.3 bushels.
Oats	31.7 bushels	42.3 bushels.
Wheat	22.2 bushels	32.1 bushels.
Alfalfa	1.7 tons	1.9 tons.
Other hay	.9 tons	1.6 tons.
Corn fodder	2.2 tons	4.6 tons.

Mr. Ira E. Kelly of Mancos, president of the Mancos Valley water conservancy district, believes that the increased yields definitely resulted from the late-season storage water made available last summer for irrigation, even though "we had a long run of adjudicated water—something that seldom happens."

Mr. Kelly was asked frankly if he felt that storage water from Jackson Gulch Reservoir accounted for the improved yields shown in the crop report, or if the bumper crops might not have resulted regardless, due to improved stream flow during 1949. On April 24, 1950, Mr. Kelly wrote this answer:

"I have talked to several people who are enthusiastic about the benefits from water from Jackson Gulch Reservoir, and I shall be glad to pass on what a few have told me.

"Mr. Kenneth Summers of Mancos said that the water made 2,500 bushels of oats that otherwise would have made very little.

"Mr. Lloyd Doerfer had fine yields in hay and grain.

"Mr. Albert Gilliland feels that his pastures were greatly benefited by the extra water, thereby increasing feed for his dairy stock, as well as range cattle.

"I had the best grain and hay crop I have had in many years, in fact I had a good second cutting of hay which has been very rare these past few years. I am sure there are many others who would be glad to tell you of the benefits they had derived from the additional water.

"There is no doubt in my mind but that the reservoir water will be the salvation of the Mancos Valley as time goes on."

The Mancos project, located in the vicinity of Mancos, Colo., was authorized on October 24, 1940, under the Water Conservation and Utility Act to provide irrigation water for 8,200 acres of land, and a domestic water supply for the town of Mancos and for the Mesa Verde National Park.

Initial construction work on the project utilized labor and funds of the Works Progress Administration and the Civilian Conservation Corps. When these agencies were discontinued during the war, labor was furnished by a Civilian Public Service Camp under the Selective Service System. In July 1946 bids were opened for the completion of Jackson

BIG DAY AT MANCOS—July 3, 1949, when water was released from Jackson Gulch Reservoir into the Outlet Canal. A year later, the increases in crop yields brought about by the use of irrigation water justify the faith of the Mancos Water Conservancy District in the project. ***Photo by Lyle Eldredge, Region 4.***

Gulch Dam, inlet and outlet canals, and a contract was awarded in April 1947 to the Vinnell Co., Inc., Alhambra, Calif. Work under this contract was completed in December 1948. Prior to awarding the contract, about $600,000 had beed expended for construction to that point, bringing the total estimated cost of the project to $3,939,000.

Jackson Gulch Dam is an earth and rock fill structure 180 feet high, 1,900 feet long, and containing 1,988,000 cubic yards of embankment. It creates a reservoir of 10,000 acre-feet capacity.

About 9,000 acre-feet of storage water is available for irrigation, the remainder to be utilized by the town of Mancos and the Mesa Verde National Park, for municipal and domestic purposes. Protection of fish life is also assured by an inactive storage pool.

The reservoir, an offstream site, is filled by an inlet canal 2.5 miles long, 250 second-foot capacity, which diverts surface water from the West Mancos River. Stored water released for irrigation is returned to the stream for downstream distribution to project lands via a 1.9 mile-long outlet canal of 200 second-foot capacity. THE END

HOWDY STRANGER

(Continued from page 126)

a small group. Then there were often local farmers who also came in to meet the new settlers.

The local newspaper carried a story each week of the group meetings and picked up some side lights on the new settlers. It told about William O. White of Chicago, Ill., who had spent 41 months in a Japanese prison camp and Vincent H. Schiltz of LaCrosse, Wis., who brought his bride of 3 days with him to select their future home. These stories made it clear that history was in the making in the community. A new generation of soliders turned farmers were here to become friends, neighbors and homemakers.

After the luncheon, individual homesteaders met in turn with the examining board according to their priority numbers. The qualifications of each were verified and the first available unit on his selection list was awarded to him. The examining board cleared up questions not fully answered in the group discussion and made sure that a homestead would fill the needs, desires and temperament of each veteran and his wife. Members of the board pointed out that homesteading is no job for the fainthearted. They told the newcomers if they were to succeed, they must be willing to endure hardships and discouragements for the first year or two. However, each new settler was assured that hard work and good management would reward him, his wife and family with a farm and home of their own where there would be plenty of irrigation water, good soil and climate to make for a sound agricultural enterprise.

When the interviews ended the settlers left with a clearer understanding of the job ahead. They were grateful for frank and friendly answers to their many questions, and the interest the people of the community had taken in them and their problems. Surely they will long remember the day their new careers were launched, with the knowledge that they had come to a place full of promise, where good people were on hand to welcome them. THE END

W. C. Austin Plan—Part 3

(Continued from page 137)

its end for applying the flame to the weeds. Each nozzle is mounted on the end of a short length of pipe bent in the shape of a letter "c." The oil, preheated before coming out of the nozzles, seems to make a hotter flame; wind does not blow out the flame, and the nozzle pipes act as sled runners so that the nozzles can be operated very close to the ground without danger of gouging into the earth. Good control has been obtained by scorching young green weeds with this equipment several times each summer.

In 1949 the use of a spray of sodium salt of 2,4-D was tried on young weeds. Results were good and considerably less costly than burning. The use of 2,4-D spray is being increased in 1950. Equipment for burning is also used for chemical spraying. Troublesome grasses, especially Johnson grass, are not damaged by 2,4-D spray and they are scarcely affected by burning. An attempt to control these grasses by use of fortified oil spray will be made this summer.

When weeds and rank-growing grasses get out of hand in the ditch channels, our ace in the hole is a pull-type ditching machine. It is very well adapted to cleaning the smaller laterals. Pulled by crawler-type tractors, mounted on wheels, and hydraulically controlled, the V-type ditcher can easily be taken out of and returned to a lateral when structures must be passed. It can be adjusted for either a 4- or 6-foot bottom width, and is very useful in the winter for removing light deposits of silt and straightening crooked channels, as well as its summertime job of cleaning weeds and grass from the insides of the laterals.

There is, finally, the problem of holding operation and maintenance costs to a minimum, consistent with efficient operation and upkeep of the project works. A project that provides water only to supplement rainfall can be likened to a fire department. While it is not used continuously, a staff of ditchriders and related personnel must be on hand at all times so that delivery of water can be made on short notice when the need arises. Maintenance problems are probably as great, if not greater, than those encountered in a drier climate. Therefore, it is difficult to reduce the cost per acre served below that on other projects. And when the cost per acre-foot of water delivered is compared with other projects, it may seem abnormally high. However, when operation and maintenance costs are considered as insurance premiums against damage by unpredictable droughts, it would seem that the farmer's acre-foot of water per acre on a subhumid project is as valuable to him as is 3 or 4 acre-feet per acre to the farmer on an arid project.

NEXT MONTH: Joe Zinn, president of the Lugert-Altus irrigation district, gives a first-hand account of his experiences on the W. C. Austin project, concluding the series with his evaluation of the project's past, present and future.

RUFUS WOODS DIES

Rufus Woods, editor and publisher of the Wenatchee World, and generally recognized as the "Father of Grand Coulee Dam" passed away the latter part of May while vacationing in Toronto, Canada.

He was one of the early and determined pioneers. Through his eloquent editorials in his small town newspaper he finally attracted National attention to the possibility of damming up the Columbia River. While criticized at first for his idea, termed a "dream," he lived to see it become a reality, and today Grand Coulee Dam stands as a monument to Rufus Woods. He was the fourth nomination to Reclamation's Hall of Fame, published in the December 1949 issue of the Reclamation Era, a few copies of which are still available.

The Passing of William Lemke

(Continued from page 129)

himself. But Bill Lemke was more than that. Bill Lemke was a typical son of America. He represented a great segment of our country in the Midwest. He understood those people and worked for them. Their needs were his interest. He will always be remembered in the Midwest particularly in my State of Iowa for his coauthorship of the Frazier-Lemke Act."

Congressman John Rankin, Democrat, of Mississippi, said, "He was a real American. This morning I looked over the Record on a subject on which Mr. Lemke and I have voted together almost unanimously since he first came to this House. I refer to the power question, the saving of the water power of the Nation for the welfare of the American people, and extending power lines to the farmers of the country. I realize that many public men are prone to overlook the man who tills the soil. * * * That man never had a better friend in Congress than Bill Lemke, of North Dakota."

"As a member of the Interior Subcommittee of Appropriations, I had many visits with Bill Lemke about the problems of the 17 Western States in which he was so vitally interested. As I look back now I think of the many times I went to Bill Lemke for guidance and counsel in my desire to do what was right and proper for the development of the great West. The Honorable William Lemke was truly one of God's chosen people. We shall miss him. The Nation has lost an able legislator," said Congressman Ben Jensen, Republican, from Iowa.

Commissioner Straus said "Lemke's death leaves a gap in the Public Lands Committee that will be hard to fill. We in the Bureau sincerely mourn the passing of a great Reclamationist."

THE END

'Twas Midnight at Grand Valley

Not 12 minutes past noon, on April 27, 1950, but 12 minutes past midnight, was the time when the Grand Valley No. 3 tunnel was "holed through." (See "The Grand Valley Rescue" on page 105 of the June 1950 issue.) This could never have happened in the Army or Navy—then the telegram with the latest information to meet our deadline would have read 0012, and no question possible.

Front-End Loading Scoop

Why not use a fork lift to handle sand and gravel?

The answer to this question was worth $50, and a certificate of honorable mention, to two Bureau of Reclamation employees.

Delbert B. Anderson and Harry F. Flack, working in the Research and Geology Division at Denver, Colo., received $25 each and the certificates for their ingenuity, plus their enterprise in submitting their solution to the problem to the Interior Department Suggestions Committee.

At the Reclamation Engineering Center in Denver, Colo., sand, gravel, cement, and other loose materials are tested and classified. Reports on their suitability for construction, or other purposes are sent all over the country and even abroad. Giving this material the fine-tooth-comb treatment means that men with shovels and trucks are kept busy transporting the loose materials from place to place.

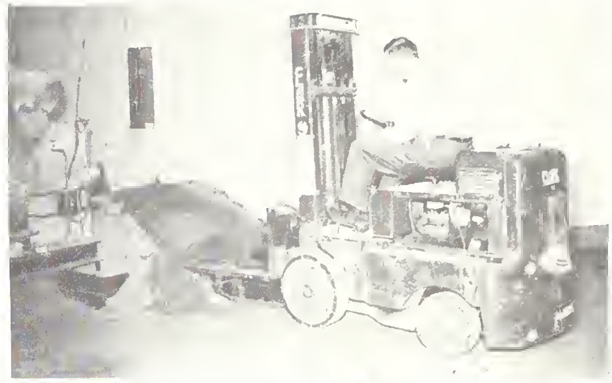
Anderson and Flack noticed the fork lifts used at the Center for handling crates and other solid materials—and changed the fork into a scoop.

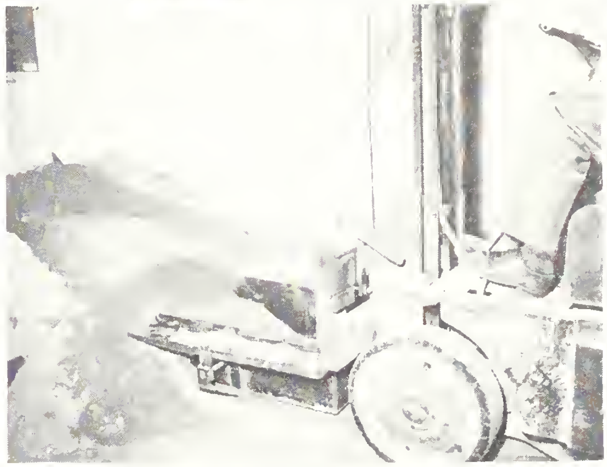
Out of scrap material which cost the Government actually nothing, they made the scoop, which looks like the body of a wheelbarrow, and bolted it between the tines of the fork, as shown in the accompanying photos. They placed the pivot point just behind the center of gravity of the scoop, and designed a catch strong enough to hold the load in a horizontal position. To unload the scoop the catch must first be released. The weight of the load then tips the scoop forward, and dumps the material. As soon as the load is dumped, the scoop automatically swings back to its horizontal position. The counter-balanced handle on the catch then snaps the catch forward and the scoop is ready to be loaded again. Remove one bolt, and the scoop can be removed from the fork lift. There are no moving parts or springs on the loading scoop to cause trouble, and it is a simple matter to attach the scoop again by replacing the bolt.

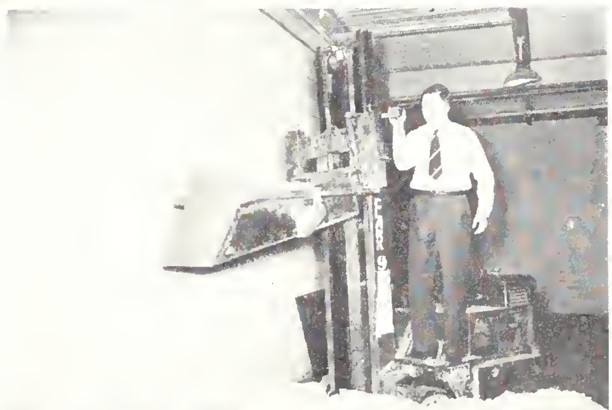
Anderson and Flack designed this scoop to make further use of the fork lifts in use at the Center, thus saving about $2,500—the cost of an expensive front-end loader. In addition, they figure their invention will save about $1,000 a year. With the front-end loading scoop, one man can do the work of three men with shovels. This saving is based on the amount of time the loading scoop is used in Denver.

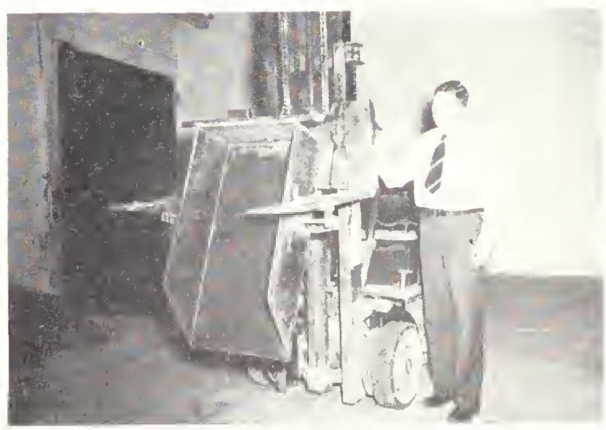
Although Anderson and Flack designed the scoop to "expedite the handling of materials in their preparation for the preliminary investigation of available materials to be used in proposed Bureau of Reclamation projects and for further studies of materials in present Bureau structures" anyone who owns a fork lift could probably make it do double duty by fixing up a similar scoop on the machine. This idea might come in handy for warehouses and packing plants, or the suggestion might be adapted to other types of forking machines. If any of our readers want more information, write to Anderson and Flack. They will be glad to help.

The End

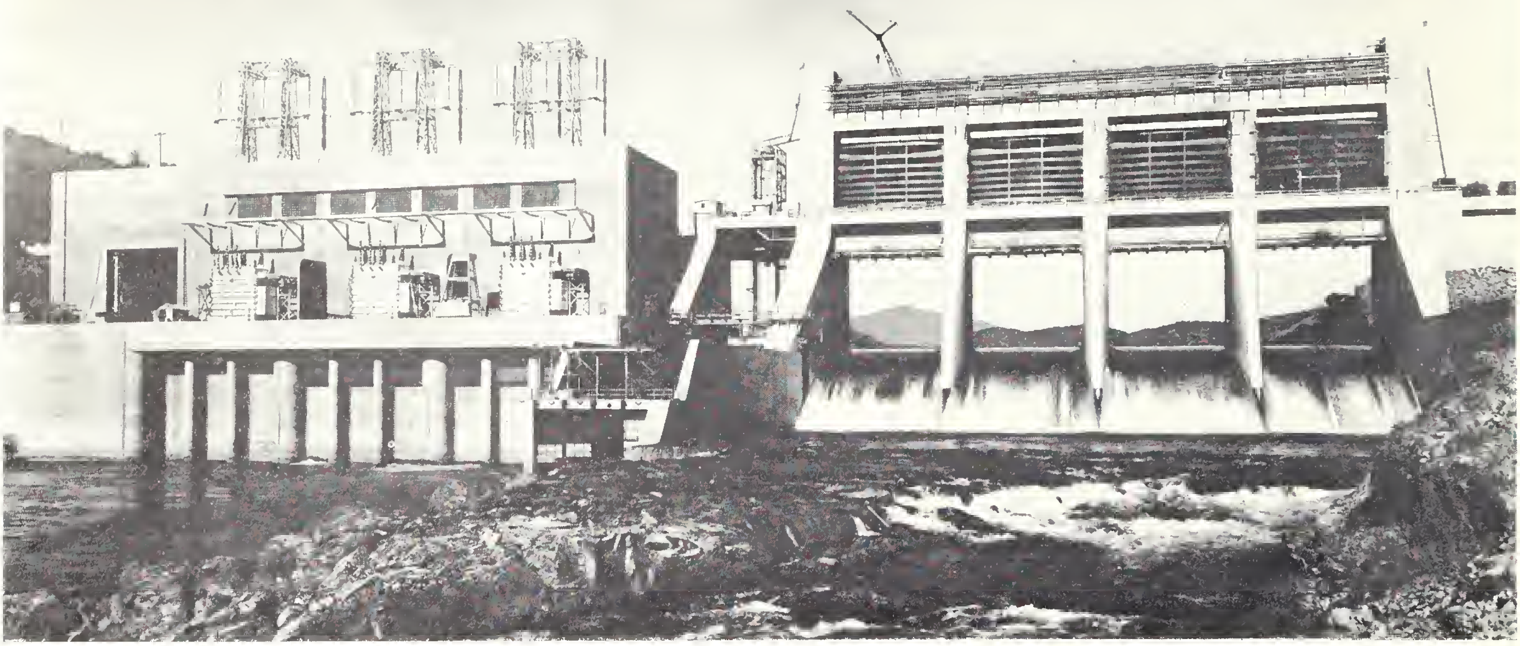








FROM FORK TO SCOOP—at top, the converted front-end loading scoop during a loading operation. Below, a close-up of the scoop digging in. Next, raising the scoop for dumping, and at bottom, the scoop in the dumping position. When the catch is released, the scoop will swing back into a horizontal position, ready for another job.



FROM THE LEFT BANK, looking upstream, Central Valley project's Keswick Dam. Photo by Ben D. Glaha, Chief Photographer, Region 2.

KESWICK DAM'S LAST GENERATOR GOES ON THE LINE

When the third and last hydroelectric generator went into service at Keswick Dam on March 31 it marked the completion of Central Valley's presently planned power installations. It also marked the completion of the dam and the filling of the reservoir behind it. A contract for constructing the base at Keswick Dam was awarded early in 1941, but like most other wartime projects construction was delayed because of the manpower, material and priority shortages.

The 25,000-kilowatt generator which brings the Central Valley installed capacity up to a total of 450,000 kilowatts was officially placed into service by Representative Clair Engle of Redbluff, Calif., who gave a long distance signal to Bureau employees at the dam to start the generator. He called from Assistant Secretary of the Interior William E. Warne's office in Washington, D. C., during a ceremony which was attended by Reclamation Commissioner Michael W. Straus.

Keswick Dam, located 9 miles downstream from Shasta Dam, the key feature of the Central Valley project, catches the water released from Shasta power plant and spillway. Keswick Dam thus serves as a second "regulator" of the Sacramento River, and as a producer of electric energy. This is called "afterbay regulation," by Reclamation engineers.

The power developed at Keswick and Shasta Dams is now available from the Central Valley project for the farms, homes, and industries of California. This power is a major factor in the continued growth and progress of the area which it serves, where large blocks of hydroelectric power will be used to pump project water, help alleviate California's shortage of electrical energy, and assist in repayment of irrigation costs. Flood control, municipal water, recreation, protection against salt-water intrusion and other measures are included in the over all Central Valley project plan.

The End

NOTES FOR CONTRACTORS

Contracts Awarded During May 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2928	Colorado-Big Thompson, Colo	May 18	One 40,000-kilovolt ampere synchronous condenser with control equipment for Beaver Creek substation.	Elliott Co., Jeannette, Pa	$289,553
[illegible]	Central Valley, Calif	May 2	Two 25,000-pound, two 5,000-pound, and three 15,000-pound radial-gate hoists for White River check, White River wasteway, and equalizing reservoir control structure, Friant-Kern canal, items 4, 5, and 6.	Pacific Coast Engineering Co., Alameda, Calif.	15,820
[illegible]	Columbia Basin, Wash	May 8	Twenty carrier-current line traps for Grand Coulee power plant	General Electric Co., Denver, Colo	32,000
[illegible]	Missouri River Basin, Wyo	May 18	One control board for Thermopolis substation, schedule 1	Kirkhof Electric Co., Grand Rapids, Mich	21,505
[illegible]	Central Valley, Calif	May 17	Constructing foundations and erecting steel towers for 67 miles of Artois-Madison 230-kilovolt transmission line, Shasta-Tracy lines 1 and 2, schedule 1.	Erickson, Phillips, and Weisberg, Oakland, Calif.	369,587
[illegible]	do	do	Stringing conductors and overhead ground wires for 67 miles of Artois-Madison and 56 miles of Cottonwood-Artois 230-kilovolt transmission lines, Shasta-Tracy lines 1 and 2, schedule 2.	L. H. Leonardi Electric Construction Co., San Rafael, Calif.	294,988
[illegible]	[illegible], Idaho	May 2	Construction of Lime Creek bridge for relocated reservoir road Anderson Ranch dam.	C. B. Lauch Construction Co., Boise, Idaho.	17,560

NOTES FOR CONTRACTORS—Contracts Awarded During May 1950 (Continued)

Spec. No.	Project	Award date	Description of work or material	Contractors's name and address	Contract amount
2951	Central Valley, Calif	May 16	Construction of earthwork, concrete lining, and structures for Newman wasteway, Delta-Mendota canal, schedule 1.	A. Teichert and Son, Inc., Sacramento, Calif.	$127,139
2951	Central Valley, Calif.	May 16	Construction of earthwork, concrete lining, and structures for Newman wasteway and service lateral, Delta-Mendota canal, schedule 2.	United Concrete Pipe Corp. and Vinnell Co., Inc., Baldwin Park, Calif	1,031,799
2953	Boulder Canyon, Ariz.-Calif.-Nev.	May 26	Two 250-volt battery distribution boards and three 160-volt power boards for units A3, A4, and A9, Hoover power plant.	General Electric Supply Corp., Denver, Colo.	11,981
2955	Missouri River Basin, Wyo	May 17	Construction of 100 miles of Alcova-Boysen 115-kilovolt transmission line.	J and J Construction Co., Oklahoma City, Okla.	587,110
2957	Cachuma, Calif	May 12	Construction of concrete pipelines and structures for South Coast conduit and Glen Anne wasteway.	American Pipe and Construction Co., Los Angeles, Calif.	1,582,886
2960	Central Valley, Calif	May 5	Two 60-foot by 30-foot radial gates for Delta Cross channel	Consolidated Western Steel Corp., San Francisco, Calif.	13,450
2966	Missouri River Basin, Mont	May 17	Three oil-pressure governors with pumping equipment for Canyon Ferry power plant.	Woodward Governor Co., Rockford, Ill	69,075
2969	Missouri River Basin, N. Dak.	May 26	Construction of 40 miles of Leeds-Rolla 69-kilovolt transmission line	Western Contracting Corp. and Philard, Inc., Sioux Falls, S. Dak	161,750
2970	Davis Dam, Ariz.-Nev.	May 11	Stringing conductors and overhead ground wires for 279 miles of Davis Dam-Coolidge 230-kilovolt transmission line.	J and J Construction Co., Oklahoma City, Okla.	371,581
2972	Gila, Ariz.	May 22	Construction of earthwork, canal lining, and structures for Mohawk canal and protective dike No. 1, including outlet channel.	Western Contracting Corp., Newman, Calif.	2,412,645
2975	Colorado-Big Thompson and Missouri River Basin, Colo.-Wyo.	May 12	Steel structures for Beaver Creek and Alcova substations	American Bridge Co., Denver, Colo	36,300
2976	Central Valley, Calif	May 8	Construction of earthwork for Delta Cross channel	George Pollock Co., Sacramento, Calif	175,400
2977	do	May 15	Two 165,000-pound radial-gate hoists for Delta Cross channel floodgate structure	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	28,510
2978	Columbia Basin, Wash	May 23	Furnishing and installing one electric elevator for Ephrata office building	Sound Elevator Co., Inc., Seattle, Wash.	21,815
2979	Central Valley, Calif	May 31	Constructing foundations and erecting steel towers for Sacramento and San Joaquin river crossings for 230-kilovolt Shasta-Tracy Nos. 1 and 2 transmission lines, Rio Vista-Tracy section, schedule 1.	Duncanson-Harrelson Co., Richmond, Calif.	313,563
2979	do	do	Stringing conductors and overhead ground wires for Sacramento and San Joaquin river crossings for 230-kilovolt Shasta-Tracy Nos. 1 and 2 transmission lines, Rio Vista-Tracy section, schedule 2.	Abbett Electric Corp., San Francisco, Calif.	112,667
2984	Columbia Basin, Wash	May 4	Three 5,000-ampere bus structures with current and potential transformers, disconnecting and grounding switches, and generator-protective equipment for units R7, R8, and R9, Grand Coulee power plant.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	195,433
2990	Boulder Canyon, Ariz.-Calif.-Nev.	May 17	Steel towers and stub angles for transformer circuits Nos. 1, 11, 12, and 13, Boulder Canyon switchyard.	Emsco Derrick and Equipment Co., Los Angeles, Calif.	36,611
3003	Colorado-Big Thompson, Colo.	May 23	One 69,000-volt grounding transformer for Estes switchyard	Westinghouse Electric Corp., Denver, Colo.	17,433
R1-CB-41	Columbia Basin, Wash	May 26	Grading, surfacing and utilities at Moses Lake, Wash., schedule 2	Beuter, Gralow, Mendenhall and O'Neil, Olympia, Wash.	13,676
R1-CB-47	do	May 25	Construction of 8 two-bedroom, 3 three-bedroom residences and 11 one-car garages, at Winchester, Wash., schedule 1.	Hopkins and Alexander, Seattle, Wash	72,992
R1-CB-47	do	do	Grading, streets and utilities at Winchester, Wash., schedule 2	Beuter, Gralow, Mendenhall and O'Neil, Olympia, Wash.	43,800
R1-81	Boise, Idaho	May 19	Construction of Mountain Home substation	C-L Electric Co. and Vernon Bros., Boise, Idaho.	21,092
R2-103	Central Valley, Calif	May 12	Grading and paving roads at Shasta Dam and power plant	Fredrickson and Watson Construction Co., Oakland, Calif.	249,634
R6-38	Missouri River Basin, S. Dak	May 8	Clearing part of Shadehill Reservoir	Midstates Construction Co., Chisholm, Minn.	45,806

Construction and Equipment for Which Bids Will Be Requested by September 1950

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Galvanized fabricated steel structures for switchyards and transformer circuits at Hoover power plant.
Carlsbad, N. Mex	Repairing Pecos River flume requiring lining 23,000 square feet with pneumatically applied mortar lining and repairing cracks, near Carlsbad, N. Mex.
Central Valley, Calif	Three 60,000-kilovolt-ampere, 0.9 power factor, 13.8-kilovolt, alternating-current generators for Folsom power plant.
Do	Construction of Delta-Mendota canal headworks pilot structure, near Tracy, Calif.
Do	Completion of electrical work in Shasta Dam and installation of left abutment parking area lighting, near Redding, Calif.
Do	Interior painting of Shasta Dam and power plant, near Redding, Calif.
Colorado-Big Thompson, Colo.	Two vertical centrifugal pumps, 200 cfs capacity at 172-foot head, for Willow Creek pumping plant.
Columbia Basin, Wash	Construction of eight permanent-type houses, garages and utilities at Mesa, Wash.
Do	Miscellaneous structural steel and aluminum for Grand Coulee Dam bus runway.
Do	Construction of 11-mile, asphalt-membrane lined lateral EL-20 and 8 miles of sublaterals on the East Low canal, 2 miles east of Moses Lake, Wash.
Do	Removal and disposal of the 30-mile construction railroad from Odair to Coulee Dam, Wash.
Do	Grading and paving of streets, construction of curbs, sidewalks, guard rails, and street lighting at Coulee Dam, Wash.
Do	Construction of about 2 miles of three-wire, wood-pole transmission line near Winchester, Wash.
Davis Dam, Ariz.-Nev	System map and miscellaneous electrical equipment for the dispatcher building at Phoenix, Ariz.
Do	Construction of residences at Mesa, Coolidge, and Tucson, Ariz.
Do	Six 69-kilovolt and 8 15-kilovolt oil circuit breakers; 12 69-kilovolt and 24 15-kilovolt disconnecting switches; neutral reactor; 3 161-kilovolt, 3 69-kilovolt, and 3 15-kilovolt lightning arresters; 7 69-kilovolt and 4 15-kilovolt potential transformers; 6 69-kilovolt and 2 15-kilovolt current transformers for Phoenix substation.
Do	Installing equipment and erecting steel structures for Cochise substation, 16,000-kilovolt-ampere capacity, 115- to 69-kilovolt, southwest of Willcox, Ariz.
Do	Installing equipment and erection of steel structures for ED-5 substation, 20,000-kilovolt-ampere capacity, 115-kilovolt, south of Eloy, Ariz.
Davis Dam, Ariz.-Nev.-Calif.	Supervisory control and telemetering equipment for Blythe and Drop No. 1 substations.
Fort Sumner, N. Mex	Construction of about 12 miles of concrete lined Main canal, 100 cubic feet per second capacity, near Fort Sumner, N. Mex.
Kendrick, Wyo	Construction of Hanna substation, 3,750-kilovolt-ampere capacity, 34.5-kilovolt primary voltage, near Hanna, Wyo., including constructing foundations, furnishing and erecting prefabricated control building and chain link fence, and erecting all structural steel and installing electrical equipment furnished by the government.
Missouri River Basin, Mont.	Galvanized fabricated steel stub angles for Canyon Ferry switchyard.
Do	One 375 cubic feet per minute and one 65 cubic feet per minute air compressor, one 8 cubic feet per minute portable air compressor, two 42-inch diameter by 10-foot air receivers and one 24-inch diameter by 6-foot air receiver for Canyon Ferry power plant.
Do	Two 300 gallons per minute and two 2,500 gallons per minute, deep well, turbine type pumps; one 20 gallons per minute and one 50 gallons per minute gear type oil pump for Canyon Ferry power plant.
Missouri River Basin, N. Dak.	Construction of Edgeley substation, 20,000-kilovolt-ampere capacity, 115-kilovolt primary voltage, near Edgeley, N. Dak.
Do	Construction of Forman substation, 10,000 kilovolt-ampere capacity, 69-kilovolt primary voltage, near Forman, N. Dak.
Missouri River Basin, S. Dak.	Complete package type switchyard for Angostura switchyard.
Missouri River Basin, Wyo.	Clearing about 3,600 acres of the Boysen Reservoir site, about 18 miles south of Thermopolis, Wyo.
Do	Relocation of about 4 miles of county road on south side of Keyhole Dam reservoir.
Do	Relocation of U. S. highway No. 14 at Keyhole damsite, about 15 miles northeast of Moorcroft, Wyo.
Do	Relocation of 3¾ miles of single track Chicago & North Western Railroad at Boysen Dam, 21 miles south of Thermopolis, Wyo.
Paonia, Colo	Enlargement of about 10 miles of Fire Mountain canal to 125 cubic feet per second capacity.
Provo River, Utah	Construction of a concrete terminal reservoir, 230 feet wide, 800 feet long, 30 feet deep, and 10,000,000-gallon capacity, on the Salt Lake aqueduct near Salt Lake City, Utah.
Rio Grande, N. Mex.-Tex	Construction of foundation and erection of steel structures for 2,000-kilovolt-ampere capacity, 115- to 12.47-kilovolt, unit-type Hollywood substation, Hollywood, N. Mex.
San Luis Valley, Colo	Construction of gatetender's house, garage, and facilities at Platoro dam, near Platoro, Colo.
W. C. Austin, Okla.	Construction of 4 miles of Altus canal wasteway, 120 cubic feet per second capacity, Ozark lateral wasteway, 10 cubic feet per second capacity; and 3.5-mile drain "F", near Altus, Okla

THE RECLAMATION AREA

The Reclamation ERA

August 1950

Official Publication of the Bureau of Reclamation

The Reclamation ERA

August 1950

Volume 36, No. 8

Issued monthly by

The Bureau of Reclamation

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

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

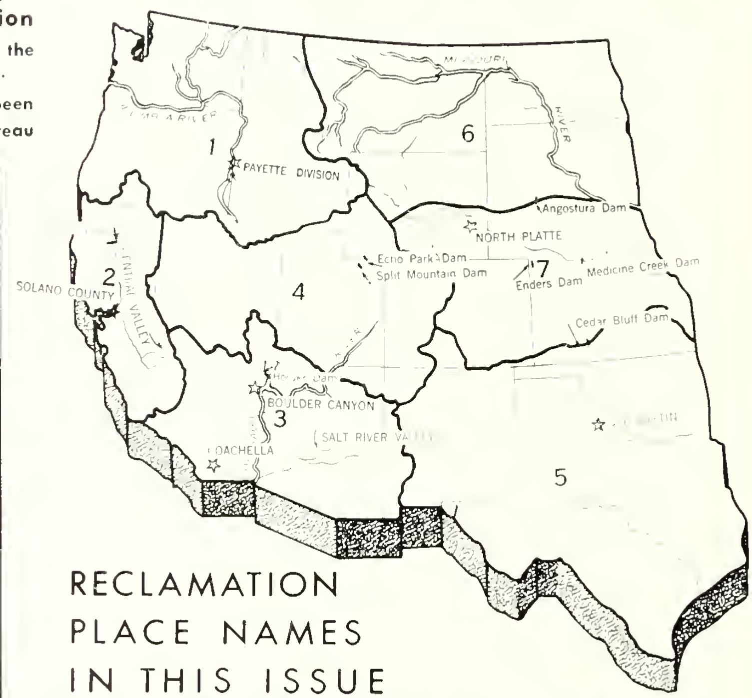
CONTENTS

FEATURE ARTICLES

SHORT FEATURES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.



RECLAMATION PLACE NAMES IN THIS ISSUE

OUR FRONT COVER

CHILI BEANS—displayed by settler W. D. Patterson, of Pasco Unit 25, Columbia Basin project, Washington. This bag of Mexican field (chili) beans is a sample of those grown on the 33 acres which are yielding about 3,300 pounds to the acre. A major in World War II, Mr. Patterson is specializing in certified seed, and also has 16 acres in Kenland clover for that purpose. For the latest in sorting beans, see "Beans on Television" on page 159. *Front cover photo by Harold E. Foss, Region 1 photographer.*

Credit where due.—Last month's front cover photograph and all the photos illustrating "Science Center," which told the story of the dedication of the Reclamation Engineering Center at Denver, Colo., were taken by Charles Knell, Region 6 photographer. Region 1 photographers H. W. Fuller and F. B. Pomeroy took the pictures of Frank Banks on pages 130 and 132 of last month's issue, respectively.

THE WHITE HOUSE

WASHINGTON, *June 8, 1950.*

MY DEAR MR. WARNE: Will you convey to those attending the dedication of Shasta Dam and the California Centennial Celebration my sincere regrets that I could not be with them?

It is most appropriate that these two events, both of which are milestones in the remarkable progress of California and its people, should be held at the same time. For 48 years—almost half of the century since California became a State—the Reclamation program, of which Shasta Dam is a part, has been contributing much to the growth and prosperity of California and our other Western States.

The dedication of Shasta signifies much more than just the completion of another Reclamation dam, spectacular though this dam is as an engineering achievement. It symbolizes the hopes and aspirations of this and preceding generations of Californians who would make the broadest, wisest use of their natural resources. It is the reward of their vision and unrelenting efforts.

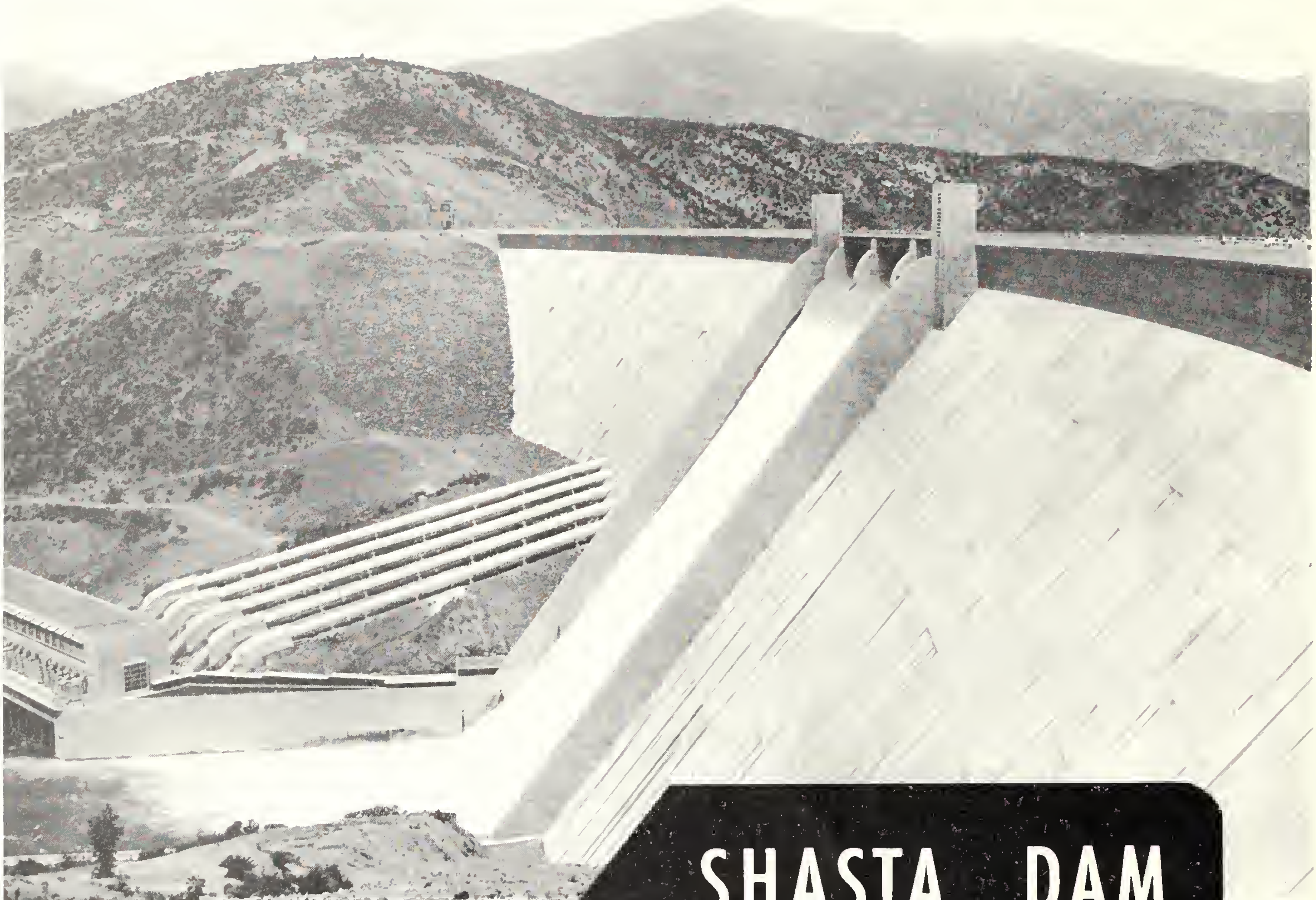
The development of irrigation, hydroelectric power, municipal water, navigation, and other uses of our water resources and the provision of flood control comprise the very foundation of progress in our Western States. In this great Central Valley Reclamation project, the people of California have found, with the assistance of their United States Government, a democratic means whereby their water resources can be fully developed and fairly shared for the widest benefit to the people.

We have made a fine beginning with Reclamation development in the Central Valley. And, we shall continue to move forward, to open up and make available increasing use of these basic resources to accommodate the continued growth and expansion of California, which in 100 years has moved to the fore among the States of our Nation, and which, I know, in its next century will not falter, but will continue to grow and develop through wise use of its abundant God-given resources and the intelligence of its people.

Very sincerely yours,

Harry Truman

Honorable WILLIAM E. WARNE,
Assistant Secretary, Department of the Interior,
Washington, D. C.



SHASTA DAM, *photo by George V. Gideon, Region 2*

SHASTA DAM DEDICATION

By WILLIAM CARAH, Region 2, Sacramento, Calif.

SHASTA DAM, CALIFORNIA—Shasta Dam, key unit of the Central Valley project of California, was officially "enlisted in the service of California and the Nation" in dedication ceremonies held before a large crowd at the east end of the dam Saturday, June 17, 1950.

Officiating at the ceremonies was Assistant Secretary of the Interior William E. Warne, who dedicated the massive structure to "the people who helped make California great."

As he finished speaking, he cut a blue and gold ribbon, and the three huge drum gates atop the spillway section of the dam rolled down. A churning cascade of water poured over the gates and into the Sacramento River below.

The occasion was the climax to the week-long Shasta Centennial Celebration, in observance of California's one-hundredth anniversary of statehood.

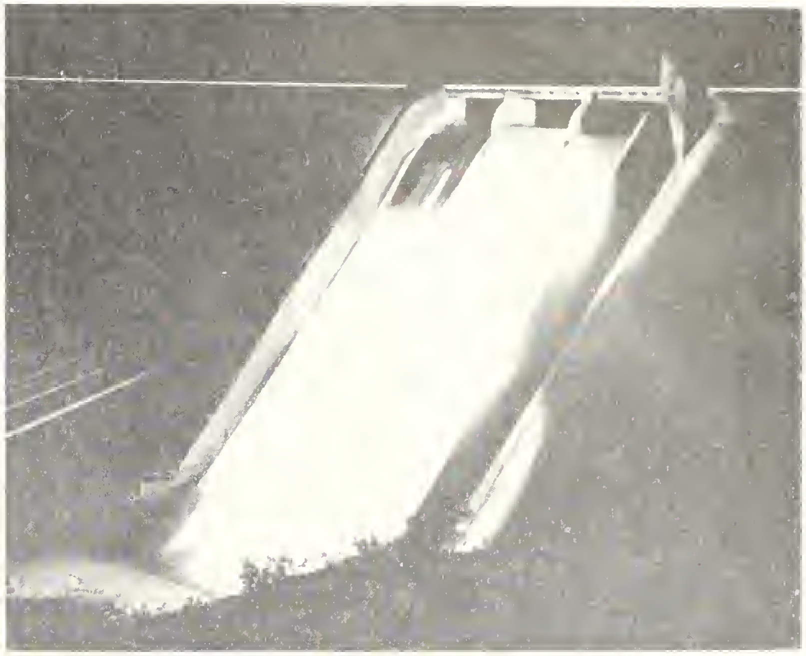
The previous evening, before 15,911 persons, an informal program was held at the dam, in which the man-made waterfall, three times the height of Niagara, was illuminated with batteries of giant searchlights.

Adding spice to the program were such entertainment stars as comedian Danny Kaye, Metropolitan Opera soprano Florence Quartaro and movie actor Leo Carillo.

A spectacular fireworks display from a barge on Shasta Lake capped the performance.

This was the moment that thousands of northern Californians, who watched the huge dam grow foot by foot, had been waiting for.

As Assistant Secretary Warne cut the ribbon, awed spectators watched the mighty cataract which symbolized precious water for use by Sacramento and San Joaquin Valley farmers.

DAY AND NIGHT at Shasta Dam. In the photo at left spectators on the spillway bridge of the gigantic dam, watching the ceremonial spill of water over the 487-foot spillway, are dwarfed by the dam's tremendous mass. Above, the 602-foot tower gives the illusion of a gigantic sliding board. *Left photo by J. D. Leeper, right photo by A. G. D'Alessandro, both of Region 2.*

For them, the event was more than a mere dedication. It meant that before long, water—most important of California's vast natural resources—would be available for the increasingly parched lands of the State's greatest agricultural area.

Already Shasta's water was being used in some sections of the State.

For 5 years power from Shasta had been in use.

But with completion of Shasta and other initial features of CVP nearing completion, farmers knew that it would not be long before their dream of sufficient water would begin to come true.

Work is under way on the Delta Cross Channel, the route which will carry water from the upper Sacramento River watershed to the huge Tracy pumping station.

This phase of the Central Valley project will be in operation in time for the 1951 irrigation season, and will deliver Shasta Reservoir water to the lower San Joaquin River.

This will permit a large portion of that river's flow to be diverted at Friant Dam into the Madera Canal and the Friant-Kern Canal.

Thus will the primary objective of the Central Valley project—that of transferring surplus water of the north to the water-deficit areas of the south—be under way.

But the dedication of completed Shasta means more than that to the agriculturists of the great Central Valley.

It means a measure of protection against damaging floods which have periodically laid waste to low lying farm lands along the Sacramento River.

It means an abundance of low cost power for agriculture, homes, and industry.

It means protection for low lying and rich Sacramento River Delta farm lands against encroachment of salt water from San Francisco Bay.

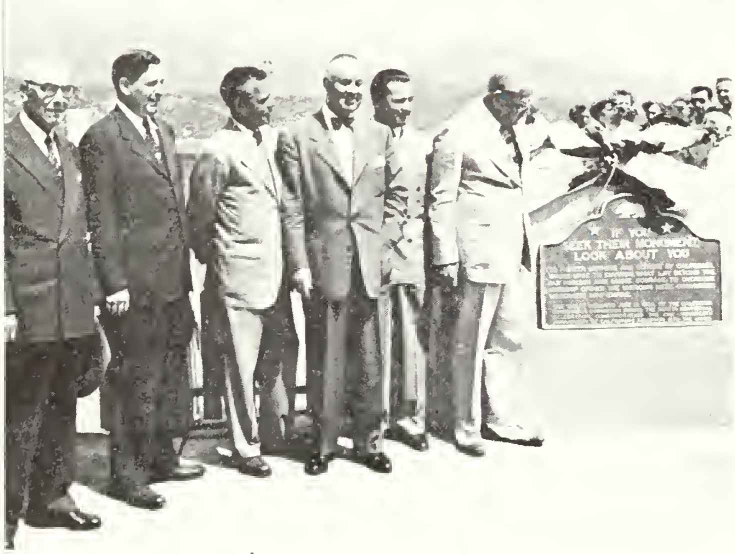
It means year-round navigation on the Sacramento, which taps one of the Nation's richest agricultural areas.

Even the water which cascaded over the dam, 487 feet to the river bed below, during the ceremonial spills was put to work before it began its journey to the parched lands of the San Joaquin.

It was caught and retained in Keswick Reservoir, 9 miles downstream from Shasta, and turned the three 25,000 kilowatt generators at Keswick power plant before being released in a constant, even flow down the river.

As Mr. Warne said, in dedicating the dam:

"The Central Valley project, as it stands today, is only



Top left: Celebrities on hand, left to right, Metropolitan Opera star Florence Quartaro; Joseph R. Knowland, chairman, California's Centennials Commission; State Senator Edwin J. Regan, and actor Leo Carrillo. Bottom left: Charles H. Purcell, California's Director of Public Works; Assistant Secretary of the Department of the Interior William E. Warne; Regional Director of the Bureau's Sacramento, Calif., office; Richard L. Boke; Senator Regan; Honorable Clair Engle of California, and Mr. Knowland. *Photos by George V. Gideon, Region 2.*

the beginning. Our goal is to help put every practicable drop of water to work creating new wealth."

He envisioned full development of the watershed of California's Central Valley.

Previous to the dedication ceremonies, the California Centennials Commission unveiled a plaque on the roadway abutment of the dam's east end, dedicated to California's pioneers.

In unveiling the plaque, Chairman Joseph R. Knowland of the commission said:

"On the State capitol at Sacramento there is an inscription reading 'Bring Me Men to Match My Mountains.' "

"Our California pioneers and those who followed have matched those mountains," he declared, pointing toward the majestic mass of Shasta, which towers 602 feet above the bedrock of the Sacramento River, and whose 3,500-foot crest spans the canyon in the foothills of the Cascade Mountains.

At the same time Mr. Warne cut the ribbon which opened the drum gates, providing the spectacular spill of water, the simple action also dropped a red, white, and blue bunting from a bronze plaque on the passenger elevator tower of the dam.

Its simple message reminded all that the full benefits from Shasta and the Central Valley project belong to all the people.

The inscription reads:

"Built By and For the People of the United States."

Echo Park-Split Mountain Dams Approved

Secretary of the Interior Oscar L. Chapman recently approved the construction by the Bureau of Reclamation of the Echo Park and Split Mountain Dams on the upper Colorado River in Utah.

In view of the demonstrated need for water in the area, he concluded that the construction of the dams which will be located on a portion of the Dinosaur National Monument area was the only solution to the problem. He explained that his decision in this particular instance was in no way intended to establish a precedent for tampering with the inviolability of our national parks or monuments, but that in this particular case he had no other choice.

The decision was made after numerous conservation and engineering authorities familiar with the area had testified as to the merits and need for the dams. The significant factor brought to the fore during this testimony was the question of evaporation. Engineering witnesses stated that any group of reservoirs on the upper basin of the Colorado River which did not include Echo Park and Split Mountain would result in increased evaporation, lower annual revenue and higher unit power costs. It was estimated that the minimum increased loss of evaporation would amount to 350,000 acre-feet of water annually. This would irrigate 230,000 acres of land or supply municipal water for a town of about one and a half million persons. •

Reclamation Crops Valued at Forty Times Federal Investment

Some cumulative crop values on older Reclamation projects amounted to 40 times the Federal investment in the projects at the final check-up on the 1949 crop results.

The Salt River project in Arizona in which the Bureau invested $17,500,000 has returned crops with a gross value of $749,000,000 since 1906. Simultaneously water users are repaying the Government investment in irrigation works for an estimated 234,000 acres of land in Maricopa and Pinal Counties.

The total crop value for 1949, $516,329,000 again surpassed the half billion dollar mark for the fourth consecutive year. The record high year was set in 1947 with values exceeding $555,420,000. The highest per acre value for 1949 was reported on the Coachella Valley in California. It reached $658 per acre. •

HOW MUCH IS YOUR LAND WORTH?

The Bureau of Reclamation's yardsticks for measuring the value of land generally agree with those of Mr. Harris. However, there are important differences in the way the Bureau measures and evaluates soil texture, depth, and other "basic factors" mentioned in the following article, which is presented here as an interesting and thought-provoking contribution to literature on this subject. Subsequent issues of the ERA will present the Bureau's official land classification standards.

WHAT GIVES AGRICULTURAL VALUE TO LAND?

The ability to produce plant growth, answers Karl Harris, irrigation engineer of the division of irrigation and water conservation of the Soil Conservation Service and Arizona Agricultural Experiment Station.

Karl Harris has had many years of experience in irrigation and the evaluation of soil-water relationships on the Salt River Valley project, and in other sections of southern Arizona. His findings are highly respected by a multitude of irrigation farmers. No day is too hot, no soil too tough—no shirt is dry on his back when Harris is digging for information. This is a summary of his informative, useful and practical ideas, which appeared as Arizona Agricultural Experiment Station Bulletin 223, July 1948, Factors That Give Value to Land or Basic Land Values. The complete bulletin is commended to the attention of ERA readers, as is the fact that Mr. Harris based his findings upon conditions in the Salt River Valley of Arizona, and all of his daring concepts may not apply to other regions.

Soil, water, and climate are the most important factors in producing plant growth, says Mr. Harris. Regardless of the climate, lands which have the most favorable water relationships have the best chance to produce crops—and the highest basic values.

The term "water relationship" includes such questions as:

1. Is water available to the land, either as rain or irrigation?
2. Can the soil absorb this water?
3. Can the soil retain this water?
4. Can the soil give up this water to feed the plants?

As you see, water relationship merely means the way water and soil react to each other and work together.

The answers you can give to these questions will help you to determine the value of your farm, for the greatest influence soils have on crop production, and therefore on land values, lies in their water relationships. There are several basic things that influence these relationships, for better or worse. So let's consider the soils, for a moment. Check the following:

1. Texture of the surface soil. (Karl Harris considers the surface soil the upper 2 feet, and the subsoil the portion below this depth. The reason for his designation being that the top 2 feet of soil may be modified by tillage operations.)
2. The type of subsoil. This is important as it indicates the amount of water under the surface soil which is available to plants.
3. The depth of soil (surface and subsoil). You need to know its water-absorbing and water-holding capacity.
4. The slope of the land. This influences erosion and water absorption.

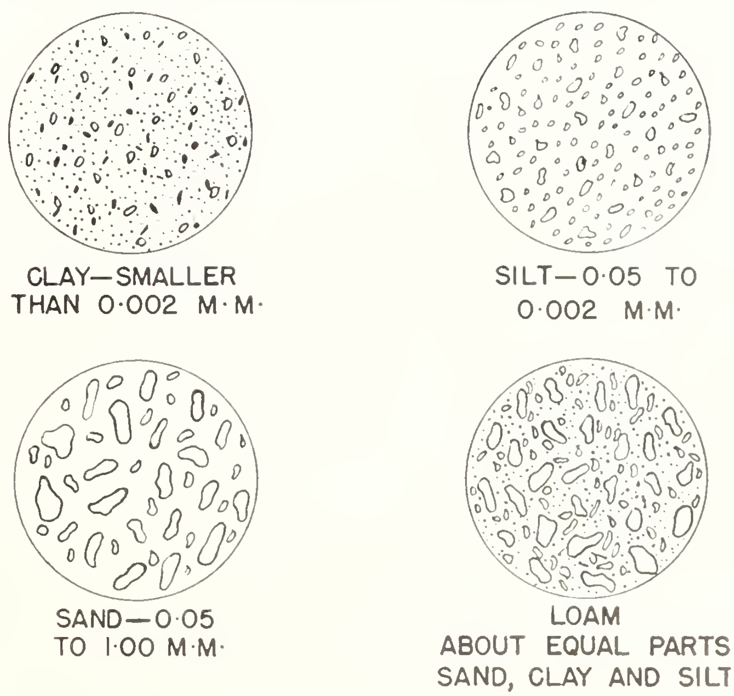
TEXTURE OF THE SURFACE SOIL. By this term, Mr. Harris means the size of the particles making up the soil. Is the soil mostly sand, silt or clay, or what combination of these simple ingredients? Soil particles range from fine gravel down to the clay which is so fine that its particles cannot be distinguished even with a powerful microscope. Most soils contain a mixture of all the different sizes of particles. If the sand particles predominate, the soil is called sand; if the clay predominates, it is called clay. The silt falls between the clay and sands. The loams are medium-textured soils; that is, they have about equal amounts of clay, silt, and sand particles. Here is the table which Karl Harris uses to determine the relative values of soil based on texture.

Relative Values of Soil Based on Texture

Loam	Fine sandy loam	Silt loam	Medium sandy loam	Clay loam	Silty clay loam	Clay	Silty clay	Coarse sandy loam	Gravelly loam	Sand
100	95	90	85	80	75	70	60	55	50	45

You will note that the loams and fine sandy loams are given the highest ratings, although Mr. Harris believes that an operator who knows how to handle the heavier types of soil, like clay loams, will produce more than he would on the lighter soils. The heavy soils require special handling, and the coarse sandy loams, gravelly loams or sands do not hold enough water and must be irrigated so frequently that their value is greatly reduced.

CHECK THE TEXTURE. The size of the particles making up the surface soil has a great deal to do with the agricultural potentiality of your land and its value for raising crops. This is figure 1 from Karl Harris' bulletin.



THE TYPE OF SUBSOIL. The subsoil (the depth below the top 2 feet of surface soil) is very important to crop production, and therefore to the value of your land, as it determines how far down the roots of the plants can grow. The best type of subsoil has good internal drainage, and at the same time can hold a sufficient amount of water to feed the plant roots. Here is Karl Harris' method of determining the relative value of subsoils:

The Relative Value of Subsoils

100—Uniform soil with 1½ to 2 inches of water-holding capacity per foot of soil.

95—Uniform soil with 1 inch to 1½ inches water-holding capacity per foot of soil.

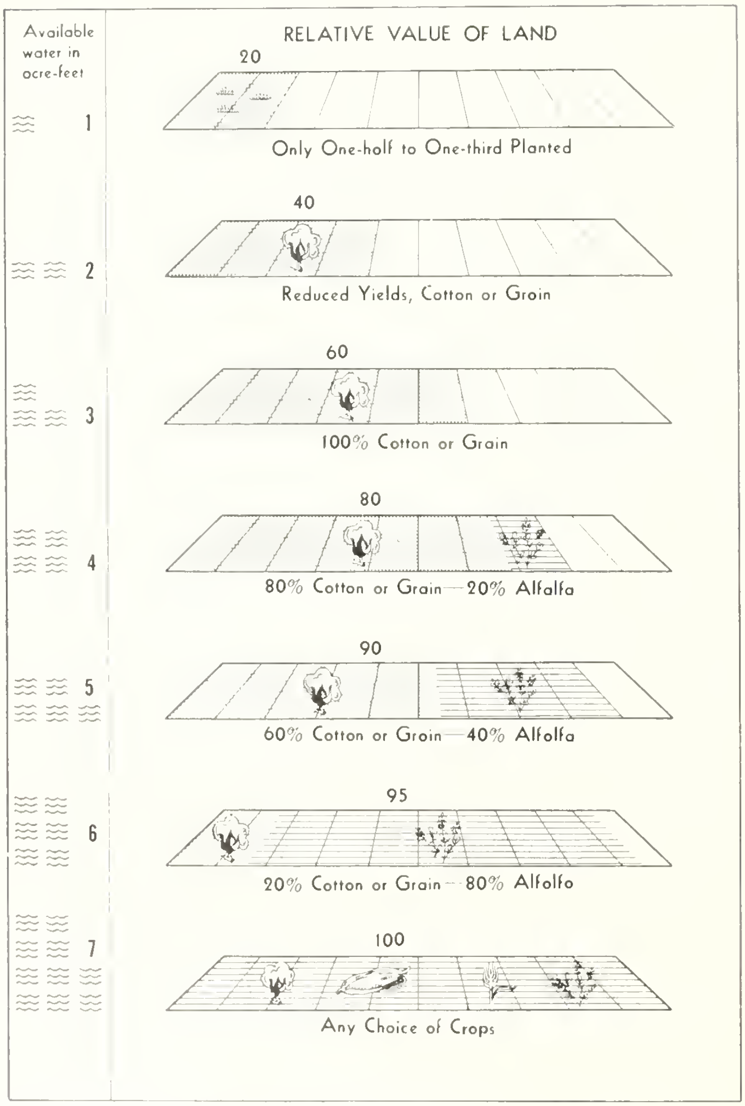
90—Soft caliche (Laveen type).

85—Caliche (Mohave type).

80—Light soil with ¾ inch to 1 inch water-holding capacity per foot of soil.

75—Caliche in hard chunks, massive but fractured (roots still able to penetrate).

70—Caliche with granite rocks (Pinal type).



HOW MUCH WATER? Karl Harris believes in plenty of it. The above drawing is based on figure 4 of this bulletin, in which he states "often in fields of the Southwest the best crops appear at the upper end of the field where the water has been on longest." This applies to the Salt River Valley of Arizona and may not be applicable to other areas.

65—Sand with less than ¾-inch water-holding capacity per foot of soil.

55—Extremely heavy clay with slow internal drainage.

50—Salty clay.

DEPTH OF SOIL. Karl Harris means by this term, how far down your soil (both surface and sub) can absorb and hold water. This also influences plant growth, and in turn, land values. Most of the annual crops will develop a 6-foot root system by the end of the season if soil conditions are favorable. Favorable soil conditions include:

1. Available moisture.
2. Air.
3. Plant food.
4. An absence of toxic material, such as excessive amounts of soluble salts.

Karl Harris' bulletin includes a table which rates soil with a depth of 10 feet at 100, 6 feet at about 85, 5 feet at about 78, 4 feet at 60; 3 feet at 40; 2 feet at 20, and 1 foot and less at zero. Mr. Harris realizes that in climates cooler than Salt River Valley, or in areas with a different cropping system, a different set of relative values would be found. In any event, regardless of climate or cropping systems, the depth of the soil should be counted as part of the value of the land.

THE SLOPE OF THE LAND. The slope of the land has a strong influence on land values, although it is probable that no two areas are affected alike. Where there is considerable organic matter in the soil, and water moves through the soil readily, increased slopes do not affect the land values as much as they do in the Southwest. In Arizona, excessive slopes are subject to erosion and present serious obstacles to proper moisture penetration, because of the high velocity of the water.

In the Salt River Valley, slopes up to 16 inches per 100 feet can be handled by using certain simple precautions. With greater slopes, the penetration problem becomes so acute that it reduces the value of the land. Mr. Harris' bulletin contains a chart attempting to show the relative value of land with various slopes. Although it will not fit conditions other than those of Salt River Valley, slope is a factor of land values in every area, and it is interesting to note that the values range from 100 for land with 4 inches slope per 100 feet, to 15 for land with 36 inches slope per 100 feet.

So much for the soils. As every western irrigation farmer knows, water is a major factor that gives agricultural value to land. Without water supplied either by irrigation or natural precipitation, there can be no plant life. Irrigation water has the greatest influence on land values in areas of low rainfall. As the rainfall decreases, the effect of irrigation water on crop production increases, as does its effect on land values. The following are the chief factors that determine the effect of water on land values:

1. Quantity of water.
2. Quality of water.
3. The time of the year this water is available.

Quantity of Water

The amount of water needed for maximum production is dependent upon the crop, the temperature, the relative humidity, the fertility of the soil, the quality of the water, and the efficiency of irrigation. The evaporation of water from a Weather Bureau pan is probably as good an indicator of the relative water requirements as any other. If there is precipitation or irrigation water equal to the evaporation, maximum yields of any combination of crops adapted to that area can be attained. If the water supply is less than the evaporation, the operator is limited somewhat in his choice of crops to obtain maximum yields.

The illustration on page 150 based on figure 4 in Karl Harris' bulletin, shows the cropping systems suited to different amounts of water, for the Salt River Valley. For any area, the quantity of water available influences the land value.

Quality of water

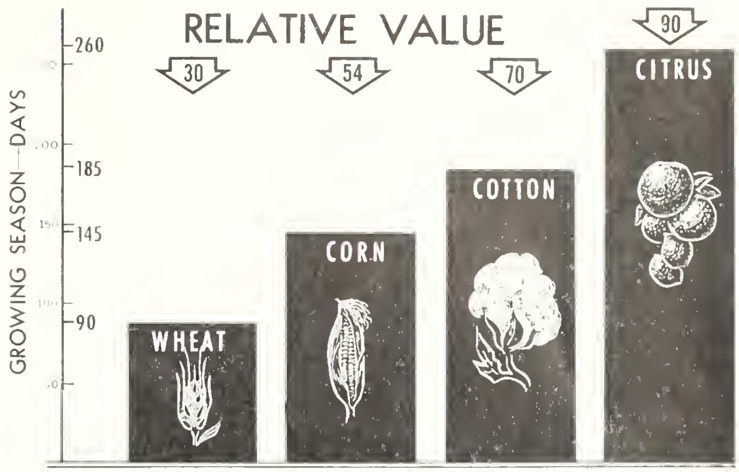
The quality of irrigation water also greatly influences crop production and consequent land values. Yields may decline as much as 25 or 30 percent before it is realized that the salt content of the irigation water is the cause of the reduction. However, the effect of salt in the water on the crop is probably subject to more modifications than any of the other factors considered so far. These qualifying conditions include:

1. The kind of salt in the water; that is, the ratio of sodium to calcium and magnesium.
2. The type of surface soil (upper 2 feet). The more open soils are less subject to damage over a long period of time than the heavier clay loam or clay types.
3. Soils that are well aggregated and less susceptible to damage than soils that are dispersed.
4. Soils that have an appreciable amount of calcium carbonate are probably subject to less damage than soils that contain only a little calcium carbonate.
5. Soils that have open permeable subsoils are less subject to damage than subsoils which do not allow the easy movement of water through them.
6. The availability of certain soil amendments (or corrections) may be a factor.
7. In case the salt content is high, more water must be used in order to prevent accumulation of salt in the soil; hence, the quantity of water available is important.

Climate as a Factor in Land Values

The length of the growing season is an important factor in that it influences the productive capacity of the land. In most of the Western States wide variations in the length of the growing season are encountered, owing to changes in elevation. In determining relative values in which the length of the growing period is the variable, the following are important:

1. If citrus can be grown, feed and vegetables can also be grown during the winter months, which permits a wide choice of both summer and winter crops.
2. If the season is long enough to grow cotton, it will also be long enough to produce a great variety of crops, with high yields of alfalfa.
3. If the season is long enough to grow corn, it will also permit the growing of any of the small grains and at least three cuttings of alfalfa.



HOW LONG? This illustration, based on figure 7 of Mr. Harris' bulletin is an attempt to show how land is evaluated when all other factors are equal and the length of the growing season is the variable, in the Salt River Valley of Arizona.

4. If the season is just long enough to grow the small grains, it will only produce low yields of alfalfa. More acres will be needed to feed a given number of livestock or people.

The illustration above, based on figure 7 of Mr. Harris' bulletin is an attempt to evaluate land when all other factors are equal and the length of the growing season is the variable.

For those who wish to go into this subject in more detail, we suggest you write to the Agricultural Experiment Station, University of Arizona, Tucson, Ariz., for Bulletin 223, Factors That Give Value to Land or Basic Land Values.

THE END

Preliminary Solano County Project Ground Water Study Completed

The Geological Survey recently released its preliminary ground water survey conducted in connection with the Bureau of Reclamation's proposed Solano County project in California.

The study was undertaken by the Geological Survey at the request of the Bureau of Reclamation which was authorized to build the project last year. The proposed development provides for the construction of Monticello Dam on Putah Creek which will create a reservoir capable of storing 1,600,000 acre-feet of water for irrigation use on 83,000 acres of of land. It will also provide water for domestic use in the cities of Vallejo, Fairfield, Suisun, and Benecia, as well as Mare Island Navy Yard, the Benecia Arsenal and the Fairfield air base.

The natural storage in underground reservoirs can be used in connection with the operation of Monticello reservoir to insure full development of the water resources of the county.

The preliminary investigation has been devoted largely to the collection of basic data, including the canvas of about 1,500 water wells, from which some 600 driller's logs were located; the assembling of 10,000 water-level measurements in 400 wells, which were made by various agencies during the past 20 years; stream-flow measurements along Putah Creek; and study of geologic features of the area. •

Author gets facts first hand from D. G. Fredricksen, owner of the Payette Hardware Store, Payette, Idaho. *Photo by Stanley Rasmussen, Region 1.*

Irrigation Goes to Town

Or

How much wealth Payette, Idaho, creates for its surrounding area as indirect benefits from irrigation

by M. E. MARTS, Region 1, Boise, Idaho

Farmers are not the only ones who benefit from irrigation.

Scattered throughout the western United States are scores of cities whose chief means of support is irrigation agriculture. Without irrigation such cities as Greeley, Fresno, Boise, Yakima, and many others would be of negligible importance—or wouldn't exist at all. The townspeople—grocers, jewelers, manufacturers, and dentists—enjoy indirectly an important share of the benefits created by irrigation projects. We should not overlook this wealth which irrigation projects contribute to the national economy. These indirect benefits must be evaluated and added to the direct benefits enjoyed by the farmers.

It is not easy to measure indirect benefits. Several people have tried to devise various methods of estimating them, but each method has its draw-backs. Surprisingly little statistical information on this important class of benefits exists, considering that a large part of the economic growth of the West has stemmed from the indirect effects of irrigation.

How large are these indirect benefits compared to the direct benefits (the income of the farmers)? How much irrigated land is required to support a town?

To answer these questions, I attempted to measure the net income earned within a local trade area. The study was sponsored by the Bureau of Reclamation, with the advice and assistance of economists from the University of Idaho. The community studied was the southwestern Idaho town of Payette (in the Payette Division of the Boise project), and the surrounding area which depends upon Payette for goods and services. This includes two small towns, New Plymouth and Fruitland. The total population of the trade area in 1940 was 11,000, of which the farm population was approximately 4,300 and the nonfarm population 6,700.

Without irrigation, the only people around Payette would be a few sheepherders, highway, and railroad workers. The area is too dry for dry farming and possesses no known mineral or timber resources. Irrigation was necessary for a local economy to develop.

With irrigation, the area supports 1,170 farms, comprising approximately 55,000 acres of irrigated land, intensively cultivated. Farms are small, the majority of them 40 acres or less, and the major crops are alfalfa, apples, prunes, potatoes, sugar beets, vegetables, and small grains.

In starting the study, first I had to find out how much the people within the trade area earned. The year 1946 turned out to be the most recent year for which data were available at the time the study was begun. I deducted the costs of operating farms and businesses, and measured net income only—the income available for family living, for food, housing, recreation, and education.

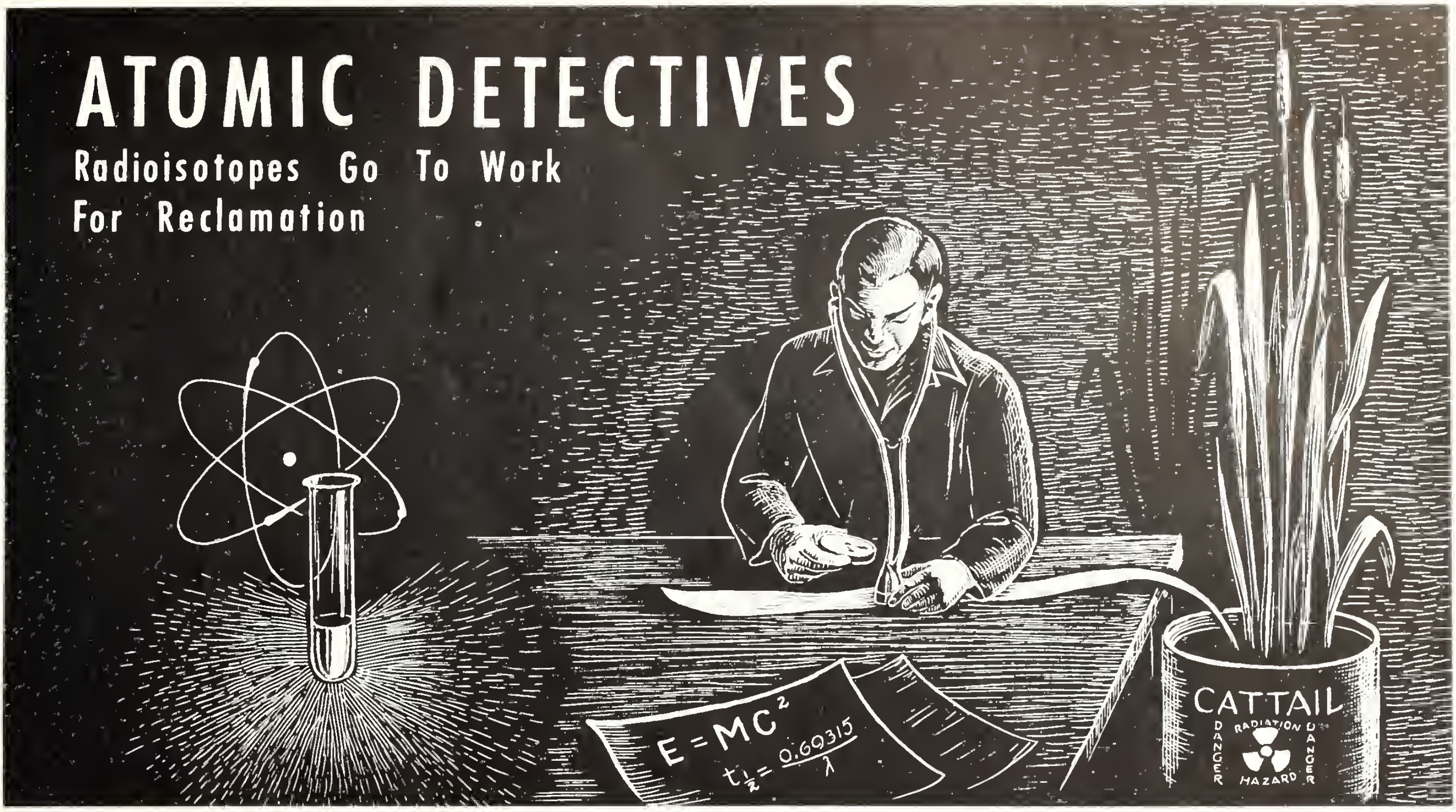
Direct benefits were fairly easy to estimate. By using census data, other statistical material, and farm budget data prepared by Bureau of Reclamation economists familiar with the area, the net farm income—the direct benefits—was estimated at $4,635,000 for 1946, an average of $84 per irrigated acre. This figure includes the net income of farm

(Please turn to page 162)

At left, Payette, Idaho, a typical irrigation-created town. Above, a view of the farming area which surrounds the town of Payette. Through irrigation only are most of such towns possible west of the ninety-seventh meridian. *Photos by Stanley Rasmussen, Region 1.*

ATOMIC DETECTIVES

Radioisotopes Go To Work For Reclamation



by Harold E. Hosticka, Physicist, Denver, Colo.

How can atomic energy be used to reduce the cost of water on irrigated farms? To make stronger and more durable concrete? To help engineers design more efficient and economical structures? And to aid in the solution of many other problems of the Bureau of Reclamation?

One way is to apply the energy released by controlled nuclear energy reactors (atomic energy plants) to the pumping of water, excavating canals, generating electric power, and many other necessary tasks. But these developments are in the future.

A more immediate and practical application of atomic energy to the solution of Bureau engineering problems has already begun. It is the use of radioisotopes, often referred to as "tagged atoms," in our research studies.

These atomic "detectives" are being put to work to aid in the solution of some of the mysteries that have been baffling the researchers in irrigation developments—mysteries in such fields as chemistry, hydraulics, soil mechanics, concrete technology, and many others. In our new laboratory, recently installed as an integral part of the research and geology laboratories in Denver, we are exploring the potentialities of this new research tool. We are laying the ground work for applying the discoveries of basic atomic research to the solution of our day-to-day problems for the ultimate beneficiaries of Reclamation research—the water users.

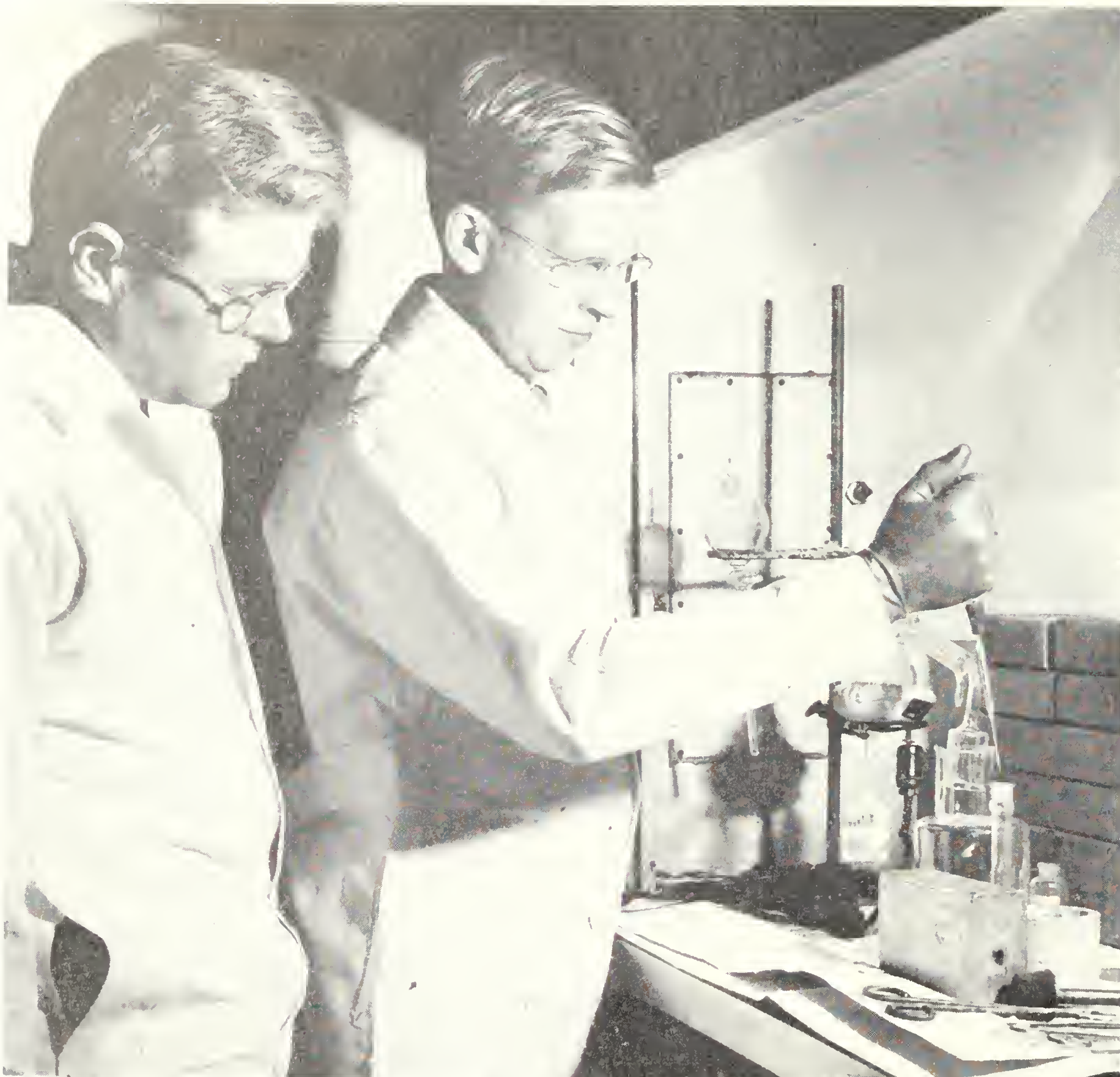
For example, cheaper water will result from better methods of aquatic weed control. But to find more effective controls, more must be learned about the way in which compounds are absorbed and how and where they move around in the structure of aquatic plants. That is a study in which radioisotopes or tagged atoms can be used to advantage.

If we knew more about how the seeds of weeds move through the systems of canals and ditches and how many carry over from one season to the next, we could better plan our control procedures. That problem can be attacked by feeding radioactive materials to the plants, thus "tagging" their seeds.

If we can more accurately locate the sources of seepage losses from canals and then line only those parts where significant losses occur, we can save millions of dollars, and tagged atoms can be used in that study. If we know more of the details of the chemical reactions that deteriorate concrete, we can improve the durability and reduce the cost of many concrete structures. Radioisotopes can assist in finding these answers.

What are these new and amazing radioisotopes? Nothing new, really. Radioactivity is as old as the universe. It is only that we have recently become aware of its existence and utility, and, more importantly, we have learned how to manufacture radioactive atoms from ordinary stable atoms.

By going back far enough it can be shown that all of the forms of energy which have been used by man have their sources in atomic energy. From the sun comes the energy that grows our food and timber and supported the living things that decayed to form coal and oil. From the sun comes the energy that transforms the water from the sea into vapor in the atmosphere so that upon returning to the earth as rain, and then rivers, it can turn our generators and produce electricity. The energy of the sun is atomic, thought to be derived chiefly from the fusion of hydrogen into helium. Part of the heat of the earth comes from nuclear reactions in the material of the earth.



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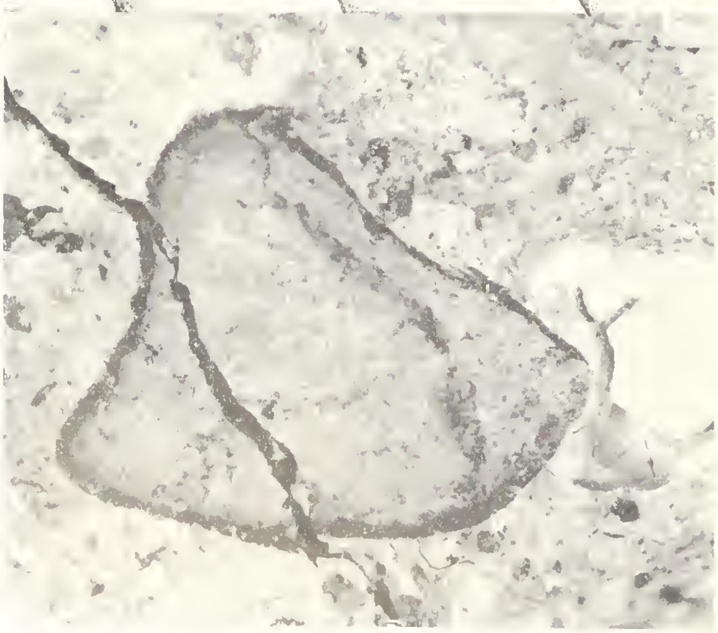


Atoms are not solid and indivisible as was once supposed, but are composed of what the physicists call particles. Some of these particles form the nucleus in which almost all the mass of the atom is concentrated and which has one or more positive charges. Surrounding the nucleus at large distances (compared with the size of the nucleus) are exactly the same number of electrons as there are positive charges in the nucleus, so that the atom as a whole is electrically neutral.

The number and arrangement of the electrons in the atoms determines almost entirely the chemical and physical properties of the material composed of the atoms.

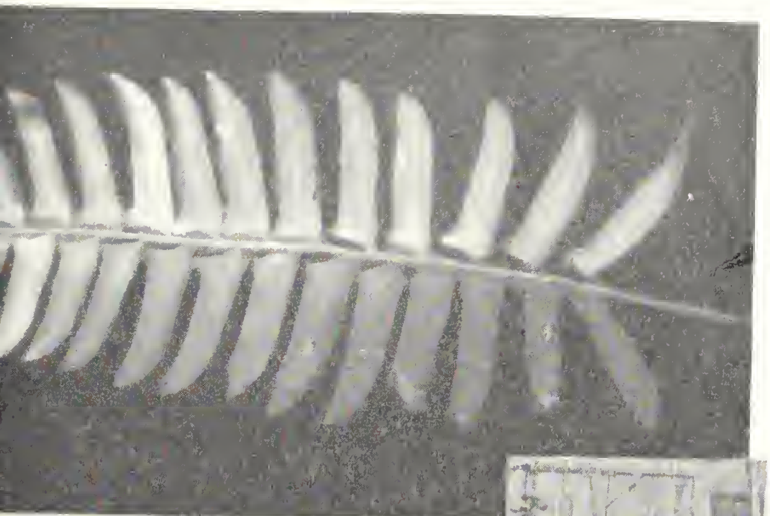
All atoms of the same element have the same electrical charge on the nucleus and therefore have similar chemical and physical properties. They may, however, have different masses. All the atoms of the same element that have the same mass are the same isotope. Some isotopes are stable and some are radioactive. Some radioisotopes occur naturally but radioactive isotopes of all the elements can be produced artificially.

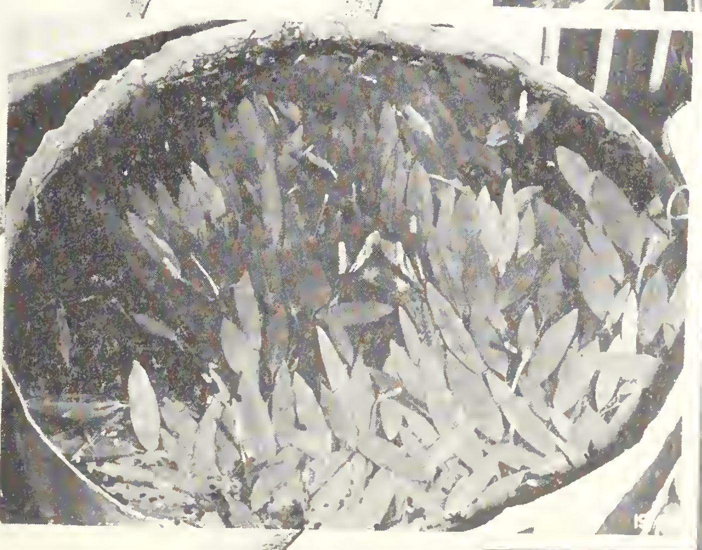
What characterizes a radioisotope is that a certain fraction of the nuclei of a radioisotope will disintegrate in a given period of time. The time for one-half of the atoms of a radioisotope to disintegrate is characteristic of the isotope and is called the "half life." Half lives can be as short as 0.0000000000000000001 second (as in beryllium mass eight), or can be as long as 6,000,000,000,000,000 years (as in tin mass 124). For use in the laboratory a half life of several weeks is usually most convenient.

Radioisotopes of many elements occur naturally and are present in our bodies. For example, each of us has about 1,650,000,000,000,000,000,000,000 sodium atoms in our bodies. Each sodium atom is exactly like every other sodium atom and is stable and as far as we know will always be a sodium atom. We have also about 2,250,000,000,000,000,000,000,000 potassium atoms in our bodies but they are not all alike. Out of each 10,000 atoms about 9,320 are all alike and stable. About 679 are like the others except that they are about 2 percent heavier, and stable. About 1 is like the others except it is 1 percent heavier and also has a 50–50 chance of disintegrating to an atom of calcium in the next 400,000,000 years, and so it is radioactive. If it survives the next 400,000,000 years it still has a 50–50 chance of surviving the next 400,000,000 years, and so on.

Since we have so many atoms of potassium in us, there are about 750,000 potassium atoms disintegrating within us each minute. When each potassium atom disintegrates, it is a

(Please turn to page 162)





K. Dr. Rex Fluharty and the author of
ms they will tackle (cracked concrete)
liograph of fern leaf. At right, E. T.
" weeds like the one inset below, at
enhouse. *Photos by L. S. Chastagner*
ge, and Denver photographers.

THE W. C. AUSTIN PLAN—PART 4

EXPERIENCES OF A DRY-LAND FARMER TURNED IRRIGATIONIST

by JOE ZINN, President, Lugert-Altus Irrigation District, W. C. Austin Project, Oklahoma

When I was asked to write about the experiences encountered to date by farmers on the W. C. Austin project in Oklahoma, my thoughts turned instinctively to the early days of white settlement in this area.

Until recently we had been dry-land farmers since Statehood. Year upon year we plowed and planted our fields and then, as recounted by Oklahoma's Senator Bob Kerr, "We prayed for rain." Occasionally there was too much rain, with resulting floods in the valley.

For many years we had worked and hoped for an irrigation project. Then, one day in 1946, some of us received our first irrigation order. With the main canal running full and the laterals delivering precious water to our lands, we knew for sure that we had bargained for a new brand of pioneering.

I was 15 months old when my father moved from Young County, Tex., to Greer County, Tex. Later, in 1896, the United States Supreme Court ruled that Greer County was in Oklahoma Territory. With the coming of Statehood on November 16, 1907, a new county (Jackson County) was formed out of a part of old Greer County. By virtue of these changes in boundary lines, I have lived in two States, one Territory, and two counties without moving from the place on which my father homesteaded in 1892.

Joe Zinn, the author.

Oklahoma today is vastly different from the land we found on our arrival here 58 years ago. Then, there were no telephones, no electricity, no highways, no school, bus or milk routes, no railroads. The nearest railhead was at Vernon, Tex., 55 weary miles by wagon freight. But we had some things of tremendous value. We had the good earth—rich and fine—as good as could be found in all the West. And we had something more—a type of pioneer citizenship that would not recognize defeat.

We often talk about our fathers. We recall how they slaved through the dry years of blazing heat. Sometimes our crops were destroyed by floods. Drought or flood, results were the same: crop failure, a scarcity of feed for the livestock; less fuel, food, and clothing, for the men, women, and children: virtual ruin.

Sons and daughters of the pioneers share memories of the past, and we are conscious of the vision, courage, and faith that our mothers and fathers had in this land which, in former times, was characterized by some as "God-forsaken." Automobiles now speed along modern highways through our verdant valley, past beautiful homes and thriving communities, a valley woven with irrigation ditches, and we are thankful for the heritage that is ours. We wonder, too, if there are men and women living today who possess the courage and determination equal to those qualities which distinguished our parents.

My father and mother were examples of Oklahoma's pioneers. My parents reared 10 children. If we could but know the work involved in providing food, clothing, housing, healthful living, and education for a family of 10 youngsters under conditions that prevailed in the West before the turn of the century, we would appreciate more completely the task that was theirs, and the things they did so well.

As long ago as memory serves me, farmers were saying, "If we could get one good rain, we'd make a crop." That was a common expression almost every July and August. Generally, however, the rain never came in time to make a harvest. Now, as then, we have many wet springs, but dry summers are to be expected, almost without exception.

The need for irrigation was apparent in the early 1900's, as the first settlers turned from cattle grazing and began breaking the sod for wheat and livestock feed production. Local climatic conditions were believed to be unsatisfactory for growing cotton, which now is one of our big money crops.

Discussions about the possibilities of irrigation in the area between the Salt Fork River on the west and the North Fork River on the east reached a climax when the people sent an appeal for a survey to the Federal Government. This plea for an irrigation study resulted in a party of Government engineers establishing a camp in the valley and initiating investigation.

Hardly had the engineers taken the first peek through their

At left, aerial view of the Altus Canal. At right, W. C. Austin project office, Altus, Okla. Lugert-Altus irrigation district offices are also located here. ***Left photo by R. M. Reynolds, right photo by J. A. Callan, both of Region 5.***

instruments when it began to rain. It continued raining for days and days. Floods roared down the streams and swept over the valley. When one of the survey crewmen almost drowned, the engineers salvaged their supplies, abandoned the investigation and returned to Washington, D. C., where they reported, "the area needs flood control, not irrigation."

The statement about our need for flood control was not in error, for storage of flood waters for use in dry years was essential. Evidence of this is shown by the fact that the Lugert-Altus irrigation district received a credit of approximately 20 percent of the original estimated project cost for flood-control benefits.

About 4 out of every 5 years that followed the ill-fated survey of a half century ago were so dry that farming was unprofitable or so discouraging that many families moved away. The need for water conservation measures were paramount during the drought and depression years of the 1930's. Valley residents were desperate; they renewed their plea for a complete survey to determine the practicability of a dam on the North Fork of the Red River to store water for irrigating lands in southern Greer County and the east and central parts of Jackson County, and to provide municipal water for the city of Altus.

In the fall of 1936, the late Judge W. C. Austin telephoned and asked if I would be interested in helping to obtain an irrigation project for the valley. The noted reclamationist might as well have asked if I wanted to continue breathing. Attending that first meeting were more than 20 farmers and civic leaders from all sections of the area. From that day to this I do not recall having missed one of scores of meetings except in the case of illness or some other justifiable reason. Most of my neighbors have been equally loyal, but had it not been for Judge Austin's ability for leadership and willingness to sacrifice personal interests, the project would have been doomed to failure.

Preliminary surveys were started soon after that initial meeting arranged by Judge Austin. The project was found to be feasible, and the long-cherished dream began to materialize when construction began in 1941. I believe that completion of the project was the best thing that ever happened for this part of Oklahoma.

As might be expected, we experienced numerous difficulties during the construction stage. We still have problems, but with the help of high caliber men who represent the various governmental agencies interested in the project and its people, I am sure that we shall be successful in every particular. Special tribute is due many public employees, including the late Russell Lieurance, the Bureau of Reclamation's first construction engineer on this project, and Howard E. Robbins who succeeded Mr. Lieurance. Mr. Robbins later was named director of the Bureau's region 5 program, and in that capacity his sound advice and cherished friendship still are available to us. Wayne Byrne, who followed Mr. Robbins as project engineer, was held in high esteem, but he was soon called to perform engineering work on a Bureau project in Nebraska. Jim Callan, our present project engineer, is respected and appreciated by everyone in the valley. Just for the record, Jim is not for sale, trade, or lease, insofar as the water users are concerned.

Several of the Bureau's officials stationed in the Denver and Washington, D. C., offices have honored us with their visits. Each one has won for himself a warm spot in our hearts.

Our experiences with irrigation up to this time have been varied, interesting, and challenging. I hardly need cite the fact that we still do not know everything there is to learn about handling water deliveries and producing crops with moisture that is brought to us for the asking. We look upon ourselves as modern pioneers, for we are trying new methods, making new discoveries, and blazing a trail for our children. Despite some difficulties, we are determined to prove that we are cut from the same cloth that carried our fathers and mothers to hard-won victories on the land in the earlier years of its settlement and development. We too have an opportunity to leave our children a heritage—something that is desired by all normal parents and good citizens.

I believe that wheat production on the project will continue to decline. Cotton should always be a major crop. Alfalfa will be important under irrigation as it was prior to project construction. Dairying should increase. Economic conditions have been excellent in the 4 years since water was first received on some of the land in our project. However, the time will come when each family will note the value of a diversified, live-at-home program, with cows, pigs, and chickens adding to the balance of their cash-crop operations. I believe also that limited truck cropping has a potential value for project farmers, who could expect active markets in several large cities in three States and which are only over-night by truck and train from project farms.

These changes will not come rapidly. We farmers were intimately acquainted with our soil under dry farming conditions; now we shall have to learn its good points and limitations under irrigation. Even now we know that we must prepare our land properly for irrigation and that we need to use our water wisely. I should think that we will reach our maximum production possibilities within the next 5 years.

There has been an intermingling of trials and humorous incidents associated with our transition from dry land to irrigated farming. When the project works were completed and the distribution system constructed to serve the first several hundred acres in the area, we found ourselves with a new baby. We were proud though awkward parents but we're learning the proper formula and we will soon be dressing up the youngster with the finest clothing that Nature, with our help, can provide.

We are mighty thankful for the change from the old days—days of prairie fires, drought, and flood—days when we met at the community church to pray for rain, or perhaps, to pray for it to cease raining. No longer do we fear the dry years, for there is water stored behind Altus Dam. Nor do we fear the wet years; we have adequate drainage.

Perhaps people who live elsewhere will pardon my preference for Oklahoma. Oklahoma is my home. I see it as a land of fair gods; a land where angels swept the prairies level and molded a thousand purple hills upon which we and our posterity may stand to behold the panorama of the meadows and drink the fragrance of each blissful morning. Day after day as I cross the project's main canals or stand by the laterals and small ditches that carry water to our thirsty crops, a thrill comes over me that is beyond anything I ever dreamed. My neighbors and I are humble and grateful to the God in Heaven for having had an opportunity to help bring to fruition a project that eliminates so many of the hardships and discouragements shared by our parents. Here, in our valley are lush crops, comfortable homes, busy contented people—men, women, and children who enjoy the accomplishments of things worthwhile. THE END

Carlo P. Christensen Dies

Carlo P. Christensen

Carlo P. Christensen, Boulder Canyon project director of power since December 1, 1944, and long-time employee of the Bureau of Reclamation, died in the Boulder City Hospital on June 15, 1950, after a lingering illness.

He had been member of the Boulder Canyon staff since 1934. As an associate engineer, he was placed in direct charge of the installation of much of the generating equipment in the Hoover power plant. He advanced rapidly, and in 1940 became assistant director of power of the local project.

In the early part of that year he was transferred to Grand Coulee Dam, where for the next 4 years he was in charge of installation of the first units of that giant plant. Thus, in the last 16 years Mr. Christensen has had the rather unusual experience of being directly associated with the installations of the world's two largest hydroelectric projects.

He was born in Helena, Mont., in 1885 and attended public schools at Flathead and Kalispell, and was graduated from the Kalispell high school in 1905.

Mr. Christensen was graduated with a degree in electrical engineering from Stanford University in 1911.

Before joining the Bureau Mr. Christensen was employed by leading mining and power companies in California and Montana. At various times he was employed by such firms as Stone & Webster Construction Co., Anaconda Copper Mining Co., the San Joaquin Light & Power Corp., the Southern California Edison Co., the Western Precipitation Co. of Los Angeles, and the Metropolitan Water District of Southern California.

Truly it can be said of Mr. Christensen that his whole life was devoted to public service. Not only was he employed by firms almost wholly concerned with serving the public interest, but he went far beyond the call of duty to better the communities in which he lived.

An active member of the local Chamber of Commerce, he has also been vitally concerned with all phases of community betterment.

But perhaps his chief concern during the past few years has been the status of Boulder City as a permanent community. Being keenly aware of the changing nature of the town, for he has seen it since its early beginnings, he has been constantly seeking an answer to its many problems. During the past year, in particular, and during the months when the Reining study was being made of the city's administration, he spent countless hours and went far beyond the actual call of duty to offer every available assistance to the end that the result would be a constructive solution to the community's destiny. It was while he was still engaged in compiling data and reports for this study that he was striken by his final illness. ●

BEANS ON TELEVISION

by BILL HOSOKAWA

IN AMERICA'S VALLEY OF THE NILE—the North Platte Valley of Nebraska—billions upon billions of beans are grown each season. In the shipping sheds, it's a year-round chore simply to sort the good beans from the bad.

But since 1939, when "electronics" was still an unfamiliar word, the magic of photo-electric eyes and cathode ray tubes has been used to remove much of the drudgery attached to sorting, just as electrically operated pumps tap underground reservoirs for irrigating the fields of this area.

The sorting is done by strangely complicated devices manufactured by the Electric Sorting Machine Co. of Grand Rapids, Mich. By some black magic not intelligible to the uninitiated, these machines can sort beans three times as fast as human beings standing watch over a conveyor belt, and much more accurately.

Yet, the process is so simple, once the fundamentals are mastered, that even ex-field hands can be taught to operate them.

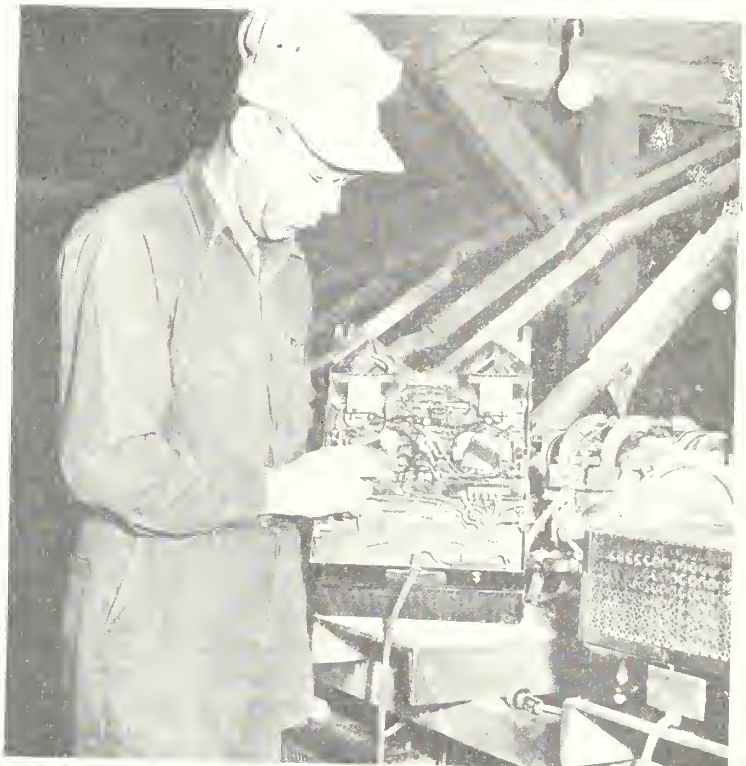
The machines were introduced into the North Platte Valley by Chester B. Brown of Morrill, Nebr., who pioneered bean-growing in the area in 1923. Brown died not long after the machines were put in. His successors acquired improved machines in 1947. Some 40 of these new models, and 48 of the earlier type are operating today in the Brown plant at Gering, Nebr.

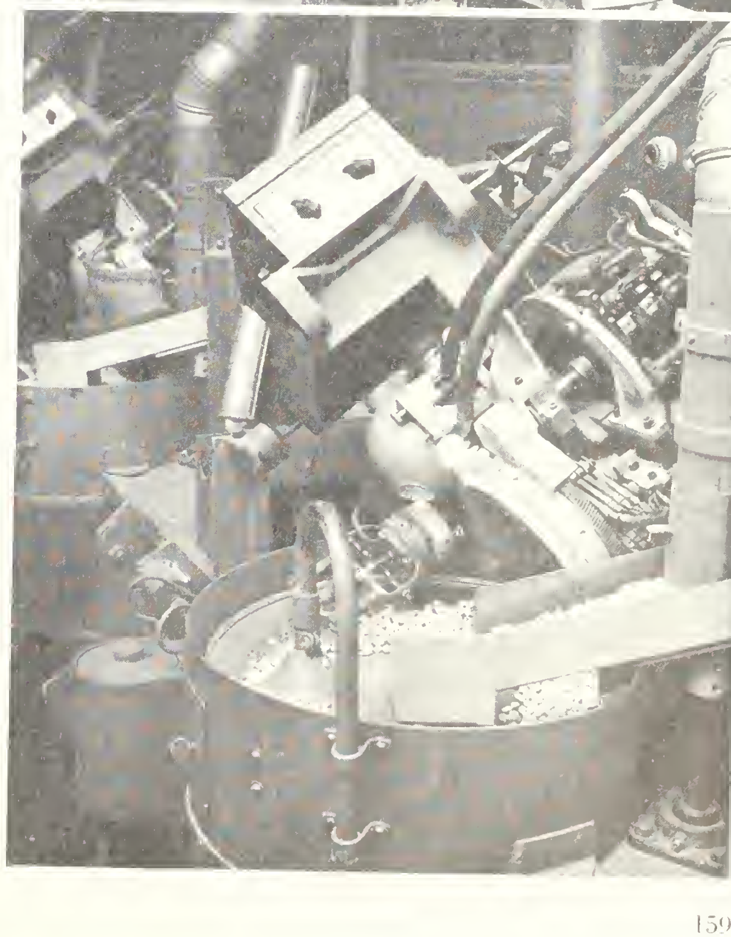
The new machines are lined up in a long, corridor-like, clatter-filled room, 20 on each side of an endless belt. They are ungainly gadgets, looking like a cross between washing machines and linotype machines with table model radios mounted on the sides.

And yet they are uncanny devices. They are capable of making almost 4,000 "yes" and "no" decisions per minute. They work 24 hours a day, day in and day out, with almost no attention except an occasional dusting out.

To look down the twin row of unattended machines, chattering as they work, gives one an odd sense of peeking into tomorrow when, presumably, a variety of such wonderful contrivances will have banished human drudgery.

The beans are funneled into the machines by tubes from an overhead bin. The sorted beans drop on the belt and ride into the packaging room. What happens between the first and last steps is simple—if you know your electronics, or have someone like George Klein to explain it to you.





Upper right: George Klein, maintenance chief of the Chester B. Brown bean sorting shed with radio-like mechanism of a sorter. Lower right: The ingenious machine that sorts the beans. They slide down the chute, extreme right, into hopper, from which they are picked up by nozzles on the drum and into judging chamber. Note "radio" at side of machine.

George is solemn and bespectacled. He was just an ordinary farm laborer 8 years ago when he first went to work on the sorters. A knack for electronics, plus a large quota of study and ambition, elevated him to the job of chief of maintenance.

George stops a machine so that he can explain its operations. He points to the drum, which looks like a flywheel and is about as large across as a dinner plate. It revolves exactly 105 times a minute.

Evenly spaced around the rim of the drum are 36 little nozzles. By suction, like that of a vacuum cleaner, each of the nozzles picks up a single bean on each revolution of the wheel.

The spinning drum carries the bean into what is called a judging chamber, which is simply a brightly lighted little pocket. A photo-electric tube has its all-seeing eye focused on the chamber, and it "sees" each bean as it whirls past.

Every time the eye "sees" a bean, it sends an electric impulse to a cathode ray tube, which is the dingus in your television viewing screen that makes it possible for you to see images.

A good bean creates one kind of pattern on the cathode ray (or television) tube. A bad bean creates another kind of pattern simply because of the difference in color.

A mask is fitted over the cathode ray tube so that patterns appearing only on a certain portion of the surface can be seen. The good bean patterns flash on the visible areas, the bad bean patterns are masked out.

A second electric eye is watching the patterns as they appear on the television tube. Nothing happens so long as good bean patterns appear. But when a bad bean pattern is masked out, the electric eye instanly notices the absence of the signal and sets an ejector in motion. Like a steel finger, the ejector flips the bad bean into the cull box. The good ones pass unmolested and eventually fall on the belt.

Since the drum picks up 36 beans on each revolution and spins 105 times a minute, the machine is "looking" at and sorting 3,780 beans each minute. In other words, the ejector with marvelous electronic accuracy flips out the bad ones from a stream of beans flowing by at the rate of 63 each second.

Normal output for the battery of 40 sorters is 900 bags, each weighing 100 pounds, in 24 hours.

So far, we've been talking about the pinkish-white Great Northern beans, of which the North Platte Valley last year harvested 1,562,000 bags. By a simple adjustment, the machines can be fixed to sort red beans or black beans, or beans of any hue. Even the mottled pinto beans can be sorted electronically.

Black-Eyed Pea is Baffling

Only the black-eyed pea baffles the electronic brain; no way has been found to teach the electric eye the difference between a discoloration and the distinctive black spot.

Packaging is also an assembly line operation. A machine unrolls a reel of cellophane, cuts it into proper lengths, folds it into bags, seals the seams, and holds the bag open. Another machine weighs and dumps the beans into the waiting bags, which then are automatically sealed.

The Gering plant, one of eight operated in the valley by the Chester B. Brown Co., is a far cry from the industry's humble beginnings. Back in 1923, Brown planted a few acres of beans as an experiment. In 1928, he opened his first plant at Morrill and went into the shipping business.

Last year, 92,000 acres of the Valley were planted in beans, with the Chester B. Brown Co. packing the lion's share of the million and one-half bag crop.

Since Brown's death, the firm has been headed by R. L. Kelley and Bernard J. Brown, son of the founder. THE END

PHOTO-ELECTRIC tube and cathode ray tube selected the good beans in the pile at left and culled the discolored beans in the other pile. In the offices of Chester R. Brown Co. are Don Phenning, bean grower, Ed Hise, manager of the Gering, Nebr., plant, Clarence Schmidt and Harold Barty, bean growers, and Bernard J. Brown, son of the founder. ***Left photo by the author.***

TREE PLANTING in the Missouri River Basin

Flowering trees and shrubs will soon cover the scars left on the face of the earth by the mammouth surgery performed to save the soil and water supplies within the Missouri River Basin. In time, perhaps, Mother Nature would have healed the marks left by bulldozers, rollers, and construction machinery busy building dams, but the Federal Government is applying special treatments to speed recovery, in order to provide the highest benefit for wildlife of the area.

In May of this year, the first three of a series of tree-planting projects was started at Angostura Reservoir in South Dakota, and Enders and Medicine Creek Reservoirs in Nebraska's Republican River Basin. This is another example of the cooperative nature of the Missouri River Basin development, as the Fish and Wildlife Service of the United States Department of the Interior and the State conservation departments worked out the plan, and the Bureau of Reclamation provided the funds as part of the construction costs.

Specially designed plantings of trees and shrubs will replace the vegetation which was flooded by the reservoirs and will furnish winter cover and year-around homes for the wild birds and animals which were forced to retreat before the onslaught of construction men and machines.

At Angostura, the Fish and Wildlife Service expects to "reclaim" pheasants, sharp-tailed grouse, cottontails, jackrabbits, skunks, beavers, muskrats, raccoons, minks, and badgers, at an estimated annual benefit of $500 a year. At Medicine Creek, wildlife experts estimated that hunters would lose about 350 animals each year, of which half would be pheasants. In addition, 80 marketable furs would be lost to the hunters as a result of construction activities. At Enders the annual losses were estimated at about 160 animals of which three-fourths were pheasants, and more than 230 marketable furs.

To do the job of providing livable and attractive new surroundings for the wildlife which was evicted from the reservoir sites 34,000 trees and shrubs are being planted in five plots, comprising 27 acres, at Angostura. At Enders, 45 acres will be covered by 45,000 trees and shrubs, while 37,000 will be planted on the 37-acre tract at Medicine Creek Reservoir. All plantings will be fenced for protection against livestock, making a total of 23 miles of fencing.

The Angostura tree-planting takes its place in a State-wide program of habitat restoration now being carried out by the South Dakota Department of Game, Fish, and Parks. When the Enders and Medicine Creek plantings are established all areas and sites will be turned over to the State of Nebraska for administration and management by the Nebraska Game, Forestation, and Parks Commission.

The Fish and Wildlife Service states that with good moisture conditions it will take about 5 years to establish these plantings, including replanting unsuccessful trees and shrubs and cultivating all plantings. However, if the area suffers a series of drought years, the development period may take 10 years before the wildlife plantings can be turned over to the State.

Other similar developments will be carried out at most of the 105 reservoirs included in the Missouri River Basin program. Through coordination between the agencies concerned, actual work can be undertaken while construction contracts are in effect, so that manpower and equipment will be available.

The End

Planting trees and shrubs on site overlooking Medicine Creek Reservoir. Clearing operations and impoundment of water have eliminated nearly all wildlife cover. Small gullies to the left of planting site were hand planted with 500 shrubs consisting of wild plum. Site will be completely fenced to protect it from grazing. *Photo courtesy Fish and Wildlife Service.*

Irrigation Goes to Town

(Continued from page 152)

operators ($3,350,000), Government payments to farmers ($333,000), and the wages of farm labor ($952,000). It might be argued that Government payments do not represent net income. The Government payments were included, however, because the study sought primarily to determine the relationship between farm income and urban income. If this important amount of farm purchasing power were omitted, in an effort to refine the estimate of direct benefits, the farm-urban income relationship would be distorted.

To estimate the income of the townspeople—the indirect benefits—I selected at random, 125 of the local business establishments, and interviewed the owners, asking them questions about their net income and payrolls. The answers I got amounted to a 36-percent sample of the total of 345 local business establishments. By expanding the sample data to represent the total, the indirect benefits were estimated at $5,891,000, an average of $107 per irrigated acre within the trade area. This includes the net income of business operators ($2,405,000); wages and salaries of employees ($3,071,000); and interest, rents, and dividends ($415,000).

The direct benefits per acre ($84) plus the indirect benefits ($107) make a total benefit of $191 per acre. This is net income, after the costs of production have been deducted. For the trade area as a whole, the total is $10,526,000—a significant amount of net income for an area that, prior to irrigation development, was a sagebrush desert. It is not surprising that, with net income of this magnitude, there is one business establishment for each 160 acres of irrigated land within the trade area.

Of even greater significance, however, than the total benefits, is the relation of the urban income to farm income. The urban income—indirect benefits—exceeds farm income by the ratio of 1.27 to 1. These figures are for the trade area alone. If I could have traced out and added the urban income resulting from the operation of Payette farms which flows into Boise, Salt Lake City, Portland, and other cities of the Nation, the indirect benefits would exceed the direct by an even greater ratio.

Even with the figures for the local area, it is clear that irrigation projects are income-generating developments of the first order. Their value is not merely in providing more farm home and farm products, but in creating and sustaining entire new segments of our national economy within which people in all walks of life can find satisfactory opportunities to earn livings and raise families. THE END

ATOMIC DETECTIVES

(Continued from page 155)

miniature atomic explosion. A beta-particle, which is a high-speed electron, is ejected with an energy of 1,400,000 volts, and a gamma ray similar to a very high energy X-ray is emitted.

If a device sensitive to these radiations were placed near our body, it would detect the radiation. However, the number of potassium atoms disintegrating in our bodies per minute is really not very large as numbers of atoms go. Taken altogether, they would weigh only 0.000000000000000017 ounce and would make a speck of material much too small to see with a powerful microscope.

Some radioactive materials can be detected in extremely small quantities. The shorter the half life, the smaller is the amount necessary to be measurable. For example, consider the amount of artificially radioactive sodium 24 with a half life of about 15 hours that would have to be added to Lake Mead in order that a measurable amount of activity would be present in any 1-ounce sample of water.

Lake Mead extends for 115 miles above Hoover Dam and contains 31,000,000 acre-feet of water, yet it would take only 0.0003 ounce of sodium 24 mixed uniformly in the lake to make each ounce of water contain a measurable amount of radioactive sodium. Thus, it is possible to trace the movements of a material through a system where only a very minute fraction of the material is radioactive.

Medical and biological researchers have already made extensive use of these "atomic facts of life" and have put them successfully to work. Metallurgists are also utilizing these data, and now engineers are recognizing the potentialities of atomic methods of research and are applying them to a diversity of problems.

The Bureau of Plant Industry, Soils, and Agricultural Engineering of the Department of Agriculture and the Bureau of Reclamation are now working together using the radioactive "detectives" to learn how various materials, especially herbicides, are moved from one part of an aquatic weed to other parts. When this answer is known, the problem of finding a material that will kill the entire plant instead of just the top will be greatly simplified and a long step will have been made toward the economical eradication of weeds in canals.

Other problems under attack by this powerful new tool in the Bureau laboratories are associated with the technology of concrete and of earth materials.

It is still too early to estimate what the results of our atomic research will be. But the more these studies reveal about natural phenomena, the more useful work nature's forces can do for us. THE END

Programing Conference at Santa Barbara

The Bureau of Reclamation's 1950 program conference was held in Santa Barbara, Calif., during the week of July 23. Conference discussions were concentrated on the role of the field organizations in the execution of the full program in the fiscal year of 1951, and on policy matters growing out of the January conference in Washington.

In attendance were Commissioner Straus, Assistant Commissioners Markwell, Nelson, and Lineweaver, all regional directors, branch heads, regional program and finance officers and others. Assistant Secretary William E. Warne reviewed the program from the Department angle. Details of the conference will be printed in the September issue of the Era.

NOTES FOR CONTRACTORS

Contracts Awarded During June 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2833	Missouri River Basin, Wyo	June 27	1 control board and 1 annunciator relay cabinet for Boysen power plant, schedule 1.	General Electric Co., Denver, Colo	$30,800
2833	do	do	1 distribution board and 1 control and distribution board for Boysen power plant, schedule 2.	Nelson Electric Manufacturing Co., Tulsa, Okla.	10,615
2833	do	do	One 1,500-kilovolt-ampere station-service unit substation and two 3-kilowatt battery chargers for Boysen power plant, schedules 3 and 4.	Zinsco Electrical Products, Los Angeles, Calif.	19,063
2924	Missouri River Basin, N. Dak	June 22	One 230,000-volt, nine 115,000-volt, five 69,000-volt, eight 46,000-volt, and one 14,400-volt circuit breakers for central North Dakota power system, items 2, 4, 12, 14, 22, 28, 38, 40, 41, 52, 58, 59, 70, 78, 85, 103, and 110.	General Electric Co., Denver, Colo	335,006
2924	do	do	Two 230,000-volt, nineteen 115,000-volt, thirty 69,000-volt, forty-eight 46,000-volt, and fifty-four 15,000-volt disconnecting switches; nine 115,000-volt, six 69,000-volt, and eight 46,000-volt horn-gap switches; and three 115,000-volt, four 69,000-volt, and four 46,000-volt interrupter switches for central North Dakota power system, items 5-9, 15-19, 23-25, 30-35, 42-48, 53-55, 61-67, 72-75, 79-81, 87-92, 97-99, 105-108, 112, and 113.	Schwager-Wood Corp., Portland, Oreg	116,182
2924	do	do	Three 156-kilovolt-ampere step-voltage regulators and one 3-kilovolt-ampere transformer for central North Dakota power system, items 83, 94, 95, and 101.	Pennsylvania Transformer Co., Canonburg, Pa.	18,938
2931	Colorado-Big Thompson, Colo	June 6	Furnishing and installing one 35,000-kilovolt-ampere vertical-shaft generator for Pole Hill power plant.	Elliott Co., Jeanette, Pa	382,646
2968	Columbia Basin, Wash	June 1	Four 59.5-cubic feet per second and two 55-cubic feet per second centrifugal-type pumping units for Quincy pumping plant.	Worthington Pump and Machinery Corp., Harrison, N. J.	125,276
2971	Missouri River Basin, Wyo	June 30	One 4,160-volt switchgear assembly, 2 generator protective equipment assemblies, 2 generator-neutral reactors, and 6 current transformers for Boysen power plant.	Westinghouse Electric Corp., Denver, Colo	29,646
2980	Hungry Horse, Mont	June 14	4 penstock gate hoists and 4 sets of controls for Hungry Horse Dam.	Willamette Iron & Steel Co., Portland, Oreg	90,966
2983	Missouri River Basin, Wyo	June 8	Construction of Keyhole Dam	Knisely-Moore Co., Douglas, Wyo	1,667,724
2985	Columbia Basin, Wash	June 12	Construction of machine shop, completion of warehouses A and B, and construction and installation of utilities in industrial area, Grand Coulee Dam.	Morrison-Knudsen Co., Inc. and Peter Kiewit Sons' Co., Seattle, Wash.	1,487,043
2987	Central Valley, Calif	June 1	Fifteen 10,000-pound and eleven 15,000-pound radial-gate hoists for Delta-Mendota Canal.	Gibson Manufacturing Corp., Longmont, Colo.	32,86[illegible]
2991	do	June 14	Two 115,000-volt circuit breakers for Tracy switchyard, schedule 1A.	Westinghouse Electric Corp., Denver, Colo	49,480
2992	Missouri River Basin and North Platte, Nebr.-Wyo.	June 6	Supervisory control and telemetering and carrier-current equipment for Gering and Sidney substations and Yoder tap.	General Electric Co., Denver, Colo	17,547
2995	Missouri River Basin, N. Dak	June 22	Galvanized-steel double-circuit towers and appurtenances for Garrison-Washburn-Bismarck 230-kilovolt transmission line.	American Bridge Co., Denver, Colo	822,284
2996	Colorado-Big Thompson, Colo	June 30	One 47,500-horsepower and one 48,000-horsepower vertical shaft hydraulic turbine for Pole Hill and Flatiron power plants.	Pelton Water Wheel Co., San Francisco, Calif.	553,700
2997	Columbia Basin, Wash	June 27	Construction of earthwork, asphaltic membrane lining, pipelines, and structures for area W4, laterals and sublaterals, and main drains 645, 645W, and 645WN, West canal laterals and drains.	J. A. Terteling & Sons, Inc., Boise, Idaho	818,089
2999	Missouri River Basin, Wyo	June 12	Fabricated structural steel for Thermopolis substation	Creamer and Dunlap, Tulsa, Okla	23,997
3000	Central Valley, Calif	June 6	Construction of earthwork, pipelines, and structures for lateral 88.4W and 90.4W and sublaterals, Lindmore irrigation district, Friant-Kern Canal distribution system.	Concrete Conduit Co., Colton, Calif	969,662
3004	do	June 5	Embedded metalwork for floodgate structure for Delta Cross Channel.	Treadwell Construction Co., Midland, Pa	12,200
3006	do	June 7	Structural steel for county highway bridges for Newman wasteway, Delta-Mendota Canal.	Gilmore Fabricators, Inc., Oakland, Calif	15,172
3007	do	June 21	Six 18-foot by 15-foot radial gates for concrete check, Delta-Mendota Canal, item 1.	Berkeley Steel Construction Co., Inc., Berkeley, Calif	10,290
3007	do	June 22	Eight 10,000-pound radial-gate hoists for concrete check and Firebaugh wasteway turnout, Delta-Mendota canal, items 4 and 6.	U. S. Pipe & Manufacturing Co., San Francisco, Calif.	12,656
3008	Boulder Canyon, Calif	June 2	Construction of operating bridges for Coachella Canal, All-American Canal system.	Norman I. Fadel, North Hollywood, Calif	65,184
3009	Missouri River Basin, Mont	June 28	Four 12.78-foot by 21.78-foot fixed-wheel gate frames for penstock and pump intake at Canyon Ferry Dam.	Puget Sound Bridge & Dredging Co., Seattle, Wash.	50,462
3010	Missouri River Basin, Mont	June 14	Three penstock gate hoists with valves and installation equipment for Canyon Ferry power plant, item 1.	Pacific Coast Engineering Co., Alameda, Calif.	29,730
3012	Columbia Basin, Wash	June 6	Installation of aluminum crest railings with lighting for Grand Coulee Dam.	E. E. Settergren, Portland, Oreg	67,109
3013	Colorado-Big Thompson, Colo	June 27	Furnishing and installing one 35,000-kilovolt-ampere vertical-shaft generator for Flatiron power plant.	Westinghouse Electric Corp., Denver, Colo	351,610
3014	Boulder Canyon, Ariz.-Calif.-Nev	June 28	3 plate-steel turbine inlet pipes for units A3, A4, and A9, Hoover power plant.	Southwest Welding & Manufacturing Co., Alhambra, Calif.	22,360
3015	Columbia Basin, Wash	do	Aluminum and steel handrailing for office wing, reception unit, and units P1 to P12, Grand Coulee pumping plant.	A. J. Bayer Co., Los Angeles, Calif	14,972
3016	Missouri River Basin, Mont	June 14	Embedded metalwork for four 51-foot by 34.5-foot radial gates at Canyon Ferry Dam.	Puget Sound Bridge and Dredging Co., Seattle, Wash.	33,685
3018	Colorado-Big Thompson, Colo	June 15	Construction of Carter Lake Reservoir, consisting of three earthfill dams.	Winston Bros. Co., Monrovia, Calif	2,389,350
3019	Missouri River Basin, N. Dak	June 27	Galvanized-steel single-circuit towers and appurtenances for Bismarck-Jamestown 230-kilovolt transmission line.	American Bridge Co., Denver, Colo	772,144
3020	Hungry Horse, Mont	do	One 125-ton gantry crane for Hungry Horse Dam	Willamette Iron & Steel Co., Portland, Oreg	128,185
3022	Missouri River Basin, Wyo	June 23	Four 3-foot 6-inch by 3-foot 6-inch high-pressure gates with four 85,000-pound hydraulic hoists, gate hangers, switch assemblies, and conduit liners for outlet works at Keyhole Dam.	Pacific Coast Engineering Co., Alameda, Calif.	27,450
3024	Hungry Horse, Mont	June 26	One 64-foot by 12-foot ring gate for spillway at Hungry Horse Dam.	Puget Sound Bridge & Dredging Co., Seattle, Wash.	59,900
3027	Boulder Canyon, Ariz.-Calif.-Nev	June 14	Steel structures for Arizona-Nevada yard transformer circuits Nos. 1 and 13, Boulder Canyon switchyard.	Snyder Engineering Corp., Los Angeles, Calif.	24,005
3029	Davis Dam, Ariz.-Nev	June 22	Construction of Tucson substation	Howard P. Foley Co., Salt Lake City, Utah	242,652
3030	Missouri River Basin, Wyo	June 16	Construction of Thermopolis substation	Utah Construction Co., Salt Lake City, Utah.	158,495
3033	Missouri River Basin, Mont	June 30	One 9.04-foot by 9.04-foot fixed-wheel gate for river outlets at Canyon Ferry Dam.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	12,467
3035	Fort Sumner, N. Mex	June 21	Construction of earthwork, pneumatically applied mortar lining, and structures for High Line Canal; and earthwork and structures for Main canal 8.4 lateral, intercepting drains A and B, and upper, middle, and lower drains.	G. I. Martin, Albuquerque, N. Mex	366,219

(Continued on next page)

NOTES FOR CONTRACTORS—Contracts Awarded During June 1950—(*Continued*)

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3036	Columbia Basin, Wash	June 23	Construction of Quincy pumping plant—earthwork, pumping-plant building, miscellaneous structures, discharge pipes, and mechanical installations, schedule 1.	United Concrete Pipe Corp., Baldwin Park, Calif.	$491,041
3036	do	do	Construction of Quincy pumping plant—electrical and hydraulic installations, schedule 2.	Picatti Bros., Yakima, Wash	33,186
3037	Central Valley, Calif	June 28	Construction of upper vista house at Shasta Dam	S. C. Giles & Co., Stockton, Calif	286,925
3038	Missouri River Basin, Nebr	June 30	Construction of Superior siphon, Superior canal	Bill Curphy Co., Des Moines, Iowa	159,706
3039	Central Valley, Calif	June 22	Construction of earthwork and structures for Delta Cross channel floodgate structure, Sta. 0+00 to 9+50.	George Pollock Co., Sacramento, Calif	644,190
3040	Missouri River Basin, Mont	June 30	Four 51-foot by 34.5-foot radial gates for Canyon Ferry Dam	John Mohr & Sons, Chicago, Ill	106,500
3014	Gila, Ariz	June 6	200,000 barrels of portland cement for construction on the Wellton-Mohawk division.	Riverside Cement Co., Los Angeles, Calif	624,000
3046	Missouri River Basin, N. Dak	June 30	Constructing foundations and erecting steel towers for 60 miles of Garrison-Washburn-Bismarck 230-kilovolt transmission line, schedule 1.	Parker-Schram Co., Portland, Oreg	487,519
3045	do	do	Stringing conductors and overhead ground wires for 60 miles of Garrison-Washburn-Bismarck 230-kilovolt transmission line, schedule 2.	Hallett Construction Co., Crosby, Minn	844,100
3047	Missouri River Basin, Nebr	June 30	Construction of Trenton Dam	Vinnell Co., Inc., Ralph A. Bell, and United Concrete Pipe Corp., Alhambra, Calif.	4,726,557
3048	do	June 29	Construction of Sidney substation	Busboom & Rauh, Salina, Kans	59,523
3052	Missouri River Basin, Mont	June 28	1 lot of stop log guides for main units and pumping intake at Canyon Ferry Dam.	Valley Iron Works, Yakima Wash	18,779
3056	Central Valley, Calif	June 27	Construction of earthwork, concrete lining, and structures for Friant-Kern canal.	Peter Kiewit Sons' Co., Delano, Calif	3,333,156
3057	Central Valley, Calif	June 29	Construction of earthwork and structures for San Luis wasteway and holding reservoir dike, Delta-Mendota Canal.	Western Contracting Corp., Newman, Calif.	1,192,515
3060	Columbia Basin, Wash	do	Construction of earthwork, asphaltic membrane lining, pipelines, and structures for area W-3 laterals and sublaterals, lateral W22 and sublateral W22E, West canal laterals, schedule 1.	United Concrete Pipe Corp., Baldwin Park, Calif.	547,621
3061	Hungry Horse, Mont	June 30	2 bus structures with current and potential transformers, grounding and disconnecting switches, and generator-protective equipment; six 5,000-ampere circuit breakers, 2 with potential transformers; four neutral-grounding reactors; and 1 unit substation for Hungry Horse power plant.	General Electric Co., Denver, Colo	413,106
3062	Boulder Canyon, Ariz.-Calif.-Nev	do	Two 3,300-ampere and one 3,000-ampere bus structures with current and potential transformers, grounding switches, and generator-protective equipment; and one 1,700-ampere bus structure for units A3, A4, and A9, and transformer bank Y, Hoover power plant.	Railway & Industrial Engineering Co., Greensburg, Pa.	240,656
3066	Missouri River Basin, N. Dak	June 30	Constructing foundations and erecting steel towers for 98 miles of Bismarck-Dawson-Jamestown 230-kilovolt transmission lines, schedules 1 and 3.	Continental Co., Dayton, Ohio	123,650
3066	do	do	Stringing conductors and overhead ground wires for 98 miles of Bismarch-Dawson-Jamestown 230-kilovolt transmission lines, schedules 2 and 4.	Hallett Construction Co., Crosby, Minn	798,740
3067	Columbia Basin, Wash	June 26	Construction of earthwork and structures for Potholes East canal, schedule 1.	Scheumann & Johnson, Seattle ,Wash	382,058
3067	do	do	Construction of Soda Lake dike, schedule 2	Guy F. Atkinson Co., Portland, Oreg	388,236
3068	do	June 29	Construction of earthwork and structures for Potholes East canal and North Scooteney dike.	J. A. Terteling & Sons, Inc., Boise, Idaho	878,717
3069	Missouri River Basin, Wyo	June 15	20,000 barrels of portland cement for construction of Keyhole Dam.	South Dakota Cement Plant, Rapid City, S. Dak.	52,000
3070	Missouri River Basin, Mont	June 28	Three 16,667/20,834 kilovolt-ampere transformers for Canyon Ferry power plant.	Pennsylvania Transformer Co., Canonsburg, Pa.	168,891
3071	Missouri River Basin, N. Dak	June 23	Fabricated structural steel for Rugby, Devils Lake, and Jamestown substations.	American Bridge Co., Denver, Colo	42,230
3072	Eden, Wyo	June 29	Construction of Big Sandy Dam and dike	S. J. Groves & Sons Co., Minneapolis, Minn	1,011,772
3073	Missouri River Basin, S. Dak	do	One 1,675-horsepower hydraulic turbine and one oil-pressure governor for Angostura power plant.	James Leffel & Co., Springfield, Ohio	30,120
3074	Colorado-Big Thompson, Colo	June 22	21,000 barrels of portland cement for construction of Carter Lake Dam and pressure tunnel.	Ideal Cement Co., Denver, Colo	68,250
3075	Missouri River Basin, S. Dak	June 30	One 1,200-kilowatt vertical-shaft generator and generator control and protective equipment for Angostura power plant.	Ideal Electric & Manufacturing Co., Mansfield, Ohio.	27,598
3076	Missouri River Basin, Nebr	do	Installation of radial gates and hollow-jet valves, and concrete and earthwork for completion of Enders Dam.	Claussen-Olson-Benner, Inc., Holdrege, Nebr.	138,032
3080	Missouri River Basin, Nebr	do	16,000 tons of bulk portland-pozzolan cement for construction of Trenton Dam.	Ash Grove Lime & Portland Cement Co., Omaha, Nebr.	293,190
3081	Colorado Big Thompson, Colo	June 29	Construction of Carter Lake pressure tunnel, Estes Park-Foothills power aqueduct.	K. S. Mittry Construction Co., Los Angeles, Calif.	1,066,940
3085	Columbia Basin, Wash	June 30	Construction of earthwork, asphaltic membrane lining, pipe lines, and structures for lateral EL20 and sublaterals, Areas E1, E2, and E3, East Low canal laterals.	J. A. Terteling & Sons, Inc., Boise, Idaho	512,247
R1 CB 37	do	June 13	Division Office Building, O. & M. Headquarters, Nr. Quincy	Sam Linden Co., Bremerton, Wash	79,943
R1 85	Yakima, Wash	June 16	Constructing 4 pump tenders' residences at Roza pumping plants, schedules 1 and 2.	Beaman and Coxe, Yakima, Wash	35,452
R1 85	do	June 19	Constructing 5 pump tenders' residences at Roza pumping plants, schedules 3 and 4.	A. E. Deatley Construction Co., Yakima, Wash.	48,546
R1 CB 57	Columbia Basin, Wash	June 23	Grading lot areas, streets and alley; moving, relocating and altering buildings and constructing garages; and constructing sewerage and water distribution systems for Hilltop area at Coulee Dam.	Fred Wager & Son, Inc., Auburn, Wash	161,609
R3 LCRD 9	Gila Project, Ariz	June 1	Roads, streets, buildings, and utilities, Wellton Government Camp.	Sooy & Jackson, Redland, Calif	319,265
R3 B15	Boulder Canyon, Ariz.-Calif.-Nev	June 19	Construction of miscellaneous rooms, structural steel balcony and installation of ventilating and air-cooling equipment at Hoover power plant.	J. A. Tiberti, Las Vegas, Nev	29,603
R7 121	Colorado-Big Thompson, Colo	June 1	Erecting warehouse building at Loveland, Colo	Lindstrom & Williams, Denver, Colo	71,826

Construction and Supplies for Which Bids Will Be Requested by October 1950

Project	Description of work or material
Cachuma, Calif.	Two 30-inch hollow jet valves for Cachuma Dam.
Central Valley, Calif.	Construction of 120-cubic-feet-per-second capacity Tranger pumping plant for Lindsay-Strathmore irrigation district, Friant-Kern Canal distribution system, 2 miles east of Lindsay, Calif.
Do	Concrete lining of 0.2 mile of 2,500-cubic-feet-per-second Friant-Kern Canal, near Fresno, Calif.
Do	Construction of 58 miles of concrete pipelines for Lindmore irrigation district, Friant-Kern Canal distribution system, near Strathmore, Calif.
Do	Construction of 8.5 miles of welded steel pipelines for Lindsay-Strathmore irrigation district, Friant-Kern Canal distribution system, near Lindsay, Calif.
Do	Construction of 2-bedroom ditchrider dwellings at Kings and Kaweah Rivers, Friant-Kern Canal.
Do	Seven vertical-shaft pumps with outdoor-type electric motors, total capacity 120-cubic-feet-per-second at 185 foot head; and two horizontal-shaft booster pumping units for Tranger pumping plant.
Do	Fifty-three motor-driven vertical-shaft pumps, ranging in capacities from 2 to 16 cubic-feet-per-second, for third unit, Southern San Joaquin municipal utility district.
Colorado-Big Thompson, Colo.	Construction of Willow Creek Dam, an earthfill structure about 96 feet high and 1,000 feet long, about 8.5 miles from Granby, Colo.
Do	Construction of Pole Hill power plant, 13 miles west of Loveland, Colo. Construction of a rock-fill diversion dam, 225 feet long and 40 feet high; an earth and rock fill afterbay dam, 210 feet long and 30 feet high; and 1.5 miles of access road.
Do	Construction of 54 by 90-foot system dispatcher's building at Flatiron power plant site, 8 miles west of Loveland, Colo.
Do	1 each oil-pressure actuator-type governor for 46,000-horsepower turbine for Flatiron power plant and 47,500-horsepower turbine for Pole Hill power plant.
Do	Control equipment and station-service equipment for Pole Hill power plant.
Columbia Basin, Wash.	Construction of 15-mile unlined section of the 2,200-cubic feet per second West canal, about 6 miles south of Quincy, Wash.
Do	One 9 by 9-foot radial gate and hoist for Potholes east canal headworks.
Do	Removal of existing fencing and furnishing and erecting permanent fencing around 115-kilovolt and 230-kilovolt left switchyard, Grand Coulee power plant.
Do	Construction of municipal maintenance office, garage, workshop, and warehouse at Coulee Dam, Wash.
Do	Construction of 2 permanent-type residences near Stratford and Soap Lake, Wash.
Davis Dam, Ariz.-Nev	Stringing 120 miles of overhead ground wires of the [illegible]ting 115-kilovolt Phoenix-Tucson No. 1 transmission line between Phoenix and Tucson, Ariz.
Do	Erection of steel structures and installation of disconnecting switches and circuit breakers for 230-kilovolt section at Prescott substation site, near Prescott, Ariz.
Do	Furnishing and installing pumps for 6 water supply wells at Tucson, Coolidge, Phoenix, and Mesa, Ariz.; and furnishing and laying pipelines for domestic water supply and fire-protection system at Mesa and Coolidge.
Do	Construction of warehouse at Phoenix, Ariz.
Do	Construction of transformer repair shop at Phoenix, Ariz.
Deschutes, Oreg.	Repairs to Arnold diversion dam, about 6 miles southwest of Bend, Oreg.
Fort Peck, Mont.	Furnishing and erecting prefabricated 36 by 60-foot metal building 7 miles southwest of Havre, Mont.
Kendrick, Wyo.	Construction of about 35 miles of double-circuit open wire telephone line from new Casper substation of Alcova Dam, Alcova, Wyo.
Do	Lining about 3,000 feet of existing 600-cubic feet per second Casper Canal with buried asphaltic membrane lining.
Do	Construction of Rawlins substation
Missouri River Basin, Nebr.	Construction of 20 miles of laterals and sublaterals on the Cambridge lateral system, 4 miles west of Holbrook, Nebr.
Do	Construction of 10-mile unlined section of Cambridge Canal, near Oxford, Nebr.
Missouri River Basin, N. Dak.	Construction of 10,000-kilovolt-ampere Carrington substation.
Do	Construction of Fort Clark River and relift pumping plants, substations for pumping plants, and canal, lateral, and drainage systems; and installation of pumping plant and substation equipment, on the Missouri River, Mercer County, N. Dak.
Missouri River Basin, Wyo.	Construction of streets, sewer, water, and electrical facilities, caretaker's residence, five temporary living units, one office building, and one garage and warehouse; and reconditioning six trailer units for Anchor Dam Government camp, 35 miles west of Thermopolis, Wyo.
North Platte, Wyo.-Nebr.	Lining with concrete and furnishing and placing concrete pipe on about 10,000 feet of laterals, Fort Laramie Canal, 6 miles southwest of Morrill, Nebr.
Parker Dam Power, Ariz.-Calif.	Removing and installing guide shoes and resetting guides for spillway gates at Parker Dam.

THE RECLAMATION AREA

The Reclamation ERA

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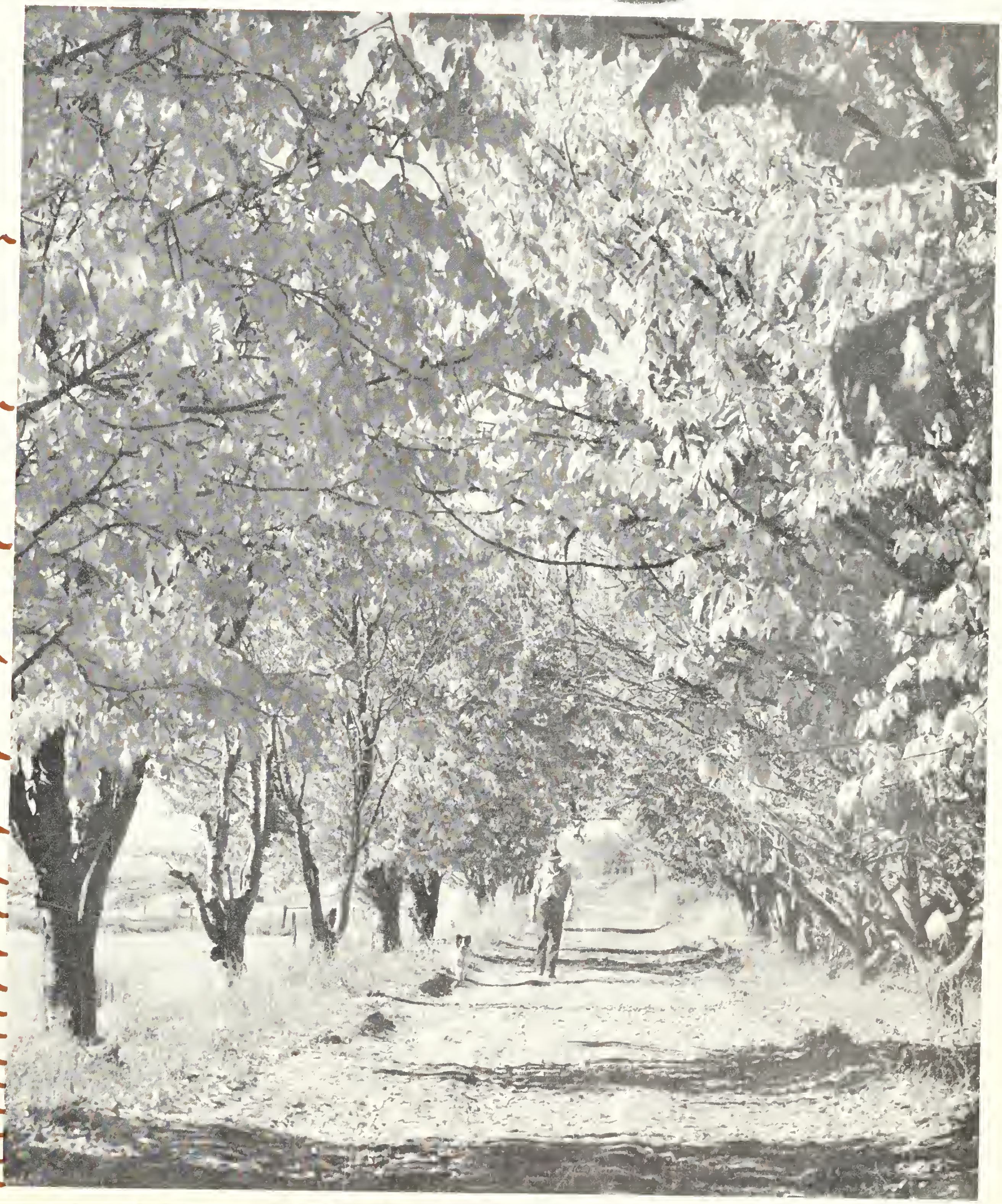

Official Publication of the Bureau of Reclamation

The Reclamation ERA

September 1950

Volume 36, No. 9

Issued monthly by

The Bureau of Reclamation

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

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

CONTENTS

FEATURE ARTICLES

SHORT FEATURES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

OUR FRONT COVER

GOLDEN GLOW. During the latter part of October the irrigated farms of the Northwest begin to take on the color of autumn. A particularly colorful attraction is this country lane lined with cherry trees on which the leaves have turned a vivid yellow-orange hue. Mr. Otis Lynskey is shown walking with his dog down the road of the R. S. Young farm on the Boise project in Idaho. *Photo by Marvin Bertrom, Region 1.*

30 YEARS AGO IN THE ERA

In the course of a speech in the House of Representatives on June 5, 1920, Representative John W. Summers, of Washington, said:

"The value of the crops harvested in the Yakima Valley last year is conservatively estimated, according to reliable figures which I shall shortly quote in detail, at $45,602,576, and I am here to say that had it not been for the passage of the Reclamation Act of June 17, 1902, and the subsequent reclamation work in that valley by our Government, the value of its crops last year would have been reduced about $40,000,000.

"Here, then, we have a concrete example of 40 millions in 1 year added to the country's production and wealth as a result of Federal reclamation work on the arid lands of one county in my district."

(From p. 406, September 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA.)

RECLAMATION PLACE NAMES IN THIS ISSUE

September 1950

Office 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.

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Kenneth Markwell, Assistant Commissioner **Wesley R. Nelson, Assistant Commissioner** **Goodrich W. Lineweaver, 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; *Acting Director, Branch of Operation and Maintenance,* E. D. Eaton; *Director, Branch of Power Utilization,* Harvey F. McPhail; *Director, Branch of Project Planning,* John W. Dixon; *Comptroller,* W. Darlington Denit; *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 Programs and Finance),* Archie M. Rankin; *Associate Director of Supply (Office of Supply),* J. C. Thrailkill; *Chief Auditor, Field Division (Office of the Comptroller),* Wendell Bramwell; *Chief, Personnel Field Office (Office of Personnel),* Everett K. Gould.

Alaskan Investigations Office, Juneau, Alaska, Joseph M. Morgan, Chief

United Western Investigations Office, 222 South West Temple, Salt Lake City, Utah, Stanford P. McCasland, Chief

REGIONS

REGION 1: Regional Office, P. O, Box 937, Reclamation Building, Fairgrounds, Boise, Idaho

Regional Director, H. T. Nelson; *Assistant Regional Director,* J. Lyle Cunningham; *Assistant Regional Director,* F. M. Clinton; *Assistant to the Regional Director,* William F. Rapp; *Regional Engineer (Branch of Design and Construction),* D. S. Walter; *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.

Operating Offices	Official in charge		Address
	Name	Title	
Anderson Ranch Dam project office	G. A. Swanson	Construction engineer	Anderson Dam, Idaho.
Central Snake River district	George N. Carter	District manager	214 Broadway, Boise, Idaho.
Boise-Payette construction field office	Earl Harmon	Construction engineer	P. O. Box 172, Caldwell, Idaho.
Boise-Payette O. & M. field office	John V. Walker	Irrigation manager	Notus, Idaho.
Cascade Dam field office	Earl Harmon	Construction engineer	P. O. Box 440, Cascade, Idaho.
Owyhee project field office	Paul L. House	Irrigation manager	Nyssa, Oreg.
Power division	F. E. Hulet	Power superintendent	Black Canyon Dam, Emmett, Idaho.
Columbia River district	F. A. Banks	District manager	Coulee Dam, Wash.
Irrigation division	H. A. Parker	Supervising engineer	P. O. Box 368 Ephrata, Wash.
Deschutes project office	J. W. Taylor	Construction engineer	1044 Bond St., Bend, Oreg.
Hydrologic Studies Office	Robert W. Gay	Chief	P. O. Box 937, Fairgrounds, Boise, Idaho.
Hungry Horse project office	C. H. Spencer	Construction Engineer	Columbia Falls, Mont.
Kalispell area planning office	Charles S. Hazen	Area Planning engineer	Ford Bldg., P. O. Box 97, Kalispell, Mont.
Lewiston Orchards project office	Wilfred L. Karrer	Construction engineer	Weisberger Bldg, 5th and Main, P. O. Box 621, Lewiston, Idaho.
Minidoka project office	J. F. Spofford	Superintendent	1359 Hanson Ave., Burley, Idaho.
Palisades project office	I. Donald Jerman	Project engineer	Palisades, Idaho, Mail Address: P. O. Box 1259, Idaho Falls, Idaho.
Salem area planning office	Lee McAllister	Area Planning engineer	460 N. High St., Salem, Oreg.
Walla Walla area planning office	M. Boyd Austin	do	Bldg. T-208, Walla Walla City-County Airport, P. O. Box 718, Walla Walla, Wash.
Yakima project office [1]	O. W. Lindgren	Superintendent	P. O. Box 1377, Federal Bldg., Yakima, Wash.

[1] Also project office for McKay Reservoir, Umatilla project.

REGION 2: Regional Office, P. O. 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),* William J. McCrystle; *Regional O. & M. Supervisor (Branch of Operation and Maintenance),* J. G. Lindley; *Regional Power Manager (Branch of Power Utilization),* Henry B. Taliaferro; *Regional Planning Engineer (Branch of Project Planning),* A. N. Murray; *Regional Programs and Finance Officer (Programs and Finance Division),* T. K. Vasey; *Chief, Land Acquisition 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.

Operating Offices	Official in charge		Address
	Name	Title	
Cachuma project	E. R. Crocker	Project manager	P. O. Box 701, Goleta, Calif.
Central Valley project operations office	Martin H. Blote	Operations superintendent	P. O. Box 2511, Sacramento, Calif.
Delta district	C. H. Kadic, Jr	District manager	P. O. Box 928, Stockton, Calif.
American River construction division	H. F. Bahmeier	Construction engineer	Folsom, Calif.
Canal construction division	O. G. Boden	do	P. O. Box 570, Tracy, Calif.
Electrical construction division	H. W. Thomson	do	Elverta, Calif.
Klamath project	E. L. Stephens	Project manager	P. O. Box 312, Klamath Falls, Oreg.
Sacramento Valley district	James K. Carr	District manager	P. O. Box 302, Chico, Calif.
Construction division	Edward Helgren	Construction engineer	Redding, Calif.
Orland field office	R. W. Hollis	Watermaster	Orland, Calif.
Shasta Dam division	George D. Atkinson, Jr	Operations superintendent	Redding, Calif.
San Joaquin Valley district	J. W. Rodner	District manager	318 Patterson Building, Fresno, Calif.
Canal construction division	S. S. Leonard	Construction engineer	Friant, Calif.
Construction division (distribution systems)	R. K. Durant	do	Lindsay, Calif.
Design division (distribution systems)	Ernest C. Fortier	Design engineer	318 Patterson Building, Fresno, Calif.

REGION 3: Regional Office, 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 Counsel (Legal Division, 620 Rowan Bldg., 458 S. Spring St., Los Angeles, Calif.)*, R. J. Coffey; *Regional Programs and Finance Officer (Programs and Finance Division)*, M. E. Rains; *Regional Supply Officer (Supply Division)*, O. J. Littler; *Regional Personnel Officer (Personnel Division)*, M. H. Mitchell; *Regional Information Officer (Information Division)*, W. J. Williams; *Chief, Office of River Control*, C. P. Vetter.

Operating Offices	Official in charge		Address
	Name	Title	
All-American Canal (Coachella division) project office	C. S. Hale	Construction engineer	Coachella, Calif.
Boulder Canyon project office	L. R. Douglass	Acting director of power	Boulder City, Nev.
Colorado River front work and levee system project office.	C. P. Vetter	Chief, office of river control	Do.
Blythe field station	B. E. Wilson	Engineer	Office of River Control, General Delivery, Blythe, Calif.
Needles field office	P. A. Oliver	Resident engineer	P. O. Box 975, Needles, Calif.
Davis Dam project office	J. R. Walton	Acting construction engineer	P. O. Box 790, Davis Dam, Nev.
Escondido area planning office	J. D. McCoy	Area planning engineer	P. O. Box 475, Escondido, Calif.
Lower Colorado River district	M. J. Miller	District manager	Yuma, Ariz.
Engineering division	G. E. Tank	Chief, engineering division	Do.
Operations division	J. P. Collopy	Chief, operations division	Do.
Overton area planning office	W. P. Adair	Area planning engineer	Johnson Bldg., Overton, Nev.
Parker Dam power project office (including Davis trans. system const.).	S. A. McWilliams	Project engineer	P. O. Box 392, Phoenix, Ariz.
Blythe construction field office	J. H. Childs	Engineer	Blythe, Calif.
Kingman construction field office	D. F. Murphy	do	Kingman, Ariz.
Parker Dam O&M field office	F. H. Sweany	Supt., Parker Dam	Parker Dam, Calif.
Phoenix area planning office	V. E. Larson	Assistant regional planning engineer	P. O. Box 2071, Phoenix, Ariz.
Salt River Rehabilitation field station	C. A. Pugh	Resident engineer	Do.

REGION 4: Headquarters, 32 Exchange Place, P. O. Box 360, Salt Lake City 10, 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 Information Officer (Information Division)*, M. C. Corhett; *Regional Programs and Finance Officer (Programs and Finance Division)*, F. J. Farrell: *Regional Personnel Officer (Personnel Division)*, G. A. McDougal; *Regional Counsel (Legal Division)*, J. S. McMaster; *Regional Supply Officer (Supply Division)*, E. G. Bywater.

Operating Offices	Official in charge		Address
	Name	Title	
Durango area office	Wm. F. Crabtree	Area engineer	Masonic Bldg., P. O. Box 640, Durango, Colo.
Mancos project office	do	do	Do.
Pine River project office	do	do	Do.
Upper Green River area office	P. B. DeLong	do	625 Broadway, Rock Springs, Wyo.
Eden construction office	A. H. Peterson	Construction engineer	First Security Bank Bldg., Rock Springs, Wyo.
Fallon area office	W. H. Slattery	Area engineer	Post Office Bldg., P. O. Box 849, Fallon, Nev.
Grand Junction area office	C. H. Jex	do	310 Post Office Bldg., P. O. Box 780, Grand Junction, Colo.
Logan area office	E. K. Thomas	do	46 East Center, P. O. Box 294, Logan, Utah.
Paonia project office	R. W. Jennings	Construction engineer	P. O. Box X, Paonia, Colo.
Provo River project office	L. R. Dunkley	Project engineer	303 Knight Block, P. O. Box 77, Provo, Utah.
San Bernardino area planning office	Frank R. Smith	Engineer	364 Mountain View Ave., San Bernardino, Calif.
Spanish Fork area office	P. R. Neeley	Area engineer	24 N. Main, P. O. Box 71, Spanish Fork, Utah.
Weber Basin area office	F. M. Warnick	do	203 24th Street, Ogden, Utah.

REGION 5: Regional Office, P. O. Box 1609, Old P. O. Building, 7th and Taylor, Amarillo, Tex.

Regional Director, H. E. Robbins; *Assistant Regional Director*, A. N. Thompson; *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; *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 Information Officer (Information Division)*, Garford L. Wilkinson; *Regional Supply Officer (Supply Division)*, I. G. Camphell; *Regional Safety Adviser*, G. F. Peterson.

Operating Offices	Official in charge		Address
	Name	Title	
Albuquerque area planning office	J. L. Mutz	Area planning engineer	P. O. Box 95, 723 N. 2d St., Albuquerque, N. Mex.
Austin area planning office	H. P. Burleigh	do	P. O. Box 817, Littlefield Bldg., Austin, Tex.
Balmorhea field station	Paul Powell	Irrigation maintenance superintendent	Balmorhea, Tex.
Carlshad field station	J. J. Brockman	Reservoir superintendent	P. O. Box 512, Fort Sumner, N. Mex.
Fort Sumner project office	W. B. Bierce	Construction engineer	P. O. Box 496, Fort Sumner, N. Mex.
Oklahoma City area planning office	M. G. Barclay	Area planning engineer	P. O. Box 495, 205 Council Bldg., Oklahoma City, Okla.
Rio Grande project office	L. R. Fiock	Project manager	U. S. Courthouse, El Paso, Tex.
Elephant Butte division office	Labon Backer	Division superintendent and acting construction engineer.	Elephant Butte, N. Mex.
Las Cruces division office	E. S. Mayfield	Division superintendent	Las Cruces, N. Mex.
Ysleta division office	F. D. Postle	do	Ysleta, Tex.
San Luis Valley project office	W. H. Sweet	Project engineer	117 Jefferson St. Monte Vista, Colo.
Platoro Dam field office	L. F. Wylie	Construction engineer	Do.
Tucumcari project office	R. J. Lyman	Project manager	Tucumcari, N. Mex.
W. C. Austin project office	J. A. Callan	Project engineer	Altus, Okla.

REGION 6: Regional Office, Yale Building, P. O. 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 O. & M. 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; *Regional Information Officer (Information Division)*, Harold I. Sylten; *Regional Personnel Officer (Personnel Division)*, Howard M. Watts; *Regional Supply Officer (Supply Division)*, Fred W. Gilhert; *Regional Safety Engineer (Safety Division)*, Charles C. Parsons; *Chief, Municipal Water Supply Investigations Unit*, Stanton J. Ware.

Operating Offices	Official in charge		Address
	Name	Title	
Big Horn district	Charles T. Hinze	District manager	P. O. Box 839, Cody, Wyo.
Boysen project field office	G. R. Rolin	Project engineer	P. O. Box 1111, Thermopolis, Wyo.
Heart Mountain project field office	Alden S. Ingraham	Acting project superintendent	P. O. Box 900, Cody, Wyo.
Riverton project field office	T. A. Clark	Project engineer	P. O. Box 71, Riverton, Wyo.
Missouri-Oahe district	Joseph W. Grimes	Acting district manager	P. O. Box 825, Huron, S. Dak.
Angostura construction field office	Norval E. Enger	Acting construction engineer	P. O. Box 812, Hot Springs, S. Dak.
Bixhy construction field office	H. M. Crowell	Construction engineer	P. O. Box 326, Newell, S. Dak.
Keyhole construction field office	F. E. Goehring	do	P. O. Box 278, Moorcroft, Wyo.
Shadehill construction field office	D. M. Forester	do	P. O. Box 298, Lemmon, S. Dak.
Missouri-Souris district	Bruce Johnson	District manager	P. O. Box 1050, Bismarck, N. Dak.
Heart Butte construction field office	Bayard L. Mendenhall	Acting construction engineer	Glen Ullin, N. Dak.
Minot investigations field office	George J. Cheney	Chief, Investigations Unit	P. O. Box 1869, Minot, N. Dak.
Wolf Point Investigations field office	F. A. Ashury	do	Wolf Point, Mont.
Upper Missouri district	Harold E. Aldrich	District manager	P. O. Box 1629, Great Falls, Mont.
Canyon Ferry construction field office	W. P. Price, Jr	Construction engineer	Canyon Ferry, Mont.
Helena investigations field office	F. V. Munro	Engineer	P. O. Box 1164, Helena, Mont.
Lower Marias investigations field office	T. R. Smith	do	P. O. Box 1729, Great Falls, Mont.
Milk River project field office	Bruce E. Garlinghouse	Superintendent	Malta, Mont.
Sun River project field office	George Ehner	do	Fairfield, Mont.
Tiher Dam construction field office	Walter Sanford	Acting construction engineer	P. O. Box 218, Chester, Mont.
Yellowstone district	Donald C. Ketcham	District manager	P. O. Box 1264, Billings, Mont.
Fort Peck project field office	Merle Rainey	Superintendent of operations	P. O. Box 1245, Fort Peck, Mont.
Hardin construction field office	R. F. Herdman	Construction engineer	P. O. Box 516, Hardin, Mont.
Miles City investigations field office	A. Hugh Whitmore	Field engineer	P. O. Box 720, Miles City, Mont.

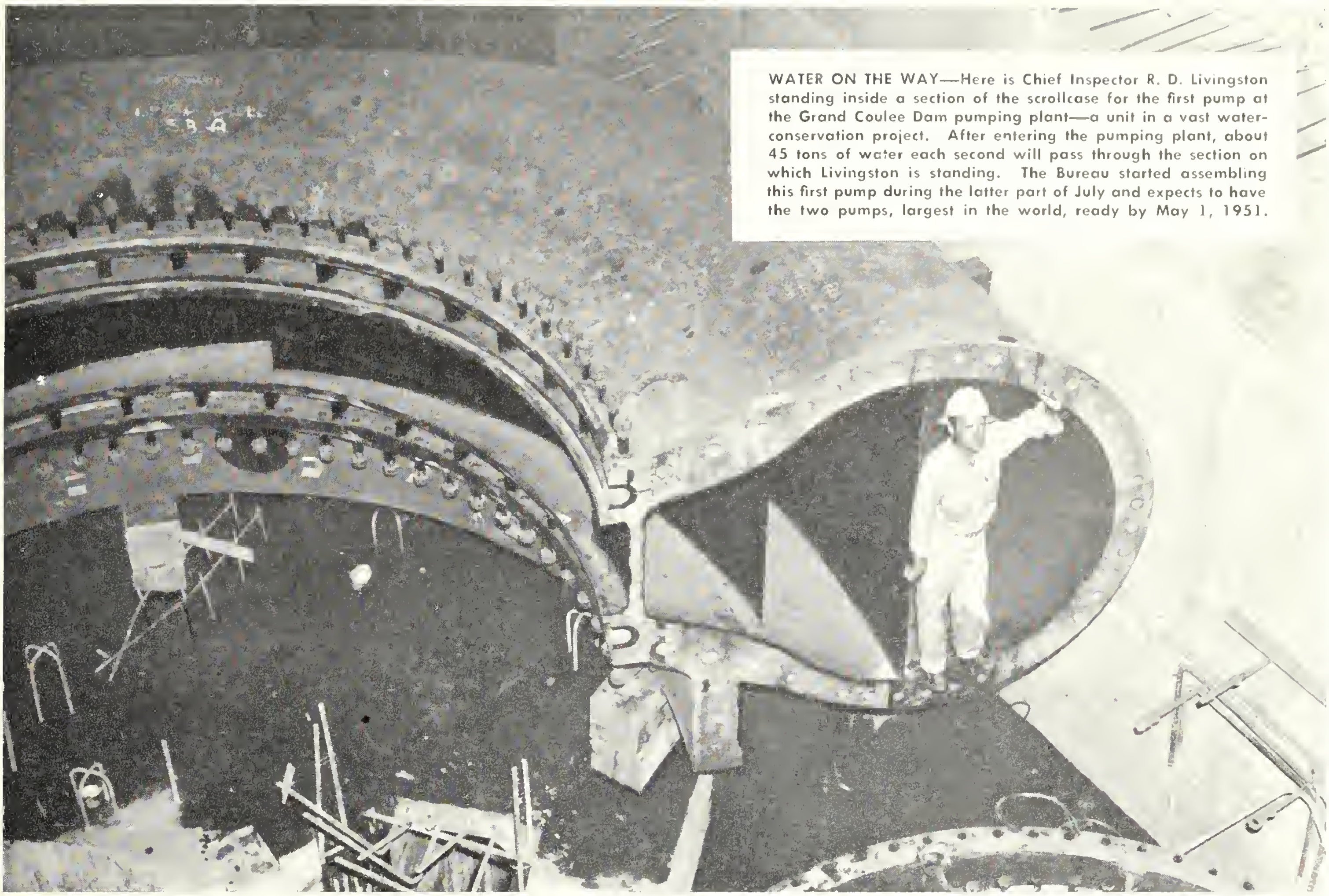
REGION 7: Headquarters, 318 New Customhouse, Denver 2, Colo.

Regional Director, Avery A. Batson; *Assistant Regional Director*, E. V. Lindseth; *Regional Administrative Officer (Administrative Division)*, H. S. Varner, Jr.; *Regional Engineer (Branch of Design and Construction)*, Herhert E. Prater; *Regional O. & M. Supervisor (Branch of Operation and Maintenance)*, John N. Spencer; *Regional Power Manager (Branch of Power Utilization)*, Harold R. Lee; *Regional Planning Engineer (Branch of Project Planning)*, John A. Keimig; *Regional Programs and Finance Officer (Programs and Finance Division)*, W. H. C. Sigerson; *Regional Counsel (Legal Division)*, Clarence Eynon; *Regional Personnel Officer (Personnel Division)*, Albert R. Novak; *Regional Information Officer (Information Division)*, Ralph L. Williams; *Regional Supply Officer (Supply Division)*, William F. Sha; *Regional Safety Engineer (Safety Division)*, Alton T. Cromwell.

Operating Offices	Official in charge		Address
	Name	Title	
Kansas River district	H. E. Rohinson	District manager	P. O. Box 737, McCook, Nebr.
Bonny field office	Clifford L. Mutch	Construction engineer	P. O. Box 67, St. Francis, Kans.
Bostwick field office	Paul E. Strouse	do	P. O. Box 512, Superior, Nebr.
Cambridge distribution system field office	C. M. Jackson	do	Arapahoe, Nebr.
Cedar Bluff field office	R. J. Walter, Jr	do	P. O. Box T, Ellis, Kans.
Enders field office	C. O. Crane	Acting construction engineer	P. O. Box 17, Enders, Nebr.
Medicine Creek field office	William J. Quinn	do	P. O. Box 157, Cambridge, Nebr.
Trenton field office	Ellis L. Armstrong	Construction engineer	P. O. Box 63, Trenton, Nebr.
Lower Platte River area office	P. L. Harley	Area engineer	P. O. Box 997, Grand Island, Nebr.
Niobrara River area office	C. E. Burdick	do	Ainsworth, Nebr.
Mirage Flats field office	George T. Kelly	Irrigation superintendent	Hay Springs, Nebr.
North Platte River district	I. J. Matthews	District manager	P. O. Box 280, Casper, Wyo.
Guernsey field office	K. K. Korher	Superintendent	Guernsey, Wyo.
Kortes field office	C. S. Rippon	Construction engineer	P. O. Box 280, Casper, Wyo.
Transmission Lines field office	Othello F. Tucker	do	Do.
Torrington field office	C. M. Rader	Engineer	Torrington, Wyo.
South Platte River district	J. H. Knights	District manager	Bldg. 10, DFC, Denver, Colo.
Estes Park field office	F. K. Matejka	Construction engineer	P. O. Box 996, Estes Park, Colo.
Fort Collins field office	C. E. Klingensmith	Construction engineer	P. O. Box 551, Fort Collins, Colo.
Fort Morgan field office	Roh Roy Buirgy	Acting resident engineer	P. O. Box 152, Fort Morgan, Colo.
Grand Lake field office	U. V. Engstrom	Construction engineer	Grand Lake, Colo.
Kremmling field station	B. B. Dawson	Resident engineer	Kremmling, Colo.
Loveland field office	G. R. Highley	Construction engineer	P. O. Box 449, Loveland, Colo.
Upper Arkansas River area office	B. F. Powell	Area engineer	P. O. Box 515, Puehlo, 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.
Belle Fourche	Belle Fourche irrigation district	Newell, S. Dak	Oliver G. Rose	do	Vern Hafner	Newell, S. Dak.
Bitter Root	Bitter Root irrigation district	Hamilton, Mont	Pearl Wilcox	Supt	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	Supt	H. W. Van Slyke	Notus, Idaho.
Burnt River	Burnt River irrigation district	Hereford, Oreg	Edward Sullivan	Manager	Harold Hursh	Huntington, Oreg.
Carlsbad	Carlsbad irrigation district	Carlsbad, N. Mex	J. C. Howard	do		Carlsbad, N. Mex.
Deschutes (Crane Prairie Storage)	Central Oregon irrigation district	Redmond, Oreg	O. E. Anderson	Supt	J. M. Shively	Redmond, Oreg.
Deschutes (Arnold irrigation district)	Arnold irrigation district	Bend, Oreg	Kenneth Slack	Manager	J. F. Arnold	Bend, Oreg.
Deschutes (Grants Pass irrigation district).	Grants Pass irrigation district	Grants Pass, Oreg	Ted M. Hon	Secretary-Manager.	Ted M. Hon	Grants Pass, Oreg.
Deschutes (Ochoco Dam division)	Ochoco irrigation district	Prineville, Oreg	La Salle E. Coles	do	La Salle E. Coles	Prineville, Oreg.
Frenchtown	Frenchtown irrigation district	Frenchtown, Mont.	Arthur Donlan	President	Ralph P. Scheffer	Huson, Mont
Fruitgrowers Dam	Orchard City irrigation district	Austin, Colo	Frank Hart	Supt	William Griffith	Cory, Colo.
Grand Valley	Grand Valley Water Users' Association	Grand Junction, Colo.	W. J. Chiesman	Manager	C.E. Blumenshine	Grand Junction, Colo.
Grand Valley, Orchard Mesa	Orchard Mesa irrigation district	Palisade, Colo	Leo Brown	Supt	C. J. McCormick	Do.
Grand Valley, Mesa County	Mesa County irrigation district	do	Cecil Jenkins	do	H. B. Smith	Palisade, Colo
Grand Valley, Palisade	Palisade irrigation district	do	S. F. Patterson	do	W. E. Funk	Do.
Humboldt	Pershing County water conservation district	Lovelock, Nev	Robert S. Leighton	Secretary-manager.	R. S. Leighton	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	Supt	Lamont M. Allan	Wellsville, Utah.
Klamath (Langell Valley division)	Langell Valley irrigation district	Bonanza, Oreg	L. L. Crawford	President	C. W. Wooten	Route 1, Bonanza, Oreg.
Klamath (Bonanza Springs division)	Horsefly irrigation district	do	Cecil C. Haley	do	J. F. Heyden	4516 Winter Av., Klamath Falls, Oreg.
Klamath (Lower Klamath Lake division).	Klamath drainage district	Klamath Falls, Oreg.	Dick Hanzel	President	C. L. Langslet	12 Malhase Bldg., Klamath Falls, Oreg.
Klamath (Pumping division—Warren Act contractors).	Pine Grove irrigation district	do	W. E. Cunningham.	do	A. R. Campbell	Route 2, Klamath Falls, Oreg.
Klamath (Warren Act contractors)	Enterprise irrigation district		Burrell Short	do	Floyd D. Short	Route 2, Merrill, Oreg.
Klamath (Warren Act contractors)	Shasta View irrigation district	Merrill, Oreg	J. E. Craven	do	O. W. Brickner	Merrill, Oreg
Klamath (Warren Act contractors)	Malin irrigation district	Malin, Oreg	J. E. Robinson	do	Mark Evans	Malin, Oreg.
Lower Yellowstone	Districts 1 and 2	Sidney, Mont	E. M. Gardner	Manager	E. M. Gardner	Sidney, Mont.
Milk River (Chinook division)	Alfalfa Valley irrigation district	Chinook, Mont	A. L. Benton	President	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	Supt	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 (South Side 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	B. W. Powell	do	Nancy M. Haddock	Gooding, Idaho
Minidoka (Upper Snake River Div.)	Fremont-Madison irrigation district	St. Anthony, Idaho	Melvin Luke	do	R. Willis Walker	Rexburg, Idaho.
Moon Lake	Moon Lake Water Users Association	Roosevelt, Utah	Louie Galloway	do	Louie Galloway	Roosevelt, Utah
Newlands	Truckee-Carson irrigation district	Fallon, Nev	Phillip Hiibel	Supt	J. R. Hannifan	Fallon, Nev.
Newton	Newton Water Users Association	Newton, Utah	Jessie B. Barker	President	Joseph R. Tuddenham.	Newton, Utah
North Platte (Interstate division)	Pathfinder irrigation district	Mitchell, Nebr	G. H. Storm	Manager	Emily M. Knoepfel	Mitchell, Nebr
North Platte (Fort Laramie division)	Gering-Fort Laramie irrigation district	Gering, Nebr	T. P. Winchell	Supt	Charles G. Klingman.	Gering, Nebr.
	Goshen irrigation district	Torrington, Wyo	Harry Kelly	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.
Post Falls	Post Falls irrigation district	Post Falls, Idaho	Howard McGinley	President	Ben Morehouse	Provo, Utah.
Provo River (Deer Creek division)	Provo River Water Users Association	Provo, Utah	J. W. Gillman	do	E. A. Jacob	Phoenix, Ariz.
Rathdrum Prairie (Hayden Lake unit)	Hayden Lake irrigation district	Hayden Lake, Idaho	Lee Robinson	Chairman	Hulda Pfrimmer	Hayden Lake, Idaho.
Salt River	Salt River Valley Water Users Association	Phoenix, Ariz	R. J. McMullin	Irrigation 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	A. N. Smith	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	Charles H. Burris	do	William P. Peebler	Deaver, Wyo.
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.
Umatilla (Warren Act contractors)	Stanfield irrigation district	Stanfield, Oreg	Emmett Myers	Supt	Mabel M. Richards.	Stanfield, Oreg.
Umatilla (Warren Act contractors)	Westland irrigation district	Hermiston, Oreg	Ed Nunn	Manager	Al Langenwalter	Hermiston, Oreg.
Uncompahgre	Uncompahgre Valley Water Users Association	Montrose, Colo	Jesse R. Thompson	do	H. D. Galloway	Delta Colo.
Vale	Vale Oregon irrigation district	Vale, Oreg	Walter C. White	do		
Weber River (Salt Lake Basin)	Weber River Water Users Association	Ogden, Utah	D. D. Harris	do	D. D. Harris	Ogden, Utah.
Yakima (Kittitas division)	Kittitas reclamation district	Ellensburg, Wash	G. L. Sterling	do	G. L. Sterling	Ellensburg, 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	Clifford Kail	do	Clifford Kail	Yakima, Wash.



WATER ON THE WAY—Here is Chief Inspector R. D. Livingston standing inside a section of the scrollcase for the first pump at the Grand Coulee Dam pumping plant—a unit in a vast water-conservation project. After entering the pumping plant, about 45 tons of water each second will pass through the section on which Livingston is standing. The Bureau started assembling this first pump during the latter part of July and expects to have the two pumps, largest in the world, ready by May 1, 1951.

CONSERVATION of Water Resources

by W. W. JOHNSTON, Project-Development Supervisor, Columbia Basin Project, Ephrata, Wash., Region 1 (headquarters at Boise, Idaho)

Conservation is all things to all people. To the thoughtful man, it is the means of preserving and enhancing our national wealth. To the indifferent man, it is a vague and shadowy concept having something to do with saving what we have and anyway, he is in favor of it. To the exploiter, it is a threat to which he must be careful to give lip service.

All persons, even the exploiter, probably agree that a widespread intelligent awareness of conservation in all its aspects is a commendable goal, and an initial step in achieving an understanding of the subject is to define it. One of the best interpretations to come to my attention is contained in a January 1931 report to the President of the United States submitted by the Committee on the Conservation and Administration of the Public Domain. This Committee, headed by the Secretaries of the Interior and Agriculture, stated that:

* * * waste of any natural resource, whether it be one not replaceable because the alchemy of nature cannot be duplicated or one renewable by natural processes of growth and rebirth, is a wrong to the generations who will succeed us. The aim of each generation therefore should be to reduce waste to a minimum and to eliminate it where possible. At least, conservation carries a mandate to that extent.

"But there is a distinction between wanton waste and that which is not voluntary and results from imperfect and inefficient methods of production and utilization in industry and from overproduction. The first can be remedied by invoking the police powers of Nations and State; the second, only by the education of our people under an enlightened and courageous leadership."

In the Pacific Northwest, we have come to realize finally that water is the irreducible basic resource. What is done with it is of paramount importance and the nature of its use determines the extent of an expanding or a crippled economy.

To residents west of the Cascades the chief water problem is one of eliminating excesses. To dwellers east of the mountains the problem is one either of actual or economic shortages, with the latter of concern where excessive costs make it difficult to match need with available supply. But all persons should be concerned with the whole water problem because each State is an integrated economic unit and not a series of isolated economic islands. As a matter of fact, regional thinking is required because of the Columbia River; it weaves a thread—a lifeline that ignores commonwealth boundaries.

The spectacular aspects of the Columbia Basin project tend to obscure older and well-established irrigated farming areas where the water-scarcity problem either has been solved or is tolerated. As an example, the Tieton Division of the Yakima project, obtaining its water from a Columbia River tributary, found it necessary to operate with a limited supply. The efficient use of water was an important factor in making it possible for this Federal irrigation unit to become the first in the West to repay its entire construction obligation.

To promote similar efficiency in remaining areas to be irrigated by Columbia River water, extensive efforts are being made to encourage correct water use. Overirrigation is costly to the farmer particularly in that his profit is reduced by excessive operating costs, the productivity of his land is impaired, and ultimately, difficult drainage problems are created to jeopardize not only his property, but other land.

To further the maximum use of land and water resources, the Bureau of Reclamation plan for developing the Columbia River Basin proposes the ultimate irrigation of 5,360,000 acres of which 3,840,000 acres would be new land. Water would be supplied to 1,520,000 acres needing a supplemental supply, and diking and drainage would reestablish the usefulness of 565,000 acres. In terms of people, this means the creation of from 50,000 to 70,000 farms with an attendant quarter of a million new farm residents. Benefits from a development of this order spread until the basis of support is provided for a million persons throughout the United States. Annual benefits from irrigation alone would total more than 200 million dollars.

At the present stage of water-resource development, irrigation and low-cost hydroelectric power production are inseparable factors. In several instances the power is necessary not only to pump water but power revenue is essential to pay a substantial portion of irrigation construction costs. The Bureau's plans for power generation on the Columbia include the ultimate production of 55,600,000,000 kilowatt-hours of firm energy and approximately 9 billion kilowatt-hours of secondary energy annually. Aside from irrigation, the need for additional electric power for agriculture, industry, and other uses may never be satisfied by known existing sources.

Considering the central Washington area, the comparable irrigable area for which it is economically possible to supply water totals more than 1 million acres. The power potential amounts to more than 6⅔ million killowatts of installed generating capacity without taking into account generation at upstream storage and control reservoirs considered essential for the ultimate maximum utilization of Columbia River water.

Other conservation factors stemming from the controlled and multiple use of water include the Columbia River fisheries program, new and enlarged wildlife habitats, new and expanded recreational facilities, navigation, and flood control. From the standpoint of plans proposed for control of the Columbia River, the menace of floods on the lower reaches of the Columbia and its major tributaries would be largely eliminated by the construction of upstream multiple-purpose dams and reservoirs.

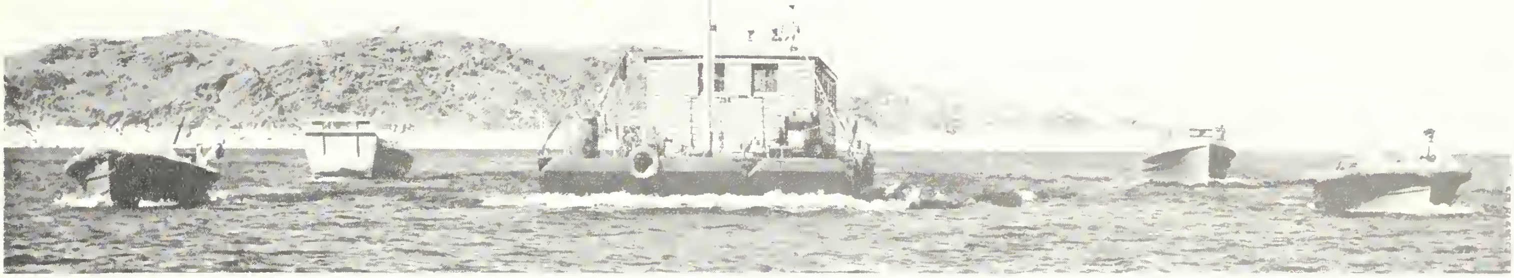
Considering water as a part of the general conservation problem, the outstanding needs in preserving our natural resource heritage are (1) a thorough and comprehensive understanding of the problem in all its aspects, (2) a discriminating knowledge of the best current and impartial thinking on the subject, and (3) a sense of social consciousness and responsibility instilled in those whose task it will be to safeguard water, oil, coal, forests, soil, and all the other natural resources.

Some conservation education is an inevitable byproduct of the work of agencies concerned with these resources. However, the schools of Washington and the Pacific Northwest have a definite long-range responsibility for making students and parents conscious of resource development, and the importance to them of the wise use of natural resources.

A growing realization of water's actual and economic scarcity is the first step on the road to its wise use. THE END

WATER AT WORK—on the Moses Lake Development Farm on the Columbia Basin project. On a "seeing's believing" basis, the Moses Lake Farm demonstrates cropping practices, fertilizers, and irrigation methods to help guide settlers who will move to the million-acre expanse in coming years.

Solving the Silt Mystery



The Navy also serves in time of peace. Here's the fleet on silt maneuvers at Lake Mead in March 1948. *Photo by William S. Russell, Region 3 photographer.*

Sedimentation Tests Show Reclamation Reservoirs Have Centuries of Usefulness

New and dramatic scientific research reveals that Hoover Dam, on the Colorado River, has a useful life of at least 275 years regardless of river-carried silt deposits. The case history study of the Nation's greatest reservoir exposed many uninformed estimates of Lake Mead siltation as extravagant and groundless. Similar findings are resulting from studies on other Reclamation reservoirs.

New and revealing information on silt was obtained primarily from investigations for the Bureau of Reclamation by the Geological Survey, with the aid of the Navy Department, on Lake Mead which has a storage capacity of 31,142,000 acre-feet, the large artificial lake behind Hoover Dam. During the past 2 years, these agencies have been probing the bottom of the lake, using various wartime Navy techniques developed to locate submarines and sunken ships and to chart the ocean floor.

Preliminary results of the investigations show that silt has been deposited in the reservoir at an annual rate of 105,500 acre-feet since water storage was started in 1935. The actual measurement, after 15 years operation, establishes deposits approximately as the Bureau of Reclamation calculated before it built the dam.

Some misinformed people have thought it is wasteful to build big dams, such as Hoover, because they will soon be ruined by silt. These studies definitely disprove that theory.

While conservation measures should be taken to keep silt on the land, where it belongs, Hoover Dam is not in jeopardy from it. At the present rate, it would take until the year

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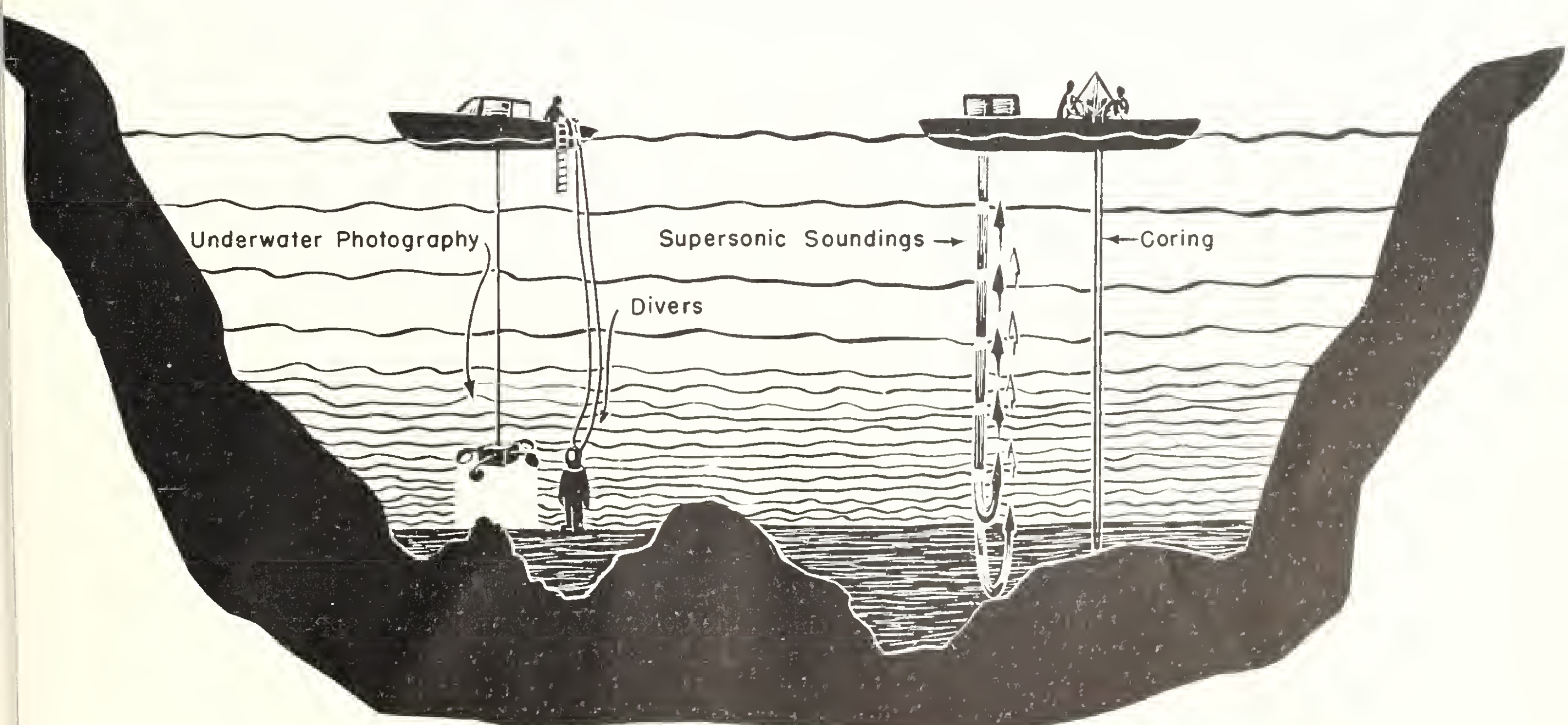
HEARD and SEEN—This drawing by the Bureau's Graphic Section shows just how the scientists tap the secrets of silt.



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SHASTA DAM IN ALL ITS SPLENDOR—This night shot of the world's second highest dam was taken from a vista point along the scenic highwoy. *Photo by Region 2's Chief Photographer, Ben Glaha.*

Only the beginning . . .

Excerpts from oddress by Assistont Secretary of the Interior Williom E. Worne at dedication of Shosta Dam, Calif., 11 a. m., June 17, 1950.

It is appropriate that we should dedicate Shasta Dam in June of 1950. For this is California's Centennial year as a State and today is the forty-eighth birthday of the Reclamation Act. It was this act, signed by President Theodore Roosevelt in 1902, that opened the way for us to develop California's water resources on a broad scale and thus mightily help to lay the basis for the State's future growth and prosperity. And it was under this and later laws that we began building the Central Valley project, of which Shasta Dam, as you know, is the key water conservation feature. * * *

The development of irrigation in California, and the transformation of the Central Valley from a waste of deserts and swamps to one of the richest agricultural areas in the country, is a dramatic story.

The settlers who poured into California by the thousands in the wake of the gold rush found little free public lands awaiting them. Vast acreages beckoned the plow, and there was ample water in the streams. But most of the good agricultural lands were owned by a few people. Some of these had been given land grants by the Spanish and Mexican Governments before California joined the Union; others obtained large tracts by grabs after California became part of the United States.

When settlers found they could not buy farms without paying tribute to land speculators, tensions and unrest grew. Land hunger in some instances led to bloody conflict, as in the squatters' riot in Sacramento in 1850. * * *

A complex of water rights problems bred further strife and confusion. As the placers gave way to hydraulic mining, for example, there was bitter competition between miners and farmers for the use of water. In quest of gold, men tore away the soil with powerful streams of water, and the silt and sludge—known as "slickens" in those days—clogged the river channels and overran the fields. Then spring freshets pouring down the clogged streams brought floods in their wake. Hydraulic mining was a bonanza for the miners, but it spelled disaster to the farmers. Bitter controversy finally resulted in closing down the hydraulic mines until years later provision was made for debris dams in the foothills to protect the valley lands.

In 1887, the California Legislature passed the Wright Act, which paved the way for the organization of the modern irrigation district, through which the people could use the powers of government to help them develop water resources. This act provided for relief from the arbitrary exactions of companies that controlled the canals. In addition, it gave men of small means a chance to join in the development of irrigation and to get the capital to build dams, reservoirs, canals, and other works. The Wright Act, serving as a model for similar laws in other States, significantly influenced the development of the West.

By the turn of the century, a million acres of land in the Central Valley had been placed under irrigation. Yet only a start had been made toward broad development of water resources. As the population of the Valley grew and water needs increased, more complicated and more costly irrigation systems, involving storage of flood waters, became necessary. Water companies were formed and large amounts of capital were invested in irrigation enterprises. * * *

Although a number of studies of the water resources of the Central Valley were carried out by Federal agencies between 1900 and 1930, it was Col. Robert Bradford Marshall who first conceived the Central Valley project. (See January 1950 issue of the RECLAMATION ERA for his nomination to Reclamation's Hall of Fame—Ed.) One of the Nation's outstanding geographers, he carried on irrigation and power surveys in the Sacramento and San Joaquin Valleys for more than a quarter of a century, and his plan for a vast system of dams, canals, and hydroelectric power plants was later adopted by both State and Federal Governments without substantial change. From it grew the State water plan and the Central Valley project that we know today. In 1933 the Central Valley project was approved by the legislature and later by popular vote on a State-wide referendum.

At the instance of the State of California, the Central

(Please turn to page 182)

Reclamation Power Production Heading For New High

Power production, which hit a new peak on multipurpose Federal reclamation projects during the last fiscal year, is already heading for a new high mark this fiscal year as national security efforts are stepped up, according to a recent announcement by Secretary of the Interior Oscar L. Chapman.

The Bureau of Reclamation began this fiscal year, last July 1, with the highest installed power capacity on record, 3,218,400 kilowatts, Secretary Chapman said, and it is anticipated that 663,100 additional kilowatts generating capacity will be installed this fiscal year.

"As a matter of fact," Secretary Chapman said, "another 108,000-kilowatt-capacity generator at Grand Coulee has already gone on the line this year and there is hardly a month between now and next July when some new generator will not start turning, on one reclamation project or another."

Commissioner of Reclamation Michael W. Straus advised Secretary Chapman that the 663,100 kilowatts of added capacity, which will mean a total of 3,881,500 kilowatts productive capacity by next July 1, is scheduled to go on the line according to the following schedule:

Grand Coulee—108,000 kilowatts added in July; 108,000 kilowatts in October; 108,000 kilowatts next April, and a 10,000-kilowatt-station service unit in September.

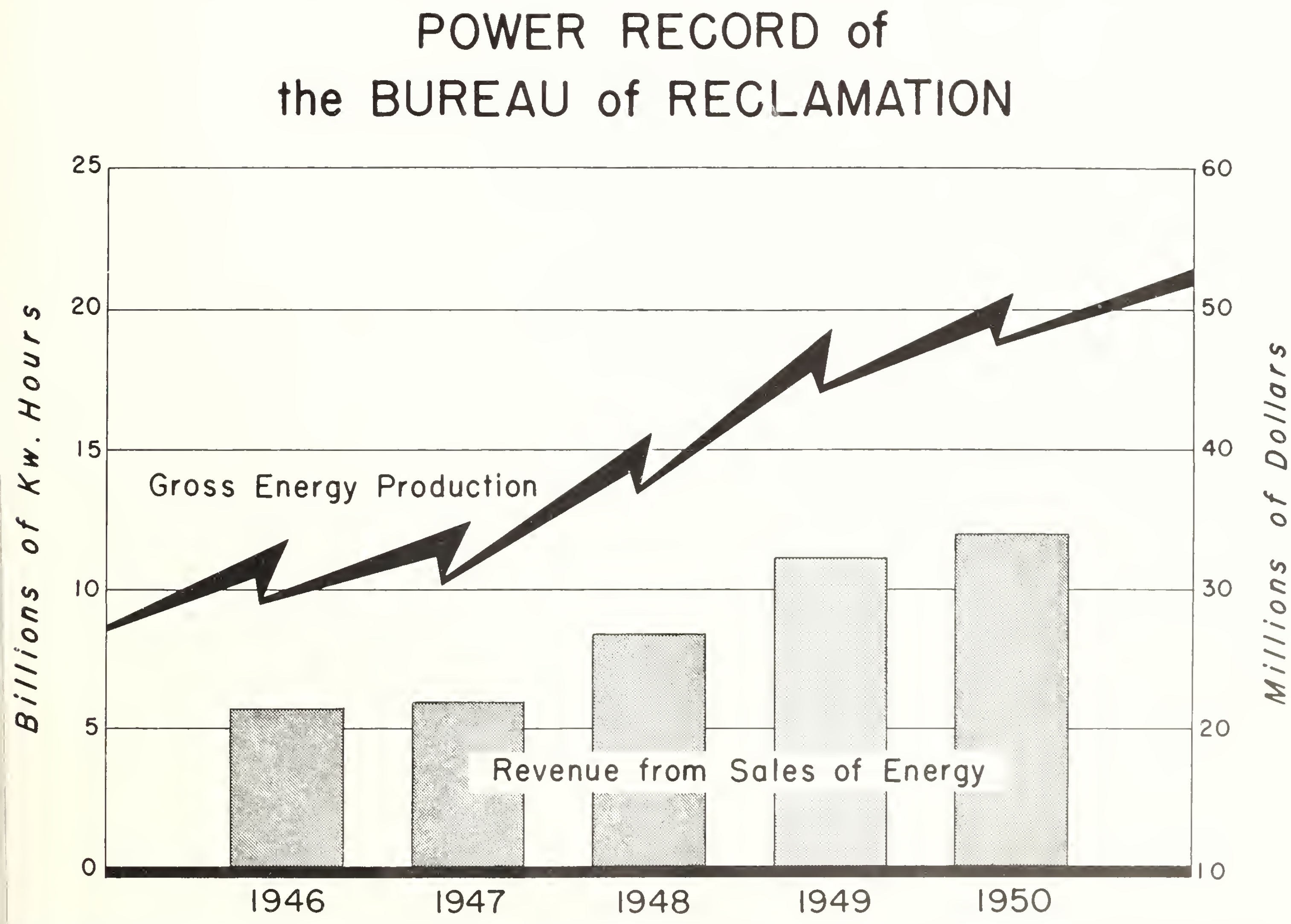
Anderson Ranch Dam in Idaho—13,500 kilowatts in September and 13,500 in December.

Davis Dam, on the Colorado River, between Arizona and Nevada—15,000 kilowatts each in February, March, April, May, and June, or a total of 225,000 kilowatts for this new plant.

Marys Lake hydroelectric plant, on the Colorado-Big Thompson project—8,100 kilowatts in August.

Estes hydroelectric plant, also on the Colorado-Big Thompson project—15,000 in August and 30,000 in September.

Kortes Dam, on the North Platte River, in Wyoming—12,000 already added in July, to the first 12,000-kilowatt generator which went on the line in June, and 12,000 in November, or a total from this plant of 36,000 kilowatts. Kortes is the first power plant authorized as a part of the Missouri River Basin project to go into production.



FIVE YEARS OF POWER PRODUCTION by the Bureau of Reclamation reveals the following facts in output and revenue for the fiscal years 1946–50: 1946, 11,449,-276,184 kilowatt-hours and $21,071,212; 1947, 12,229,590,098 kilowatt-hours and $21,447,800; 1948, 15,413,924,514 kilowatt-hours and $26,222,198; 1949, 18,356,098,684 kilowatt-hours and $31,865,357; and for 1950 the record production of 19,796,568,376 kilowatt-hours and revenue of $33,211,377.

In the meantime, the Bureau is pushing construction on other power plants and further installation of generators at some plants already in operation, to bring in additional productive capacity in future years.

Power production during the past fiscal year totaled 19,796,568,376 kilowatt-hours compared with 18,356,098,684 kilowatt-hours produced in 1949 fiscal year. These totals include power generated by other federally operated plants which was marketed by the Bureau of Reclamation. Revenue returned to the Federal treasury from the sale of this power totaled $33,211,337, compared with $31,865,357 a year ago. The total production was sufficient to have supplied a highly industrialized city of nearly 4,000,000 people or 8 residential cities the size of Washington, D. C.

Of last year's record-breaking installed generating capacity in reclamation plants of 3,218,400 kilowatts, 411,000 kilowatts were installed during the fiscal year, including 324,000 kilowatts in three more generators at Grand Coulee, installation of three generators with a combined capacity of 75,000 kilowatts at the new Keswick power plant, below Shasta Dam in California, and the first 12,000-kilowatt generator at the Kortes Dam and power plant on the North Platte River in Wyoming.

"This record-breaking year of power production by Federal hydroelectric plants in the Western States," Secretary Chapman said, "has been of invaluable assistance in keeping the wheels of industry turning at a record-breaking peacetime rate and in supplying low-cost power for homes and farms. Now, as we head into a change-over to production for national defense, these great power producers on our western rivers will prove their worth again as they did in the last war."

Secretary Chapman pointed out that Federal reclamation plants now have three times the hydroelectric capacity they had in the last fiscal year before Pearl Harbor.

"In the decade between 1930 and 1940," he said, "the installed capacity of Federal reclamation plants jumped from 106,412 to 850,327 kilowatts. In the decade from 1940 to 1950, Grand Coulee came in to exceed Hoover as the largest hydroelectric power producer in the world with an installed capacity on June 30 of 1,424,000 kilowatts. The Shasta plant in California was completed with 379,000 kilowatts capacity. Keswick has been added to the Central Valley system below Shasta. Parker came into production below Hoover on the Colorado River, the Green Mountain plant produced the first power on the Colorado-Big Thompson project, and Kortes produced the first power on the Missouri River Basin project, to name only a few." •

Reclamation Chiefs Plan Year's Program

A work schedule for the current fiscal year which, it is anticipated, may be Reclamation's largest annual program thus far in developing western water resources was completed by administrators and engineers of the Bureau of Reclamation at Santa Barbara, Calif., during the week of July 24.

The approved program of approximately $400,000,000 is subject to two major considerations. One is the final congressional action on appropriations for the year. The other is the relationship of the Reclamation program to the President's directive to Government agencies to adjust their work schedule to the national defense effort. Among matters considered were possible steps for expediting construction of hydroelectric power plants and other water resource work essential to furthering the national security.

The total program compares with last year's program of $387,000,000. It includes construction work on 75 projects in 17 States including units of the Missouri River Basin project.

The program as planned would bring 57,100 new acres under irrigation this year, add more water for 232,000 additional acres now inadequately supplied, and install 663,100 kilowatts of hydroelectric generating capacity. Furthermore, the work would continue the progress made to complete projects that will yield increasingly greater irrigated acreage and kilowatts of power in succeeding 2 years.

"Though Reclamation is continuing to work in high gear, we are still a long way from catching up with the West's growing demands for water and power," Commissioner Straus stated. "The people out here can put new water and power to work growing crops and producing new wealth at a phenomenal rate."

The construction program will involve work on 32 dams, 11 hydroelectric power plants, and over 4,000 miles of transmission lines, and uncounted miles of canals and laterals to bring the water to the thirsty acres of the Western States. Exact work schedules of the projects will be adjusted according to appropriations as finally approved by the Congress. The specific work to be done on each project will be announced after such adjustments have been made. Like the construction program, the project planning program will extend into virtually every one of the Western States.

"After more than 100 years of effort by private groups and the Federal Government," Commissioner Straus said, "we have barely passed the half-way mark in putting the irrigable land of the West 'under ditch.' At the same time, we have hardly more than scratched the surface in utilizing the power our rivers can supply as they plunge downward from the high mountains to the ocean. That is why the planning for future projects is so important in our operations."

Mr. Straus, in opening the week-long conference on Monday, July 24, told the field executives that the program ahead will require full use and careful coordination of the Bureau's manpower and other resources, for successful accomplishment, explaining that the new format of appropriations, dividing the funds into four general divisions and eliminating the several pages of restrictions and special provisos of former years, gives the Bureau a freer hand to get the job done.

"The freedom and discretion allowed in handling these funds and the lack of restrictions written into the appropriation bill," he told the regional directors, "can be called a vote of confidence by the Congress, but will not be considered a license to do anything that any of us think we should do or would like to do. We will use these funds for exactly what purposes we told the Administration and the Congress we intended to use them." •

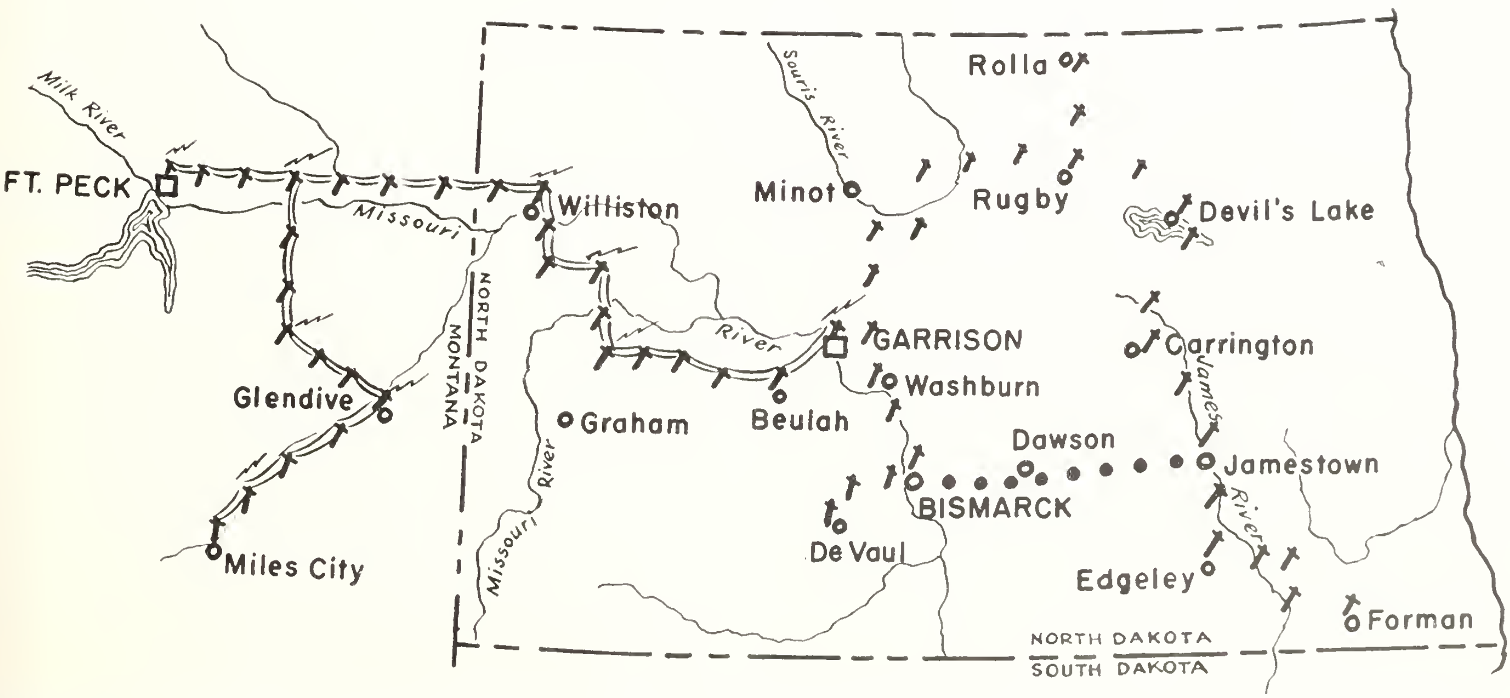
Last Link in North Dakota Public Power System

The contract for the last 98 miles of transmission lines in the 600-mile system now under construction by the Bureau of Reclamation in the State of North Dakota was recently awarded to the Continental Co. of Dayton, Ohio, and the Hallett Construction Co. of Crosby, Minn. The contract provides for the construction of a 230-kilovolt transmission line between Bismarck, Dawson, and Jamestown, N. Dak.

The high-tension lines are part of the Bureau's multiple-purpose Missouri River Basin program and are intended to be available to transmit hydroelectric power as soon as it is available at Garrison Dam now being built by the Corps of Engineers as part of the integrated Missouri Basin program. The generation and distribution of low-cost power to municipalities, public and cooperative utilities organizations, and the consuming public is one of the key objectives of the river development plan for the 10 Missouri River Basin States. The Bureau has contracts with REA's and a private utility in the area which eliminate the construction of hundreds of miles of line which otherwise would have been necessary.

This is the last construction contract needed to close the gap in the Bureau's advance power system program for the Central Power Electric Cooperative in North Dakota. The completed works will make adequate power facilities available to distribute low-cost electric energy from plants belonging to the people to power-deficient farms, homes, and industrial consumers in Burleigh, Kidder, and Stutsman Counties.

Work on the 98-mile line has been split into two sections, namely a line between Bismarck and Dawson and another one from Dawson to Jamestown. The work schedule has also been separated, one providing for the erection of towers and appurtenances, the other for the installation of wires and other necessary equipment. A total of 466 towers ranging from 65 to 105 feet in height will stand sentinel to carry the power across the three North Dakota counties; 232 towers on the Bismarck-Dawson arm, and 234 on the Dawson-Jamestown stretch. ●



HERE'S HOW the job shapes up now. The block dotted line between Bismarck and Jamestown represents the "last link." The poles not connected by transmission lines denote the location of the job now under construction. *Drawing by the Graphics Section of the Bureau of Reclamation's Washington, D. C., Office.*

Final Contract Awarded on Delta Mendota Canal

Farmers of the Central Valley project may look forward to the completion of the last unit of the 120-mile Delta Mendota Canal and its Tracy Pumping Plant in late 1951 or early 1952. The last major contract necessary to complete the gigantic waterway designed to transport surplus Sacramento River water to the thirsty San Joaquin River Basin was awarded on June 29, 1950. Low bidder for the job of building the 12-mile San Luis Wasteway and holding reservoir dike near Volta, Calif., was the Western Contracting Corp. of Newton, Calif.

San Joaquin farmers are already receiving some Central Valley project water for their vineyards, orchards, cottonfields, pastures, and other irrigation ventures as a result of the completion of the Madera Canal, Contra Costal Canal, and part of the big Friant Kern Canal. However, project water cannot be fully distributed throughout the valley until the Delta Mendota Canal and Tracy pumping plant (often called the "heart" of the Central Valley project) are ready to lift and carry Sacramento River water over the hump at its midway terminal between Shasta Dam in the north and the tip of the San Joaquin Valley in the South.

The Tracy pumping plant, second largest water-lift in the world, is scheduled for completion in the summer of 1951. The recent contract called for starting construction on the wasteway in July 1950, and completing the entire job within 20 months. The wasteway will have a capacity flow of 5,000 cubic feet of water per second (equal to the amount of water carried by the Friant-Kern Canal) and will serve as a safety valve to handle any waterflow in excess of the canal capacity (4,600 cubic feet per second). The wasteway will thus prevent damage to the canal and adjoining property, as will the holding reservoir which is designed to retain peak waterflows and prevent floods along Los Banos Creek in the San Joaquin Valley.

With the completion of this contract, project-wide distribution of water by the Central Valley project will be made possible. Water will be boosted by the Tracy Pumps into the Delta Mendota Canal which will carry it south into the San Joaquin River system, providing irrigation water for more than 300,000 acres of land in the San Joaquin Valley, now suffering from insufficient moisture and ground-water depletion, due to the unequal distribution of irrigable land and irrigation water in the Central Valley.

Two-thirds of the water and only one-third of the irrigable land are located in the northern Sacramento River Valley, while only one-third of the water and two-thirds of the land are in the San Joaquin, or southern part of the Central Valley. Completion of the project means redistributing the water wealth, and sending it where it is needed. In addition to performing a water conservation and distribution feat through the 500-mile length of the Central Valley, the longest distance man has ever transported mass quantities of water, the Central Valley project will provide other multiple-purpose benefits, including flood control, navigation, fish and wildlife protection, recreation, protection against salt-water intrusion, and thousands of kilowatts of hydroelectric energy for farms, homes, municipalities, and industries from power plants at Shasta and Keswick Dam. ●

WATER BALANCING ACT—Central Valley project water will be redistributed by means of the major features portrayed at left. Project-wide distribution of water awaits the completion of the Tracy Pumping Plant and San Luis Wasteway and holding reservoir dike. *Illustration by the Bureau's Graphics Section based on relief map photographed by permission of the copyright owners, Coolidge and Kittredge.*

COACHELLA'S CROPS WERE TOPS—A clue to the record value of crops grown in California's Coachella Valley, of the All-American Canal project, may be found in the symmetrical precision of these protective paper caps over tomato plants and the obviously painstaking attention to detail which makes for successful irrigation farming. *Photo by Harry W. Myers, Region 3 photographer.*

Reclamation Crops—1949

THANK YOU! The RECLAMATION ERA takes this opportunity to express publicly the Bureau of Reclamation's appreciation to those who helped gather and make available the basic data upon which this summary is based. Many thanks to all the farmers on Reclamation projects, members of water users' organizations, and Bureau people who collected and assembled the information, and to the Operation and Maintenance people in the Regional and Washington offices who reviewed, summarized and analyzed project reports. The following article summarizes the highlights of the Bureau's official report, Crop Summary and Related Data, Federal Reclamation Projects 1949.

IN 1949, IRRIGATION FARMERS on 60 projects or divisions of projects received a full or supplemental water supply through facilities constructed by the Bureau of Reclamation.

For the fourth consecutive year, these reclamation farmers produced crops worth more than one-half billion dollars—to be exact, $516,329,008. The record high was $555,420,804 in 1947, and in 1948 the farmers' crops were valued at $534,623,541. Even though prices averaged about 13 percent lower than 1948, the total value of crops produced in 1949 was only 3½ percent less than the previous year.

The average reclamation farmer produced crops worth $105.03 an acre, while the average for 1948 was $113.76 an acre.

California's Coachella Valley farmers, who receive water from the Coachella Division, All-American Canal System (see photo above) won top place with a crop value of $657.74 per acre. Principal crops grown included fruit, truck crops, cotton, vegetables, hay and forage.

With the value of 1949 crops added to the cumulative value of crops grown since irrigation water was first supplied from Reclamation projects in 1906, reclamation farmers have now produced crops worth $6,583,569,996.

Approximately 29 percent of the value reported was vegetable and truck crops, a large portion of which was grown on projects in the Southwest that supply the Nation with fresh vegetables during the off-season winter months. Another 29 percent was composed of hay, forage, and grain crops which are largely consumed by livestock in the producing areas or in feed lots near west coast cities. In the breakdown of the 1949 valuation by major groups given below, cottonseed has been included with other seed crops.

Crop group	*Value*	*Percent of total*
Vegetable and truck crops	$148, 507, 949	28. 8
Hay and forage	89, 891, 939	17. 4
Cotton lint	76, 149, 742	14. 8
Grain crops	61, 657, 904	11. 9
Fruits and nuts	46, 126, 971	8. 9
Seed crops	44, 503, 149	8. 6
Sugar beets	26, 575, 885	5. 2
Other crops	9, 379, 091	1. 8
Subtotal	502, 792, 630	97. 4
Federal and commercial payments	13, 536, 378	2. 6
Total	516, 329, 008	100. 0

VOLUME.—The volume of crops produced in 1949 amounted to 13,225,070 tons which was practically the same as the quantity produced in 1948 and compares with a record volume of over 14.4 million tons in 1946. Vegetable, truck, hay, and forage crops accounted for 59 percent of the 1949 tonnage. The most pronounced shift in volume of production by crop groups from the 1948 pattern was a 30 percent increase in the tonnage of fruit and nut crops. The volume of hay and forage crops increased 11 percent while the volume of sugar beets decreased 17 percent. Seed crops showed a decrease of 8 percent and grains 5 percent.

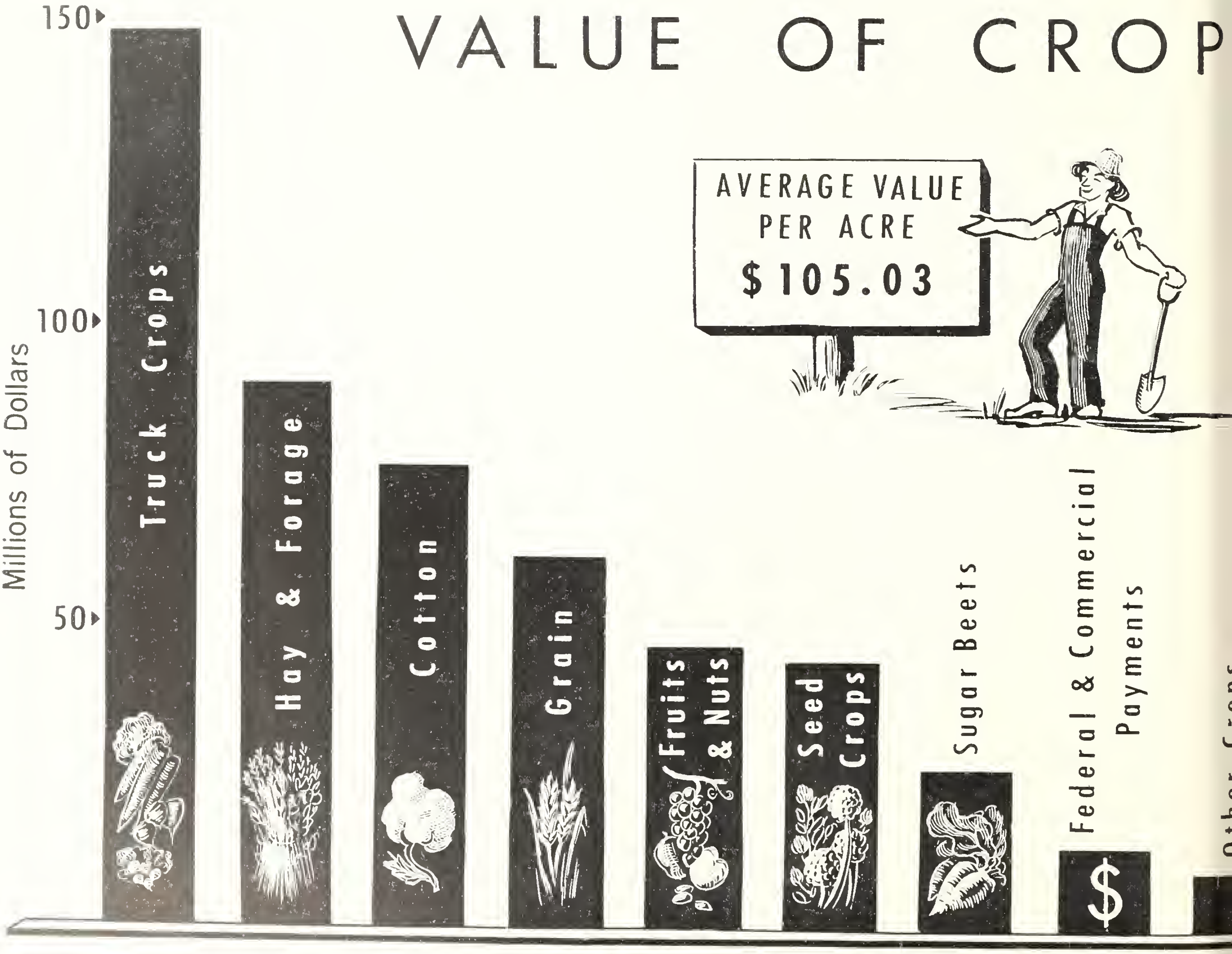
CROP YIELDS.—Irrigation farmers obtained generally favorable yields during 1949. Average yields of grain and forage crops were maintained at the fairly high level obtained in 1948. The 1949 yields were higher than 1948 for alfalfa seed, most vegetable crops, sugar beets, and most of the deciduous fruits, but were lower for potatoes, prunes, and citrus fruits. Water supplies were generally adequate for full crop production except on a few projects.

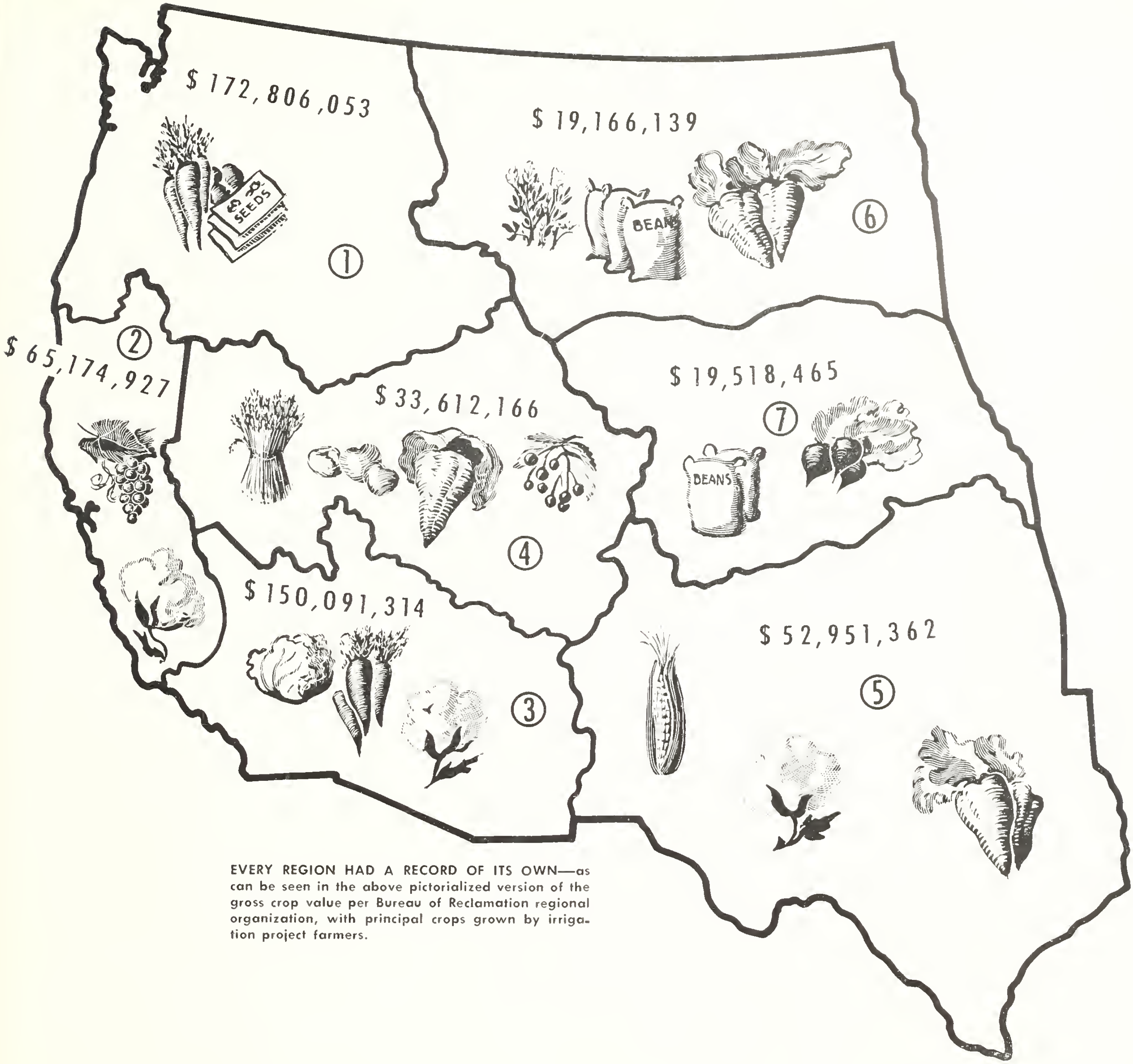
FARM PRICES.—As a whole prices received by farmers on Reclamation projects averaged less than in 1948, which was reflected in the 8 percent reduction in average crop value per acre. The decrease in farm prices from the previous year averaged about 10 percent for grain crops, 15 percent for alfalfa hay, 20 percent for beans, 45 percent for peaches and prunes, 52 percent for apples, and 68 percent for pears.

EXTENSION OF IRRIGATION.—The 4,820,589 acres irrigated on all Reclamation projects in 1949 represented an increase of 261,834 acres from the previous year. Of this land 171,733 acres were reported as receiving a full or supplemental water supply for the first time during 1949 from the federally constructed irrigation systems. It is estimated that an additional 110,000 acres will be supplied for the first time during 1950 with irrigation water.

USE OF PROJECT LANDS.—In the course of operating public lands withdrawn from entry for Reclamation purposes, the Bureau enters into leases and use permits with private individuals for grazing, agricultural, and special use purposes. During 1949, 2,603 leases were in effect covering 1,063,251 acres. Most of the leased land utilized for grazing and special purposes is unsuitable for irrigation farming. Rentals from the land were in excess of 709,000 dollars.

POPULATION.—A 1949 farm population in excess of 246,000 was reported for the 64,000 farms on regular Reclamation projects and a population of about 108,000 for the 27,000 farms receiving a water supply under Warren Act or special contracts. The total farm population for all types of proj-





EVERY REGION HAD A RECORD OF ITS OWN—as can be seen in the above pictorialized version of the gross crop value per Bureau of Reclamation regional organization, with principal crops grown by irrigation project farmers.

ects was 354,000. With the inclusion of units of less than 5 acres and the reporting of number of farms on the same basis as in previous years, the total number for 1949 was nearly 100,000 farms. A population of nearly 1,500,000 was reported for towns located on or adjacent to the irrigation projects. Thus the Reclamation area population totals approximately 1,850,000, an increase of roughly a quarter million from the population estimate for 1948. The population estimates are exclusive of the Central Valley project in California. In addition, it should be recognized that a large number of people in distant cities, towns, and rural areas receive electric energy from hydroelectric plants on Reclamation projects and others benefit directly from flood control and through use of recreational facilities created by storage reservoirs.

The development of irrigation in the West has failed to keep pace with the expanding population of the area, and as a result the west coast market has gradually been extended eastward for many food products. The 1950 civilian population of the 17 Western States was in excess of 33 million, a 24.9 percent increase from 1940. For the country as a whole the reported increase was 14.3 percent. The population of the 11 Western States, which is now close to 19 million, increased by 39.6 percent from 1940.

Livestock and Equipment.—Livestock and equipment on Reclamation farms November 1, 1949, were valued at 220 million dollars which represents approximately the same value reported in November 1948. The value of livestock amounted to 89 million dollars and equipment, 131 million dollars. Tractors, trucks, and other motor vehicles accounted for two-thirds of the inventory value of equipment. Marked increases in inventory values of machinery and equipment on Reclamation projects have occurred in recent years, while in 1949 the increase amounted to only 4 percent. The small increase in valuations for the 1949 season indicates that project farmers may have largely replaced the machinery worn out during the war years.

Seventy-six percent of the livestock inventory value was represented by cattle. Sheep accounted for 12 percent of the inventory value, poultry 5 percent, hogs 3 percent, horses and mules 3 percent, and miscellaneous livestock 1 percent.

1949 Highlights by Regions

REGION 1.—Projects in region 1 accounted for 40 percent of the crop acreage and about 34 percent of the crop value reported in 1949 for all Reclamation lands. The nearly 173 million-dollar crop income for the region was about 15 percent less than in 1948 while the net increase in cropped acreage amounted to 40 thousand.

The first important use of project water on the Columbia Basin project occurred in 1949 with the irrigation of an additional 2,130 acres in the Pasco pumping unit. Over 50 percent of the acreage was used for production of vegetable and seed crops. Water was available to the entire 50 thousand acres in the North unit, Deschutes project, for the first time during the 1949 irrigation season. With the development of irrigation on the North unit, there has been a marked increase in livestock production.

Crop values of about 20 percent less than in 1948 on the Yakima project were mainly due to lower income in the fruit industry. A reduction in crop value per acre of 14 percent from the 1948 level on the Boise project resulted largely from lower prices. The percentage of land in row crops on the project remained relatively stable. The average crop return per acre on the Minidoka project was less than in the previous year. However, the Hunt unit, Gooding division, which is now in the development stage, had increased returns.

REGION 2.—The year 1949 was generally favorable for crops on projects in region 2. The crop income of slightly more than 65 million dollars represented nearly 13 percent of that reported for all Reclamation projects. Cotton was the most important crop reported from both an acreage and value standpoint. Prices received for specialty crops declined about 8 percent from the 1948 level.

Water deliveries were made from the Friant-Kern Canal of the Central Valley project to the following four additional irrigation districts during 1949: Orange Cove, Ivanhoe, Lindsay-Strathmore, and Tulare. For the entire project, the increase in crop value from 1948 to 1949 amounted to 17 million dollars with an additional cultivated acreage on the project of nearly 120 thousand. In the San Joaquin Valley of the Central Valley project, lower prices were received for deciduous fruits, nuts, and cotton. With the rapidly expanding use of mechanical cotton pickers, it is estimated that one machine was available for each 1,000 acres in the San Joaquin Valley in 1949. A new Acala variety of cotton, "4-42," has been selling well because of its greater textile strength.

Returns to individual farmers on the Klamath project were more variable than usual because of the effects of frost damage particularly on potatoes. On the Orland project a good yield of almonds coupled with a favorable price for the crop plus high returns from olives about offset the lower returns from citrus resulting from frost damage.

REGION 3.—Crops produced on Federal Reclamation projects in region 3 in 1949 were valued at 150 million dollars, an average value of \$178 an acre for the 844,000 acres in cultivation. The total represents 29 percent of the 1949 valuation of crops from all Reclamation areas, while the acreage in cultivation for the region was 17 percent of the total of all areas.

Crop values averaging \$658 an acre in the Coachella Division, All-American Canal System, were the highest for any Bureau project in 1949. Of the 21,183 acres irrigated in the Coachella Valley, 5,672 received a full or partial water supply from the Bureau-constructed system. By the end of the year, 153 miles of laterals had been completed which are capable of serving 25,000 acres.

In response to changing price relationships and somewhat improved water supplies, farmers on the Salt River project during 1949 increased the acreage in vegetable crops by 24 percent, more than doubled the acreage of cotton and increased plantings of alfalfa by 11 percent. These shifts were brought about largely through a reduction of acreage in grain crops. During the year the Salt River Valley Water Users' Association, which operates the project, drilled additional wells to augment the water supply and continued efforts to increase precipitation on the watershed by artificial methods.

Fifty percent of the total crop value on the Yuma project was from the sale of head lettuce which is harvested during the winter months. The Yuma growers benefited from severe freezes in competing areas during January 1949, which resulted in high prices for both lettuce and citrus. A marked increase in cultivated acreage on the Reservation Division occurred with improvement of drainage facilities and execution of long-term leases for development of Indian lands by white operators.

Favorable crop returns were received by the 54 homestead entrymen who operate most of the acreage under irrigation on the Yuma Mesa portion of the Gila project. Production on farms where alfalfa was harvested only for hay averaged nearly 6 tons to the acre.

REGION 4.—Crop values on a number of projects in region 4 were adversely affected by the drop in prices of deciduous fruits. However, the 1949 valuation of 33.6 million dollars was only 8 percent less than in 1948.

Irrigation water from Jackson Gulch Reservoir was first made available to the Mancos project lands in Colorado on July 29, 1949, and by the end of the year many water users expressed themselves as satisfied that the supplemental water supply would more than pay for itself from increased yields. Crop values on the Grand Valley project were the lowest in 8 years because of the break in the price of deciduous fruits. However, better than average yields were obtained. A large number of feeder lambs were fattened in the area during the year. On the Uncompahgre project, sugar beets produced a record tonnage of 14.6 per acre, the highest average yield ever reported for the area. For the Pine River project, unusually high yields for hay and grain resulted in the second highest crop value in 1949 since the initial crop report was made in 1940.

The Truckee River Storage project lands adjacent to the cities of Reno and Sparks are rapidly being subdivided into residential and industrial sites. Nearly half of the cultivated acreage on the Humbolt project was in alfalfa and a bumper crop was produced.

For the seventh consecutive year, farmers on the Weber River project in north central Utah have reported an average return of more than \$100 an acre on about 91,000 acres. As a result of low market prices, about 80 percent of the apricots, 30 percent of the peaches, and 25 percent of the cherries on the Ogden River project were not harvested. With a marked increase in yields, crop values on the Scofield project were only slightly lower than the record crop of 1947. According to the Secretary of the Provo River Water Users Association, most of the apricots and prunes, many apples, and some peaches were not harvested because of market conditions.

REGION 5.—The 1949 crop year was characterized by large increases in the acreage in cotton and with lower prices for most crops. The acreage irrigated on projects in the region increased by nearly 33,000. The 1949 crop value for region 5 projects of nearly 53 million dollars represents slightly more than 10 percent of the value from all projects.

Irrigation water was available to all of the land in the W. C. Austin project in 1949 and water was supplied to about 75 percent of the irrigable acreage. Rapid progress is being made in the development and settlement of Tucumcari project lands; however, in 1949 crop yields were impaired by lack of adequate land preparation and from inexperience of the irrigators. Sugar beets and broomcorn were new crops on the project in 1949. With adequate irrigation water supplies on the Carlsbad project in 1949, crop values were higher than in the previous year. Increased crop returns on the Rio Grande project were attributable mainly to an expansion in cotton acreage. On the Fort Sumner project, crop values were less than could have been secured with an adequate water supply.

REGION 6.—Projects in region 6 reported a 1949 crop value of \$19,166,-139 which represented an average return of \$44 an acre for the 434,000 acres in crop. This compares with a total crop value of \$18,949,414 in 1948 and a per acre value of \$43.

Lower prices were received in 1949 for grains and beans which for the region were offset by increased production of sugar beets and higher forage crop prices. The leading crops from the standpoint of value were grains and sugar beets which were of about equal importance and made up over half of the total.

REGION 7.—The 1949 crop value for projects in region 7 of \$19,518,465 was 96 percent of that reported in 1948. Returns per acre averaged \$56 and \$59, respectively, for the 2 years.

The season was generally favorable for crops on the North Platte project. However, the quality of the bean crop was inferior to previous years because of rust and blight. Introduction of safflower into the cropping pattern of the valley should tend to equalize the demand for irrigation water and labor as the crop requires irrigation ahead of the peak demand on beans, beets, and potatoes. Bean yields on the Mirage Flats project were reduced nearly one-half from the average in 1948 by rust damage. On the Kendrick project the effect of lower prices on crop income was more than compensated for by higher yields for most crops. A comparison of production on land dry farmed with irrigated land emphasizes the complete dependence of the Kendrick f. rmers on irrigation to assure satisfactory crop yields.

THE END

Modern Haymaking

Two tractor-mounted buckrakes and an overshot stacker in the upper left photo bring up the hay as fast as three-man crew can lay the stack—possibly the fastest way. Rackless trailer, in combination with self-tying pick-up baler, saves extra work of picking up bales in the field (at top). Field chopper with wagon trailer is fast labor-saving one-man machine. Last Roundup—Stationary blower carries chopped hay from wagon to mow. *Photos by Woltner, courtesy of the Dakota Farmer.*

The old "armstrong" methods of stacking and loading hay have largely disappeared. A few farmers still put up hay, usually small acreages, the hand pitching way, but faster and less laborious methods are generally used.

How you put up your hay—by stacker, baler, or field chopper, is a matter of personal preference. Each method has points in its favor, as well as possible disadvantages.

Probably the haybuck and overshot stacker combination is the fastest method of getting up the hay. A large acreage can be taken care of in a short time—often an important factor when rainy weather must be reckoned with. However, when field-stacked, the hay must be handled more times than by other methods, for there is still the work of loading the stacks on racks and hauling to feed lots, unless the cattle are allowed to range to the stacks for winter feeding.

Next to stacking, baling is second in speed, and many prefer handling baled hay, both at putting up time and in feeding. Much less storage space is required, of course, than for loose hay. The bales are easy to stack and to move wherever needed for feeding and, with legume hay, there is much less loss of leaf than with loose hay. One disadvantage of bales is their weight, which makes rather heavy work in handling, and whole-hay bales require effort in tearing apart at feeding time. The newer sliced bales make feeding easier. A pickup baler used to take a three-man crew—one man on the tractor and two to tie, but the newer self-tying balers reduce this to a one-man job, and using a trailer wagon behind the baler saves the extra operation of picking up bales from the ground.

Boosting bales to the loft is still done, on many farms, with the hay sling, but elevators have been developed for the purpose, and some farmers have rigged their own, built in their own shops.

Where there is a lot of hay to put up, a method rapidly coming into favor is field chopping. The chopper requires the least amount of manual labor, as it blows the hay into a wagon trailed alongside, and from the wagon a stationary blower at the barn puts it into the mow. Of course the hay must be thoroughly dry for chopping, to prevent packing and heating.

No special type of trail wagon is as yet considered essential—grain wagons with top extension boards are used; some operators have built special wagons with large boxes. Some trail wagons have false fronts, which are pulled back to push the hay off the wagon into the blower hopper, from whence it is blown up into the mow.

Chopped hay, fed from mow to manger, is easy to handle, and affords a good method of preserving the value of the leaves. There is not much waste—even when the hay is somewhat coarse cattle will eat it, instead of nosing stems out of the manger.

Each operator will choose the method of putting up hay best suited to his particular situation, always recognizing that no handling method improves the natural quality of the hay. The best that handling can do is to preserve the quality "sealed in" by the stage of maturity when cut, and by the curing.—Elma Waltner (*from the Dakota Farmer, July 15, 1950 edition, p. 6*).

Alternate windrows of cut hay were swept to the stack as whole hay, while the remaining windrows were field chopped. From 22-acre field the field-chopped stack weighed nearly 2 tons more than whole hay. *Photo courtesy of the Colorado A & M News.*

THIS *IS* HAY

How much is in a chopped stack?

by WILLIAM P. KINTZLEY, Farm Manager, Colorado A. & M. College

Since windrow hay choppers have become extensively used in putting up alfalfa hay, we have received many requests at the Colorado A. & M. College farm for information on how to measure cut hay in the stack.

As a result, we have tried to figure out a formula for measuring chopped hay stacked in ricks. We believe our findings can be used with a reasonable degree of accuracy until such time as more extensive research can be conducted and more accurate results obtained.

Regardless of the rule used, the result can be only an approximation of the amount of hay in the stack. There are many factors involved that cannot be computed with a tape line. Outstanding difficulties are the variations in size and shape of stacks, and the lack of means for measuring density. Where to hold the tape in measuring length and width to get solid hay is merely a matter of judgment. It should be understood that we are dealing with hay chopped from windrows rather than ground hay. The latter has greater density and the figures for chopped hay would not apply. In our method the hay was chopped with a John Deere No. 62 pick-up hay chopper with a four-knife cutter head which gave an average length of stems from 1½ to 2 inches. If machines that cut shorter are used, greater density will result and proportionately fewer feet per ton should be used in calculating.

We began this project in the summer of 1949 on a 22-acre field of second cutting alfalfa. The field was cut and single windrowed and the hay turned before stacking. When stacking, we used two outfits simultaneously, taking every other windrow with each machine.

For the whole hay we used a powered sweep to bring the hay to the stacker, and for chopped hay, we used the windrow chopper and trucks. Our objectives were to get equal amounts of hay in each stack with uniform moisture content; to find the number of cubic feet in each stack; and to determine the difference in density. Four ricks of chopped hay were measured and later the hay was hauled in and weighed. From these measurements and weights we found that usual methods of calculating volume and tonnage gave poor results because of the differences in the shapes of stacks.

However, after considerable study it was apparent that the inaccuracy was due principally to the difference in widths of the stacks. After much adjusting, we have come up with the following formula which varies the percentages of overthrow with the width of the stack, when calculating volume and tonnage. This field chopped hay was found to have a density of 270 cubic feet per ton and the volume of a stack is converted to tonnage when divided by 270.

Tonnage = width × length × overthrow × percentage factor divided by 270 (cubic feet per ton).

Width	*Factor*	*Width*	*Factor*
13 feet	0.25	17 feet	0.19
14 feet	.23	18 and 19 feet	.18
15 feet	.21	20 and up	.17
16 feet	.20		

As an example the tonnage of a stack 17 feet wide, 40 feet long, and with a 24-foot overthrow is calculated as follows:

$$\frac{17 \times 40 \times 24 \times 0.19+}{270} = 11.48 \text{ tons}$$

In case other methods of stacking are used such as elevating to get greater height with sides carried up as in whole hay stacking, a rule applied to whole hay can be used, but 270 cubic feet should be used to determine the tonnage. (In arriving at these conclusions S. W. McBirney, senior agricultural engineer, stationed at Colorado A. & M. by the U. S. Department of Agriculture, deserves much credit since he had cross-section measurements of stacks made and helped to work out the formula. It was he who arrived at the figure of 270 cubic feet per ton which applies to these ricks of field chopped hay.)

In taking measurements the width should be taken about a foot from the ground and both ends should be measured and averaged. In measuring length, the tape should be held where ends will square up and in case of differences in widths of the ends or lack of uniform height, an average overthrow should be taken.

The amount of waste has perhaps never been fully realized by those of us who have been bringing the hay to the stacker with sweeps. In our investigations we divided the hay from the 22-acre field into two stacks as evenly as it could be done. Later the stack of whole hay weighed 18,170 pounds, and the chopped stack, 22,080 pounds, a difference of 3,910 pounds or almost 2 tons. This was a shocking difference because in looking over the field, both sweep and chopper apparently had done a clean job of gathering the hay.

These findings point to the sweep as a waster of hay when used on alfalfa because the stiff stubble acts as a brush in tearing off leaves and breaking stems. The loss on half our

(Please turn to page 180)

Windrow Chopped Alfalfa Best

Hay buck and hayloader were used for stacking the whole hay taken from alternate windrows on the 22-acre field. The remaining windrows were field chopped and stacked in long, low ricks. *Photo courtesy of the Colorado A & M News.*

FEED YOUR STEERS WINDROW CHOPPED ALFALFA. Every 100 pounds they gain will cost you less, and they will grade consistently better than those fed alfalfa processed in other ways, according to preliminary results of cattle fattening experiments at Colorado A. & M. College experiment station as reported by W. E. Connell, animal husbandman. He made the report during the annual Feeder's Day attended by upwards of 800 persons on the Colorado A. & M. College campus.

Steers fed windrow chopped alfalfa in a ration of grain, soy bean meal, and hay, produced as high daily gains as those fed alfalfa-molasses silage or alfalfa silage without preservative, and higher gains than the lots fed alfalfa acid silage, dehydrated alfalfa pellets, windrow baled alfalfa, or stacked alfalfa hay, Connell said. Lots fed stacked alfalfa hay made the lowest daily gains.

Results of lamb feeding tests reveal that corn silage when fed with good quality alfalfa hay increased the gains by 18 percent and lowered the cost by $1.57 per 100 pounds gained, A. L. Esplin, associate animal husbandman, reported.

A cost comparison in the lamb feeding studies shows that at present prices, use of dehydrated alfalfa when fed with good quality hay, is not economical, Esplin added. While the dehydrated alfalfa shows up to 20 percent more total gain in the feed lot, the cost is two and one-third times the cost of chopped alfalfa hay.

Esplin also reported trace minerals, iron, copper, and manganese did not increase the gains materially. The researchers emphasized that the results given are preliminary and final reports will be made following six more weeks of feeding.

Feeding studies on small and conventional type steers have shown no consistent differences between the types in pounds of feed required per pound gained, H. H. Stonaker, animal hubsandman, told the feeders. Stonaker and Melvin Hazaleus, associate animal husbandman, reported on 2 years of progress on the feedlot and carcass studies conducted by the college experiment station.

"These results may seem contrary to results of other research which has shown faster gaining calves to be more efficient in feed utilization," Stonaker said. However these previous studies were conducted within a type rather than by comparing small and conventional type steers, he pointed out.

Conventional type calves had larger daily gains, ate more feed per day, and produced larger steer carcasses and wholesale cuts when finished than the small type calves, the researches reported. There was no difference in the percentage of wholesale cuts nor percentage of fat, lean, and bone in the rib cut.

Small type calves graded significantly higher as feeders than did the conventional type calves, Stonaker said.

"Field chopping of alfalfa from the windrow and piling it near the feedlot at harvest time, was the least expensive method of harvesting," Harry Sitler, United States Department of Agriculture economist, told the feeders in reporting on an experiment to determine the comparative costs of handling alfalfa hay.

Stacked and baled alfalfa showed about the same costs per acre and were both more expensive than field cropping; grinding from the stack was more expensive than feeding long, loose alfalfa, and ensiling was the most expensive method tested, Siltler said.

Some of the more expensive harvesting methods may reduce the feeding costs enough to make the total expense of handling about equal to some of the other methods. Sitler explained that the cost for baling was approximately $2 more per acre than the stacking of long loose alfalfa, but the lower cost of feeding bales makes the total handling cost about the same for baled and stacked hay.

Irvin Jacob, secretary-manager of the Producers Livestock Marketing Association, Salt Lake City, Utah, analyzed the changes in livestock marketing in the Western territory during the past few years. Results of cattle and lamb feeding experiments were reported by W. E. Connell and A. L. Esplin, of the experiment station staff.

"We plan to conduct some feeding studies in both the San Luis Valley and the Arkansas Valley when a 'borrowing' fund can be set up in agreement with the legislature," Homer J. Henney, director of the experiment station, told the feeders. (*From the April 1950 issue of the Colorado A. & M. News, Publication of Colorado A. & M. College, Fort Collins, Colo.*)

Solving the Silt Mystery

(Continued from page 167)

2225 for Lake Mead to fill up with silt. The compaction of sediment into a smaller area as tons of new silt pile up on it over the years will extend this date to the year 2380, according to the estimate of Geological Survey technicians. However, even that deadline will never come in the foreseeable future because dams still to be built upstream from Lake Mead will stop its siltation.

Bureau of Reclamation hydrologists have been keeping a close check on siltation in other Reclamation reservoirs and their findings, like the results of the Lake Mead test, show the useful life of the reservoirs will extend well beyond the payout period.

The Guernsey Reservoir, on the North Platte River in Wyoming, has the highest rate of siltation of any Federal Reclamation installation with 33 percent of its capacity lost in 20 years. Even at this rate, it would have a useful life well beyond the 40-year payout period. However, construction of Glendo Dam on the North Platte River above the Guernsey Reservoir is awaiting discussion between Wyoming, Colorado, and Nebraska. It will intercept water from 87 percent of the drainage area now pouring silt into Guernsey, thus cutting Guernsey's rate of sedimentation to less than 1 percent per year. In designing Glendo, storage space was provided to take care of sedimentation for 100 years before other functions of the multipurpose structure are affected in any way.

Elephant Butte Dam on the Rio Grande in southern New Mexico has lost 16½ percent of its capacity in 32 years. At this rate it is good for about 160 years more.

The Arrowrock Reservoir on the Boise River in Idaho has lost only 2.76 percent of its capacity in 32 years of operation and at the present rate, would require over 1,100 years to fill, the Bureau survey showed.

Among the more recently developed reservoirs, the Bureau surveyed the Altus on the North Fork of the Red River in Oklahoma. This reservoir has lost roughly 5 percent of its capacity in 8 years and at the end of the 40-year repayment period will still have 73 percent of its capacity. In the meantime, conservation measures are being undertaken on the watersheds draining into this reservoir, and local project officials believe this sedimentation rate will be materially reduced.

Irrigation farmers on the 42-year-old Belle Fourche project in South Dakota do not need to worry about silt filling up the Belle Fourche Reservoir located on the project.

The results of a recent sedimentation survey of the reservoir by Bureau of Reclamation technicians showed conclusively that this Reclamation reservoir also will have a long and useful life.

Last fall during the low-water periods, the Bureau surveyors found that the original storage capacity of 208,850 acre feet has only been reduced 16,880 since the beginning of operations. This is a loss of less than 9 percent. At the same time the area of the reservoir at crest stage had expanded 30 feet. This was attributed to bank erosion which has been unusually heavy. Actually about 2 percent of the total depletion in storage has resulted from sediment washing down from the shore.

The Belle Fourche, which has two sources of water supply, one direct from Owl Creek, the other, by diversion from the Belle Fourche River, provides an irrigation supply for approximately 41,000 acres of land in the Belle Fourche Reclamation project located in Butte and Mead Counties, S. Dak.

In a statement announcing the results of the surveys, Commissioner of Reclamation Michael W. Straus said: "These reservoirs will serve mankind just about as long as water runs downhill." THE END

THIS *IS* HAY—

How much is in a chopped stack?

(Continued from page 178)

field, or 11 acres, at the present price of hay amounts to about $40 (figuring alfalfa at $20 per ton).

This is too much profit to sacrifice to any method of operation and it should be discontinued if possible. However, the difficulty at present is that where there are large acreages of hay, no other method is fast enough to get the crop in on time.

To see if the weight difference was due to more moisture retained in chopped hay we took samples of both types to W. E. Pyke of the chemistry department where it was dehydrated to determine moisture content. It was found that chopped hay did not retain the most moisture. Apparently the sweep was wasting the whole hay and the waste was principally in lost leaves. However, a portion of the loss was in stems that were broken as the hay was swept over the ground.

Since the loss is mostly in leaves, it is a still greater loss than would be indicated by the difference in weight. L. E. Washburn, professor in animal husbandry, reveals that the leaves in alfalfa hay contain approximately 50 percent more food value than the stems.

Let us hope field choppers and balers or whatever other equipment may be devised will soon be of greater capacity and speed. (*From the April 1950 issue of the Colorado A. & M. News, Publication of Colorado A. & M. College, Fort Collins, Colo.*)

OLD—ALSO VERY NEW

Farming is as "old as the hills"—next to hunting, probably the oldest of man's efforts to make a living, but because of this century's fast-stepping developments, and those in the immediate offing, modern farming is as new as the latest pail of milk.

We are all growing so accustomed to new practices that it is hard to remember that the most far-reaching of them are all very recent; that much of the industry's great contributions to farming came out of things learned during the last two wars; and that the work of State experiment stations—now considered all-essential—started only 75 years ago.

It was in 1875 that the Connecticut Legislature hatched out the first State agricultural experiment station in the U. S. A., and started the chain reaction that has taught us how completely necessary careful and continuous experimentation is. (*From p. 4 of the July 1, 1950 issue, The Dakota Farmer.*)

Water Resource Development in the Philippines

by RAMON R. RAVANZO, Civil Engineer, Republic of the Philippines

Because of the favorable tariff regulations enjoyed by the Philippines under the terms of the independence act, and the fairly large dollar credits granted the Philippines as war damages, they are now in a very good position with respect to international trade. However, they foresee that this position will not last and are interested in developing their industries to a point where they can compete successfully on equal terms with other nations.

The Philippines must import fuels and food. They are therefore particularly interested in the development of cheap hydroelectric power and the expansion of their agriculture through irrigation. The power development is handled by the National Power Corp. while the development of roads and irrigation is under the director of public works.

It is particularly interesting to note that in a country having an annual rainfall of between 80 and 90 inches irrigation is still vitally needed. The reason is, of course, that distribution of rainfall is not always favorable for crop growth, and total annual rainfall means little if it comes after crops have dried up during unseasonable drought periods.

Rice is the principal food of the Philippines and only about 85 percent of the requirements of this grain is produced in the country. The growing season for rice is about 100 days. The rainy season on the western side of the islands, where most of the agricultural lands are located, begins in June and lasts about 4 months. The rainfall during this period is not well distributed, however, and crops planted in June may be destroyed or seriously damaged by lack of rain during this growing season. Rainfall intensities of 48 inches in 24 hours have been recorded and intensities of 30 inches in 24 hours are not uncommon.

The drainage basins of the streams are covered by dense tropical growth which tends to aid in slowing run-off and makes possible the development of considerable irrigation by diversion without storage reservoirs. There are between 1,000,000 and 1,500,000 acres of land under irrigation, mostly in small, privately developed tracts. Because irrigation investigations have not been developed, the exact extent of irrigation is not known. The use of irrigation extends back to the time of the Spanish occupation of the islands and until the recent passage of the water appropriation law, the question of water rights was a complicating factor in the development of additional irrigation. On the other hand, the people of the islands have seen at first hand the benefits of irrigation and it is not necessary to convince them that it will be profitable before they are willing to practice it, as is the case in some of the semiarid regions of western Kansas.

Present communistic unrest in the Philippines stems from conditions which had their beginning during the Spanish control of the islands. Large land grants were given individuals who were in the favor of the government and are still held by descendents of those people. The church also holds large areas of agricultural lands. In many instances the population of several villages and the surrounding agricultural lands are tenants of rich landowners or the church. The people were not allowed to migrate freely over the islands and are now too poor to do so. Private holdings of small landowners which were once adequate for the support of the family have been so divided by inheritance that it is no longer possible for individual landowners to make a living on their small tracts, and they must seek other employment in order to exist. Wages for common labor range from about 87 cents to $1.25 per day. Since commodities which they must buy come principally from the United States and must be purchased at prices comparable to, or higher than, our present inflated level, it is understandable under such conditions that the communist doctrines are being accepted by some of these people.

Since little or no rainfall occurs except during the rainy season, farming operations are limited to that time. However, with the tropical climate, when adequate supplies of irrigation water are available, two crops can be grown each year instead of one. Large areas of public lands suitable for irrigation development and settlement exist in the islands, and present an opportunity for the government to solve its social and economic problems. Development of irrigation by the government to date amounts to less than 100,000 acres however, and no integrated planning for multiple purpose development of resources, like that in the United States has been initiated. Such piecemeal development as is being done may therefore later be found inadequate to serve the over-all needs of the areas the Philippine Government hopes to improve for settlement.

Engineering problems in hydroelectric and irrigation developments are much greater than those in the United States. Some rivers have an average fall of about 42 feet to the mile and are confined in narrow, deep channels. Very high dams therefore produce relatively small storage capacities. Spillway problems are also greater. Spillway discharges of 25,000 cubic feet per second have been recorded on a reservoir with only 36 square miles of drainage area. By way of

THE AUTHOR

Mr. Ravanzo is a graduate of the University of the Philippines in Manila, Philippine Islands, and has been associated with the National Power Corp., a Philippine governmental agency, for the past 15 years. He is in this country as a Fellow of the United Nations. Besides being well versed in the engineering phases of his country's development, Mr. Ravanzo displays a broad knowledge of the social, economic, and political problems in his country which is now operating as an independent nation after many years as a territorial possession. Photo by Norton T. Novitt, Region 7 photographer.

comparison the highest discharge of record at the Cedar Bluff Dam (which occurred in 1938) was about 61,000 cubic feet per second. The drainage area above the Cedar Bluff Dam is 5,300 square miles.

Philippine engineers have in several instances utilized the fall below their dams for power development rather than depending upon the head created by the dam. The Caliraya Dam on the island of Luzon is a good example of this. A 140-foot dam with a storage capacity of about 63,000 acre-feet provides a regulated flow of 200 cubic feet per second. Since the river makes a 6¼ mile loop which doubles back to within about 2½ miles of the dam and falls 800 feet in that distance, they have cut a mile-long tunnel, installed a surge tank and 2,000 feet of penstock to the powerhouse, constructed a mile-long tail race canal, and developed a total power head of about 900 feet.

Most power development has been done on the Island of Luzon since large centers of population like Manila are there. However, less populous islands, like Mindanao have better hydroelectric possibilities and it is estimated that power can be developed there at ⅙th to $\frac{1}{10}$th the cost of that on Luzon. This will require the building of new industrial cities, roads, communications, and agriculture on the less populous islands.

Construction work on government projects is done almost entirely by contract. The smaller contracts are handled by Philippine contractors, while the larger ones go to foreign firms. The American firm of Morrison-Knudson is one large contractor in the islands.

There is little specialization among Philippines engineers; they are all "general practitioners." No engineering geologists have been trained in the islands and this work is being done by American consultants.

There are quite a number of projects in the Philippines in which mechanization of operations, as done in the United States, would be the cheapest means of construction. The use and choice of machinery for any particular job should, however, be studied in the light of certain important considerations, chief among which are the following:

(1) Common labor in the Philippines receives only 10 to 15 percent as much as common labor in the United States.

(2) All equipment and machinery as well as fuels and oils must be imported. They must necessarily cost more because of transportation, and constitute an additional drain on dollar reserves.

(3) The comparative rarity of projects or jobs in which certain types of special plants may be used to advantage might necessitate charging most, or all, of the cost of such plants to just one job.

(4) In general, the projects are small due to the smallness of the islands and the consequent limited areas of the river basins.

(5) The difficulty and delays incident to the procurement of spare parts and supplies often tie up valuable equipment.

(6) The unavailability of trained personnel to handle machinery may hamper the efficiency of the equipment and/or shorten its useful life.

(7) Weather conditions and topography affect the choice of equipment, particularly earth movers. THE END

Only the beginning . . .

(Continued from page 168)

Valley project became a Federal undertaking in 1935, when President Franklin D. Roosevelt approved a report submitted by Secretary of the Interior Harold L. Ickes testifying to its feasibility. President Roosevelt then allocated emergency relief funds to begin construction. The Congress first appropriated funds in 1936; it reauthorized the project in later years.

In the last 15 years, few areas on the globe have been changed more by the hand of man, intelligently and industriously applied, than here in the Central Valley. Your Central Valley project—and it is your project; it belongs to the people—will answer water needs that stretch all the way back to the last century. At long last, Californians can look ahead to the day when they will enjoy full access to the water and power available from their streams.

Today the initial features of the Central Valley project, as authorized by Congress, are nearing completion. You have already made use of the initial quantities of water and electric power and you have already experienced the benefits of flood control and the repulsion of salt water from your lands. People are using the lake at Shasta as a playground. While the Central Valley project has already delivered part of each of the benefits for which it was built, about a year from now you will begin to receive major benefits of project-wide operation of the irrigation and power features. These will become available with the completion of the giant pumping plant now being built at Tracy, the establishment of transmission lines linking Shasta and Keswick power plants to the Tracy pumping plant and serving communities along the way, and the completion of key links in the Delta Mendota and Friant-Kern Canals.

By virtue of their size, geographical spread, and technical complexity, these works must be numbered among the engineering wonders of the world. They will, in effect, move great quantities of water virtually the entire 500-mile length of the Central Valley.

When completed, the works under construction will supply water for a million acres of rich California farm lands, including both new acreages and more for farms now inadequately irrigated. This water for crops, the half million kilowatts of power capacity already harnessed at Shasta and Keswick Dams, the water for municipal uses, the control of floods, the repulsion of salt water intrusion, the recreational and other benefits will mean a great boost to the prosperity of this State. Each of you, here, and the entire Nation, will share in it.

Furthermore, if we remain vigilant, the small farmer and the common man can be sure that, under the reclamation laws that their forebears helped to write, the water and the power made available by this project will be fairly distributed.

The delivery of water is limited by the Congress to not more than 160 acres in any individual holding, or not more than 320 acres for man and wife. * * * Within the last few weeks, Secretary of the Interior Oscar L. Chapman has approved contracts, embodying the acreage-limitation principle, entered into by the Department of the Interior and more than half of the water users' districts in the San

CACHUMA DAM CONSTRUCTION SCHEDULED

Artist M. H. Willson's conception of Cachuma Dam, which will be located near Santa Barbara, Calif., and supply municipal and irrigation water for the area.

Construction on the Cachuma Dam, located near Santa Barbara, Calif., designed to add to the municipal water supply of that city, and irrigate 29,650 acres of land in Santa Barbara County, is under way.

The contract for the earth-fill dam was awarded to Mittry Constructors, Inc., of West Los Angeles, Calif. The dam and reservoir will provide storage capacity for 210,000 acre-feet of excess seasonal water from the Santa Ynez River. Surplus water not required by water users in Santa Ynez Valley will be diverted to the south coast area surrounding Santa Barbara through the 6-mile Tecolote Tunnel and the 28-mile Goleta-South Coast Conduit. Work on these two structures is also under way.

Reclamation Commissioner Michael W. Straus, who authorized the award of the contract, said this is the third major contract award on the Cachuma project in the last 6 months. "We are moving ahead rapidly since the ratification of the repayment contract by vote of the water users last November," Commissioner Straus said. "Work is already under way on the Tecolote Tunnel and the Goleta-South Coast Conduit, and with the award of this job we will have over 13 million dollars of contracts in force. We hope to begin the initial delivery of water in 1954."

Joaquin Valley. We expect that within a short time 84 percent of the firm water supply of Millerton Reservoir, behind Friant Dam on the San Joaquin River, will be committed under contract. Acreage limitation is fast becoming an academic issue because of these contracts and through them the long fight against land monopoly in California is now being won. * * *

Federal laws and policies require, however, that the benefits accruing from low-cost power, generated at federally constructed dams like Shasta shall be as widely distributed to the public as possible and at as low cost as is consistent with good business practices. Preference is granted, in the distribution of public power, to rural electrification cooperatives and to municipalities and other public agencies, which assures that profit-making agencies cannot ursurp the rights of the people to their own power. * * *

Because irrigation and power are inextricably linked, each depending on the other, multiple-purpose development of the Central Valley's rivers by public agencies is essential if we are to make prudent and optimum use of these water resources. * * *

California can put to beneficial use every drop of water that can be harnessed. And it can absorb every kilowatt-hour of power that can be developed from her streams. It is predicted that California will gain over two and a half million new citizens during the 1950's and that her population will eventually reach 20,000,000. Considering that the State's present population density on arable land—excluding mountains, deserts, and forests—is still only one-eighth that of Massachusetts, despite the very large gains during and since the war, these predictions do not seem unreasonable, provided, however, that California continues both to develop and to conserve her water resources.

The growth of California's population and the expansion of her economy are of utmost importance to the national economy, and particularly to the West. It means not only new production of wealth in California, but it means, also, new markets in California for the products of other States. Oregon, for instance, once had to ship lumber and cheese 2,000 miles to find a market of 10,000,000 consumers. Now she has a market of that size on the Southern Pacific Railway's 700-mile Shasta route, out of Portland. * * *

No one man and no agency can claim Shasta Dam exclusively as his own. It is the fruit of the dream and work of millions. So let it stand here for hundreds—dare we hope thousands—of years serving the people. To future generations we give it as a symbol of the toil, the hope, and the aspirations of the ordinary citizen of our twentieth century. He has found a way in our democracy to join in cooperation with his fellowmen, and through his government—local, State, and national—to do his great works and to reap the full measure of the fruit of the earth.

The End

THRU THIS CYLINDER (tunnel liner) pass the most faithful devotees of Reclamation Engineering. *Photo by Harry Meyers, Bureau of Reclamation photographer.*

Engineering Center Dedication

An estimated 40,000 to 45,000 persons, who saw about 300 exhibits and many special demonstrations, attended the open house during the dedication program for the Reclamation Engineering Center at Denver, Colo., on July 19, 20, and 21. The city of Denver was official sponsor of the dedication event.

A preview of the exhibition, attended by about 500 invited guests, was held on Wednesday, July 19. The preview also was sponsored by the city of Denver and the Associated General Contractors.

On July 20, Commissioner Straus addressed the 2,000 Reclamation employees at the Denver Federal Center—the largest group assembled in 15 years. At noon he spoke before the Denver Rotary Club, on the topic, "Water in our World," in which he told of the important part the Center has played in reclaiming western lands and its present role in domestic and international water resource development.

That evening, during the dedication program at the Center, Commissioner Straus read the following message from President of the United States, Harry S. Truman:

"MY DEAR COMMISSIONER STRAUS: The dedication of the Reclamation Engineering Center at Denver, Colo., is an event worthy of the widest recognition. I am very sorry that I cannot attend.

"In this Center you have concentrated the wide range of scientific skills and experience and are providing the engineering teamwork required to assure the fullest and most economical development of our western irrigation, hydroelectric power, and related water resources which we can achieve by modern techniques.

"That is a most worthwhile accomplishment. The development of the water resources of our Western States is essential to the advancement of the Nation. By placing natural resources that otherwise would be inaccessible within reach of the people, the Federal Reclamation program is opening up the new economic opportunities from which our people can create new wealth, better living, and more security for all of us.

"Another measure of Reclamation's value is the interest and inspiration it has aroused in other nations. Water resources development is one of the principal means by which better living, more security, and peace can be achieved all over the globe. Already the benefits of our knowledge, our methods, and our accomplishments are being sought in all quarters of the world. In the future, under the point 4 program, Reclamation and its Engineering Center will play an even larger part in helping to solve the problems of feeding and clothing the growing, restless populations of the earth."

Friday, July 21, was "International Day" and was marked by the visit of Capus M. Waynick, special assistant to the Under Secretary of State, in charge of the point 4 program. Former Commissioner of Reclamation Harry W. Bashore, Former Reclamation Chief Engineer Walker R. Young, Assistant Commissioners of Reclamation Lineweaver, and Markwell were among the visitors.

The Missouri Basin Inter-Agency Committee met July 20 in connection with the dedication. State governors Roy J. Turner of Oklahoma, John W. Bonner of Montana, Fred G. Aandahl of North Dakota, George T. Michelson of South Dakota and Walter W. Johnson of Colorado and United States Congressman from Colorado, Wayne N. Aspinall, also were among those present. L. N. McClellan, the Bureau's chief engineer, was official host, and Walter E. Blomgren, assistant chief engineer, was chairman of the dedication committee. •

NOTES FOR CONTRACTORS

Contracts Awarded During July 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
2967	Lewiston Orchards, Idaho	July 10	Construction of Clearwater Reservoir	Henly Construction Co., Boise, Idaho	$63,708
3001	Columbia Basin, Wash	July 12	Hollow metal doors for service bay RS, control bay R, and units R1 to R9, Grand Coulee power plant, and pumping plant, schedule 1.	M. Reuter & Sons, Portland, Oreg	48,211
3017	Boulder Canyon, Ariz.-Calif.-Nev	July 7	Six current and 6 potential transformers for Nevada State switchyard, schedule 3.	Allis-Chalmers Manufacturing Co., Milwaukee, Wis.	13,050
3017	do	do	Six 69,000-volt lightning arresters, 3 current and 3 potential transformers, and 1 10 kilovolt-ampere transformer for Nevada State and Metropolitan switchyards, schedules 4, 5, and 6.	Westinghouse Electric Corp., Denver, Colo	42,576
3031	Missouri River Basin, Mont	July 17	One 125-ton traveling crane for Canyon Ferry power plant	Whiting Corp., Harvey, Ill	58,850
3032	Missouri River Basin, N. Dak	July 24	Construction of 119 miles of Garrison-Voltaire, Devils Lake-Lakota, and Jamestown-Valley City 115-kilovolt transmission lines.	Orlando Construction Co., Coleman, Wis	752,500
3045	Columbia Basin, Wash	July 27	Construction of earthwork, pipe lines, and structures for area E 2, laterals and sublaterals, East Low canal laterals.	Intermountain Plumbing Co., Inc., and Henry L. Horn, Caldwell, Idaho.	250,970
3050	Missouri River Basin, Colorado-Big Thompson, North Platte, and Kendrick, Wyo.-Nebr.-Colo.	July 10	Supervisory control and telemetering equipment, 1 load-frequency control board, 9 telemeter transmitters, 1 telemeter receiver, 1 telemetering switchboard, 11 sets of carrier-current transmitting equipment, and 6 sets of carrier-current receiving equipment for region 7 centralized power dispatching system, schedule 1, 2, and group 1 of 3.	Westinghouse Electric Corp., Denver, Colo	84,000

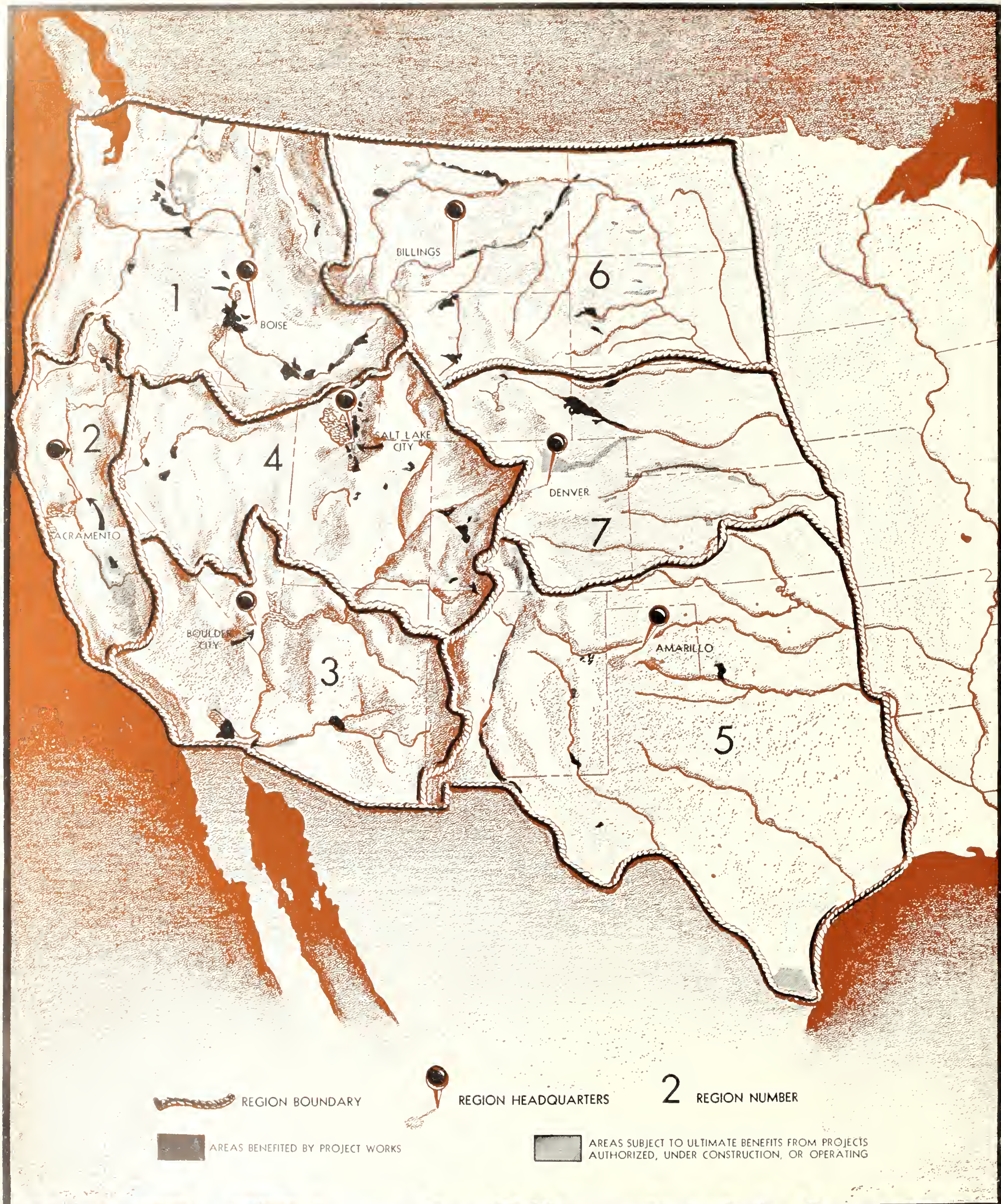
Contracts Awarded During July 1950 (Continued)

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3059	Columbia Basin, Wash	July 17	Eight 16- by 14.5-foot radial gates for concrete checks, West canal, item 1.	General Machinery Co., Spokane, Wash	12,960
3059	do	do	Nine 10,000-pound radial-gate hoists for concrete checks, West canal, items 5 and 8.	Gibson Manufacturing Corp., Longmont, Colo.	13,041
3078	Davis Dam, Ariz.-Nev	July 18	Construction of ED-2 and ED-4 substations	Harold Ashton Building Co., Tucson, Ariz	50,310
3079	do	do	Construction of 21.5 miles of 34.5-kilovolt transmission lines, Gila substation to Wellton-Mohawk switchyard and Wellton-Mohawk switchyard to pumping plants Nos. 1 and 3 switchyards.	Trans-Electric Co., Louisville, Ky	202,553
3082	Missouri River Basin, Mont.	July 13	One 70-ton gantry crane for Canyon Ferry Dam	Treadwell Construction Co., Midland, Pa	65,817
3084	Cachuma, Calif	July 26	Construction of Cachuma Dam	Mittry Constructors, Los Angeles, Calif	6,722,520
3087	Central Valley, Calif	July 24	Structural steel for Southern Pacific R. R. bridge and county highway bridge, Delta Cross Channel.	Consolidated Western Steel Corp., Los Angeles, Calif	51,400
3089	Colorado-Big Thompson, Colo.	July 21	Three 12,800/16,000-kilovolt-ampere transformers for Beaver Creek substation.	Moloney Electric Co., St. Louis, Mo	129,575
3092	Missouri River Basin, Nebr	July 17	Construction of 69 miles of Sidney-Ogallala 115-kilovolt transmission line.	R. N. Campsey Construction Co., Denver, Colo.	432,691
3093	Davis Dam and Boulder Canyon, Ariz.-Calif.-Nev.	July 14	Auxiliary control board extension and unmounted equipment for units A3, A4, and A9, Hoover power plant, Davis power plant, and Phoenix dispatchers office, schedule 2.	Bethlehem Steel Co., Baltimore, Md	51,068
3094	Davis Dam, Ariz.-Nev.	July 25	Carrier-current telemetering equipment for Davis Dam, Hoover and Parker power plants, and Phoenix substation.	General Electric Co., Denver, Colo	11,225
R1-CB-52	Columbia Basin, Wash	July 11	Construction of residences at Operation and Maintenance Headquarters, Warden, Wash., schedule 1.	Cherf Bros Construction Co., Ephrata, Wash.	160,685
R1-CB-52	do	do	Construction of residences at Operation and Maintenance Headquarters, Warden, Wash., schedule 2.	M. G. M. Construction Co., Olympia, Wash.	40,542
R1-CB-58	do	July 6	Constructing additions to 1-bedroom houses at Coulee Dam, Wash.	Neuman Co., Salem, Oreg	97,731
R1-92	Boise, Idaho	July 18	Clearing part of Cascade Reservoir site	Paul C. Helmick, Seattle, Wash	358,280
R1-CB-61	Columbia Basin, Wash	do	Construction of transshipment facilities at Odair, Wash	Don Akins, Inc., Ellensburgh, Wash	48,166
R1-CB-60	do	July 11	Automatic fire detection system for 16 buildings at Grand Coulee Dam.	Protectowire Pacific Co., Longview, Wash	34,641
R1-CB-65	do	July 10	High-school building and bus garage	Riverman & Sons, Portland, Oreg.	522,261
R2-108	Central Valley, Calif	July 5	Erection of 30-ton cableway and painting cofferdam steel at Shasta Dam.	John C. Gist, Sacramento, Calif.	86,218
R2-107	do	July 7	Reconditioning or rebuilding 36 residences for the Government camp at Shasta Dam.	McDaniel Construction Co., Marysville, Calif.	250,533
R2-110	do	July 14	Canal road surfacing, station 1628+79 to station 2532+33, Friant-Kern Canal.	California-Fresno Asphalt Co., Fresno, Calif	15,050
R2-105A	do	July 20	Rock Creek access road, station 0+00 to station 54+99.67, Keswick Dam.	W. C. Smith and E. D. Hews, Portland, Oreg.	47,155
R7-134	Missouri River Basin, Kans	July 24	Clearing Cedar Bluff reservoir site.	The Smith-Miller Construction Co., Pleasanton, Kans.	11,915

Construction and Supplies for Which Bids Will Be Requested by November 1950

Project	Description of work or material
W. C. Austin, Okla	Construction of 4 miles of 120-cubic feet per second Altus canal wasteway and 3.5-mile drain "F" near Altus, Okla.
Boulder Canyon, Ariz.-Nev.	Lifting beam and jacking frame for unit A9 generator, Hoover power plant.
Central Valley, Calif	Completion of electrical work in Shasta Dam and installation of left abutment parking area lighting, near Redding, Calif.
Colorado-Big Thompson, Colo.	Construction of 2,670-foot, 250-cubic feet per second, concrete-lined Windsor Canal extension, about 8 miles northwest of Fort Collins, Colo.
Do	Construction of 6,750-foot, 960-cubic feet per second concrete-lined Bald Mountain pressure tunnel from Rattlesnake Reservoir to Flatiron power plant, about 10 miles west of Loveland, Colo.
Do	2 vertical-shaft centrifugal pumps, 200 cubic feet per second capacity at 172 foot head, for Willow Creek pumping plant.
Do	Construction of Willow Creek Dam, an earthfill structure about 96 feet high and 1,000 feet long, on Willow Creek 8½ miles from Granby, Colo.
Columbia Basin, Wash	Constructing and paving highways near Coulee Dam.
Do	Construction of 7 permanent-type houses with garages, and streets and utilities at Adco operation and maintenance site, Adco, Wash.
Do	Construction of office building, garage, warehouse, and shop at O. & M. headquarters near Adco, Wash.
Do	Construction of about 5½ miles of main drains in lateral areas W-6 and W-7 near Burke, Wash.
Do	Construction of 12 permanent-type residences with garages, and streets and utilities to be located in lateral areas W-2A, W-3, W-4, E-1, and E-2, and at O'Sullivan and Long Lake Dams.
Do	Construction of office building, garage, warehouse, and shop at O. & M. headquarters near Winchester, Wash.
Do	1 oil purifier of 300 gallons per hour capacity and 1 oil purifier of 1,200 gallons per hour capacity for Grand Coulee power plant.
Davis Dam, Ariz.-Nev	Construction of warehouse and transformer repair shop at Phoenix, Ariz.
Do	Construction of 14 residences at Mesa, Coolidge, and Tucson, Ariz.
Do	Furnishing and installing pumps for 7 water supply wells at Tucson, Collidge, Phoenix, and Mesa, Ariz.; and furnishing and laying pipelines for domestic water supply and fire-protection system at Mesa and Coolidge.
Do	System map for the dispatcher's building at Phoenix, Ariz.
Fort Sumner, N. Mex	Reconstruction of about 12 miles of 100 cubic feet per second capacity Main canal from station 137+65 to end, and Main canal laterals, including pneumatically applied mortar lining, near Fort Sumner, N. Mex.
Grand Valley, Colo	Construction of 6 concrete flumes on the Highline canal near Grand Junction, Colo.
Hungry Horse, Mont	One 96-inch ring follower gate hoist control for Hungry Horse Dam.
Kendrick, Wyo	Construction of 3,750-kilovolt-ampere Rawlins substation near Rawlins, Wyo.
Mancos, Colo.	Furnishing and erecting about 2,900 feet of 48-inch chain link safety fence around 2 concrete chutes on Inlet and Outlet canals near Mancos, Colo.
Missouri River Basin, Mont	Two 300 gallons per minute and two 2,500 gallons per minute, deepwell, turbine-type pumps; one 20 gallons per minute and one 50 gallons per minute gear-type oil pump for Canyon Ferry power plant.
Do	460-volt distribution board, 125-volt direct-current distribution board, 7,200/480-volt unit substation, and battery charger motor-generator set for Canyon Ferry power plant.
Do	Air compressors and air receivers for Canyon Ferry power plant.
Missouri River Basin, Nebr	Construction of a 10 mile long unlined section of Cambridge canal, 210 to 125 cubic feet per second capacity, near Oxford, Nebr.
Missouri River Basin, N. Dak	Construction of 15,000-kilovolt-ampere Leeds substation.
Do	Construction of 4,500-kilovolt-ampere Rolla substation.
Do	Construction of 15,000-kilovolt-ampere Bisbee substation.
Do	Construction of 15,000-kilovolt-ampere Valley City substation.
Do	Construction of 15,000-kilovolt-ampere Lakota substation.
Do	One 1,800 gallon per hour capacity oil filter press for Bismarck substation.
Do	Construction of 41-mile Bismarck-DeVaul 69-kilovolt wood-pole, H-frame transmission line between Bismarck, N. Dak., and the DeVaul substation southeast of Almont, N. Dak.
Missouri River Basin, Wyo	Clearing about 3,600 acres of Boysen Reservoir site about 18 miles south of Thermopolis, Wyo.
Do	Construction of Anchor Dam, a concrete arch structure 200 feet high and 550 feet long, on Owl Creek, about 40 miles northwest of Thermopolis, Wyo.
Do	Relocation of about 12 miles of U. S. Highway No. 11 at Keyhole dam site, about 15 miles northeast of Moorcroft, Wyo.
Do	160,000 pounds of galvanized fabricated steel structures for switchyard and transformer circuits at Boysen power plant.
North Platte, Wyo.-Nebr	Removing and salvaging portions of existing 290-foot timber bridge at Whalen diversion dam, Whalen, Wyo.
Do	Lining with concrete and furnishing and placing concrete pipe on about 10,000 feet of laterals 98.1, 98.1B, and 98.1C, Fort Laramie Canal, 6 miles southwest of Morrill, Nebr.
Paonia, Colo	Reconstructing and enlarging 3.1-mile Overland Canal to an initial capacity of 110 second-feet, between Paonia and Cedaredge, Colo.
Riverton, Wyo	Construction of a 14-mile section of Wyoming Canal and laterals, 25 miles north of Riverton, Wyo.
Do	Asphalt lining of 7.5 miles of Wyoming Canal.
Do	Lining 17 miles of Wyoming Canal.
Vale, Oreg	Repairs to steel, 1.1-mile, 8.1-foot diameter Bully Creek siphon, southwest of Vale, Oreg.

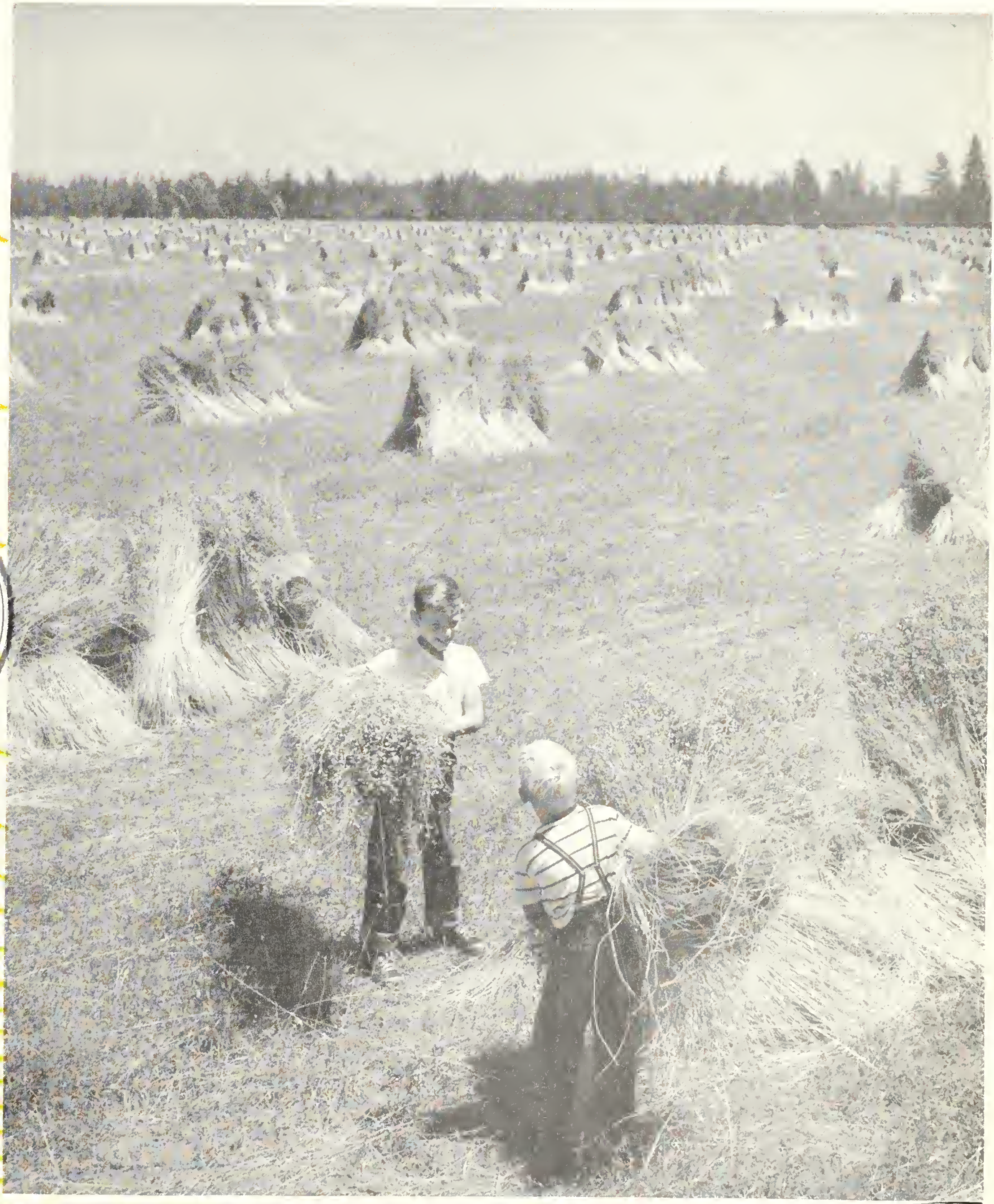
U. S. GOVERNMENT PRINTING OFFICE 1950



THE RECLAMATION AREA

The Reclamation ERA

October 1950



Official Publication of the Bureau of Reclamation

The Reclamation ERA

October 1950
Volume 36, No. 10

Issued monthly by
The Bureau of Reclamation
United States Department of the Interior, Washington 25, D. C.

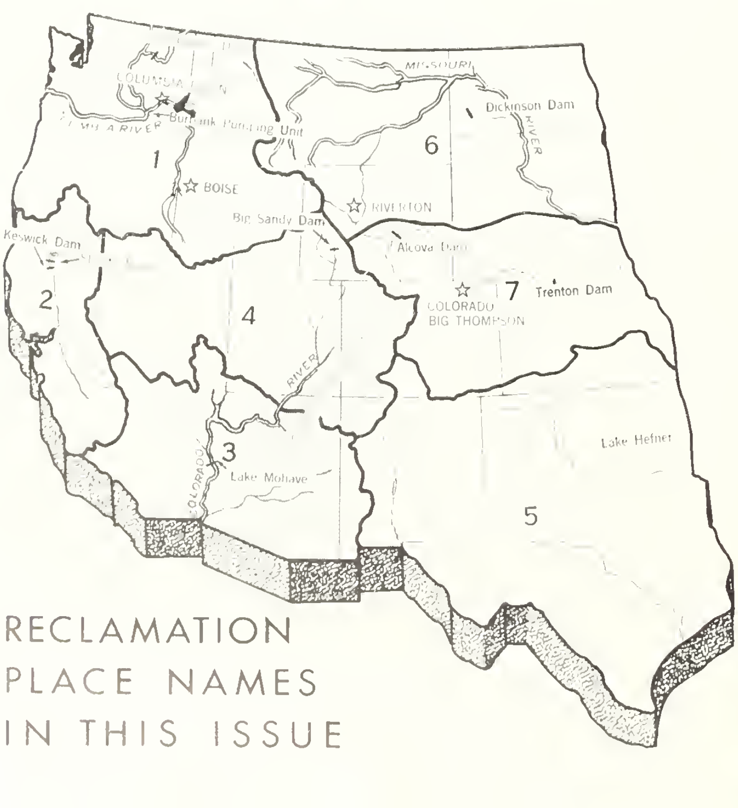
The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

CONTENTS

FEATURE ARTICLES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.



RECLAMATION PLACE NAMES IN THIS ISSUE

30 YEARS AGO IN THE ERA

CHANGE OF ADDRESS*

Water users receiving the RECLAMATION RECORD *who wish to notify the Washington office of a change of address should state that they are water users and also give the name of the project on which they are located. If this is not done, it will be necessary for this office to write to such water users for the desired information before the name can be located on the mailing list and the proper change made. Help us and help yourselves by giving us this information in your first letter, and we will do our best to see that the change is made and that the* RECORD *is sent to your new address without unnecessary delay.*

(From p. 471, October 1920 issue of the RECLAMATION RECORD, predecessor of the RECLAMATION ERA)

*We have the same problem in 1950!

United States Department of the Interior
Oscar L. Chapman, Secretary
BUREAU OF RECLAMATION OFFICES

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

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BURY THE LINING

by JEWELL R. BENSON, Engineer Branch of Design and Construction, Denver, Colo.

UNDER A BLANKET OF SOIL—A Bureau-operated dragline places a cover of earth 1 foot deep over newly sprayed asphalt membrane lining in the Wyoming Canal of the Riverton project, Wyoming. The cover soil is the same material excavated from the canal to smooth and grade it in preparation for the new lining. *All photos for this article taken by Jewell R. Benson.*

WATER USERS, ARE YOU LOOKING FOR AN INEXPENSIVE CANAL LINING?

You may be encouraged by the news of a new type of lining developed by engineers of the Bureau of Reclamation. This lining, a buried asphalt membrane, should play an important part in solving the problem of lining canals and laterals at a reasonable cost.

The Bureau thinks so highly of this innovation that over 1,000,000 square yards of this type of lining will be constructed this year. A patent covering a prefabricated type of this lining has been applied for.

Hollis Sanford (now Assistant Director, Branch of Operation and Maintenance) while at the Boise, Idaho, office of the Bureau of Reclamation, is credited with the first developments from which the membrane lining evolved. Sanford, in 1942, spread light asphaltic oils on damp soil. The oils soaked down into 1 to 3 inches of the soil. Over this primed earth, he sprayed and troweled heavier asphalts, some filled with fine earth. Today, 8 years later, 6 out of the original 11 sections of his experimental installation in the H Line Canal of the Boise project in Idaho are still in serviceable condition.

Costs, however, presented an obstacle. The asphalt surface membrane would not stay in place unless the asphaltic oils penetrated more than 1 inch of the soil. This required repeated application of liquid asphalt. Soil conditions varied, as did moisture conditions and weather, making results uncertain. The exposed membrane was supposed to make the canal watertight but cattle and sheep dug holes as they walked over the lined area. In addition, unless "fillers" were mixed into the material, wind and weather wore the membrane away rapidly.

How to lengthen the life of the membrane and lower the costs? The answer was—bury it! The asphalt membrane was placed directly on the subgrade—the only preparation necessary was smoothing the bottom and sides of the canal. The membrane could then be covered with enough earth to hold it in place, protect it from livestock, and reduce weathering. The engineers found an unexpected advantage—this lining could be constructed in practically any kind of weather. Most important, of course, was the cost—about 70 cents a square yard, including subgrade preparation.

Three things made this new lining possible, and were responsible for its success: (1) The fact that the same soil which is removed from the canal, as it is being smoothed and graded, can be used as a cover to hold the membrane in place, (2) the development of special asphaltic materials which have a long life, are tough, easy to handle in cold weather, and do not soften in hot weather and (3) simplicity of construction.

Construction methods are simple. To allow space for the cover material, the canal is first overexcavated by dragline to a depth of 1 foot. If conditions are severe and greater cover depth is required to protect the membrane, the dragline excavates to a depth of 2 feet. Side slopes are also flattened to 1¾ to 1, or 2 to 1, in order to keep the cover soil in place later. The removed soil is stockpiled on the berm (or top of the canal bank) so that it will be ready when needed for replacement as cover. After excavation, the surface is generally rough, but a smooth surface is required to obtain a tight, uniform membrane. This is obtained by first dragging, and then lightly rolling the subgrade. Only a few trips by each piece of equipment are needed.

At the refinery, generally located within a few hundred mile radius of the job, the asphalt (heated to a temperature of 400° F.) is loaded in insulated railroad tank cars holding 10,000 gallons, or in insulated truck transports carrying from 2,500 to 5,000 gallons. If the haul can be made within 24 hours, the material may frequently be used without reheating. However, if greater time is required, "boosters," resembling water boilers except that asphalt is circulated instead of water, are used to bring the temperature back to its original 400°. The asphalt is then pumped into truck tanks equipped with pumps and pressure lines, called "distributors." From these distributors, asphalt is forced through flexible metallic hoses and spray bars, and applied directly to the soil subgrade.

It takes from 1.25 to 1.75 gallons to form a square yard of asphalt membrane from three-sixteenths to three-eighths of an inch thick. The asphalt cools rapidly and the required thickness can generally be obtained by one application. Recently, spray bars attached directly to the distributors have been used. With this equipment, the distributor can travel in the canal bottom or on the berm and spray asphalt in a wide swath up to 20 feet or more. Although the spray bar usually has to make two or three trips over the area, the asphalt can be applied very rapidly and evenly. This method is a considerable improvement over hand-spraying.

As soon as the asphalt has cooled, it may be covered by using the dragline to scoop the soil from the berm directly on the membrane until the required depth of cover, allowing for settlement, is obtained. Then the surface is smoothed by dragging, and the canal is ready for use. If the canal is subject to erosion, it's a good idea to cover the soil with a gravel blanket 4 inches to a foot deep, depending on the erosion situation. The cover soil is not compacted but allowed to settle during use. It is sometimes necessary, during the settlement period, to add some soil or gravel to the top of the berm to restore it to its former height.

The next improvement over the sprayed membrane was a prefabricated-type lining. Instead of expensive reinforcing material, costing from 10 to 50 cents a square yard, heavy kraft paper available at a cost of less than 1 cent per square yard was used. The kraft paper was coated lightly (three-sixteenths of an inch) with asphaltic material similar to that used in the spray-type lining. The asphalt surface was then thoroughly coated with talc or mica, and made up in rolls 36 inches wide, and about 36 feet long, weighing about 130 pounds. Late in 1949, 8,000 square yards of this material were placed in two laterals of California's Tule Lake Division of the Klamath project. Except for the damage done by a severe wind in one area before the cover had been placed, the installation is considered successful. Since that time, experimental installations have been made near Cody, Wyo., Ellensburg, Wash., Malta, Mont., and Altus, Okla. Other installations are planned.

This lining is also simple to place. The subgrade is prepared the same way as for spraying. Coarse rocks and clods are removed or crushed into the soil by rolling. The prefabricated lining may then be placed either the long way of the canal or across it. If the canal is large enough, longitudinal placing is quicker and eliminates a considerable amount of "paper" cutting. The strips are joined together by coating the exposed edge of a placed sheet with a rapid curing cut-back asphalt, usually poured from a sprinkling can with the head removed, and then lapping the next sheet over the coated area, a 2-inch lap generally being sufficient. To anchor the lining until soil cover can be placed, wire pins or nails (up to 8 inches long for soft ground) are placed about every 2 feet in the overlap. As soon as possible, soil is spread over the prefabricated lining in a manner similar to the method used for sprayed-type membrane.

The prefabricated lining does cost more than the sprayed

(Please turn to page 203)

WALKING ON GLASS—At upper left a new type of glass-reinforced prefabricated asphalt membrane lining is being placed in a lateral on the W. C. Austin project, Oklahoma. The rock stockpiled on the berm was spread 6 inches deep over the lining to hold it in place. **SPRAY IT BY MACHINE**—As shown in photo lower left, where an asphalt distributor holding 1,200 gallons applied asphalt through a 20-foot spray bar to the side slopes of the Wyoming canal, Riverton project. Two passes were required on the side slopes and one pass on the bottom. The tank was emptied in 15 minutes. **SPRAY BY HAND**—Photo below shows how three hand sprays facilitated the placing of membrane lining in the same Wyoming canal. As with the distributor, the rate of application was about 1½ gallons a square yard.

THE DAWSON PLANTING TOOL

by LOUIS TEMPLE, Landscape Architect, Shasta Dam, Calif., Region 2 (Headquarters, Sacramento, Calif.)

Barren red hills overlooking Shasta and Keswick Dams are taking on a new and less desolate look these days. A big factor in this metamorphosis is the ingenuity of a Bureau of Reclamation employee, Gordon Dawson, Field Foreman of the Erosion and Drainage Control Unit, at Shasta Dam.

Forty years ago or more, copper smelters in the area were going full blast. Although many of their sites are now submerged hundreds of feet below the surface of Shasta Lake, the acrid fumes which they belched forth in their heyday have left an indelible mark on the steep hills of the Sacramento River Canyon and adjacent areas. Prior to the construction of Shasta and Keswick Dams, these hills, in many cases completely denuded of vegetation, created a difficult erosion problem as a result of the heavy annual winter and spring rains characteristic of the area.

During the construction period, field examinations indicated that the natural vegetation was beginning to make a come-back. It was clear, however, that supplemental planting would be necessary to stem the flow of soil into the gullies, canyons, and eventually into Keswick Reservoir. Thus, in cooperation with the Forest Service, a program of planting ponderosa pine seedlings and black oak acorns was initiated.

Because of the steep, rocky nature of the terrain, more than the usual difficulties were encountered with conventional planting tools. In March of 1949 while directing operations of a crew so equipped, Field Foreman Gordon R. Dawson conceived the idea of a more efficient planting instrument. After some experimentation, he evolved the new tool which to date has far exceeded expectations as to effectiveness. The Dawson tool consists of a T-shaped tube with a sharp steel point and a stirrup 12 inches from the point to force the tool into the ground.

As soon as field crews were equipped with the Dawson tool, its advantages became readily apparent. Rocky ground had previously been written off as impossible to plant with conventional tools. Areas of this type are now easily planted with the new device, permitting expansion of the erosion-control program. This same ease of planting has reflected itself in a 50- to 100-percent increase in the number of seedlings which can effectively be planted by a single crewman in a day.

In use, the Dawson tool makes a round hole in the ground with firm sidewalls without disturbing the ground around the hole. This factor is important not only in conserving moisture but in preventing further erosion around the seedlings on steep slopes. It is found that the soil around seedlings, newly planted by the Dawson-tool method, is easily firmed in around the roots, thus preventing air pockets which would in time result in the death of the seedlings. Another advantage of the tool is that it eliminates the planter's temptation to make shallow holes and jam the seedling into the ground leaving U-shaped roots which in turn yield unhealthy trees.

The natural vegetation in the Keswick-Shasta area includes ponderosa pine and several varieties of oak and other broadleaf species. It is an important asset that the Dawson planter works equally well with pine, broadleaf seedlings, and medium to large seeds such as acorns. Acorn seed spots prepared with conventional planting tools frequently prove highly vulnerable to the forays of rodents. Since the crews were equipped with Dawson planters there has been no sign of acorn loss from rodents.

The future value of this tool will probably not be limited to Bureau projects alone. Recently it was demonstrated before a group of officials of the Forest Service's Region 5, who were greatly impressed by the efficiency of the instrument

(Please turn to page 197)

EROSION ATTACK—Gordon R. Dawson, field foreman for the Erosion and Drainage Control Unit at Shasta Dam, and two members of the crew (above) use the new Dawson planting invention in a revegetation program to halt erosion around Shasta and Keswick reservoirs. At right, close-up of Dawson and his contribution to soil and water conservation.

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THE FIRST CAPSULE, drawn by Miss Lavonne Wood, queen of the 1950 Riverton rodeo, is handed to E. D. Eaton, Director of the Bureau's Branch of Operation and Maintenance, as W. E. Rawlings of Billings, Mont., Assistant Director of the Bureau's Region 6, witnesses the proceeding. The name of Calvin J. Probst of Midway, Utah, was contained in the tiny cylinder, giving him first priority by which he will be considered for one of the 54 irrigable farm units open for homestead settlement on the Bureau of Reclamation's Riverton project in central Wyoming. *All photos for this article taken by C. A. Knell, Region 6 Photographer.*

RIVERTON FARM DRAWING

HERE IS AN INDICATION of the widespread interest of World War II veterans in securing an irrigable farm on a Bureau of Reclamation project: 10 States were represented in the first 10 names drawn at a public program conducted August 26 at Riverton, Wyo., to establish a priority by which applicants will be considered for the 54 irrigable farms opened for homestead settlement on the Bureau of Reclamation's Riverton project in central Wyoming.

Calvin J. Probst of Midway, Utah, drew the number one position. If he meets all requirements he will have first choice of the 54 farms, which average about 130 acres of land that can be irrigated from Bureau-constructed facilities. On Probst's heels came Warren D. Krieger of Lindsay, Calif., Jerome T. Brown of Warno, Wyo., Edward J. Pflanzer of Chicago, Ill., Jay B. McCoskey of Pekin, Ind., Edwin D. Moler of Martinsburg, W. Va., Charles F. Noland of Deer Island, Oreg., Clarence W. Ferguson of Miami, Tex., Benjamin K. Wilkinson of Valentine, Nebr., and Elmer F. Meidinger of Marsh, Mont.

At the drawing, conducted as a part of the Fremont County Fair, 162 names were drawn from the 1,369 applicants who had submitted complete application forms and established veterans preference, allowing two alternates for each of the farms in case some of the applicants do not fully qualify after an intensive review by an examining board composed of Riverton residents. Thirty States were included in the 162 names drawn. Leading was Utah with 19 names, Nebraska with 15 names, California with 14 names, Montana with 12, and Oklahoma and Wyoming with 10 each. Other States represented were Alabama, Arizona, Colorado, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Minnesota, Missouri, New Mexico, New York, North Dakota, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Texas, Washington, West Virginia, and Wisconsin.

The importance of reclamation projects in national strength and security was the keynote of the principal address—given by E. D. Eaton of Washington, D. C., director of the Bureau of Reclamation's Branch of Operation and Maintenance.

Mr. Eaton said, "For the past 25 years, the Riverton project has been one of the many Bureau of Reclamation developments that has given men throughout the Nation an opportunity to make homes and livelihoods for themselves and their families. There are varied important ways in which Reclamation projects contribute to national strength and security. One important role is the contribution to the Nation's food supply. The Riverton project, for example, sends its produce all over the United States. Beans raised here command premium prices in eastern markets because of their recognized high quality. Sugar beets and potatoes are also of top quality and project-grown alfalfa and other crops help supply national livestock feed requirements. During the present critical international situation, as during the past war, the productivity of our western Reclamation projects is a strong element in national security.

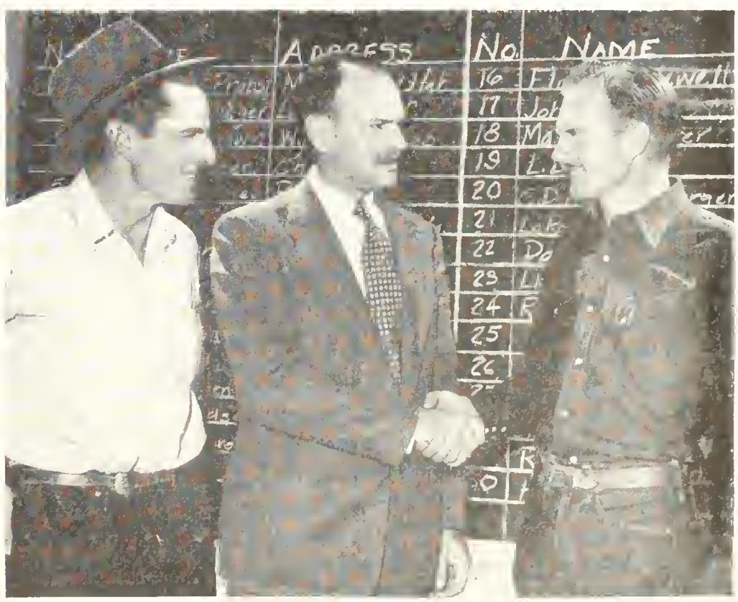
"In looking ahead, we can foresee the increasing importance of Reclamation in the national picture. Production from the areas being developed today will be urgently needed for our growing population. In 25 years—which is only as far ahead as the time since first irrigation deliveries were made on this project—there will be a national population of 199,000,000, or one-fourth more people than live in the United States today. The increase and stabilization of food production resulting from irrigation on existing and new Reclamation projects is a key to unlock the door of supply for the food to care for our growing population. Maintaining adequate food supplies is essential to keep our American standard of living from gradually slipping downhill as has happened in many of the less foresighted nations. That high American standard of living is our surest guarantee of national strength and security in the midst of a troubled world. We are proud, therefore, that the Riverton project and other Reclamation developments not only bring prosperity to the project settlers and to the local towns and trading areas, but also fill an increasingly important niche in our constant struggle for a stronger and richer United States."

Other speakers at the event were William E. Rawlings of Billings, Mont., Assistant Director of the Bureau's Region 6, and E. T. Copenhaver of Cheyenne, Wyo., auditor for the State of Wyoming, representing Wyoming's Gov. A. G. Crane. Participating in the drawing, other than the speakers, were Mrs. Carroll Riggs, representing the postwar homesteaders on the Riverton project; Charles T. Hinze of Cody, Wyo., acting district manager of the Bureau's Big Horn District; T. A. Clark, project engineer of the Riverton project; Walter Samuelson, chairman of the Fremont County Fair Board; E. E. Peters, commander of the Wind River Post of the Veterans of Foreign Wars, and Miss Lavonne Wood, Queen of the 1950 Riverton Rodeo.

The first applicant in the audience whose name was drawn from the glass bowl was Lawrence E. Runge, of Powell, Wyo., who is well-acquainted with reclamation farming, having resided for many years at Powell, Wyo., which is located in the heart of the Bureau's Shoshone Reclamation project—one of the first reclamation developments in the West, being authorized for construction in 1908. Both Mr. Runge and Dale T. Smith, of Riverton—the second applicant in the audience whose name was drawn—expressed high praise for their good fortune in being among the winners of top priority for consideration for a farm which is destined to be as productive as the hundreds of other Riverton Reclamation project farms that have operated successfully under irrigation for many years. In addition to wanting the security and financial reward resulting from the operation of an irrigated reclamation farm, Smith had an added incentive, he said. His wife and three children have been eager to join the ranks of Riverton project farm owners, and now, he explained, he can please not only himself, but the entire family.

The two men are justified in believing in their good fortune. Between the time the Secretary of the Interior opened the land to homestead settlement on March 28, 1950, and the close of the simultaneous filing period on June 26, about 8,500 inquiries had been received from persons residing in all 48 of the States of the Union, Alaska, Panama Canal Zone, District of Columbia, and Arabia. From the applications received,

THAT'S MY NAME!—Lawrence E. Runge of Powell, Wyo., with his daughter and neighbors (lower left), gives typical reaction as his name is drawn from the 19th capsule. **CONGRATULATIONS** are extended to two top priority winners, Lawrence E. Runge, left, and Dale T. Smith, right, by Operation and Maintenance Director E. D. Eaton. Smith, a resident of Riverton, has watched the farms grow from sage-brush-covered land and is eager to become a Riverton project farmer.



1,389 were considered to be qualified for the drawing. These applications represented 41 States and 2 applicants were working in Jeddah, Saudi Arabia. These two men, Charles A. Spoon, formerly of San Bernardino, Calif., and Horace Celaya, formerly of Tucson, Ariz., are employed with a firm engaged in oil activities. Mr. Celaya stated in his letter of application that he was working in Arabia for the sole purpose of saving enough money to begin farming in the West.

Unfortunately neither of the men were among the first 162 on the priority register. However, they will have other opportunities to try for an irrigable homestead made possible through the construction work of the Bureau of Reclamation on the Riverton project and other Reclamation projects throughout the West. It is presently planned to conduct four more homestead openings on the Riverton project from 1952 through 1955. About 130 new farms will be established as a result of these scheduled openings and the Riverton project will be increased to about 96,000 acres. Forty-two thousand acres of the project were settled before World War II and it is on these irrigated lands that the project farmers are able to produce top quality crops running as high as 2,500 pounds to the acre for commercial beans, 20 tons to the acre for sugar beets, and 5 tons to the acre for alfalfa.

"Reclamation farms bring prosperity not only to the individual farm operator but to the Nation," Mr. Eaton explained. "Bringing Reclamation projects into production involves large-scale Government expenditures running into many millions of dollars, but the return is far greater not only in money but in the strength and security of the Nation. On seven typical Reclamation projects, Mr. Eaton said, "the Government spent for construction $168,000,000. In addition to providing a return to the Treasury of almost the entire construction costs through water and power revenues, these same seven projects have already put into the Federal Treasury more than twice their construction costs in the form of income taxes paid." THE END

Applications Close for Part-Time Farms This Month

People who are applying for a chance to buy a small irrigated farm site on the Bureau of Reclamation's first part-time irrigation project must have their applications in by 2 p. m., October 23, 1950.

Copies of public announcements and application forms for these 56 part-time units in irrigation block 2, first Burbank pumping unit, Columbia Basin project, Wash., have been available since September 8, 1950, at the project office at Ephrata, Wash., the regional office at Boise, Idaho, and the Washington, D. C., office of the Bureau of Reclamation.

A public drawing will be held to determine the order in which applicants will be examined. If found qualified, applicants may select the unit of their choice, in the order in which their names were drawn. Seventy-five percent of the farm units are to be open to veterans. The remaining 25 percent will be available to nonveteran applicants.

The units range in size from 1½ to 5½ acres, with a price range from $75 to $250 for the land. Each person who is awarded a part-time unit will be expected to pay a certain share of the cost for the special concrete pipe distribution system which carries irrigation water to each unit. The district manager will apportion this cost among the part-time farm owners, and according to preliminary estimates, it will range from $200 to $800 per unit, to be paid off in equal annual installments within 10 years at 3 percent interest. A down payment of $100 is required for each purchaser. Irrigation water will be distributed to each unit and a minimum charge set for delivery, operation, and maintenance of this special system. Each purchaser will be required to build a suitable dwelling on his unit, have made a good start on it within a year and a half, and have it completed 2½ years from the date the sales contract is signed. After the 10-year development period, each purchaser will be required to pay a share of the construction costs of the project, which will amount to $2.12 per acre each year for 40 years, averaging a total payment of $85 per acre. ●

Two Contracts Speed Trenton Dam Construction

Earth-filling machines, compactors, bull-dozers, gigantic trucks and other construction machinery will start rolling soon when the final stage of construction gets under way on Trenton Dam in Nebraska. This is the third of three dams making up the Frenchman-Cambridge unit of the Republican River Valley development, an important part of the vast Missouri River Basin project.

Work on the dam was divided into two separate contracts in order to speed up construction. The first contract which provided for the excavation work and the preliminary work necessary for the foundation is now nearing completion. The recent contract awarded on June 30 to three California companies, the Vinnel Co. of Alhambra; Ralph A. Bell of Los Angeles, and the United Concrete Pipe Corp. of Baldwin Park, provides for placing the earth in the dam proper and constructing the spillway and canal outlet works.

The Frenchman-Cambridge Division, in addition to the Trenton Dam, includes two other multiple-purpose dams already completed. They are the Medicine Creek Dam located on Medicine Creek 8 miles northeast of Cambridge, Nebr., and Enders Dam on Frenchman Creek near Enders, Nebr. These three structures will form reservoirs which will provide 339,000 acre-feet of irrigation storage, flood control, and silt retention facilities for lands in the division.

In addition to the three multiple-purpose dams, the unit will contain four diversion dams and five main canals and laterals to irrigate approximately 53,000 acres of land along the Republican River in southern Nebraska. ●

Reservoir Behind Davis Dam Named Lake Mohave

When Senate bill 2117 became law in June 1950, the reservoir formed behind Davis Dam was officially named Lake Mohave. (See New Lake in the Desert, p. 70, April 1950 issue.) It was so designated because of its proximity to the Mohave Desert and the Mohave Indian Reservation. Mohave, or Mojave, is a name well known in the area where the lake is located. ●

TWO HUNDRED FOOT LONG "FREE CREST" (meaning free of outlet gates or other water releasing devices) in the 2,200-foot long spillway for Dickinson Dam on the Heart River, 2 miles west of Dickinson, N. Dak., provides maximum benefits at minimum cost for the people of the area. *Photo by Donald H. Demarest, Region 6 photographer.*

Dickinson Dam Dedication

NORTH DAKOTA'S GOVERNOR FRED G. AANDAHL, the principal speaker at the August 13 dedication of the Bureau of Reclamation's Dickinson Dam, said that the many benefits that will accrue to the people of North Dakota as a result of the construction of the dam are being repeated throughout the Missouri River Basin as a result of the vast program in progress by the Bureau of Reclamation to conserve and control the water resources of the basin in order that these waters may be put to use serving the many needs of mankind.

The ceremonies marking the end of construction of Dickinson Dam on the Heart River—almost a year before the scheduled completion date—were conducted at the damsite near Dickinson, N. Dak., and were attended by approximately 400 persons.

The dam, a part of the Heart Division of the Missouri River Basin project, will make possible the provision of an adequate and stable supply of municipal water for the city of Dickinson, provide for the irrigation of about 915 acres of new land in small pumping units downstream and adjacent to the reservoir, minimize flood threats to the city of Dickinson and the farm and ranch lands in the Heart River Valley, expand recreational possibilities and improve habitat for fish and wildlife.

W. E. Rawlings of Billings, Mont., assistant director of the Bureau's Region 6, which encompasses Montana east of the Continental Divide, the northern half of Wyoming east of the Divide, and North and South Dakota, shared speaking honors with Governor Aandahl. The assistant director stressed that "Dickinson Dam has become a reality because the people of the community planned and worked for its construction."

The dam, 2 miles west of Dickinson, is an earthfill structure with a height of 65 feet, 45 of which is above the normal stream bed. The crest is 2,200 feet long, including a 200-foot-long "free crest" concrete spillway on the right abutment. The reservoir backed by the dam has a capacity of 16,500 acre-feet, with additional temporary superstorage of 9,200 acre-feet for exceptional flood conditions.

The provision of a dependable source of water for use by the city of Dickinson is one of the major purposes of the Dickinson Dam. The city has been faced with an ever increasing shortage of water for domestic, municipal, and industrial purposes during recent years. Its major water supply has been from wells, with supplemental water obtained in periods of peak demand by pumping from the Heart River. The wells are becoming increasingly inadequate for the demand and in the periods of peak water use—summer and fall months—the Heart River reaches its lowest flow limiting the amount of water available.

A contract between the Bureau and the city of Dickinson was executed last September stipulating that the Government will provide, at the outlet works of the dam, a water supply for the city. Under terms of the contract, the city has prior rights for 1,100 acre-feet (359,000,000 gallons) of water annually from the reservoir. This amount of water is more than sufficient for present needs and is estimated to be sufficient to meet the city requirements 40 years from now—the term of the contract. Water for the city supply will be released from the dam to a temporary treatment plant that is now in use. The city plans to construct a permanent treatment plant for its municipal supply in the near future.

Benefits to the people of Dickinson from the new water supply include the stabilization of the existing supply, extension of water service to more residents, increase in supplies for fire protection and sanitation, provision of water for industrial expansion now hampered by the lack of water, and will make possible the institution of a planned city-beautification program and serve many other purposes.

A. J. Dexter of St. Paul, Minn., agricultural development agent for the Northern Pacific Railway, served as master of ceremonies at the event. Invocation and benediction were given by the Reverend William A. Cross and the Right Reverend Monsignor George P. Aberle. The Honorable Edgar T. Agnew, president of the Dickinson City Commission, gave the welcome and other speakers were Harold C. Adler of the Adler Construction Co.—contracting firm for the dam; Bruce Johnson of Bismarck, N. Dak., manager of the Bureau's Missouri-Souris District, and Charles R. Whipple, Bureau construction engineer for Dickinson Unit. Orville F. Burda served as dedication chairman. THE END

"GETTING THE EVIDENCE" ON EVAPORATION

Water rustlers are taking the place of cattle rustlers in the West.

They have been stealing precious water needed for hydroelectric power development and irrigation. Moreover, they have been carrying on their nefarious activities in plain view, sometimes with, and sometimes without, the knowledge of the people who were trying to conserve water, and most of the time getting away with more water loot than anyone realized.

Gradually the water rustlers are being unmasked, their hiding places uncovered, and the evidence of their crimes assembled. Silt, long suspected of robbing reservoirs of their water capacity, has been under close scrutiny for some time. Scientists continue to shadow this suspect, and the Reclamation Era will continue to publish the facts regarding silt, alias sedimentation, as it did in the articles, The Life of Hoover Dam, in April 1948; Science to Solve Silt Problem in June 1948, and Solving the Silt Mystery, in September 1950.

Another poacher of precipitation (in the form of water stored in reservoirs) is now under close scientific observation—evaporation. This is one of the most elusive of the water thieves, as it is practically invisible, and literally vanishes into thin air. However, enough evidence has been accumulated to justify a thorough investigation of this water enemy.

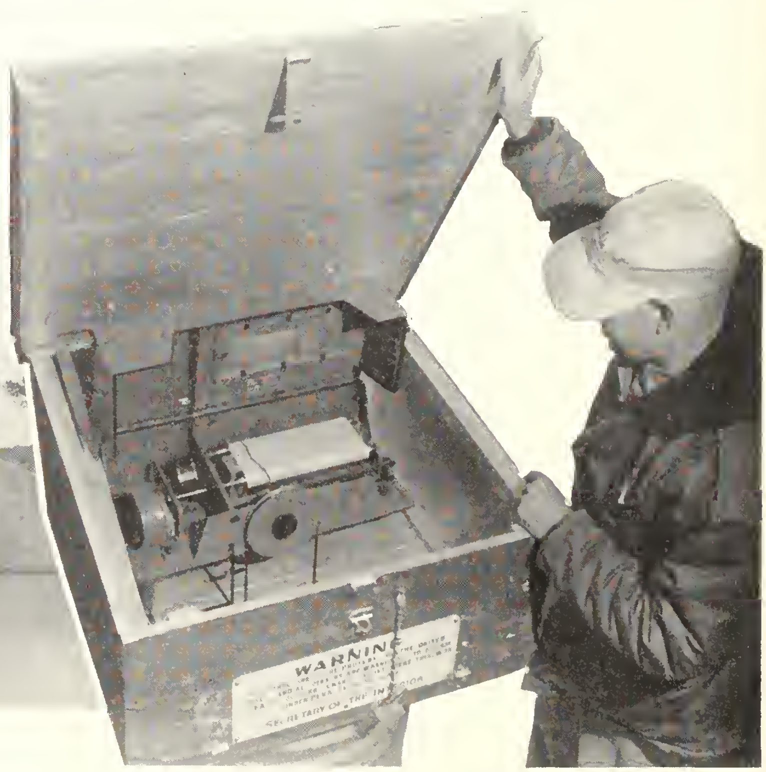
Bureau of Reclamation officials have charged evaporation with the crime of stealing more than 800,000 acre-feet per year, or 260 trillion gallons of water from Lake Mead, the reservoir backed up by Hoover Dam. Carl P. Vetter, Chief of the Office of River Control for the Bureau of Reclamation at Boulder City, Nev., has stated that evaporation would be capable of stealing more than 2,000,000 acre-feet of water a year from present and proposed reservoirs in the Colorado River Basin, and channels in the lower part of the basin. This would be enough water to irrigate 400,000 acres or provide 2 billion kilowatt-hours of hydroelectric power a year, enough to serve a community like Oklahoma City for more than 2 years.

These charges, however, must be supported by scientific evidence. Scientists from the Bureau of Reclamation, Geological Survey, Department of the Navy, and the Weather Bureau decided it would be too difficult to track down evaporation from Lake Mead, largest storage reservoir in the world. Among other things, Lake Mead is too long, too deep, and has too irregular a shoreline. What they needed was a reservoir shaped like a saucer, several miles in diameter, with a bottom that didn't leak, so that literally every drop of water in the reservoir, coming into the reservoir, and leaving the reservoir could be measured accurately.

Geological Survey and Bureau of Reclamation scientists canvassed their field offices in search of such a lake. After considering more than 100 throughout the West, Oklahoma City's Lake Hefner was found to come about as close to providing a natural outdoor laboratory as could be expected. Lake Hefner is a saucer about 2½ miles in diameter scooped out at the very headwaters of a drainage basin. Very little water is lost through its dike (or dam) almost 4 miles long, and even this can be measured accurately. The compacted red clay bottom is practically watertight.

Other natural advantages which made Lake Hefner the perfect choice were its almost unobstructed expanse of water,

CHECKING WHAT COMES IN—At one of the main inflow measuring stations for Lake Hefner. At right, closeup of the equipment in the box perched on the pipe at left of the weir. *All photos for this article made available through the courtesy of the United States Geological Survey of the Department of the Interior.*



the lack of trees around the reservoir rim, and the fact that Oklahoma City does not depend upon local rains to fill the lake. Whenever the nearby North Canadian River reaches flood stage, city water chemistry experts measure the mineral and salt content of the muddy river. When the waters are sufficiently diluted, a special diversion canal is opened and Lake Hefner is filled from the river. This takes about 5 or 6 days and raises the lake level by about 6 or 8 feet.

One method to be used in gathering evaporation data at the Hefner laboratory is known as the "water budget." The amount of evaporation is determined by measuring the amount of water flowing into the reservoir, the amount flowing out, and changes in the amount of water stored. Like any household budget, the difference between the amount of money you had at the beginning and what you have left, after you have added what came in, and what went out is not always the same. That unaccounted-for difference, we often say, has "evaporated." It's the same with the water budget, although the amount of evaporation is often small compared to errors in measuring the inflow and outflow, and there is some difficulty involved in accurately measuring seepage and bank storage.

However, the water budget will be used as a control to check with the other three methods being used at Lake Hefner. The amount of water flowing into the lake is being measured at the Canadian River diversion canal when Oklahoma City chemists give the word to release the water into the lake. There are also a half dozen small streams, dry most of the time, which occasionally carry water into the reservoir. Weirs and recording gages have been installed near the mouths of these streams to measure the amount of water which goes into Lake Hefner.

Any rain which falls into the lake and upon the surrounding area will be caught and measured by 23 rain gages. Multiplying this figure by the total lake surface will give the amount of water added directly through precipitation. The Air Force flew a pattern over the lake area and turned out needed air photographs to supplement existing and new maps needed to plot the drainage area and determine accurate water runoff figures after each storm.

So that the amount of water drawn out of the lake to supply Oklahoma City could be accurately measured, Bureau of Reclamation engineers calibrated the venturi meter that measures the outflow at the filtration plant, so that the meter is now considered accurate to within 1 percent.

With the water exits and entrances thus closely guarded, Lake Hefner's "water budget" should be a relatively accurate figure.

Keeping track of the water additions and losses will be the work of Geological Survey's Water Resources Division, under the supervision of G. Earl Harbeck. This will be accomplished on a daily basis as well as weekly.

Survey engineers will be responsible for the preparation of an accurate area-capacity curve for the lake, based on hydrographic surveys made by Navy personnel with echo sounding equipment.

A second and "indirect" method of determining evaporation is through the use of "evaporation pans," in which Weather Bureau scientists place a known amount of water and then measure the rate at which this disappears under the influence of the sun and wind. But scientists have long suspected that there may be a big difference between the evaporation rate from a shallow pan and from a reservoir, lake, or the ocean. Evidently, you cannot merely compare the relative surface areas and come up with an accurate figure. You have to take into consideration such things as the depth of the water, its temperature, the amount of heat it absorbs, and above all, the difference in scale between a pan and a large body of water with quite different wind effects. However, Weather Bureau technicians have installed several types of evaporation pans, complete with anemometers (anemo meaning wind or current of air), water and air thermometers, and other meteorological equipment in and around Lake Hefner. They will study these data in relation to corresponding observations on the lake and compare their evaporation figures with the water budget, to devise more reliable and sounder methods of using pan evaporation data. This will be a notable contribution to this cooperative study.

Now we come to the third and fourth methods of getting evidence on evaporation. Only as a result of recent theories developed from water and weather (oceanographic and meteorological) studies, have these methods been made possible. Up to now the theories have not been adequately tested in practice. The banding together of various scientists to make

GETTING IT IN THE RECORD—Within this prosaic looking cabinet are clever electronic gadgets which measure the rainfall, speed, and direction of wind (recorder at left on top shelf). At right on the top shelf is recorded the difference in temperature between the air at various levels and ice water (kept in a thermos bottle in the wooden box at lower right at a temmepature of 32° F.). The smaller box in the middle of the top shelf contains the amplifying equipment which makes it possible to record the data. The battery number 13 has no particular significance, and the technicians are not superstitious.

the Lake Mead silt investigations set the pattern for these cooperative water loss studies.

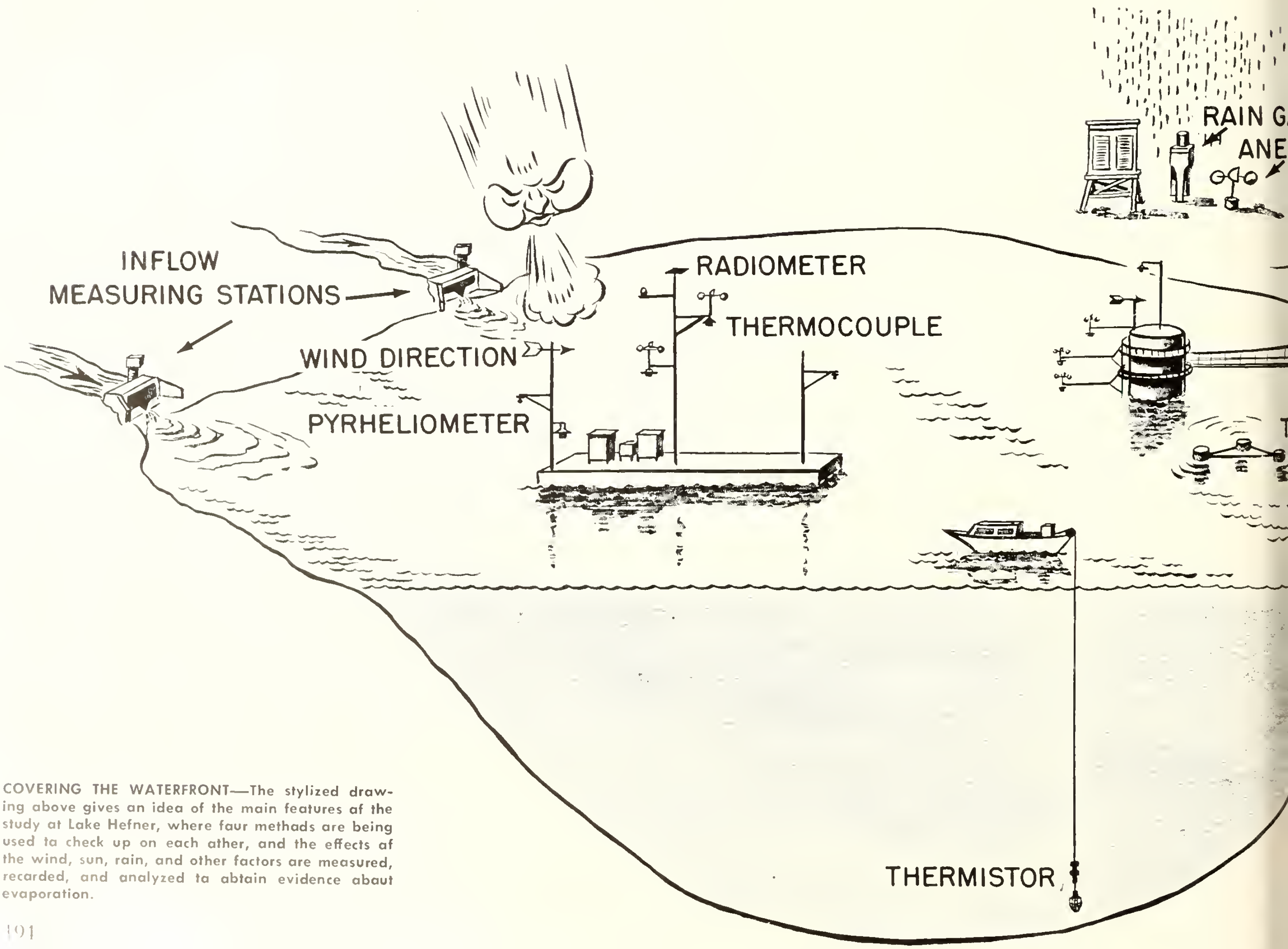
The third method is known as the "energy budget" or "heat budget" of Lake Hefner. Flat plate radiometers, and pyrheliometers (pyr meaning fire + helio meaning sun + meter for measuring device) some facing up, and some facing down, will measure the sun's rays as they beat upon the lake's surface and also as they are reflected from the water. The information collected by these energy detectors will be recorded electronically. An accurate account will be kept of all radiation from the sun in the course of a year, against which will be charged the reflected radiation and heat radiated back to the air. The rest, allowing for changes in the amount of heat stored in the lake, must be what is used up in evaporation processes. Heat absorbed by the water will be measured by thermocouples (heat measuring devices) and ingenious thermometers (called thermistors) which are lowered from boats, and send (via cable) a continuous message about the temperature of the water all the way down to the bottom of the lake to a recording machine in the boat above.

The fourth method, based upon the "mass transfer theory," takes into account all the things which cause water to change into vapor. Evaporation follows definite physical laws and is affected by such things as air and water temperature, the amount of moisture already in the air, the velocity of the wind, and height of waves kicked up. All these factors can and will be measured, and will enter into the final computations.

For more than a year, the Navy Electronics Laboratory has been developing the instruments necessary to gather data with which to study the "energy budget" and "mass transfer" methods of accumulating evidence about evaporation, and has furnished the special electronic instruments designed for these studies. NEL researchers under Dr. R. Dana Russell will be responsible for the meteorological observations, the thermal (temperature) survey, and for analysis of the data. Their studies to date have been summarized in a recently issued report, "A Review of Evaporation Theory and Development of Instrumentation" by E. R. Anderson, L. J. Anderson, and J. J. Marciano, all of NEL.

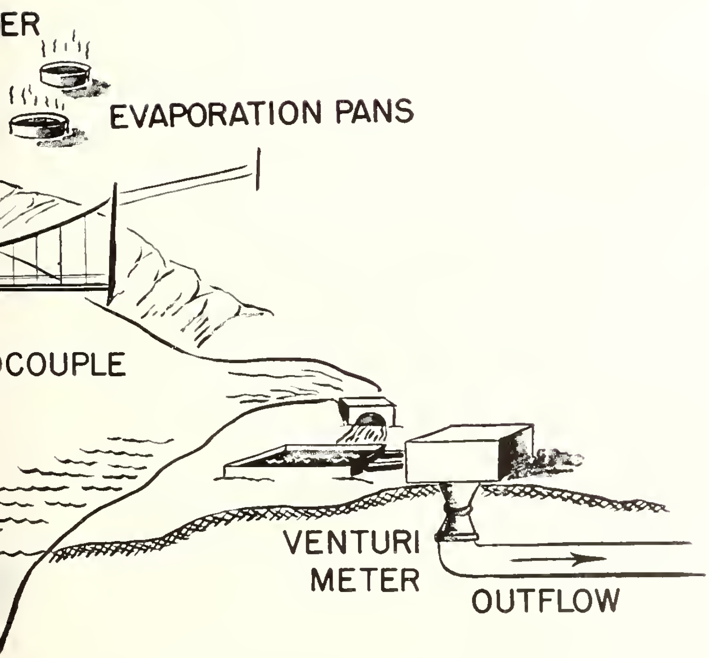
Navy and Geological Survey technicians have established four collection points for the data, three on land and one in midlake. (See photo on p. 195.)

Each of these stations seems alive with whirling cup anemometers to determine wind velocities at different elevations above the water, specially designed "hats" containing



COVERING THE WATERFRONT—The stylized drawing above gives an idea of the main features of the study at Lake Hefner, where four methods are being used to check up on each other, and the effects of the wind, sun, rain, and other factors are measured, recorded, and analyzed to obtain evidence about evaporation.

DETECTIVES AT WORK—Below is the midlake barge with its anemometers, pyrheliometers, radiometers, rain gages, recorders, etc. At center, a closeup of a downward-facing pyrheliometer with its specially designed "hat" to measure radiation from the sun reflected from the water surface. At left is a closeup of one mast with equipment to measure wind direction, solar radiation, temperature, humidity, and the speed of wind.



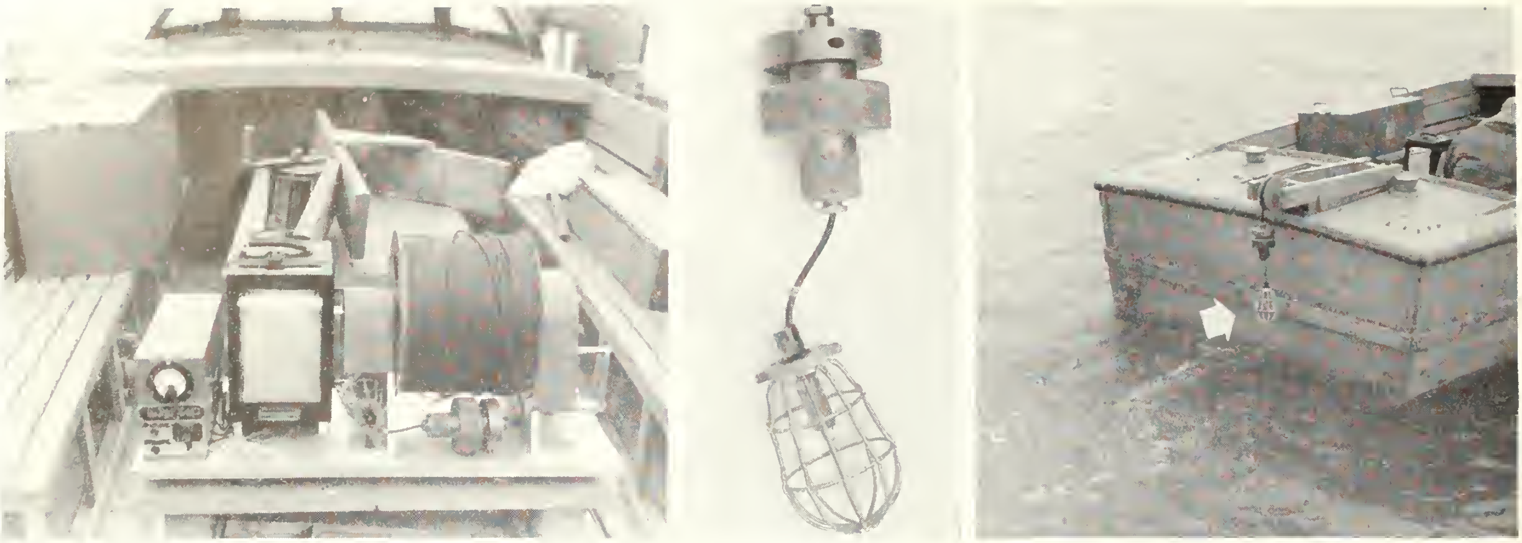
thermocouples to measure temperature and humidity, and a vane to note wind direction. The large station is also equipped with radiometers and pyrheliometers to pick up the sun's rays.

A thermocouple held just below the water surface by a special float of three small pill-box-shaped buoys, anchored well away from shore, accompanies each station to provide a record of the temperature of the lake surface. The thermocouple is connected by a long cable to the same recorder used for the air-temperature elements.

The recording apparatus, particularly the amplifier, is an ingenious combination of electronic devices—and represents the removal of a stumbling block which might have prevented the whole progam of evaporation studies. Dependable and plentiful electric power, taken for granted by many city dwellers, is not available at many isolated lakes and reservoirs, and special equipment had to be designed to overcome this obstacle. The only power used is that supplied by batteries, and each of the tiny electric voltages coming from the various instruments had to be amplified so that a visible record could be kept. Ordinarily this calls for a sizable amount of power, but the Navy solved the problem by developing a new system whereby each of the small voltages could be amplified separately.

The observations at Lake Hefner, made at the rate of one every 30 minutes for 13 months will be recorded on punch cards, and will furnish information valuable not only for these immediate studies, but for scientists who may have need of it in the future. When all the records are in, it is expected there will be more than 80,000 cards involved. High-speed analysis and computation machinery will be used to make the results immediately available.

"Such data," said Secretary of the Interior Oscar L. Chapman in announcing the survey, "will be of tremendous importance for the planning of future water resource development in the Western States. As the need for maximum con-



IT WRITES UNDER WATER—Or more properly, the thermistor bead shown in the center panel above sends messages which are recorded on the device in the boat (upper left). Once a week thermistor visits 16 specific locations, takes a dive to the bottom of Lake Hefner, and on the way down sends a continuous report on the temperature of the water to the recording machine.

servation and putting to use of every available drop of water becomes more pressing. Bureau of Reclamation engineers must know exactly what losses by evaporation are likely to occur before they take a dam past the investigation stage."

"No single scientific approach," he added, "could possibly yield such conclusive results as may be expected from the present combined attack on the problem. It again demonstrates the high degree of cooperation which exists between Government agencies in which they pool equipment and scientific knowledge and experience."

The evidence is piling up. Within a year we will know what evaporation's "take" has been at Lake Hefner. From there on, Navy, Weather Bureau, Reclamation, and Geological Survey engineers will be armed with increasingly accurate techniques and tools for gathering evidence on what this water thief pilfers from other reservoirs. THE END

Recreation Spots in Colorado River Basin Surveyed

Secretary of the Interior Oscar L. Chapman stresses the importance of preserving the Colorado River Basin's scenic character and developing its recreational possibilities in the foreword to A Survey of the Recreation Resources of the Colorado River Basin, a National Park Service publication released August 20, 1950.

"Wise utilization of all resources," the forward continues, "requires careful and thorough study of all their potentialities so that the best possible use may be made of them in providing a good life for the people within the basin and for the benefit of the Nation as a whole."

The National Park Service started the survey in July 1941, with funds supplied by the Bureau of Reclamation. The Secretary of the Interior authorized the use of the money which was earmarked for over-all studies and investigations of the Colorado River system.

The area covered by the survey is one of the outstanding recreational regions of the United States because of its varied natural scenery, climatic conditions, areas and objects of scientific interest, abundant evidence of prehistoric occupation, and present Indian, Spanish, and Anglo cultures.

In this region, embracing latitudes from Mexico almost to Yellowstone National Park in Wyoming-Montana-Idaho, and altitudes ranging from 248 feet below sea level to 14,431 feet above sea level, one may enjoy a large amount of sunshine and find perfect climates and settings for various types of outdoor recreation the year round. According to the report, the Colorado River Basin comprises 8.7 percent of the United States but contains only 0.7 percent of the population.

In the introduction to the report, Director Newton B. Drury of the National Park Service states that the principal purpose of the survey was "to obtain facts essential to the establishment of departmental policies regarding classification, development, and administration of possible water-control projects and areas within the basin, giving due regard to recreational possibilities and the preservation of scenery and other natural features." "The survey," he adds, "also embraced the study of recreational resources of large portions of the basin not administered by the Department of the Interior. Information thus gained will be helpful to the Bureau of Reclamation in avoiding needless sacrifices of existing and potential recreational values, and in utilizing opportunities to obtain recreational benefits as an incident to the development of water resources."

"Another purpose of the survey," Director Drury points out "was to identify and evaluate such areas as might be of outstanding national importance, so that measures may be taken to maintain them in a high state of preservation for public enjoyment. This study was not exhaustive. An attempt to enumerate and evaluate all types of recreational resources, both existing and potential, throughout the entire basin, would have been a huge undertaking beyond the scope of this survey."

Copies of this 242-page report, containing more than 100 photographs and maps, may be purchased from the Superintendent of Documents, Washington, D. C., for $3.25 each. •

Grand Coulee's 14th Generator

Grand Coulee Dam placed its fourteenth completed generator on the line at approximately 4 a. m., Thursday, July 13.

The twin powerhouses of nine 108,000 kilowatt generators each, are now 77.7 percent in service, feeding power to cities and industries of the Pacific Northwest.

One more generator is scheduled to go into service in 1950. The tentative date is October 15. The final three generators will go on the line in 1951, to bring to completion the world's largest power-producing plant.

The first 108,000 kilowatt generator went into service at Grand Coulee Dam on October 1, 1941. Six and a half years later, on April 23, 1948, the final generator of the west powerhouse—L–9—went on the line.

President Truman pressed a special button at the White House at 11 a. m., May 20, 1949, to place into operation the first unit of the east powerhouse, and since then assembly has proceeded, on schedule, for the remaining nine generators.

Grand Coulee Dam already holds hourly, daily, weekly, and monthly world's records for power production. Records made to date are: Hourly: 1,625,000 kilowatt-hours, January 4, 1950; 24-hours: 35,894,000 kilowatt-hours, January 18, 1950; weekly: 246,287,000, January 30 to February 5, 1950; monthly: 1,022,062,000, January 1950.

The rated capacity of each generating unit is 108,000 kilowatts, but units can operate without harm at approximately 125,000 kilowatts peak capacity. Peak rating of the 14 generators now in operation is 1,750,000 kilowatts. •

The Dawson Planting Tool

(Continued from page 187)

and borrowed a number for test plantings on selected forest sites. Thus with the development of this cheap but ingenious planting tool, requiring little or no maintenance cost, the efficiency of the Bureau's erosion control unit has been more than doubled and a notable contribution made to wild land reforestation in general.

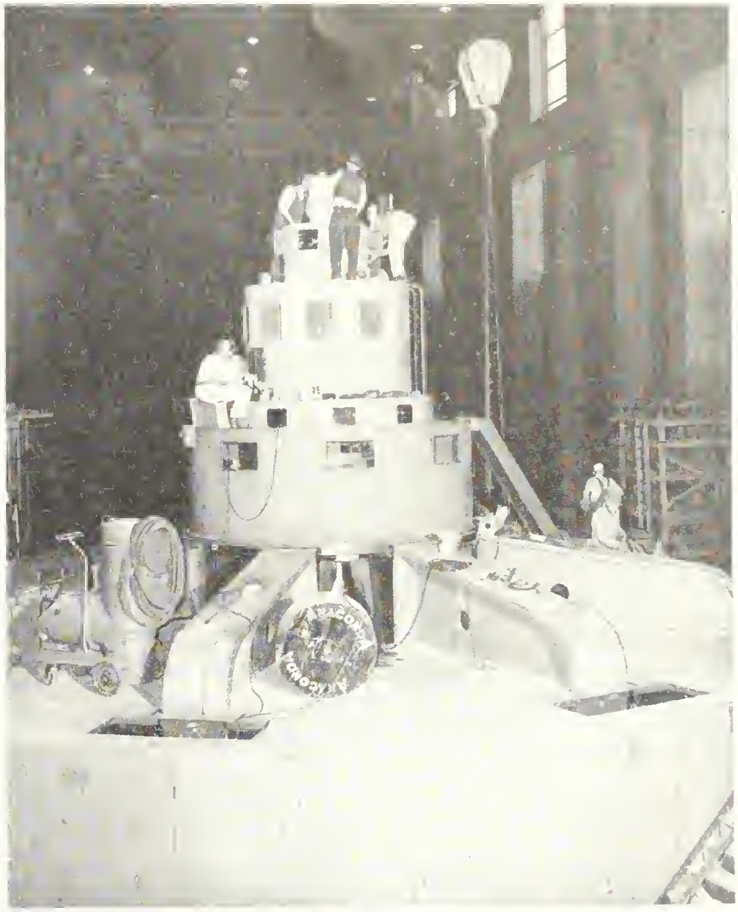
Construction Engineer Edward Helgren of Shasta points out that the Bureau of Reclamation has instituted patent proceedings to protect Mr. Dawson's highly valuable device and in so doing recognizes another fine example of difficult problems being met through the ingenuity of the Bureau's fieldmen. THE END

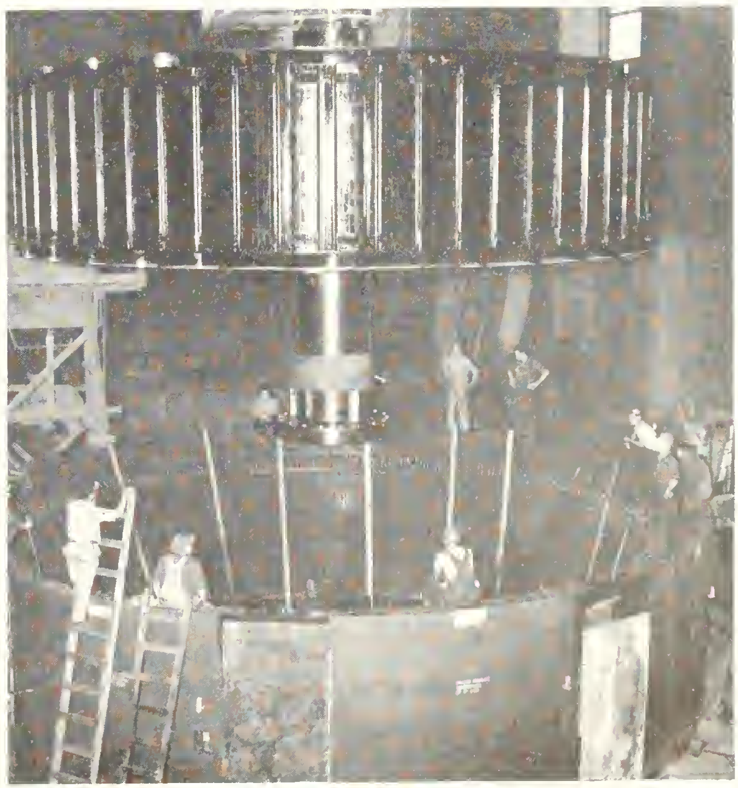
Fisher Succeeds Fix as Chief Counsel

Edward W. Fisher, Legislative Attorney and Assistant Chief Counsel in the Bureau of Reclamation's Washington Office was named by Secretary of the Interior Oscar L. Chapman to succeed Clifford E. Fix as Chief Counsel for the Bureau on September 11, 1950.

Mr. Fix, a specialist in land and irrigation laws, retired as Chief Counsel to enter private practice in his home town of Twin Falls, Idaho. •

INSTALLING THE FOURTEENTH—Immediately below, the final pieces of the fourteenth generator at Grand Coulee Dam, as it looked on June 27, 1950. The machine setting on the generator at left is a vacuum cleaner, which was used to assure absolute cleanliness before the test run started. *Photo by F. B. Pomeroy, Region 1 photographer.* NEXT ON THE SCHEDULE—The fifteenth generator (photo at bottom of page) going on the line this month. Workmen set the rotor, 587-ton revolving core, early in August. *Photo by H. Wayne Fuller Region 1 photographer*





COLUMBIA, YOUR LINING'S SHOWING!—When this photo was taken in July 1950 from the top of Grand Coulee Dam, 320 feet above the river, the first two layers of Columbia River's armor plate riverbank protection had been placed—5 feet of small riprap covering a 2½-foot blanket of gravel. Heavy armor rock, blasted from the quarry on the west bank (see arrow), will cover the top bank. *All photos for this article taken by F. B. Pomeroy, Region 1 photographer.*

Armor Plating The Columbia

by RAY J. SCHRICK, Coulee Dam, Wash., Region 1 (Headquarters at Boise, Idaho)

Columbia, the Knight of the Pacific Northwest, is being fitted to a coat of armor.

The Columbia River's new armor plate will be made of three layers of gravel, rock, and boulders, 5 to 10 feet thick, 75 to 100 feet wide, protecting the riverbanks at the downstream base of the Grand Coulee Dam for a distance of about 3,500 feet on the west, and almost a mile on the east, or right bank.

Millions of acre-feet of rampaging water cascade down one of the world's highest man-made waterfalls, and tear at the banks below.

Under an 18-month riverbank improvement program started in 1949, the powerful Columbia will be well-garbed to ward off erosion and the onslaught of the untamed water rushing over the spillway of the great dam. Water tamed by the huge generating units and released from twin powerhouses at either bank downstream, fight the churning spillway currents, helping to reduce their force, while the heaviest load of water is channeled across the spillway down the center. Still the threshing currents throw mist 100 feet high as they grasp toward the riverbanks.

Heavy armor plate made of boulders up to 34-tons weight—big enough for 40 men to stand on the top face, now protect the banks below the Grand Coulee Dam. This covering proved its value during the 1950 flood of 500,000 second-feet, when logs huge enough to be used as telegraph poles were tossed onto the rock-lined shores like kindling. The granite walls are designed to protect the downstream riverbank against a flood of 725,000 cubic feet per second, which, according to the experts, might occur once in a century. The last flood of this magnitude was in 1894.

Even during a normal season, the Columbia continues to eat away the sediment left in its gorge by glaciers that departed thousands of years ago. Studies in 1940 and 1949, by the chief engineer's board of consultants, and even before dam construction started in 1933, foresaw the need for the present program which will reinforce the riverbank protection designed by mother nature, and restrain the river from dissipating its water wealth (needed for irrigation downstream) in destructive forays against its natural retaining walls.

Bureau of Reclamation engineers, and the contractor's men of Morrison-Knudsen Co., Inc., Boise, Idaho, are now working together on the $1,691,666 contract to do the job.

The fruition of their plans is being echoed in daily blasts of dynamite. Single blasts, up to 10,000 pounds of 40 percent dynamite, jar the homes and typewriters of government workers in Coulee Dam, as three-quarter million tons of granite are blasted from the downstream, Bull Canyon, quarry.

During the night and early morning, heavy, towering 20-cubic-yard trucks haul the rocks from the quarry to the riverbank 16 hours daily, 4 a. m. to 9:30 p. m. Six of the two-motor giants average 200 trips a day.

The granite is being laid out, at three different levels, of three different-sized material.

Gravel will form the bottom layer of the armor plating next to the soil and clay of the Columbia River bank. The gravel will be 2½ feet deep.

On top of this will be jagged riprap, 1 cubic foot to 1½ cubic yards, approximately 5 feet deep.

At the top, will be the shock absorber—armor rock. No single rock weighs less than 3 tons and in some locations 6 tons per rock is the minimum size. The heaviest armor is laid closest to the dam to combat the most violent currents. Ten thousand pounds of 40-percent dynamite will be detonated in single blasts roughly every 2 weeks for the next year, in addition to daily "softer" touches, to provide the needed rock. Each big blast requires approximately 65 holes, each about 30 feet deep into the rock. It is the biggest sustained blast program required in the course of development of the Grand Coulee Dam and the hundreds of miles of canals and tunnels which will carry water to irrigate ultimately one million acres in the Columbia Basin project. More recently, the contractors have blasted "coyote holes" in breaking the granite wall of the quarry. These are caves, approximately 5 to 6 feet in diameter, and running 40 feet deep into the granite mountain. Each coyote hole is packed with 5,000 to 1,000 pounds of bag powder.

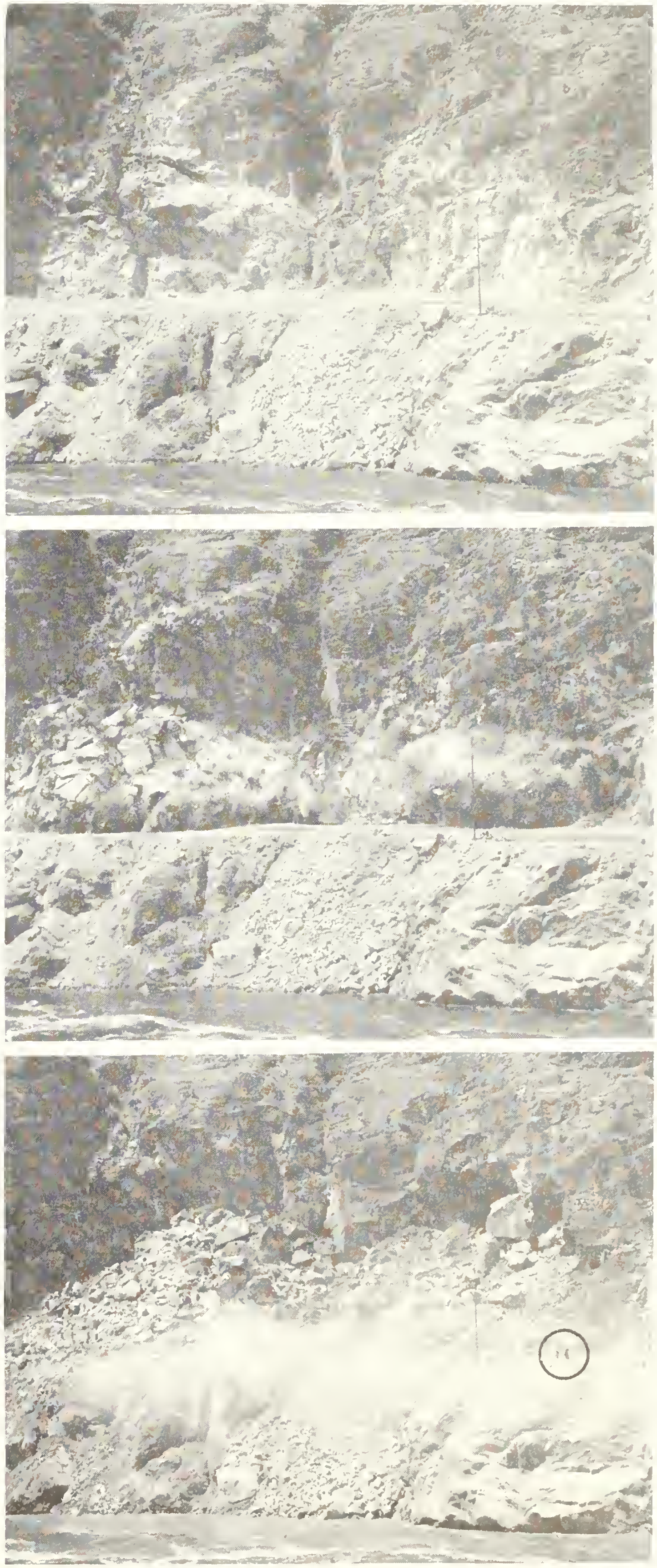
At the quarry end, two shovels are kept busy scooping up the boulders after they have been ripped loose from the granite wall, and loading them into the trucks.

A huge crane, with a boom 120 feet long, handles these boulders, rolling them, lifting them, dropping them into their proper place on the riverbanks.

The current program will require almost another year to complete, and one of the most dramatic features in the riverbank protection is now in progress. Almost all the riprap and armor rock has been placed on the west side—the same side as the quarry. At Columbia's low water stage, the delicate job of ferrying thousands of tons of granite to the opposite shore began. Crossing the bridge would tie up traffic and involve unnecessarily long hauls, wasting time and money.

The crews are working against time. Only in low water can the pontoon barge, operating on a cross-river cable, make the many difficult crossings—and low water lasts 6 months at most.

Approximately 350,000 tons of granite must be moved cross-



IT'S DYNAMITE!—The sequence at right, taken June 19, 1950, shows what happens when 9,500 pounds of 40-percent dynamite goes off in one blast. **BEFORE THE BLAST**—Three dynamite packers have spent approximately 1 week placing the 4¾ tons of dynamite sticks. Holes are set as deep as 30 feet to lift the face of the rock. **LET 'ER GO!**—At about 12:40 p. m., the changing time between shifts, the blast was detonated, jarring some nerves and about 40,000 tons of granite, but causing no other untoward damage. **AFTER THE BLAST WAS OVER**—Dust hovers over setting, as blasted rock buries quarry roadway. Extent of the blast area can be gathered by comparing height with men (in circle) along roadway to right of the blast proper.

ROCK DWARFS MAN—Although Columbia River's granite armor rock must weigh a minimum of 3 to 6 tons, some rocks weigh up to 34 tons. The one at left is in the 20-ton class. The truck above weighs almost 60,000 pounds, and can carry 20 to 30 tons, but it is not uncommon for one or two huge boulders to lift the front wheels clear off the ground. A dozer, blade visible at left of photo, solved the truck driver's dilemma in this problem.

river on so delicate a schedule that M–K contractors have figured daily crossings down to the minute, as well as the total crossings required for the season. Carrying two loaded trucks each trip, with a payload conservatively estimated at 45 tons combined, the job demands 26 trips per shift, a crossing every 18 minutes. The total for the season will be nearly 8,030 trips.

The ferry location is downstream only a short distance from one of the historic early day ferry crossings of the pre-Grand Coulee Dam era, when ranchers and pioneers had only a bobbing cable ferry to navigate the turbulent Columbia.

W. M. Cowals is the Bureau of Reclamation resident engineer in charge of the program. Art Verling is field engineer; Fred Powell, chief inspector, Bert A. Hall is assistant supervising engineer, civil and structural, Coulee Dam division. George Wells is project manager for the Morrison-Knudsen Co., Inc. F. A. Banks, former district manager, Columbia River district, and A. F. Darland, supervising engineer, Coulee Dam division, were members of the consulting board which outlined the program in 1949.

Through their know-how, and that of others, the Columbia River will soon wear an armor befitting its strength and importance as a producer of wealth and power for the Pacific Northwest.

THE END

Power Plant for Alcova Dam Proposed

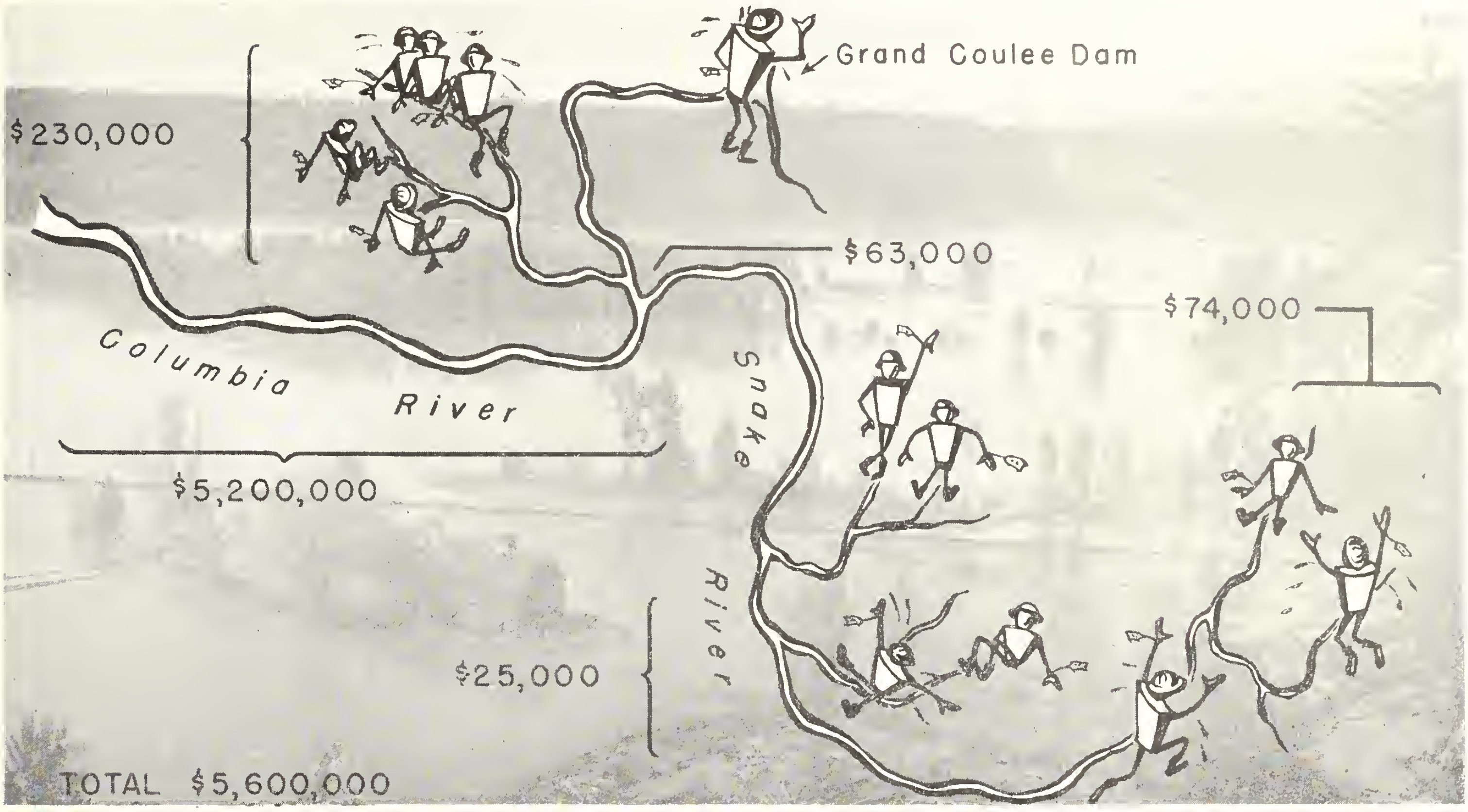
A Bureau of Reclamation plan to install a hydroelectric power plant at Alcova Dam on the Kendrick project near Casper, Wyo., was sent to Congress on August 23, 1950, by Secretary of the Interior Oscar L. Chapman. The Bureau of the Budget submitted the formal report with a letter stating that the proposal was in conformity with the President's fiscal program.

The Alcova power plant would require a 3-year construction period. The Bureau's plan calls for a slight modification of the 256-foot-high Alcova Dam, an earth and rock-fill structure completed in 1938, to provide a penstock to carry water to the proposed power plant, which would have 33,000 kilowatts rated capacity and provide 92,000,000 kilowatt-hours of electric energy annually for irrigation pumping, rural electrification, municipalities, and industries in Wyoming, Colorado, and Nebraska.

The plan was authorized by Secretary Chapman on a finding of feasibility. Under the Reclamation Project Act of 1939, the Secretary is authorized to undertake a project if he finds it feasible from an engineering point of view, if no objections are raised by the States affected, and the Secretary of the Army, and if the Government can pay for the construction by revenues from power, repayment by water users, or both. The cost of the Alcova plant and necessary construction, including two generating units of 16,500 kilowatts each is estimated at $6,377,000. Revenue to the Government from the sale of power generated at the proposed plant, totaling $380,100 a year would pay operation, maintenance, and replacement charges, and retire the estimated construction costs in 50 years at 3 percent interest.

"The power which could be generated by the installation of this plant is urgently needed in the Casper area," Secretary Chapman reported to the Congress. "The use of electricity has increased since the war at rates exceeding the rate of increase before the war, and as a result existing power generating facilities are taxed to their utmost capacity to serve the present loads, without adding the many potential customers awaiting service." •

Saved—More Than Five and a Half Million Dollars



HOW THE FLOODS WERE AVERTED AND HOW MUCH THEY WOULD HAVE COST IN DAMAGES WITHOUT THE 13 RECLAMATION RESERVOIRS TO HOLD THEM BACK. *A minor, although important, potential damage of about $3,000 to the City of Richland, Wash., is not shown. The total of $5,600,000 is approximate. Drawings made by Bureau of Reclamation's Graphics staff based on data submitted by the Army's Corps of Engineers and Region 1 of the Bureau of Reclamation.*

Thirteen Reclamation reservoirs saved $5,600,000 in flood damages during the June 18 through July 15 flood crest on the Columbia River and its tributaries.

This announcement was made in a joint statement by Col. O. E. Walsh, North Pacific Division Engineer of the Corps of Engineers, Portland, Oreg., and H. T. Nelson, Regional Director of the Bureau of Reclamation, Boise, Idaho, on July 15, 1950.

This estimate of the potential damages which were averted by control of flood waters at Reclamation reservoirs does not include damages averted by levees, for which figures were not available at the time.

The bulwarks controlling the flood were Grand Coulee Dam on the Columbia River; Jackson Lake, Island Park, and American Falls Dams on the Upper Snake River Subbasin; Anderson Ranch and Arrowrock Dams in the Boise subbasin; Deadwood and Cascade Dams in the Payette River Subbasin, and the Cle Elum, Kachess, Keechelus, Bumping Lake, and Tieton Dams in the Yakima River Subbasins. The Reclamation reservoirs controlled by these dams make up the bulk of storage space now available for flood control use in the Pacific Northwest.

Grand Coulee Dam, controlling Franklin D. Roosevelt Lake, was operated by the Bureau on daily requests made by the Corps of Engineers in accord with a 3-way agreement by the Bureau of Reclamation, Bonneville Power Administration, and the Corps of Engineers, while the 12 tributary reservoirs were operated by the Bureau of Reclamation after daily consultation with the Corps of Engineers.

Except in the case of Anderson Ranch Reservoir now near completion on the Boise River, the tributary reservoirs were not built for the control of floods. Consequently their operation for flood control necessarily considered storage for irrigation as the primary objective. That some flood control benefits would result from construction of Grand Coulee Dam was recognized at the time that structure was authorized by the Congress, but it is believed that further legislation is needed if full-scale operation of that structure for flood control is to be undertaken. Power production at Grand Coulee Dam was not a consideration in limiting the drawdown of the pool in May in advance of the flood crest, although some slight reduction of generation resulted. No appreciable adverse effect on the over-all power supply in the Pacific Northwest was suffered.

Operating Grand Coulee Reservoir for flood control in 1949, and using the 13 reservoirs as a flood-control team this year is but a start in controlling Columbia River floods by levees and reservoirs either constructed, under construction, authorized, or planned. Both agencies look forward to the day when an adequate number of reservoirs will be in operation in this great river basin to eliminate for all time the present annual damages to fertile farm land, industries, cities, and towns, and the threat to human life. The benefits realized this year again demonstrate, in dollars and cents' terms, the wisdom of constructing multiple-purpose projects on our rivers. •

Construction on Big Sandy Dam To Be Resumed

Construction of the Big Sandy Dam and dike, a unit of the Eden project in Wyoming is expected to be resumed in the near future. S. J. Groves & Sons Co., Minneapolis, Minn., received the contract award on July 3, 1950, about 8 years after the War Production Board placed a stop order on the project when the structure was 16 percent completed in 1942. The "go ahead" signal was given on June 29, 1949, when Senate bill 55 was passed, authorizing completion of the project, and funds were subsequently made available for construction.

The dam and dike will provide irrigation water for approximately 20,000 acres of land on the Eden project upon its completion, now scheduled for 1952. ●

"Big Tom" Power Will Serve "Preference Customers"

On August 18, 1950, Secretary of the Interior Oscar L. Chapman approved a contract which he considered a major step in cooperation between the Federal Government and privately owned utilities, namely a contract insuring delivery of power from the Colorado-Big Thompson project to public bodies and cooperatives over power lines of the Public Service Co. of Colorado.

"This contract," Secretary Chapman said, "is a cooperative agreement in which the statutory obligation of the Federal Government to give first preference in the sale of power to public bodies and cooperatives is fully recognized. It will permit all the REA cooperatives now being served by the company and municipalities and other public bodies adjacent to the company's transmission lines to obtain Colorado-Big Thompson project power at a minimum cost to the consumer and to the Government."

Reclamation Commissioner Michael W. Straus said the Estes Park and Marys Lake power plants of the Colorado-Big Thompson project will soon be completed. The project's Green Mountain power plant, near Kremmling, has been in operation for several years.

When transmission lines now under construction are completed, the project will have a continuous high-voltage power grid extending from Oak Creek across the northern part of Colorado to Holyoke and Wray, near the eastern State boundary.

"The contract which has just been approved will continue through 1960," Mr. Straus said. "It provides for the exchange of power between the company system and the project system at existing interconnection points at Dillon and Greeley. Other interconnection points will be selected later. The company will accept power at those interconnection points for delivery to public bodies and cooperatives at agreed points on the company's lines. The charge for this service will depend upon the distance from the nearest interconnection point with the project system. Area zones have been established. Within 50 miles, the charge for transmission service will be 1 mill per kilowatt-hour; between 50 and 100 miles the charge will be 2 mills; and between 100 and 150 miles the charge will be 3 mills per kilowatt-hour."

Commissioner Straus explained that the 1-mill zone, within 50 miles of interconnection points, is within the Colorado-Big Thompson project market area, which is considered as that area in which all the energy produced by the project ultimately can be marketed. In zone 1, power and energy will be delivered and sold at the established Colorado-Big Thompson project rate, as that rate includes a transmission cost component for transmission beyond major load centers. In areas outside those included in the first zone, additional costs of transmission will be borne by the customer. This practice will continue until such time as additional and nearer interconnections are made with the company's transmission lines or proposed plants are built in those areas.

"The contract also provides a reciprocal transmission service to the company," Commissioner Straus said. "The Bureau will permit power to be transferred over its system for the company on the same cost basis the company charges the Bureau. For several months the Bureau has been permitting transmission of power from Greeley to Sterling for the company under a temporary agreement. This service will now be covered under the new contract." ●

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Sincerely,

Check (√) if member of water users association ☐

____
(Name)

____
(Address)

____
(Name and address of association)

____
(Include zone number, if any)

ARMED SERVICES CALL RECLAMATION EMPLOYEES

Capt. David M. Hudson, USMCR, attorney of the Bureau of Reclamation, was the first Interior Department employee in Washington, D. C., to be recalled to active military duty. In the photo at right, he receives best wishes from Secretary Oscar L. Chapman and Commissioner Michael W. Straus as he relinquished his civilian post on Friday, August 18. He reported for field duty with the United States Marines on the twenty-first.

A veteran of World War II, Captain Hudson joined the marines as a first lieutenant in July 1943, and returned from military duty with the rank of captain in 1945.

Beginning his public career in 1933 as an attorney in the Federal Administration of Public Works, Captain Hudson later served as assistant solicitor in the Department of the Interior and as assistant chief counsel in the Office of Petroleum Coordinator for National Defense. He was appointed attorney in the Bureau of Reclamation in 1946.

Captain Hudson is one of the many Reclamation employees who have been or will soon be recalled to active military duty.

Although Region 1 officials, with headquarters at Boise, Idaho, were unable to furnish information on the first man recalled to active military duty this year, they did report the fact that one man (name not given) from that office volunteered for military duty, reported for physical examination July 25, and entered on extended military service on July 31, 1950.

James H. Stramler, supervisory soils scientist of the San Joaquin Valley district with headquarters at Fresno, Calif., was the first man recalled to active duty as a captain in the Marine Corps, from Region 2, headquarters at Sacramento, Calif.

Burl G. Briley, Parker Dam power project payroll clerk, left his Phoenix, Ariz., office as the first man to be recalled from Region 3, headquarters at Boulder City, Nev. A World War II veteran, 36-year-old Briley rejoined the United States Marines as a corporal on July 26, 1950.

Property and supply clerk Curtis J. Thomson of Region 4's headquarters office at Salt Lake City, Utah, was the first to be recalled to active duty from that region. He reported to the Air Force as a staff sergeant.

First to leave Region 5 for military service was Tucumcari, N. Mex., project's supply clerk, Vicente R. Abeyta, who rejoined the Navy as electrician's mate, third class, on July 28, 1950.

Engineering aid William F. Miller of the Shelby Investigations Field Station, Upper Missouri district, was the first to enter military service from Region 6. Miller, prominent in football and basketball in Seattle, Wash., during his school days, rejoined the Navy as a seaman.

Another engineering aid, Jack W. Moses, employed at Ellis, Kans., in the Kansas River district, was the first to be recalled to active duty from Region 7. A member of the United States Naval Reserve, his rating was that of a construction diesel machinist, second class.

FROM THE HALLS OF INTERIOR—Former Bureau of Reclamation attorney David M. Hudson goes to rejoin his marine outfit as captain. Commissioner of Reclamation Michael W. Straus, Captain Hudson, and Secretary of the Interior Oscar L. Chapman exchange farewells. *Photo by Glen Peact, Interior photographer.*

Civil Engineer James G. Norman with the Staff Development Center, was the first employee of the Commissioner's Office in Denver, Colo., to go on military duty as a result of the present international situation. He accepted reappointment and was ordered to active duty as lieutenant, junior grade, in the United States Coast Guard on July 13, 1950.

As this issue goes to press about 1,690 (or 9 percent) of the Bureau of Reclamation employees are reserve officers. This does not include the thousands of men and women in the National Guard or enlisted reserve organizations, who are employed by the Bureau, nor does it take into account those who volunteer for service or are subject to selective service call. •

Bury the Lining

(Continued from page 186)

type of lining. However, it has many advantages which compensate to some extent for this higher cost. The material can be stored for indefinite periods, available whenever it is needed, and it can be placed with hand tools and unskilled labor.

The prefabricated lining used at Klamath Falls cost 35 cents a square yard, f. o. b. the factory. Freight brought the cost up to approximately 40 cents a square yard. Actual placing costs under rather severe conditions (including near zero temperatures and snow), amounted to 5.5 cents to 7 cents a square yard. Under favorable conditions, this cost might be reduced to about 5 cents. Installing the lining, including subgrade preparation, cost about 80 cents a square yard. This figure does not apply to contract placement, which would include overhead and profit, making the cost somewhat higher.

Technicians in the Branch of Design and Construction at Denver, Colo., and field offices are experimenting with placing asphalt penetration macadam, Portland cement concrete, and pneumatically placed mortar, over heavy membranes of asphalt. Through this composite construction they hope to be able to control weeds, seepage, and erosion at higher water velocities. Other new types of prefabricated linings are also on the way, promising even lower construction costs.

The End

Max Stern's Death Shocks Friends Throughout the United States

Max W. Stern, 66, Reclamation's regional information officer at Sacramento, Calif., and former widely known Scripps-Howard newspaper writer and editor, died unexpectedly Saturday, August 26, at Echo Lake, Calif. Services were held at Sacramento on August 29, 1950.

Max W. Stern. Photo by Harris and Ewing.

Mr. Stern previously was Director of Information of the Social Security Board, in Washington, D. C., for 6 years, and had spent 8 years as Washington correspondent for the Scripps-Howard Newspaper Alliance. He was a member of the National Press Club, in the District of Columbia.

With him, at his death, was his wife, Mrs. Beatrice Marks Stern, a sister, Miss Helen Stern of Berkeley, and two nieces. They were vacationing in the Sierra Mountains when he suddenly became ill on Friday.

"Max Stern's sudden death is most deeply regretted, and came as a shock," Reclamation Commissioner Michael W. Straus said. "He was one of the Nation's outstanding newspapermen for many years, and one of Reclamation's most able and respected officers. His untimely death is a keen loss to his wide circle of friends throughout the United States and to the Reclamation program."

As information officer for Region 2, Mr. Stern was in charge of public information for Reclamation's great Central Valley project in California, and of other Reclamation work over most of California and in southern Oregon. Readers of the ERA will remember many of the interesting and useful articles over his byline which appeared in this publication.

Mr. Stern was born July 16, 1884, at Cincinnati, Ohio. He spent part of his early years in southern Indiana, and the family moved to California while he was still in his youth. He was graduated from the University of California in 1909. He spent a short time as a laboratory assistant in bacteriology at the University of California, at Berkeley.

His long and outstanding newspaper career began as a reporter on the San Francisco Bulletin in June 1910. He later became Oakland editor of that newspaper. He worked as a feature writer for the Newspaper Enterprise Association, a newspaper feature syndicate, from January 1919, until July 1920, when he became a star reporter and political writer for the San Francisco Daily News.

During his early employment with the San Francisco Daily News, he won national fame through a series of syndicated articles exposing what the newspaper syndicate termed the "coastwide scandal" of the Alaskan salmon boats.

"Each fall brings its coastwide scandal when the Alaskan salmon boats come home," the advertisements read. "Workers complained they have been underpaid, underfed, mistreated, overworked." Stern was assigned "to sail on a 'hell ship' and to work in an Alaska cannery—the most unusual newspaper assignment of the year. * * * He landed his job by buying his outfit from agents of the Chinese boss. He lived in the stinking hole of an ancient ship for a month, while the vessel plowed her way north. A miserable shanty, with roof so low he could not stand upright, housed him in the far north. Gambling, bootlegging, profiteering, exploitation, disease, danger, even death marked the voyage that Mr. Stern took."

Joining the Scripps-Howard Newspaper Alliance as a reporter in 1922, Mr. Stern wrote articles and editorials for the San Francisco News, San Diego Sun, and Sacramento Star, as well as special assignments for other newspapers in the chain. He became well known throughout the entire West, and assignments took him to Mexico, Honolulu, Canada, and Nicaragua.

From April 1930 to May 1938, he served as a correspondent and editorial writer for the Scripps-Howard Alliance in Washington. His writings appeared in some 30 newspapers of the chain.

He entered Federal employment as Director of the Information Service of the Social Security Board, in Washington, D. C., in June 1938.

Desiring to return to his home State, California, he transferred to the Bureau of Reclamation on July 11, 1944, became Reclamation's Regional Information Officer at Sacramento.

Besides Mrs. Stern and his sister, Miss Helen Stern, he is survived by a brother, Norman B. Stern of Piedmont, Calif., and two other sisters, Mrs. Louis Samuis of Berkeley and Mrs. Anderson of San Jose, Calif. Mr. Stern resided at 1416 Wentworth Avenue, Sacramento. ●

Frank Arthur Banks Retires

Frank Arthur Banks, district manager of Grand Coulee Dam, who was nominated for Reclamation's Hall of Fame in July 1950, retired from his duties in the Bureau of Reclamation on September 29, 1950, after 44 years of service. He will continue to serve the Bureau in an advisory capacity, however, and will live at Grand Coulee, near the dam which stands as a monument to his ability.

A few copies of the July 1950 issue of the RECLAMATION ERA containing the story of Mr. Banks' colorful career and his citation for Reclamation's Hall of Fame are available at 15 cents each. ●

OUR FRONT COVER

HARVEST TIME on the E. E. Bradtl farm near Aurora, Oreg., with two small boys, Paul Pellatz and George Michael Elliott, playing with samples of a good crop of flax. ***Photo by Stanley Rasmussen, Region 1 Photographer.***

U. S. GOVERNMENT PRINTING OFFICE: 1950

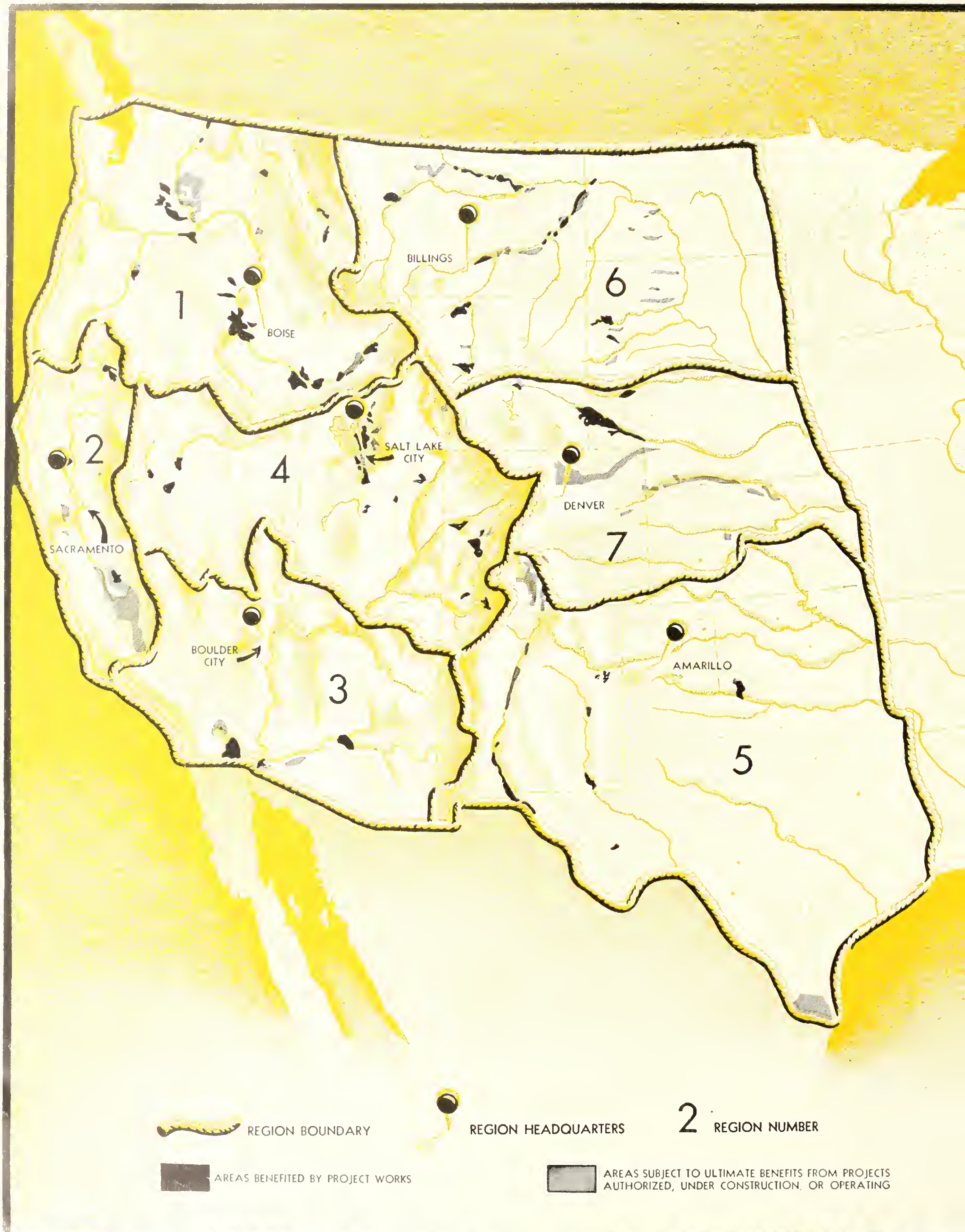
NOTES FOR CONTRACTORS

Contracts Awarded During August 1950

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3041	Hungry Horse, Mont	Aug. 10	660 trashracks for penstocks and river outlets 1, 2, and 3, Hungry Horse Dam.	Judson Pacific-Murphy Corp., Emeryville, Calif	$151,672
3042	Missouri River Basin, Mont.	do	219 trashracks for river outlets and main units at Canyon Ferry Dam	do	53,600
3096	Missouri River Basin, N. Dak.	Aug. 14	3 main control boards for Rugby, Devils Lake, and Jamestown substations, schedules 1, 2, and 3.	Kirkhof Electric Co., Grand Rapids, Mich.	46,975
3097	Davis Dam, Ariz.-Nev.	Aug. 11	3 230,000/196,000-volt selector-type disconnecting switches for Prescott substation.	Pacific Electric Manufacturing Corp., San Francisco, Calif.	22,799
3098	Colorado-Big Thompson, Colo.	Aug. 16	1 5,000-kilovolt-ampere transformer with 3 115,000-volt and 3 12,470-volt lightning arresters for Flatiron construction substation.	Westinghouse Electric Corp., Denver, Colo	36,899
3101	Columbia Basin, Wash.	Aug. 31	Construction of earthwork, asphaltic membrane lining, pipe lines, and structures in irrigation blocks 70 and 701, for laterals and sublaterals, Main, East Low, and West canal laterals.	Collins Concrete and Steel Pipe Co., Portland, Oreg.	421,711
3102	Missouri River Basin, N. Dak	Aug. 3	Construction of 15,000-kilovolt-ampere Rugby substation, 15,000-kilovolt-ampere Devils Lake substation, and 7,500-kilovolt-ampere Jamestown substation.	D. J. Killoren Co., Appleton, Wis.	286,627
3103	Eden, Wyo.	Aug. 4	7,000 barrels of bulk portland cement for construction of Big Sandy Dam.	Monolith Portland Midwest Co., Denver, Colo.	22,400
3104	Missouri River Basin, Wyo.	Aug. 25	One 5,000-volt unit substation switch gear and 3 potential transformers for Alcova switchyard, schedules 1 and 2.	General Electric Co., Denver, Colo.	23,496
3114	Central Valley, Calif.	Aug. 7	2 sets of replacement bronze guide-vane thrust collars for turbines, units 3 and 4, Shasta power plant.	Allis-Chalmers Manufacturing Co., Denver, Colo.	10,100
3120	Missouri River Basin, Wyo.	Aug. 31	Construction of 115-kilovolt Alcova switchyard	Van Dyke Co. and McClellan and MacQueen, Inc., Worland, Wyo.	63,515
3126	Colorado-Big Thompson, Colo.	Aug. 30	Construction of 115/69-kilovolt Beaver Creek substation.	Sturgeon Electric Co., Inc. and Stapp Engineering Co., Denver, Colo.	131,205

Construction and Materials for Which Bids Will Be Requested by December 1950

Project	Description of work or material
Boulder Canyon, Ariz.-Nev.	Furnishing and installing air conditioning equipment in municipal building at Boulder City, Nev.
Do	Construction of streets, sidewalks, curbs, and gutters, and extending sewerage and water distribution systems at Boulder City, Nev.
Cachuma, Calif.	Construction of Lauro regulating reservoir, an earth dam 110 feet high and 335 feet long, to impound an area of 22 acres with 647 acre-feet of water, located at Santa Barbara, Calif.
Central Valley, Calif.	Construction of 58 miles of concrete pipe lines for the Lindmore irrigation district on the Friant-Kern Canal distribution system near Strathmore, Calif.
Do	Construction of 48 miles of concrete pipe lines for the Southern San Joaquin municipal utility district on the Friant-Kern Canal distribution system near Delano, Calif.
Do	Construction of reinforced concrete building for electrical laboratory and shop at Tracy switchyard, about 8 miles west of Tracy, Calif.
Do	Seven vertical-shaft water pumps with outdoor-type electric motors, total capacity 120 cubic feet per second at 185 foot head; and 2 horizontal-shaft booster pumping units, total capacity 23 cubic feet per second at 65 foot head, for Trauger pumping plant.
Do	53 motor-driven vertical-shaft water pumps, 2 cubic feet per second to 16 cubic feet per second capacity, for third unit, southern San Joaquin municipal utility district.
Colorado-Big Thompson, Colo.	Construction of Willow Creek Dam, an earthfill structure about 96 feet high and 1,000 feet long, on Willow Creek 8.5 miles from Granby, Colo.
Do	Construction of 6,750-foot long, 960-cubic-feet-per-second capacity, concrete-lined Bald Mountain pressure tunnel from Rattlesnake Reservoir to Flatiron power plant, about 10 miles west of Loveland, Colo.
Do	Construction of 2,670-foot long Windsor Canal extension, 250-cubic-feet-per-second capacity, about 8 miles northwest of Fort Collins, Colo.
Do	Construction of a steel-frame 54-foot by 90-foot system dispatcher's building at Flatiron power plant site, 8 miles west of Loveland, Colo.
Do	2 vertical-shaft centrifugal water pumps, 200-cubic-feet-per-second capacity at 172 foot head, for Willow Creek pumping plant.
Do	13,800- to 480-volt unit substation, control board, 460-volt alternating-current distribution board, 125-volt direct-current distribution board, and battery chargers for Flatiron power plant.
Do	1 or 2 motor-driven vertical-shaft centrifugal water pumps, 400 cubic feet per second capacity and head range from 200 to 300 feet, for Flatiron pumping plant.
Columbia Basin, Wash.	Clearing 950 acres of land back of Long Lake dam, about 2.5 miles northeast of Stratford, Wash.
Do	Paving 0.9 mile of existing 4-lane highway; constructing and paving 0.4 mile of 4-lane extension and 1.5 miles of switchyard access road; and 0.4 mile of sidewalk and highway lighting at Coulee Dam.
Do	Construction of two 34- by 26-foot wood-frame buildings with full basements at Moses Lake and Winchester, Wash.
Do	Construction of 7 permanent-type houses with garages, and streets and utilities at Adco O & M site near Adco, Wash.
Davis Dam, Ariz.-Nev.	Construction of 20,000-kilovolt-ampere Maricopa substation near Maricopa, Ariz.
Davis Dam, Ariz.-Nev.	Construction of 100- by 100-foot steel transformer repair shop at Phoenix, Ariz.
Do	Construction of 80- by 100-foot warehouse at Phoenix, Ariz.
Do	One 100-ton traveling crane for machine and apparatus repair shops at Phoenix, Ariz.
Fort Peck, Mont	Construction of pole top extensions and stringing overhead ground wires for 50 miles of Fort Peck-Glendive 115-kilovolt transmission line.
Do	Construction of 14 miles of Fort Peck-Glasgow Bench 69-kilovolt transmission line.
Kendrick, Wyo.	Construction of 3,750-kilovolt-ampere Rawlins substation.
Do	Construction of 40 miles of Seminoe-Bairoil 34.5-kilovolt transmission line.
Do	Construction of 30 miles of Sinclair-Hanna 34.5-kilovolt transmission line.
Do	Construction of 35 miles of double-circuit open-wire telephone line from new Casper substation to Alcova Dam, Alcova, Wyo.
Missouri River Basin, Mont	7,200- to 480-volt unit substation, control board, annunciator relay cabinet, 460-volt alternating-current distribution board, 125-volt direct-current distribution board and battery charger motor-generator set for Canyon Ferry power plant.
Do	2 300-gallons-per-minute and 2 2,500-gallons-per-minute deep well, turbine-type water pumps; and 1 20-gallons-per-minute and 1 50-gallons-per-minute gear-type oil pump for Canyon Ferry power plant.
Missouri River Basin, Nebr.	Construction of 26 miles of laterals and sublaterals on the Superior lateral system, west of Guide Rock and Hardy, Nebr.
Missouri River Basin, Nebr.-Kans.	Construction of 13-mile unlined section of Courtland Canal, 685 cubic feet per second capacity, including 6 10.5-foot diameter monolithic siphons, 16 drainage culverts, and 3 siphon spill-ways and wasteway.
Missouri River Basin, N. Dak	Construction of 15,000-kilovolt-ampere Lakota substation.
Do	Construction of 15,000-kilovolt-ampere Valley City substation.
Missouri River Basin, S. Dak	Construction of 30-mile section of concrete and asphalt membrane lined Angostura Canal, 290 cubic feet per second maximum capacity, and lateral and drainage systems, 10 miles southeast of Hot Springs, S. Dak.
Missouri River Basin, Wyo.	Construction of Anchor Dam, a concrete arch structure 200 feet high and 550 feet long, on Owl Creek, a tributary of the Big Horn River, about 40 miles northwest of Thermopolis, Wyo.
Do	Relocation of about 12 miles of U. S. Highway No. 14 at Keyhole damsite, 15 miles northeast of Moorcroft, Wyo.
Do	160,000 pounds of galvanized fabricated steel structures for switchyard and transformer circuits at Boysen power plant.
Paonia, Colo	Enlargement of about 10 miles of Fire Mountain Canal near Paonia, Colo.
Do	Reconstructing and enlarging 3.4 mile Overland Canal to an initial capacity of 140 cubic feet per second, near Paonia, Colo.
Rio Grande, N. Mex.	Construction of 72 miles of 115-kilovolt Socorro-Albuquerque transmission line.
Riverton, Wyo	Placing asphalt lining on 7.5 miles of Wyoming Canal, 20 miles northwest of Riverton, Wyo.
Do	Lining 17 miles of Wyoming Canal.



THE RECLAMATION AREA

The Reclamation ERA

November

1950

Official Publication of the Bureau of Reclamation

The Reclamation ERA

November 1950
Volume 36, No. 11

Issued monthly by
The Bureau of Reclamation
United States Department of the Interior, Washington 25, D. C.

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

CONTENTS

FEATURE ARTICLES

SHORT FEATURES

RECLAMATION PLACE NAMES IN THIS ISSUE

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

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OUR FRONT COVER

"Thank you for the food we eat
Thank you for the world so sweet
Thank you for the birds that sing,
Thank you, God, for everything."

All this and the blessings of free people living in a country where a family can enjoy the fruits of their own labor in their own home, is expressed in this photo by Stanley Rasmussen, Region 1 photographer.

United States Department of the Interior
Oscar L. Chapman, Secretary
BUREAU OF RECLAMATION OFFICES

ANY QUESTIONS?

Every day, you, as a farmer tilling land reclaimed from the desert or wilderness, or you, a person interested in the reclamation program, must ask yourself some questions such as, "Am I using too much or too little water on this crop?" or "What is the Bureau of Reclamation's policy on this matter?" or "I wonder if there is an easier way to do the job?" or "How can I improve this livestock so I can make more money on it?" Here is where you can get the answers—here in the pages of the RECLAMATION ERA, the official publication of the Bureau of Reclamation, devoted to the interests of those who actually receive water from facilities made available by the Bureau of Reclamation, or those who are directly concerned with reclamation activities. Send in your questions, as many as you want, and as often as you please. We will get the outstanding authorities in the country to answer them, and print the questions and answers in a new feature. As this is your magazine, why not send in suggestions for naming this feature—along with your questions? Address the Editor, RECLAMATION ERA, Bureau of Reclamation, Washington 25, D. C.

COULD YOU WIPE OUT WATER WEEDS THIS WAY? The men in the photo above are introducing aromatic solvents to kill water weeds. Perhaps you have a question about weed control. Send it in. We will get the answer and print it in the Reclamation Era. This will help you and other farmers facing similar problems. *Photo by W. H. Farmer, Region 1.*

Bureau to Share Power Lines With South Dakota Co-op

Commissioner Michael W. Straus recently announced that the Bureau of Reclamation and the East River Electric Power Cooperative, Inc., of South Dakota, had approved a draft of a contract providing for the use of each other's transmission lines. Commissioner Straus has sent the draft to the organization of 21 REA's (Rural Electrification Administrations) which make up the East River Cooperative, for execution of the contract.

Under the contract the Bureau of Reclamation will construct approximately 556 miles of 115-kilovolt capacity transmission lines in eastern South Dakota; the cooperative will be permitted to transmit power over Bureau lines before the Fort Randall hydroelectric power plant, now under construction on the Missouri River in South Dakota by the Army's Corps of Engineers, goes into operation; and the Bureau of Reclamation, in turn, is authorized to transmit power over the lines of the Cooperative to its member cooperatives.

The Bureau will receive a variable rate for transmitting Co-op power depending upon the capacity and operating voltage of Reclamation lines until Fort Randall power is available. At that time the Cooperative will pay the Government a standard rate of one mill per kilowatt-hour for the Reclamation power transmitted over its lines.

Former plans called for power delivery by 1953, but under the stepped-up program to meet national defense power needs, Commissioner Straus announces the lines will be available in a year or so.

The Bureau of Reclamation transmission grid, necessary to service the contract, loops from Fort Randall through Armour, Huron, Aberdeen, Andover, Watertown, Brookings, Sioux Falls, and Gavins Point. Under the terms of the 1951 appropriation bill $3,000,000 is available to begin construction immediately. A second three million dollars worth of contracts can be awarded for construction. Payment for this work would be made during the next fiscal year or whenever it is needed after that time. •

NRA Convention To Be Held at Spokane

The Annual convention of the National Reclamation Association will be held in Spokane, Washington, on November 15, 16, and 17. Reclamation Commissioner Michael W. Straus will be a guest speaker on Thursday morning November 16. His topic will be "Reclamation's program and problems." The Commissioner will also be available to discuss various problems with water users in attendance at the meeting as has been the custom in the past. Among the highlights of the meeting will be a specially conducted tour of the Columbia Basin project. Representatives of the western railroads have made elaborate plans for the delegates attending this, the nineteenth annual convention of the association. •

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THE SILVER LINING to Shoshone farmer Vetchel Olsen meant one thing, WATER—life-giving water flowing down the ditch. With the threat of a water shortage behind him, he is enjoying his chore of irrigating a field of Certified Frontier Barley.

Quick Cure for Heart Break

THE WATER STOPPED FLOWING DOWN THE DITCH.

William Wibel, Heart Mountain homesteader, was irrigating his fields late Sunday evening when this, the nightmare of every irrigation farmer, became an alarming reality.

Wibel, along with other irrigation farmers on the 214 farms making up the Heart Mountain division of the Bureau of Reclamation's Shoshone project in Wyoming, depended for his livelihood on the irrigation water from the Heart Mountain Canal. Crops were due for harvest in 30 days. Peas, grain, alfalfa, clover seed, potatoes, beans, pasture and other crops worth $700,000 would have small chance for survival without irrigation water during the hot, dry months of late summer.

Wibel lost no time locating ditchrider Everett Tucker. The ditchrider couldn't understand it either. Tucker had made his regular patrol over the length of the canal serving the Heart Mountain district at 7:30 that morning. Everything had looked okay—his trained eyes had discovered no indications of seepage or a break. The two men decided to investigate. An hour later they saw an example of water power—on the loose. A few feet down-canal from the outlet of the Trail Creek siphon, Heart Mountain canal water was rushing out of bounds, in a stream 100 feet wide, tearing an outlet that flowed into Trail Creek. It was a sure-enough canal break—one of the most dreaded catastrophes in the reclamation area. Tucker rushed to the nearest phone, called Lloyd H. Lasher, General Foreman of the Power Section at Buffalo Bill Dam, who closed the headgates of the canal shortly after midnight, at 12:23 a. m. to be exact.

By Monday morning, the rampaging water was stilled. During its unauthorized excursion, it had considerately chosen a route back to the Shoshone River, which avoided damaging farms or private property.

All was not quiet along the Heart Mountain Canal waterfront, however. Worried farmers began to gather at the scene of the break-through, now an ugly washed-out hole, 100 feet wide, and 50 feet deep. A quarter of a mile below the break were pieces of concrete tile weighing between 300 to 400 pounds—mute evidence of the force of the water as it broke through the bank. The solemn group of men and women grew. Reclamation Bureau officials were on the scene early in the morning. Acting District Manager Charles T. Hinze, District Engineer Walter F. Kemp, Acting Project Superintendent Alden S. Ingraham, Irrigation Manager A. E. Beseda and Project Administrative Assistant, Floyd F. Lucas, talked with the scores of homesteaders, and others, heard them glumly prognosticate that it would take at least two or three weeks to close the break.

Ingraham figured the break was caused by a slow but steady penetration of moisture which had gradually undermined the embankment. When he and other Bureau experts examined the ruptured bank, they saw signs which indicated that, where the canal had been constructed, at one time there had been an eroded gully which was later filled in with granite boulders and gravel mixed with a large portion of sand. Under this filler was shattered shale. Through the large boulders were small veins of gypsum which furnished made-to-order miniature waterways for moisture which percolated down through about twenty feet of gravel to the shale. Evidently, ever since the canal was placed in operation in 1943, water had been eating away the embankment—unseen, unsuspected—until it eventually found an outlet through the shale, cut a path of increasing size, and caused the embankment to slip out from under. Thus undermined, the sides of the canal crumpled and collapsed, opening up the escape channel for the final break through.

Regardless of the reason for the break, something had to be done at once. Ingraham decided it would be necessary to dig down to bedrock, and rebuild the canal bank with material which would resist any future onslaughts of infiltrating moisture. A rough guess would be about 10,000 cubic yards of fill. Clay, which could be packed down solid, was available near-by. So was bentonite. Equipment was something else again. Orders were given that all heavy equipment in the area be immediately mobilized at the site of the break. Round-the-clock work was going to start as of that moment. The S. O. S. call was answered by local contractors—Kincade Bros. Construction Co., Davis Construction Co., Taggart Construction Co., and Keller & Son Construction Co. They called heavy equipment off their own jobs and sent tractors, bulldozers, scrapers, trucks, and other machines to the rescue. The Shoshone irrigation district, the Deaver irrigation district and the Willwood irrigation district of the Shoshone project also pitched in with men and machines. A call was sent to the Riverton project which came through with other needed machines and tools.

It was one of the busiest, noisiest Mondays ever seen along the Heart Mountain Canal since the days of construction. By noon that same day, the first dirt began to fly. As evening approached, the problem of lighting the job so work could continue through the night had already been solved. Three mobile generators were on the scene, with flood lights. Ingenious mechanics and electricians had improvised reflectors out of bright tin and other material. To add to the difficulties of the job—it rained that day. Not enough to remove the threat of dried-out crops, of course, but just enough to cause slight delays in getting started.

Local farmers, contractors, businessmen, knowing how much work would be needed, estimated three weeks to repair the job. They had not counted on a record-breaking emergency job, but that was what they got. The entire break was repaired, and water was turned back into the canal the following Sunday, August 6. If there had been a 5 o'clock whistle, that afternoon, it would have been most appropriate, for it was exactly 5 p. m., when the weary workmen completed the job, a little less than 6 days from the time the break occurred. Another record was made, too. Nobody had an accident, and none of the equipment broke down, despite the improvised nature of many of the machines and tools.

For the information of any project which faces a similar emergency, this is the equipment used: 10 crawler type tractors equipped with bulldozers; 7 carryall scrapers; 1 2-section sheepsfoot roller; 1 ¾-yard dragline; 1 heavy duty ripper; 1 dump truck; 1 5-ton truck; 1 service truck; 1 lowboy trailer; 2 flatbed trucks; 2 pumps; 1 electric welder; and the 3 mobile generators with flood lights and improvised reflectors. The workmen excavated 1,405 cubic yards; and the backfill totaled 10,771 cubic yards, of which 5,012 cubic yards were clay core, plus 8 cubic yards of bentonite.

The promptness with which the project forces acted in repairing this break brought complimentary comments from the press and from the distraught settlers whose fortunes would have been seriously harmed if water had not been forthcoming before drought retarded or ruined their growing crops. A real crop disaster was averted by the quick decisions and prompt action on the part of the Bureau and cooperating personnel. The Cody Enterprise editorially had this to say on August 8:

> A lot of us who take irrigation water for granted were rudely awakened last week when a section of the Heart Mountain Canal washed away. We talk about the importance of water. We call it Wyoming's gold, but it takes a minor catastrophe like the canal washout to give us a visual illustration of the meaning of water. We met a lot of farmers out on the canal last week. Everyone asks the same question—When does the water go on again? Caught in the middle of a busy growing season, these farmers needed water in the worst way. Their deep concern and even anger is quite understandable. Lack of water for even as short a period as to two weeks can ruin their crops, stop their income, and cripple the economy of the whole Powell-Cody area. From what we have seen, the Reclamation Bureau is doing a grade A job of repair. The equipment has been called in from all parts of the country, and a large crew is working around-the-clock to fill up the break. It is a comfort to see such efficiency.

Margaret Olson, secretary of the Mountain View Club at Ralston, which is a unit of the Shoshone project, wrote this letter to Mr. Alden S. Ingraham, acting project superintendent:

> The Mountain View Club (Ralston Flat homesteaders) voted at their last meeting to send a word of thanks to the Bureau of Reclamation for their speedy action in repairing the Heart Mountain Canal. We do appreciate your every effort to save our crops.

Crop surveys have indicated that crops, in the main, were not injured by the interruption of the service during the

WATER FLOWS AGAIN (below) through the Heart Mountain Canal after a serious break in right background had been repaired. *Bureau of Reclamation photo by Robert Fagerberg.*

THE SCAR (above) in the Heart Mountain Canal, near Cody, Wyo., is ample evidence of the power of unleashed water. BEING HEALED (at right) by men and machines which saved a $700,000 crop. *Photos by Jack Richards, publisher of the Cody Times.*

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period of the break. Some very minor damages may have been caused to the pea crop, although recent surveys show that the maximum yield on cleaned peas on the project is 1,700 pounds to the acre. Grain yield is as high as 50 to 60 bushels per acre. 18,000 acres of the Shoshone project, with an estimated crop value of $700,000, was in the threatened area where the water had been cut off because of the break.

James Caviness, a homesteader from Texas, with the fate of his very fine crop at stake, philosophically remarked: "In Texas, I spent most of my time looking at the sky for water that seldom came, and I felt confident when I looked at the empty canal that it would only be a matter of a few days before water would again be flowing to my crops. There is surely a big difference between getting your irrigating water from a canal and having to hope for water from a reluctant sky at intervals all too infrequent to make farming either profitable or pleasant." THE END

LEGISLATIVE ROUND-UP

In the latter part of the second session of the Eighty-first Congress which adjourned on September 24, four important measures which reflect an expanded Reclamation program were passed. The Eklutna project in Alaska, the Palisades project and associated developments in connection with the North Side pumping division of the Minidoka project and power installations at American Falls Dam in Idaho, Sacramento Valley Irrigation Canals in California, and the Vermejo project in New Mexico have now been authorized. Congress has already appropriated funds to commence work on the Eklutna project and a good deal of preparatory work on Palisades has been done under a prior authorization. The four acts are summarized as follows:

EKLUTNA (H. R. 940) "*To authorize construction of the Eklutna project hydroelectric generating power plant and transmission facilities in connection therewith, and for other purposes.*"

This bill authorizes the construction of a hydroelectric power project in the vicinity of Anchorage, Alaska. The primary purpose of this development is to alleviate an acute power shortage in the area as well as to provide power for national defense installations.

Key features of the project include a low concrete dam and spillway; a 4½ mile tunnel running from Lake Eklutna which will pierce Goat Mountain; a 1,250 foot long penstock; a power plant with an installed capacity of 30,000 kilowatts, and 46 miles of transmission lines.

PALISADES (S. 2195) "*To authorize the Palisades Dam and Reservoir project; to authorize the north side pumping division and related works; to provide for the disposition of reserved space in American Falls Reservoir, and for other purposes.*"

Specifically this bill provides for the installation of 142,500 kilowatts of hydroelectric power generating capacity at Palisades and American Falls dams, and for a supplemental irrigation water supply to irrigate 650,000 acres of land now inadequately served. Lands to be benefited are located downstream on the Snake River including some of the Minidoka project. The bill also provides for a full water supply to 77,000 acres of desert land in connection with the Minidoka project. Bureau lands will be available for homesteading by veterans. Palisades Dam will provide protection against recurrence of previous flood damages estimated to have reached nearly a million dollars annually in the past.

Key features authorized for construction under the bill include the Palisades Dam, Reservoir, and power plant, the North Side Pumping Unit or Division of the Minidoka project, and a power plant at the existing American Falls Reservoir of the Minidoka project. Penstocks for the latter plant have already been installed.

SACRAMENTO VALLEY CANALS (H. R. 163) "*To authorize Sacramento Valley Irrigation Canals, Central Valley project, California.*"

The purpose of this bill is to authorize construction of irrigation canals in the Sacramento Valley, as an integrated part of the Central Valley project in California, to assure the greatest and most economic use of land and water resources of the area for the widest possible public benefit. Approximately 200,000 acres of land will be served by these canals. Adequate water is now available from Shasta Dam to meet the initial requirements. Prior to initiation of construction a feasibility report to the President and the Congress is required. The canals will be coordinated, both in operation and repayment of project costs, with existing features of the Central Valley project.

VERMEJO (S. 3517) "*To authorize the construction, operation and maintenance of the Vermejo project, New Mexico.*"

The bill authorizes the Bureau, upon approval of a report by the President, to enlarge existing storage works and to rehabilitate existing diversion dams, canals, and the distribution system in order to protect land and water supplies. The reservoirs will regulate the flows of streams and provide space for the retention of water-borne silt and debris. It is estimated that approximately 7,200 acres of land will be irrigated on the project. The Maxwell Irrigation District which owns adequate water rights for the revised project (7,200 acres) will contract for repayment of reimbursable construction costs. •

Byron G. Felkner to Engineer Eklutna

Secretary of the Interior Oscar L. Chapman recently announced the appointment of Byron G. Felkner to the position of construction engineer on the Eklutna hydroelectric project located near Anchorage, Alaska.

Chief Engineer L. N. McClellan recommended Felkner due to his past experience in tunnel construction, as one of the key features of the Eklutna project is a 4½ mile tunnel extending from Eklutna Lake through Goat Mountain. He previously served as field engineer on the Boysen Dam in Wyoming where he supervised construction of a one-and-one-third mile long railroad tunnel under a portion of the reservoir site. In addition to his tunnel experience on the Boysen Dam he also supervised the construction of the 250-mile-long Los Angeles aqueduct, working at that time for the contractor. His other Bureau assignments included work on the Altus, Parker Dam, and Rio Grande projects. •

ROLLING LATERALS

by D. L. BRECHNER, Columbia Basin project, Ephrata, Washington, Region 1 (headquarters at Boise, Idaho)

"Use your head to save your feet," is an old adage by which many so-called "lazy" people save themselves time, money, and precious energy.

Under no circumstances can the settlers on Irrigation Block 1 of the Columbia Basin irrigation project in east central Washington be called lazy. But to underestimate their ingenuity would be a serious error.

As an example, Howard Hales wondered why it was necessary on his farm to stoop, lift, carry, drop, and reconnect sections of a thousand-foot sprinkler lateral. Obviously, the pipe could not be rolled across the field because it would injure crops, and of more practical importance, the risers on the pipe would interfere. But suppose the line was raised above the surface of the ground?

Hales' solution to his self-imposed problem is shown in the photo at upper right. Wheels and tires from an auto graveyard, plus some heavy strap iron, a few large diameter pipe sleeves, and chain and sprockets from an old combine with the whole rearranged by welding, gave him something new in the way of an irrigation device.

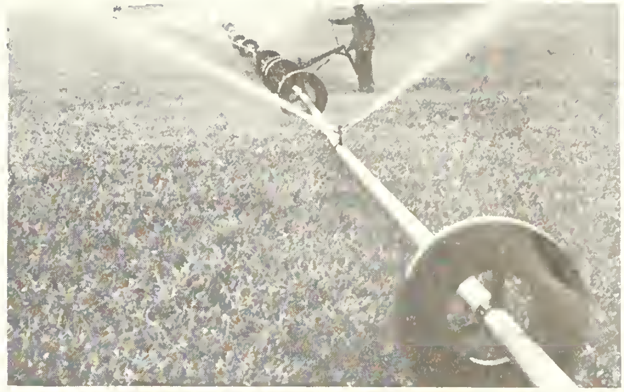
Hales' experiment was watched with keen interest by his neighbors. In 1949 he had about 35 of them in the 84-unit block. The interest was more casual among those who had leveled their land for ordinary methods of surface irrigation, but the remainder who had chosen to invest in sprinkler systems watched and waited.

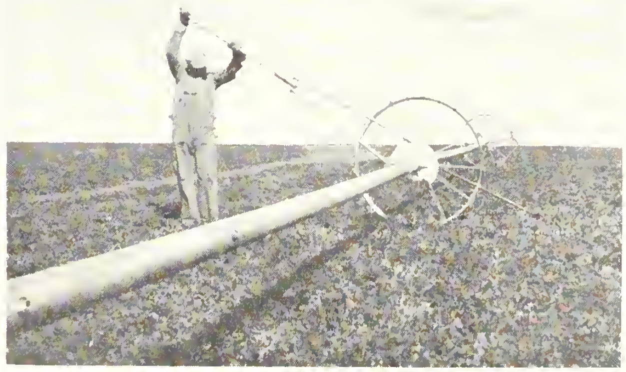
Before the close of the irrigation season, a few settlers purchased commercially manufactured wheel laterals. When the 1950 season started, 13 farmers were using wheels to irrigate all or a part of their farms.

At the close of the 1950 season, only one universal conclusion has been reached about the use of wheel laterals. They are not the perfect answer for all irrigation situations. They appear to be satisfactory for early season irrigations and low growing crops, but for corn, grain sorghums, alfalfa near the cutting stage, and similar plantings, the use of wheels becomes difficult or impossible.

Some farmers have experienced spoke breakage near the hub of the wheel. They express an opinion that by redesign the maunfacturers can correct this weakness when it appears. Careful studies of irrigation manpower requirements for wheel laterals have not been concluded on the Columbia Basin project. But preliminary reports seem to indicate that a considerable saving is effected by their use. Power, depreciation, and other costs may off-set the savings in man hours.

Not being the perfect answer to all problems of applying water to the land, most farmers suggest that a careful analysis be made of each farm to determine the best method of irrigation before a necessarily sizeable investment is made either in land leveling and ditching, in standard sprinkler systems, or in wheel laterals. The End





SPRINKLERS ON WHEELS—The contraption in the top photo resembling a series of airplane wheels was devised by Howard Hale, Columbia Basin project farmer. It is a sprinkler system on wheels and enables him to move 1,000 feet of pipe at a time. In the next photo Ed Horrigan, Burbank farmer, watches wheel laterals distribute first Columbia Basin water delivered to Block 2. Third photo shows operator of the Winchester development farm moving 4-inch wheel which in turn moves a 720-foot lateral through the use of a ratchet. Lateral can be moved 60 feet in about 5 minutes. Photo immediately above shows initial trial of the lateral. *All photos by H. E. Foss, Region 1.*

WATER REPORT

West-Wide Forecasts of 1950–51 Water Supplies Based on Work of the Western Snow Surveys

by R. A. WORK, Senior Irrigation Engineer, and CLYDE E. HOUSTON, Irrigation Engineer, both of the Soil Conservation Service, United States Department of Agriculture

Interested and questioning eyes and ears are being turned nowadays to enthusiastic reports from the cloud-seeding fraternity. Although it hasn't been demonstrated, thus far at least, that science can regulate the rains of heaven with much precision, there have been significant advances in this new field. However, until a great deal more progress is made, there seems dim likelihood that "rain on order" will ever do more than supplement time-proven dams and water-storing reservoirs.

Therefore, as usual, western farmers are concerned with next year's irrigation water prospects.

Well, so far as water held over in storage is concerned, the outlook for next season is spotty. Quoting from the 1950 spring water supply forecast published in the May issue of the Reclamation Era, "Plenty of water—maybe more than plenty—in the Northwest; enough in the intermountain area and the Pacific slope; not enough for comfort in the Rio Grande Valley and Arizona. That's the water promise for 1950." That's about the way the season ended. Reservoir storage reserves for irrigation in 1951 are above average in Idaho, Washington, Oregon, and Montana; are about average in Colorado, California; but are seriously below average in Arizona, New Mexico, and Nevada.

In the following paragraphs the division of irrigation and water conservation, Soil Conservation Service, describes the results of its October 1 canvass of the storage and soil-moisture situation throughout the West and compares the 1950 runoff of western streams with what was indicated by the preceding April snow survey.[1]

Accuracy of 1950 Runoff Forecasts

Readers of the May 1950 Water Forecast Report will recall the then spotty water supply outlook—potential floods for the Northwest, short water supplies for Arizona and Rio Grande Valley, but probably enough water to satisfy 1950's crop needs in the intermountain area. Gazing backward into that crystal ball we find that floods did indeed materialize in parts of the Columbia River Basin, but fortunately, due to farsighted and close collaboration between the Bureau of Reclamation, Corps of Engineers, and Bonneville Power Administration, and thanks to the long-range warnings from far-flung snow surveys, flood damage was held to a minimum.

Joint studies by the Bureau of Reclamation and Corps of Engineers showed that timely reservoir regulation in 1950 prevented $5,600,000 of flood damages along the Columbia-Snake River system. (See p. 201, October 1950 issue, Reclamation Era.) All of the 13 major reservoirs used to affect this flood control were easily filled after the danger period had passed.

Departures of actual stream flow from the amounts forecast from April snow surveys were not numerous but were most frequent in those sections of the West in which rainfall during the early summer months was unusually plentiful or strikingly deficient.

The stream flow year ends September 30, but on that date not many gaging station records had been computed. From all those at hand, however, the following statements relative to accuracy have been prepared.

Northwest and Pacific Coast

Columbia Basin (Washington, Idaho, parts of Montana, Wyoming, and Oregon).—Stream flow as judged from the data at hand did not equal the amounts forecast, as shown in the following table. This was due to subnormal spring and early summer precipitation. Runoff to be expected from the snow pack under normal conditions was correspondingly reduced.

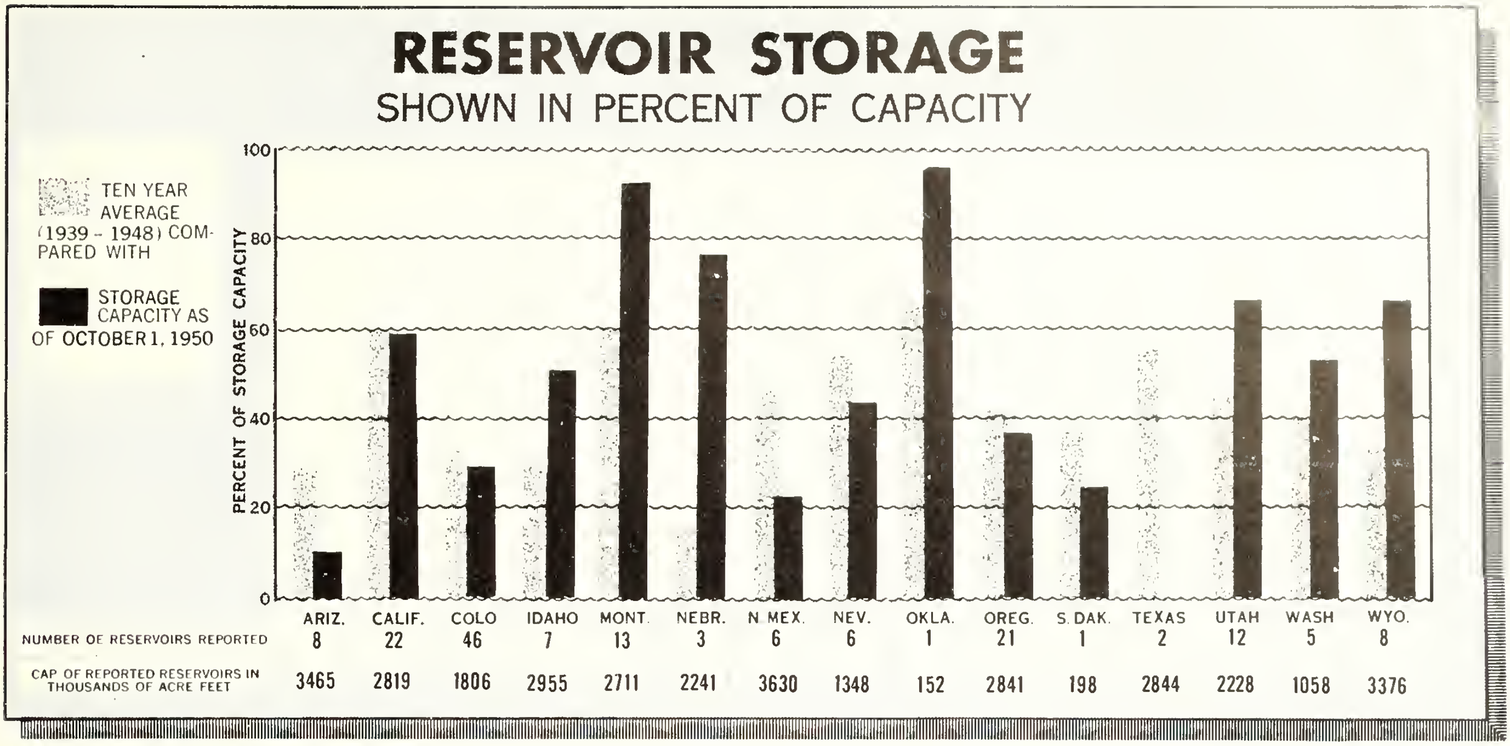
In general the high snow water content found in the mountains for the 1950 season resulted in comparatively high flows for the various tributaries of the Columbia. The main stem was saved from a disastrous volume and peak flow because the tributaries did not peak at the same time. Local floods were to be expected from the snow surveys reported in April and did materialize in places. However, the whole situation was eased by the warm dry spring and minus precipitation departures on most rivers which cut volumes as well as peaks.

Gaging station	Obtained,[1] acre-feet	Forecast for April–September			
		Apr. 1		May 1	
		Acre-feet	Error percent	Acre-feet	Error percent
Columbia—The Dalles	117,725,000	112,000,000	5	116,000,000	1
Kootenai—Leonia	10,023,000	10,200,000	2	10,200,000	2
Boise—Above Diversion	1,876,000	1,980,000	6	1,980,000	6
Owyhee above Owyhee Reservoir	326,000	320,000	2	335,000	3

[1] Data of stream flow are provided by U. S. Geological Survey; are preliminary only and subject to revision.

Oregon.—Precipitation in both western and eastern Oregon was below normal during April and markedly below normal during May.

[1] The division of irrigation and water conservation is the Federal coordinating agency of snow surveys conducted by its staff and many cooperators, including the Bureau of Reclamation, other Federal bureaus, various departments of the several States, irrigation districts, and private agencies. The California State Division of Water Resources, which conducts the snow surveys in that State contributed the California figures appearing in this article. Snow surveys in British Columbia, Canada, are under the direction of the Water Rights Branch, Department of Lands and Forests of that Province.



Most State averages are for full 10-year period, but in a few cases reservoirs having shorter records are included. CALIFORNIA—Does not include Millerton or Shasta Reservoirs. October 1 storage in these two reservoirs combined was 2,905,400 acre-feet or 58 percent of capacity. COLORADO—Does not include John Martin Reservoir. October 1 storage was 72,000 acre-feet or 11 percent of capacity. MONTANA—Does not include Fort Peck Reservoir. October 1 storage was 13,730,000 acre-feet or 72 percent of capacity. NEVADA—Does not include Lake Mead. October 1 storage was 19,751,000 acre-feet or 73 percent of capacity.

The net effect in general was to reduce the observed runoff from the forecasted flows.

Gaging station	Obtained,[1] acre-feet	Forecast for April–September Apr. 1	
		Acre-feet	Error percent
Clear Lake inflow	33,800	31,500	7
Gerber Reservoir inflow	14,700	20,000	36
Upper Klamath Lake inflow	423,000	448,000	6
North Fork Rogue River	387,000	375,000	3

[1] Preliminary only, subject to revision.

California.—On April 1, runoff from the melting Sierra snow pack was expected to average 87 percent of normal. Conditions which prevailed during April slightly improved the May 1 overall expectancy. However, due to the scattered pattern of April rains, some forecasts were reduced at the same time as several of the other forecasts were increased.

Preliminary computations of the April-July flows indicate that the 87 percent of normal expectancy was obtained for the area as a whole.

Gaging station	Obtained,[1] acre-feet	Forecast for April-July full natural flow			
		Apr. 1		May 1	
		Acre-feet	Error percent	Acre-feet	Error percent
Sacramento River into Shasta Reservoir [2]	1,460,000	1,690,000	16	1,525,000	11
Feather River near Oroville	1,970,000	1,890,000	4	2,000,000	2
Yuba River at Smartsville	1,240,000	1,220,000	2	1,220,000	2
American River at Fair Oaks	1,581,000	1,620,000	2	1,750,000	11
Mokelumne River, near Mokelumne Hill	580,000	575,000	1	610,000	5
Stanislaus River below Melones	852,000	855,000	0	855,000	0
Tuolumne River at La Grange	1,172,900	1,150,000	2	1,210,000	3
Merced River at Exchequer	551,000	550,000	0	550,000	0
San Joaquin River at Friant	1,012,000	1,010,000	0	1,010,000	0
Kings River at Piedra [2]	1,028,000	900,000	14	880,000	14
Keweah River near Three Rivers [2]	222,000	195,000	12	200,000	10
Kern River near Bakersfield [2]	300,000	340,000	13	290,000	3

[1] Preliminary only and subject to revision.
[2] Impaired flows—not full natural flows.

	percent
Average error of Apr. 1 forecasts	5.3
Average error of May 1 forecasts	4.5

The table below lists the main subbasin forecasts together with the preliminary computed runoffs.

Arizona.—Precipitation on the main watersheds of the State has been below normal during the past summer months. Stream flow into the eight major reservoirs of the State has been disappointing. The flow into these reservoirs is about 300,000 acre-feet below normal. The stored water is about one-half of last year's storage and about one-third of the 1939-48 average.

Intermountain Areas

Utah.—At the time of the April 1 forecast, water supply prospects in Utah varied from excellent in the northern and northeastern part of the State through good in the center to fair to poor in the south. The runoff followed this pattern, with some deviation due to abnormal preciptation during April and May.

April was a dry month throughout the State, but in northern Utah during early May a storm on most of the watersheds raised the April-May precipitation above normal, with streams producing more runoff than forecast. In southern Utah, the drought of April continued through May and June, reducing the actual runoff below forecasted amounts.

On the Bear River where the runoff exceeded the forecast amount so far, it is believed that this was due to the varying consumptive use in the long valley about 100 miles long between the mountains and the forecast station. Last year the runoff was 25 percent below the forecast. April-September runoff this year is greater than the October-September runoff for all years since 1923.

In southern Utah, April-May precipitation at valley stations was as low as 25 percent of normal. Precipitation at Beaver was 29 percent of normal.

Nevada.—Accuracy of April 1 forecasts for near normal snow melt runoff are verified by the following preliminary discharge figures:

Gaging station	Obtained[1] April-July, acre-feet	Forecast for April-July Apr. 1	
		Acre-feet	Error percent
Humboldt River at Palisade, Nev	195,000	200,000	3
West Walker River near Coleville, Calif.	140,000	150,000	7
Carson River near Fort Churchill, Nev	195,000	200,000	3

[1] Preliminary only, subject to revision

Climatic conditions during the runoff season were near normal with late season stream flow maintained.

(Please turn to page 216)

Water Stored in Reclamation Reservoirs

Location	Project	Reservoir	Storage (in acre feet) Active capacity [1]	Sept. 30, 1949	Sept. 30, 1950
Region 1	Baker	Thief Valley	17, 400	0	600
	Bitterroot	Lake Como	34, 800	2, 800	12, 600
	Boise	Anderson Ranch	464, 200	12, 300	266, 900
		Arrowrock	286, 600	24, 500	10, 000
		Deadwood	161, 900	89, 600	127, 000
		Lake Lowell	169, 000	22, 500	38, 900
	Burnt River	Unity	25, 200	2, 500	5, 200
	Columbia Basin	F. D. Roosevelt	5, 370, 000	5, 155, 000	5, 200, 000
	Deschutes	Crane Prairie	50, 000	55, 000	34, 700
		Wickiup	180, 200	13, 900	28, 300
	Minidoka	American Falls	1, 700, 000	537, 100	923, 600
		Jackson Lake	847, 000	273, 100	568, 500
		Lake Walcott	95, 200	95, 200	93, 300
		Grassy Lake	15, 200	11, 900	12, 200
		Island Park	127, 300	29, 100	87, 900
	Okanogan	Conconnully	13, 000	5, 600	3, 600
		Salmon Lake	10, 500	6, 600	10, 100
	Owyhee	Owyhee	715, 000	328, 700	350, 100
	Umatilla	Cold Springs	50, 000	2, 200	6, 100
		McKay	73, 800	10, 300	22, 300
	Vale	Agency Valley	60, 000	10, 200	0
		Warm Springs	191, 000	100	0
	Yakima	Bumping Lake	33, 800	2, 700	4, 600
		Cle Elum	435, 700	148, 800	229, 700
		Kachess	239, 000	98, 600	129, 800
		Keechelus	153, 000	127, 300	86, 800
		Tieton	197, 000	108, 600	112, 400
Region 2	Central Valley	Millerton Lake	500, 000	55, 100	57, 100
		Shasta	4, 374, 100	2, 459, 300	2, 702, 000
	Klamath	Clear Lake	513, 100	116, 600	87, 700
		Gerber	94, 000	11, 200	10, 200
		Upper Klamath Lake	524, 800	231, 100	265, 800
	Orland	East Park	50, 600	18, 800	10, 300
		Stony Gorge	50, 000	4, 100	6, 600
Region 3	Boulder Canyon	Lake Mead	27, 935, 000	22, 828, 000	19, 751, 000
	Parker Dam Power	Havasu	688, 000	613, 400	588, 800
	Salt River	Bartlett	179, 500	8, 900	2, 900
		Horse Mesa	245, 100	166, 900	200, 800
		Horseshoe	67, 900	500	800
		Mormon Flat	57, 900	35, 200	52, 200
		Roosevelt	1, 398, 400	385, 600	5, 200
		Stewart Mountain	69, 800	34, 700	45, 600
Region 4	Fruit Growers	Fruit Growers	4, 500	400	700
	Humbolt	Rye Patch	179, 000	35, 500	28, 900
	Hyrum	Hyrum	15, 300	4, 900	6, 900
	Moon Lake	Moon Lake	35, 800	9, 700	10, 900
	Newlands	Lahontan	290, 900	72, 500	159, 800
		Lake Tahoe	732, 000	127, 200	332, 400
	Newton	Newton	5, 300	1, 000	1, 100
	Ogden River	Pine View	44, 200	11, 100	15, 600
	Pine River	Vallecito	126, 300	59, 900	24, 800
	Provo River	Deer Creek	149, 700	116, 000	120, 400
	Scofield	Scofield	65, 800	19, 900	26, 900
	Strawberry Valley	Strawberry	270, 000	104, 900	123, 800
	Truckee River Storage	Boca	40, 900	17, 600	27, 700
	Uncompahgre	Taylor Park	106, 200	65, 900	35, 200
	Weber River	Echo	73, 900	19, 000	39, 500
Region 5	W. C. Austin	Altus	145, 000	120, 800	148, 900
	Carlsbad	Alamogordo	132, 200	106, 200	95, 200
	Colorado River	Marshall Ford	810, 000	509, 500	157, 600
	Rio Grande	Caballo	346, 000	67, 900	43, 000
		Elephant Butte	2, 197, 600	714, 400	333, 500
	Tucumcari	Conchas	274, 900	252, 400	214, 000
Region 6	Belle Fourche	Belle Fourche	177, 500	34, 200	47, 900
	Milk River	Fresno	127, 200	10, 400	34, 100
		Nelson	68, 800	0	19, 000
		Sherburne Lakes	66, 100	9, 900	22, 000
	Rapid Valley	Deerfield	15, 000	13, 100	12, 600
	Riverton	Bull Lake	152, 000	71, 100	101, 300
		Pilot Butte	31, 500	3, 100	6, 200
	Shoshone	Buffalo Bill	456, 600	336, 100	391, 300
	Sun River	Gibson	105, 000	4, 300	63, 500
		Pishkun	32, 100	11, 300	23, 800
		Willow Creek	32, 300	1, 000	21, 200
Region 7	Colorado-Big Thompson	Green Mountain	146, 900	140, 900	119, 400
	Kendrick	Alcova	190, 000	156, 800	173, 000
		Seminoe	970, 000	801, 000	713, 000
	Mirage Flats	Box Butte	31, 600	13, 400	10, 300
	North Platte	Guernsey	49, 000	32, 000	16, 900
		Lake Alice	11, 000	1, 600	2, 400
		Lake Minatare	57, 000	5, 400	13, 900
		Pathfinder	1, 040, 500	469, 900	587, 800

[1] Available for irrigation.

POINTING TO NORTH PLATTE—The project he visited almost 30 years ago, as probably the first fully accredited trainee in Reclamation, from a foreign country. From left to right, Professor Sutton, Commissioner of Reclamation Michael W. Straus, and Sumner P. Wing, who heads up the present reclamation program for technical assistance to foreign countries. *Photo by Glen Peart, Interior Department photographer.*

SUTTON of South Africa

THIRTY YEARS AGO William Godfrey Sutton, an assistant engineer of the irrigation department in South Africa, was awarded a scholarship, and chose a year's study of the Reclamation Service's construction work in the United States.

Arrangements were made between the director of irrigation in Pretoria, South Africa, and Secretary of the Interior John Barton Payne, whereby the South African Department paid Sutton's expenses, and the Reclamation Service welcomed the opportunity to show the young man how reclamation worked. Sutton arrived in the States, perhaps the first international "trainee" to be officially cleared for training in United States reclamation practices. Commissioner of Reclamation Michael W. Straus estimates that over 200 foreign trainees have exchanged Reclamation know-how and show-how since World War II and have thus extended the benefits of irrigation development to the far corners of the earth.

In addition, thousands of government officials, engineers, scientists, and students have made visits to this country for the express purpose of exchanging technical information with the Bureau of Reclamation on an informal basis.

Commissioner Straus, speaking on "Water in our World" at the dedication of the Reclamation Engineering Center on July 20 (see Reclamation Era, July and September, 1950) called this Reclamation's Point 4 program of technical assistance to foreign countries. Professor Sutton's return to the United States proved it has been going on for a long time.

During his first visit, student Sutton spent two months in Denver, Colo., headquarters for the Chief Engineer, where he learned how the engineers developed plans and designs for reclamation projects. He studied and took notes on the many intricate and important details which go into the building, operating and maintaining of reclamation systems. He also participated in the preliminary designs for Boulder (now Hoover) Dam. He was also stationed on the North Platte project in Wyoming and Nebraska, where he gained experience in operation and maintenance on the Interstate canal system, and also in construction, as the Fort Laramie canal was being built at that time. He traveled to the Yakima project in the State of Washington and studied construction, and methods of computing unit costs under the late Frank Crowe who was in charge of construction for Tieton Dam. He traveled through California, Arizona and New Mexico, and remembers the Salt River project vividly, as irrigation farming methods and crops were very similar to those of South Africa. During his training, he followed the instructions of the South African Director to "go from work to work under construction to study designs, methods and application."

He returned to South Africa to resume his duties as an assistant engineer in the Irrigation Department of the Union of South Africa, where he was engaged on the construction of the Hartebeestepoort irrigation scheme (as projects are called in that country) and also designed various other projects in the Union of South Africa.

This year, he returned to the United States, as a full-fledged Professor of Civil Engineering from the University of the Witwatersrand in Johannesburg. Witwatersrand means "white waters ridge"—it is the center of the fabulous gold mines of that country. Professor Sutton is particularly interested in the potentialities of the water wealth of the country in relation to national development, and is a member of the Natural Resource Development Council, and

TWO CONTINENTS find themselves in mutual accord on basic interests such as the need for irrigation and regional development of natural resources. International swapping of "know-how" and "show-how" by students who later become authorities in their field, like Professor Sutton, help forge links of understanding between the free nations of the world.

the Standards Council, which directs the activities of the South African Standards Bureau, an organization similar to our Bureau of Standards.

Like the many other overseas trainees who included a tour of duty in the Reclamation Service (and later the Bureau of Reclamation) in their interneship for careers of developing their nations' water resources, Professor Sutton returned to check on the progress which had been made during his absence, to brush up on the latest methods and machines, and to renew old acquaintances. He regretted not having been able to meet former Reclamation Commissioner Harry W. Bashore, who was assistant project manager of the North Platte project, and under whom he worked, during his former tour.

His 1950 trip is under the aegis of the Carnegie Corporation, which made him a grant for this purpose. He is on leave of absence from the University, and because of his former experience, he decided to implement his study of American reclamation and irrigation methods with a view to applying his findings to his native land.

He was mostly impressed by the brilliantly conceived large dams which had been built since his last visit. "America's Reclamation Bureau has made unbelievable strides in the past 28 years," the professor said at an interview in Casper, Wyo. "When I made my first trip here, Arrowrock Dam near Boise, Idaho, was the biggest structure of its kind in the world. It was very much bigger than its nearest rival, and its prime purpose was to serve the needs of irrigation. Today the value of multiple-purpose dams is well recognized in the United States and full attention is now paid to the needs of regional development," he said.

Later, in Washington, D. C., in a conversation with Commissioner Straus, Professor Sutton said, "In my country we consider water to be one of the resources to be developed on a regional basis—but the most important one. As in America, we are endeavoring to amend our irrigation laws to meet modern requirements. We started on an unsatisfactory water law based on riparian rights, giving priority to domestic, agricultural and industrial uses in that order, and we must now decide how much water is to be used for agricultural and industrial purposes. The application of the principles of priorities: primary—for the maintenance of human and animal life; secondary—for the support of agriculture, and tertiary—for industry, may have an adverse effect upon the development of South African industry, since there is not enough water to meet all the demands."

Professor Sutton revealed that the South African Government generously subsidizes reclamation works, believing it to be in the national interest to have irrigation. Also, the Government gives loans to settlers. Previously, Irrigation Boards, similar to water users' organizations in the United States, were set up. These received loans from the Government which expected repayment for construction, operation and maintenance charges. Many of these contracts had to

"SO WELL REMEMBERED"—Arrowrock Dam, of the Boise project in Idaho, once the champion of them all, now dwarfed by the giants—Grand Coulee, Hoover, Shasta and others built later. Its fame was world-wide, and visitors from foreign lands, once impressed by its size, now marvel at the Bureau of Reclamation's rapid progress through the intervening years.

be written off, as the Irrigation Boards could not meet their obligations. There is now a tendency to abandon this system and to build Government projects and provide water on a "water rental" basis, but to limit the size of irrigated farm holdings so that all the benefits of the project will not revert to one or two large holders. Based on previous experience with large landholders and speculators, surprisingly parallel to occurrences in America, the South African Government does whatever possible to avoid speculation on land within nationally sponsored irrigation projects.

The prosperity of reclamation farmers and towns in the reclamation area recently visited by Professor Sutton impressed him greatly. Mechanization of farms had altered the appearance of many of the irrigation projects, but although more farms were in cultivation, the agricultural products were much the same as those raised during his visit 30 years ago. South African farmers are now gradually mechanizing their farming operations and are using tractors, motor-driven plows and other up-to-date machines.

As a matter of fact, said Professor Sutton, irrigated crops in the Southwest of the United States were very similar to those raised in South Africa, where fruits, mostly oranges, and grapefruit, tobacco and wheat, are the principal crops under irrigation.

The growing season is also similar, but reversed on the calendar—their rainy summer season is from mid-September to April, and their snow-free, but dry and cold, winter is from May to August. Like the Southwest, even during the "rainy" growing season, sometimes there is not enough rain, or the rain does not always fall when it is needed, and the crops require irrigation.

Another similarity between water resource development concepts in the United States and the Union of South Africa is the fact that the South African government has appointed a Commission to coordinate the amendments to the irrigation law and to deal with administrative problems associated with irrigation development. The terms of reference of this Commission appear to be very much like the President of the United States' Water Resources Policy Commission. Three or four years ago an Irrigation Finance Commission was appointed in South Africa, and one portion of the report dealt with the indirect benefits of irrigation—a subject which has been under study here for some time.

Professor Sutton is enthusiastic about his two trips to the United States which he believes to have been well worth while. The Bureau of Reclamation has gained in the swap, and the importance of William Godfrey Sutton to the world scene was evidenced on October 3, 1950, when he spoke over the great Voice of America network, to tell the people of the world about the United States' democratic, opportunity-filled, peaceful invasion of desert lands, which brought prosperity to thousands of families now tilling their own soil, earning their own incomes and enjoying the high standard of living typical of America.

THE END

WATER REPORT— (Continued from page 211)

Rocky Mountain and Great Plains Areas

MONTANA.—The irrigation water supply throughout the various tributary basins to the Upper Missouri River for the season 1950 was far better than was anticipated in April and May. The continually wet summer accompanied by cool temperatures provided an ideal snow melt season and above-normal runoff during almost every month of the irrigation season. This was particularly noted in the Beaverhead Basin where snow measurements were slightly below average. The runoff from this particular basin stood up very well during the early summer months and was not critical at any time.

Irrigation water supply of the main stem of the Missouri River and Upper Yellowstone was close to that anticipated from the snow measurements made in April and May. The Upper Columbia River in Montana experienced some high water which would have been in damaging proportions had snow melt season temperatures and precipitation been anywhere close to normal. Temperatures were far below normal and precipitation through the melt season was very slight. Cloudy days prevailed through the spring months.

Gaging station	Obtained,[1] acre-feet	Forecast for May–June—Apr. 1	
		Acre-feet	Error percent
Yellowstone River at Corwin Springs	1, 157, 000	992, 600	14

[1] Preliminary only, subject to revision

WYOMING.—With the exception of the Laramie River the irrigation water supply was excellent in the southern half of Wyoming during 1950. Summer supply was excellent in the southern half of Wyoming during 1950. Summer precipitation was somewhat deficient except for the extreme eastern part of Wyoming and western Nebraska. Summer flow of the Upper North Platte and Laramie Rivers was about normal. The high-storage carryover in North Platte Reservoirs provided more than adequate water supplies in the lower reaches of the North Platte in Wyoming and Nebraska.

Summer runoff from the Green River watershed was well above normal. No stream flow information is available but it is estimated to be somewhat less than the record snow cover for May 1 indicated. Precipitation was deficient during the summer months.

SOUTH DAKOTA. The irrigation water supply for the Belle Fourche project was inadequate and stream flow below normal. The Belle Fourche River receives most of its water from plains rainfall. The water supply was inadequate on the main stream in spite of heavy March snowfall in the Black Hills area. Better water supply conditions existed on tributary streams from the mountain areas.

COLORADO.—Irrigation water supply east of the Continental Divide was slightly inadequate during the past year in most areas. It was necessary to use carryover irrigation water storage to supplement stream flow. Due to extremely dry conditions there was some deficiency of flow from the Arkansas River watershed through the middle of July.

In the South Platte Valley, stream flow was slightly below normal and precipitation near the mountains was also deficient. There was some shortage of water supply reported but by careful allotment of water there was little crop loss due to lack of water. In this well-developed area, an average stream flow is usually accompanied by some water shortage. In the lower South Platte Valley in eastern Colorado water supplies were adequate due to good reservoir storage in the spring and above normal rainfall during the summer months.

Snow surveys during the 1950 season indicated that the flow of the Arkansas River would be definitely below normal this past summer. This shortage occurred, and in combination with low rainfall through the middle of July the water supply outlook was poor. Irrigation water was at a premium and range land was useless. Since the middle of July, precipitation has been well above normal. The increased precipitation improved the situation but the general crop outlook is still reported as only fair. Below Caddoa Dam, irrigation water supplies were adequate, due to carryover storage from the 1949 floods.

On the Rio Grande watershed the water supply was definitely below normal. The summer flow of the Rio Grande and tributaries from the Continental Divide ranged from 75 to 85 percent of normal. Summer precipitation in San Luis Valley has been less than one-half of average. The flow from streams originating in the Sangre de Cristo range was near a minimum of record.

On the western slope the summer runoff ranged from a little above normal on the Yampa and White to much below normal on the San Juan and its tributaries. This follows the pattern indicated by the snow cover last spring except that the runoff from all streams was less than expected. From a limited number of precipitation stations the rainfall was about 40 percent of normal during the 5 months period April through August. This is extremely low for so long a period. Due to a combination of low rainfall and diversion and storage to the Colorado-Big Thompson project, there was a reported lack of water to meet irrigation demands for short periods on the Colorado River above Grand Junction. There was a substantial lack of water on the Uncompahgre project. This was expected due to extremely low snow cover this past winter.

NEW MEXICO.—Summer runoff and precipitation along the Rio Grande in New Mexico has been less than any year since 1946 and may have been less than for that year when records are compiled. The water supply was extremely poor.

The Status of Storage

The October 1 status of carryover storage summarized State by State is as follows:

ARIZONA.—The water shortage continues. The past dry summer was responsible for a heavy decline in reservoir storage to the point where eight important reservoirs with a total capacity of 3,465,000 acre-feet contained only 308,000 acre-feet on October 1. If greater than normal snowfall is not forthcoming this winter, the outlook for next summer will be for an extremely short water supply.

CALIFORNIA.—As the opening of the rainy season is approached, California has in storage a 10 percent greater supply than carried forward at the same date last year, each subbasin storage exceeding that of last year. Thus 25 reservoirs serving the Sacramento and San Joaquin held 4,581,200 acre-feet on September 30, 1950, or 58 percent of capacity as compared with 4,112,900 acre-feet, or 52 percent of capacity on September 30, 1949. The 1950 storage was normal as compared to records for the 10-year (1939–48) period.

Watershed	Number of reservoirs	Capacity	Water stored Sept. 30	
			1949	1950
Sacramento	1	4, 500, 000	2, 585, 200	2, 827, 900
Feather	4	826, 800	529, 309	632, 600
Yuba	3	244, 800	118, 900	153, 900
Bear	1	7, 200	600	1, 700
American	2	30, 200	19, 100	19, 900
Mokelumne	2	349, 000	246, 200	271, 000
Stanislaus	3	145, 500	27, 900	32, 900
Tuolumne	3	627, 800	311, 900	356, 000
Merced	1	281, 000	12, 100	16, 900
San Joaquin	5	854, 400	261, 700	268, 400
Total	25	7, 866, 700	4, 112, 900	4, 581, 200

COLORADO.—Carryover water in the South Platte Valley is now very short and a much above average snow cover will be necessary this winter to avoid a water shortage next year. Reservoir storage for use in the San Luis Valley was practically nonexistent at the end of the season. Soil moisture conditions are poor.

COLUMBIA BASIN.—The following tabulation shows that Columbia Basin irrigation reservoirs contain good carryover storage even though some were drawn down prior to the irrigation season in order to reduce forecasted peak flows.

Reservoir	Capacity, acre-feet	Active storage Oct. 1	
		1950, acre-feet	1939–48, acre-feet
Idaho and Snake River in Wyoming			
American Falls	1, 700, 000	923, 600	569, 900
Arrowrock	286, 600	10, 000	37, 200
Anderson Ranch	464, 200	266, 900	[1] 58, 400
Lake Lowell	169, 000	38, 900	35, 200
Island Park	127, 300	87, 900	52, 200
McKay	73, 800	22, 300	6, 500
Deadwood	161, 900	127, 000	82, 100
Jackson Lake	847, 000	568, 500	364, 900
Grassy Lake	15, 200	12, 200	10, 400
Washington			
Yakima Basin (5 reservoirs)	1, 058, 500	563, 300	401, 900

[1] 5-year average.

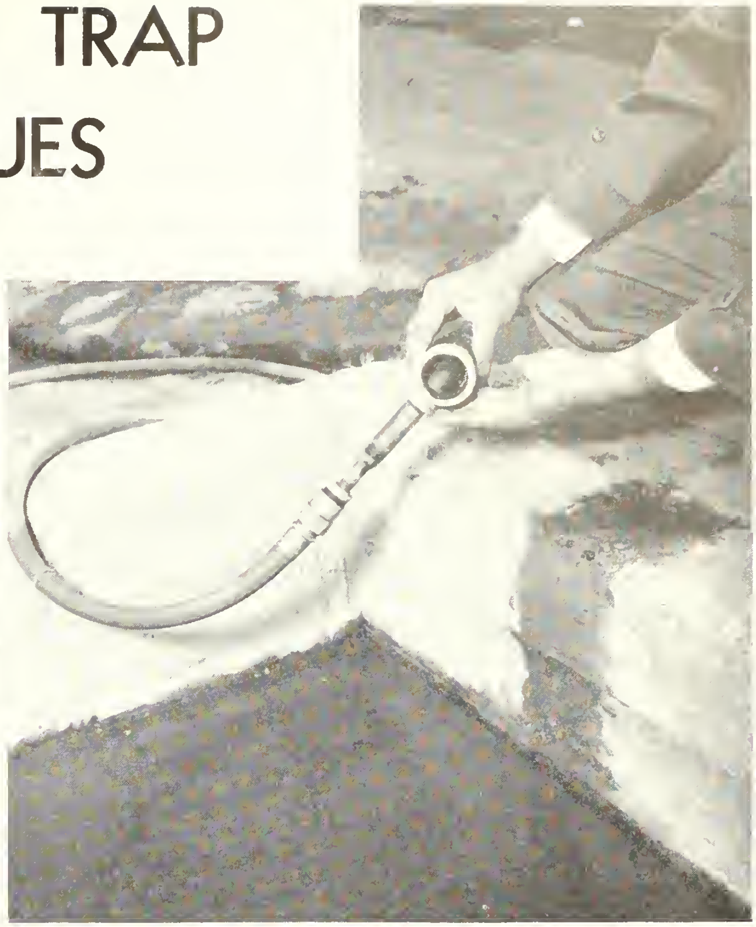
MONTANA.—Reservoir storage throughout the State as of October 1 is exceptionally good. All the reservoirs from which reports have been received indicate that they have a fair amount of carryover storage. Perhaps the lowest figure in the State was the Fresno Reservoir on the Milk River which ended the season with 34,100 acre-feet, or 27 percent of capacity.

NEVADA.—Holdover reservoir storage as of October 1 is about twice that available on this date last year but still below the past 10-year average. Heavy snow during the winter of 1950–51 is needed throughout the State to guarantee ample water supplies during the 1951 irrigation season.

(Please turn to page 218)

SAND TRAP BLUES

Jack Eickmeyer operating sand pump to remove silt from concrete chamber used to clean water before it enters pump and sprinkling system. Water and pressure required to operate jet-pump is obtained through garden hose from discharge side of sprinkler pump. *Both photos by H. E. Foss, Region 1.*



Suction end of the home-made jet-type sand pump. Position of pipe elbow used to direct the jet through discharge end is clearly visible. The pump body, held between thumb and fingers, is a standard 1¼-inch reducing pipe tee. The hose brings water under pressure from discharge side of sprinkler pump.

by MILO W. HOISVEEN, agricultural engineer, Bend, Oreg., and DARWIN L. BRECHNER, Coulee Dam, Wash., both of Region 1 (headquarters at Boise, Idaho)

To AN ENGINEER, sand is a lovely and essential material, but to Jack Eickmeyer it was just a pain in the neck. He had to shovel the stuff.

Jack is a son of Ezra A. Eickmeyer, owner of farm unit No. 59 in block 1 of the Columbia Basin project near Pasco, Wash. Jack's dad irrigates his farm with a sprinkler system. In accord with good sprinkler practice Mr. Eickmeyer has a desilting chamber between his pump and the Bureau of Reclamation turn-out on the Pasco Pump Lateral.

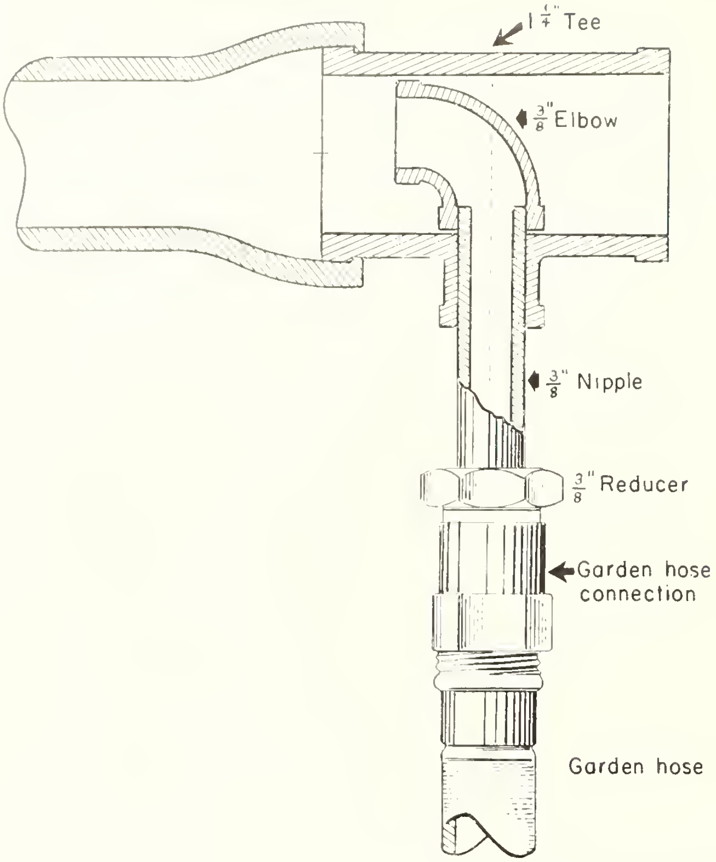
To Jack falls the job of mucking out the pit of the trap and he didn't like the messy, wet, sloppy job of shoveling it out. Anyway, he nearly always had to do it while the pump was in operation and, while he managed to get most of the sand and silt out of the box, there was no way he could keep from roiling up the water in the process. Dirty water went into the pump intake and, to Jack, all this meant that he had to change worn-out sprinkler heads oftener than he had any desire to do.

Being an American, unhampered by tradition, Jack put his brain to work and came up with a scheme that saved himself a lot of hard, unpleasant work and reduced his dad's costs for replacing worn pump impellors and sprinkler heads. To solve his problem, he spent a little of his time and less than $2.50.

Without benefit of a formal education in hydraulics or in mechanics either, for that matter, Jack built himself a sand pump out of pipe connections that empties the pit quickly, efficiently, and with practically no physical effort at all. It cost him the price of a tee, an elbow, three short lengths of pipe, a connector, a length of discarded hose for a discharge line, and a little welding.

Actually, Jack built a jet type pump but not before some of the wiseacres in town told him it wouldn't work. They were invited out to swallow their words after Jack got it built and had tried it out. It works beautifully. Its operating principle and simplicity of construction are shown clearly and graphically by the accompanying diagram and photographs.

Jack says, "When I build another one, I'm going to use a little bigger tee. I think it will work better that way." It works well now but a standard tenet of the American way



JET SAND PUMP—Better results may be obtained with the use of a reducing street elbow three-eighths to one-quarter inch instead of the standard elbow as shown above.

of doing things is "improve the product." "*Quien sabe*," as the Spanish say, maybe it *will* work better that way.

If you had trouble this past summer keeping your pump pit clean, consider Jack and how he works. If you heed the advice, "goest thou and do likewise," perhaps, come spring, you too can face a carefree summer relieved of the necessity of mucking out the sand trap with a shovel. THE END

WATER REPORT— (Continued from page 216)

NEW MEXICO.—Reservoir storage is at the lowest point for many years. Unless the snow cover on the Upper Rio Grande is well above normal during the 1951 season a more critical water supply situation will be in order for the entire Rio Grande watershed. Storage for the Lower Rio Grande Valley is only about 15 percent of capacity and about 25 percent of normal. There is practically no water in El Vado Reservoir for the Middle Rio Grande District.

OREGON. On October 1, 1950, a total of 21 reservoirs in Oregon with a capacity of 2,841,000 acre-feet were then holding 1,051,700 as compared with the average (1939-48) of 1,160,400 acre-feet.

Storage is exceptionally good on all portions of the Deschutes River and on Upper Klamath Lake where storage is the greatest for this date since 1932.

No water is in storage on the Malheur River area in the big Warm Springs and Agency Valley reservoirs.

SOUTH DAKOTA. Storage in Belle Fourche reservoir is now about two-thirds of normal for October 1 and 24 percent of capacity.

UTAH. Reservoir storage as of October 1 demonstrates the excellent water supply in the north and the drought in southern Utah. In northern and northeastern Utah, October 1 storage is 80 percent of capacity while the 10-year average is 45 percent of capacity. In central and southern Utah October 1 storage is 16 percent of capacity, the 10 year average being 36 percent of capacity.

WYOMING. Storage in the four major reservoirs on the North Platte in Wyoming is now 1,490,700 acre feet as compared to 1,459,700 a year

Reservoir	Capacity, acre-feet	Active storage Oct. 1	
		1950, acre-feet	1939-48, acre-feet
Bear Lake	1, 420, 000	1, 222, 000	682, 940
Deer Creek	149, 700	120, 400	76, 470
East Canyon	28, 730	14, 500	13, 840
Echo	73, 900	39, 500	16, 370
Hyrum	15, 300	6, 900	4, 530
Moon Lake	35, 800	10, 900	8, 000
Pineview	44, 200	15, 600	13, 000
Scofield	65, 800	26, 900	6, 410
Otter Creek	52, 600	10, 460	23, 280
Piute	84, 750	3, 200	11, 560
Rocky Ford	23, 300	2, 810	9, 530
Sevier Bridge	236, 000	45, 300	99, 420

ago. It would appear that a new record carryover has been established and next year's irrigation water supply below Pathfinder Reservoir is assured. ●

New Development Farm for Columbia Basin

Work will soon begin on the Bureau's fourth development farm on the Columbia Basin project in Washington. This farm, known as the Burke Development Farm, will be located about 15 miles south of Quincy. The farm derives it name from the nearby town of Burke and the fact that the soil on it is the Burke series type.

Livestock and the problems of raising and fattening beef in an irrigated area will be emphasized. Other farms now operating specialize in dairying, intensive crop production, and general farming.

After purchasing development farms, the Bureau clears the land, installs the irrigation system, and does what is necessary to get the land ready for irrigation farming. The farms are then leased to experienced farmers who pay the Government a cash rental and a percentage of profits after expenses are deducted. One of the provisions of such a lease is that the farmer use 25 percent of the acreage for experimental crops. The experimental program is conducted by agricultural specialists at the State College of Washington and the United States Department of Agriculture. The latter publishes an annual bulletin covering results which is available for the advice and guidance of new settlers. ●

Fish and the Tracy Pumping Plant

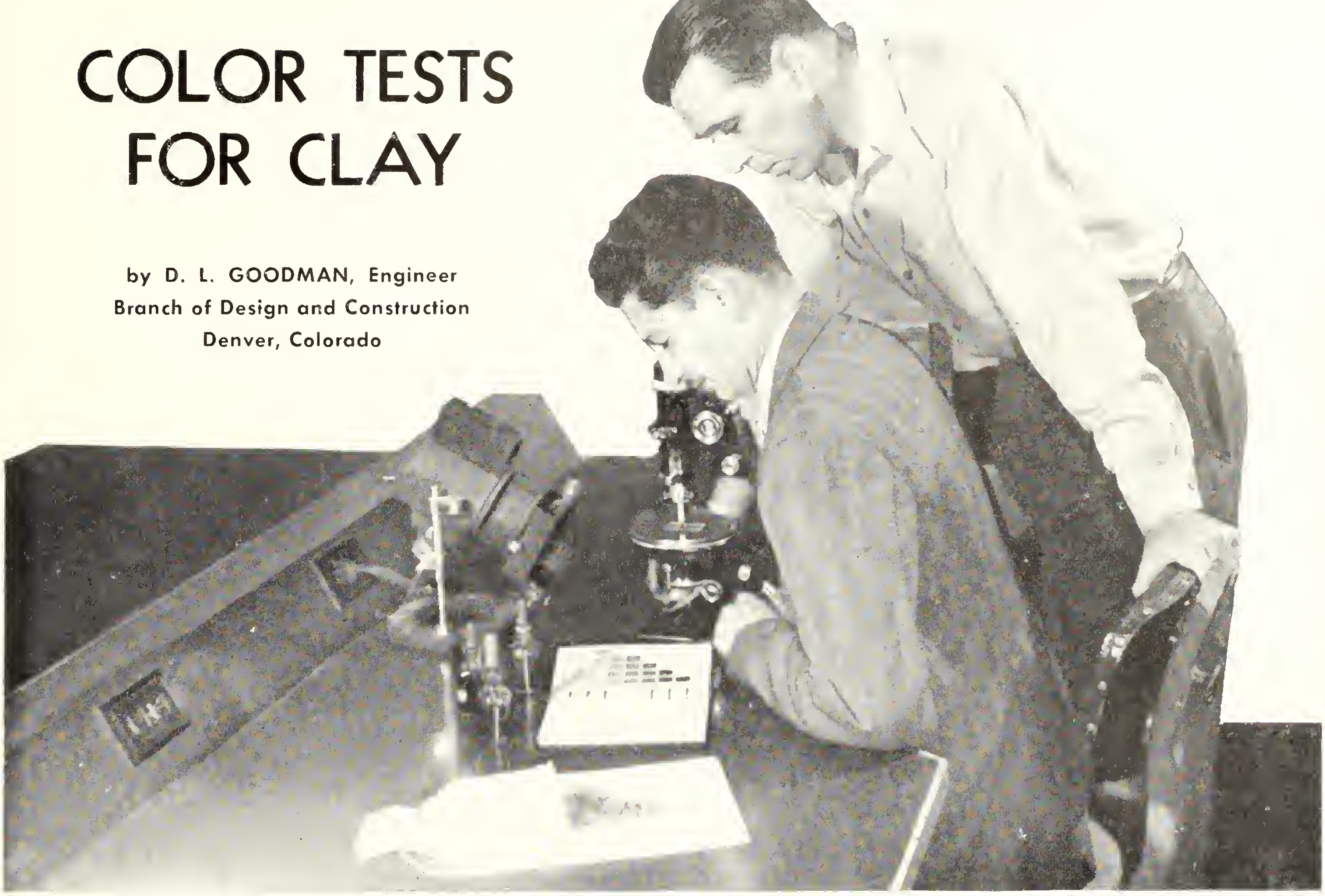
We have all heard of counting sheep but have you ever tried counting fish? At the Tracy Pumping Plant on the Central Valley project in California, representatives of the Bureau of Reclamation, Fish and Wildlife Service, and the California State Division of Fish and Game are doing just that, to make certain the salmon and striped bass in the Sacramento and San Joaquin Rivers are preserved.

Stolte, Inc., and Duncansen-Harrelson Co. of Oakland, Calif., won the contract to install a gigantic fishscreen at the Tracy plant's pumps. As soon as the screen has been installed, the fish swimming toward the pumps can be detoured from the intake channel where they would otherwise be caught in the huge pumps and deposited in the Delta-Mendota Canal. The screen will divert the fish into a holding basin. There they will be counted, then loaded on a boat, and shipped many miles downstream so they may be safely returned to the river.

The Tracy pumping plant is the key structure which will swap water in river-size quantities from the Sacramento River to the San Joaquin Basin. ●

COLOR TESTS FOR CLAY

by D. L. GOODMAN, Engineer
Branch of Design and Construction
Denver, Colorado



IS THIS CLAY?—M. E. King, right, of the Bureau's research and geology laboratories, Denver, explains clay staining tests to Jose Raphael Grillet, geologist of the Ministry of Public Works at Carcacas, Venezuela, who is a Reclamation trainee. *Photo by W. A. Batts, Denver Federal Center.*

PERHAPS IF THE MEDIEVAL ARCHITECTS of Twelfth Century Italy had had the new technical "know-how" of Bureau of Reclamation research engineers in identifying clays in foundations, they could have prevented the Leaning Tower of Pisa from assuming its famous tilt.

Recent investigations disclosed that a layer of brackish clay beneath the tower caused the tilting of the 800-year-old structure. Had the builders been able to call in the Bureau researchers to analyze the tower's clay foundation by their newly developed techniques of staining tests to identify clays, they could have been forwarned of the unstable foundation.

The new techniques were developed and improved in the Bureau's research laboratories in Denver. Now technicians can find out how much and what kind of clay is present in soils and rocks by a "color test." The way the clay changes color when certain dye solutions are added gives away its name and weight. Analyzing clay in this manner requires a minimum expenditure of time and few laboratory facilities. In turn, the engineering properties of rock and earth materials used in Bureau structures, and the quality of agricultural soils on Reclamation irrigated lands can be rapidly evaluated for the kinds and amounts of clays present.

Clays on Bureau of Reclamation projects are a mixed blessing. In many instances they are essential elements in structures. Bentonitic clays, for example, when wet, become impervious to further penetration of water and can be used to stop seepage in ponds, reservoirs, canals, and earth dams. Clays are also important ingredients in the construction of earth dams; they serve as binding materials to hold other earth elements of the dams together. Certain clays control the quality of agricultural soils through influence on soil structure, permeability, availability of soil chemicals, efficiency for fertilizers, and the effect of liming and other treatment.

On the other hand, clays can play hob with engineering works. The affinity of many clays for water and their ability to expand when wet have caused distress to canal linings, buildings, and highways. High-grade bentonite, for example, will absorb nearly five times its weight in water and at maximum saturation it will increase in volume up to 15 times its dry bulk. Swelling pressures of this type of clay up to 10 tons per square foot have been observed. The effect of this enormous pressure is exemplified by the swelling of bentonitic clay in the substrata of a siphon on a Bureau project in Oregon which moved the piers supporting the heavy siphon a distance of 1 foot.

The new clay identification laboratory techniques thus serve a twofold purpose—they provide essential information on certain clays that are beneficial to Reclamation construction and agriculture, and they help to analyze clays that may be destructive to structures supported by the clay foundations.

The laboratory tests used in identifying clay minerals are relatively simple. First, a sample of the soil containing the unidentified clay is ground up and a strong hydrochloric-acid solution is added in an amount 4 to 5 times the volume of the soil. The sample is then warmed for about 2 hours and washed with distilled water. After the excess hydrochloric acid has been washed from the sample, the remaining clay is filtered and heated in an oven for 24 hours.

A few drops of the red dye, safranine y, are then added to the dried material and the specimen is analyzed for color changes under a microscope. If "montmorillonite" clay is present, the soil will turn blue or bluish-purple. This clay is a pinkish clay and is so called because it was first found in Montmorillon, France. Other clays stain reddish-purple or violet. Still other clays can be identified because they do not stain; they merely absorb the dye solution without change in color.

When the stained clay is put under the microscope, the colors it has developed are recorded according to a system of color notations available in a specially prepared color book. Individual color charts are removed from the color book and placed on a lighted platform near the microscope. The color of the variously dyed parts of the stained material is then compared with the colors on the charts.

Rapid field tests can be carried out on certain clays by adding benzidine, an important compound used in dye manufacture, directly to untreated soils and rocks. Characteristic color changes can usually be observed within five minutes under a microscope.

Dependability of the staining methods has been verified as a result of comparisons made possible by a cooperative program of research under the auspices of the American Petroleum Institute. Through this program, a total of 63 standard reference clays, collected from all parts of the United States, were supplied to 13 industrial and university laboratories as well as the Bureau's research laboratories. Independent tests and analyses by the other laboratories established the identity of the reference clays and confirmed the validity of the Bureau's staining test techniques.

When combined with other laboratory techniques, the staining tests permit analyses of complex clay types and assist in separating clays from nonclay minerals. Moreover, development of the color tests has made possible to some extent the analysis of the amount of clay in soil specimens.

While the tests are not infallible for extremely complex clay structural elements, they do serve as valuable guides in the identification of most clays observed on Bureau projects and thus contribute to the over-all improvement of Reclamation design and construction practices, and ultimately benefit the water users on the projects. THE END

National Parks and Reclamation to Work Together on Recreational Developments

Relationships between the National Park Service and the Bureau of Reclamation in the planning and development of recreation facilities on water control projects are defined in a cooperative agreement between the two Interior agencies which was approved on July 26, 1950, by Secretary of the Interior Oscar L. Chapman.

The terms of the agreement, Secretary Chapman said, are based on more than a decade of experience, during which the National Park Service has acted as advisor to and planner for Reclamation on the recreational aspects of water control projects.

The most important provisions of the new agreement call for:

1. Early information to the National Park Service at regional levels regarding all projects to be investigated and all projects authorized for construction by the Bureau of Reclamation.

2. Early consultation, during the planning stages, so that the National Park Service may advise on the location of roads, structures and other elements of construction, both for appearance and to obtain maximum recreational benefits.

3. Recreational surveys by the National Park Service, and the preparation of reports on the recreational potentialities; Service recommendations concerning recreational developments; and the furnishing of preliminary and, when necessary, detailed plans and estimates of capital costs, for recreational developments, as well as operation and maintenance costs on Bureau of Reclamation projects.

4. National Park Service preparation of estimates of potential recreational benefits, in money terms for the use of the Bureau of Reclamation in determining the share of the "joint costs" of its projects allocable to recreation and in justifying recreational developments.

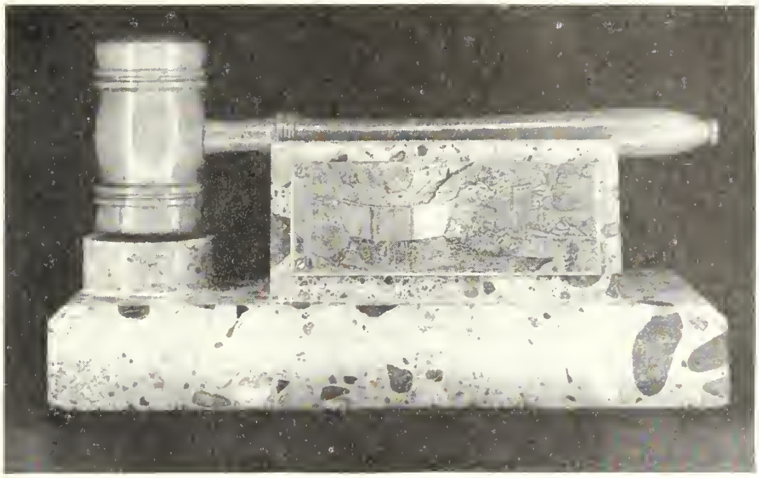
5. Inclusion in Bureau of Reclamation reports of estimates of costs of a project, costs recommended by the National Park Service and approved by the Secretary as reasonable Federal expenditures, for both detailed planning and construction of recreational developments, on a nonreimbursal basis.

6. Advances from the Bureau of Reclamation to the National Park Service to cover costs of planning work requested by the Bureau of Reclamation.

7. National Park Service conduct of negotiations with other agencies, Federal, State, or local, for the ultimate administration of recreational facilities on those projects not considered of such national significance as to warrant permanent administration by the Service.

8. Continuance of arrangement for administration by the Forest Service, Department of Agriculture, of recreational facilities on projects wholly or largely within national forests.

9. Retention by the Bureau of Reclamation of responsibility for the control and utilization of project waters, as well as for dams and appurtenant works and lands immediately surrounding them which are considered necessary in order to meet this responsibility. •



Above: Close-up of gavel presented to Senator Joseph C. O'Mahoney, Chairman of the Senate Committee on Interior and Insular Affairs. Above right: Secretary of the Interior Oscar L. Chapman presents gavel to Senator O'Mahoney, while Assistant Commissioner of Reclamation Goodrich W. Lineweaver (left) and Reclamation Commissioner Michael W. Straus (right) look on. At right, Representative J. Hardin Peterson, Chairman of the House Public Lands Committee, accepts gavel from Assistant Secretary of the Interior William E. Warne. *Photos by Glen Peart, Interior Department photographer.*

Statesmen O'Mahoney and Peterson Honored by Reclamation

Historic gavels made of materials used in the construction of famous Bureau of Reclamation dams were presented to Senator J. C. O'Mahoney, of Wyoming, Chairman of the Senate Interior and Insular Affairs Committee, and Representative J. Hardin Peterson, Chairman of the House Public Lands Committee, in ceremonies on Capitol Hill in Washington, D. C., in recognition of the outstanding public service rendered by the two national legislators in the advancement of water conservation in the West.

Secretary of the Interior Oscar L. Chapman, in presenting one of the gavels to Senator O'Mahoney on August 31st, said the people of the West owed a debt of gratitude to the Wyoming statesman for the water and hydroelectric power made available by the Bureau's multipurpose water development projects. Reclamation Commissioner Michael W. Straus, and Assistant Commissioner of Reclamation Goodrich W. Lineweaver participated in the ceremony.

At the presentation ceremony the next morning at the meeting of the House Committee on September 1, Reclamation Commissioner Michael W. Straus and Assistant Commisisoner Goodrich W. Lineweaver, joined with Assistant Secretary of the Interior William E. Warne in emphasizing the valuable contributions to the cause of water conservation made by Congressman Peterson.

The specimen of concrete forming the base of the memento presented to Senator O'Mahoney was made of materials used in the concrete for Kortes Dam on the North Platte River, in Wyoming, the first dam of the Missouri River basin project to be completed and put into operation. Authorization of construction of the Missouri River Basin project by the Bureau of Reclamation was sponsored by Senator O'Mahoney in the Flood Control Act of 1944.

A smaller block of concrete forming the holder for the handle of the gavel is made of materials to be used in the construction of Anchor Dam, a feature of the Owl Creek project in the Big Horn Basin of Wyoming, which was also authorized for construction under the Missouri River Basin project.

A bronze plate on one side of the memento depicts an upstream view of Seminoe Dam of the Kendrick project on the North Platte River in Wyoming. Seminoe Dam was completed in 1939 and its operations are coordinated with other Reclamation dams on the North Platte.

The concrete base for the memento presented to Chairman Peterson was a portion of the spillway bucket at Grand Coulee Dam, world's largest dam on the Columbia River, built by the Bureau of Reclamation. The block on which the gavel head rests is of granite extracted from bedrock deep in the foundation of Grand Coulee Dam. The bronze plate on one side of the gavel base is an engraving of Grand Coulee Dam.

The mementoes presented to the national legislators were produced in the Research and Geology Division of the Branch of Design and Construction, Bureau of Reclamation, under Chief Engineer L. N. McClellan, at Denver, Colo. ●

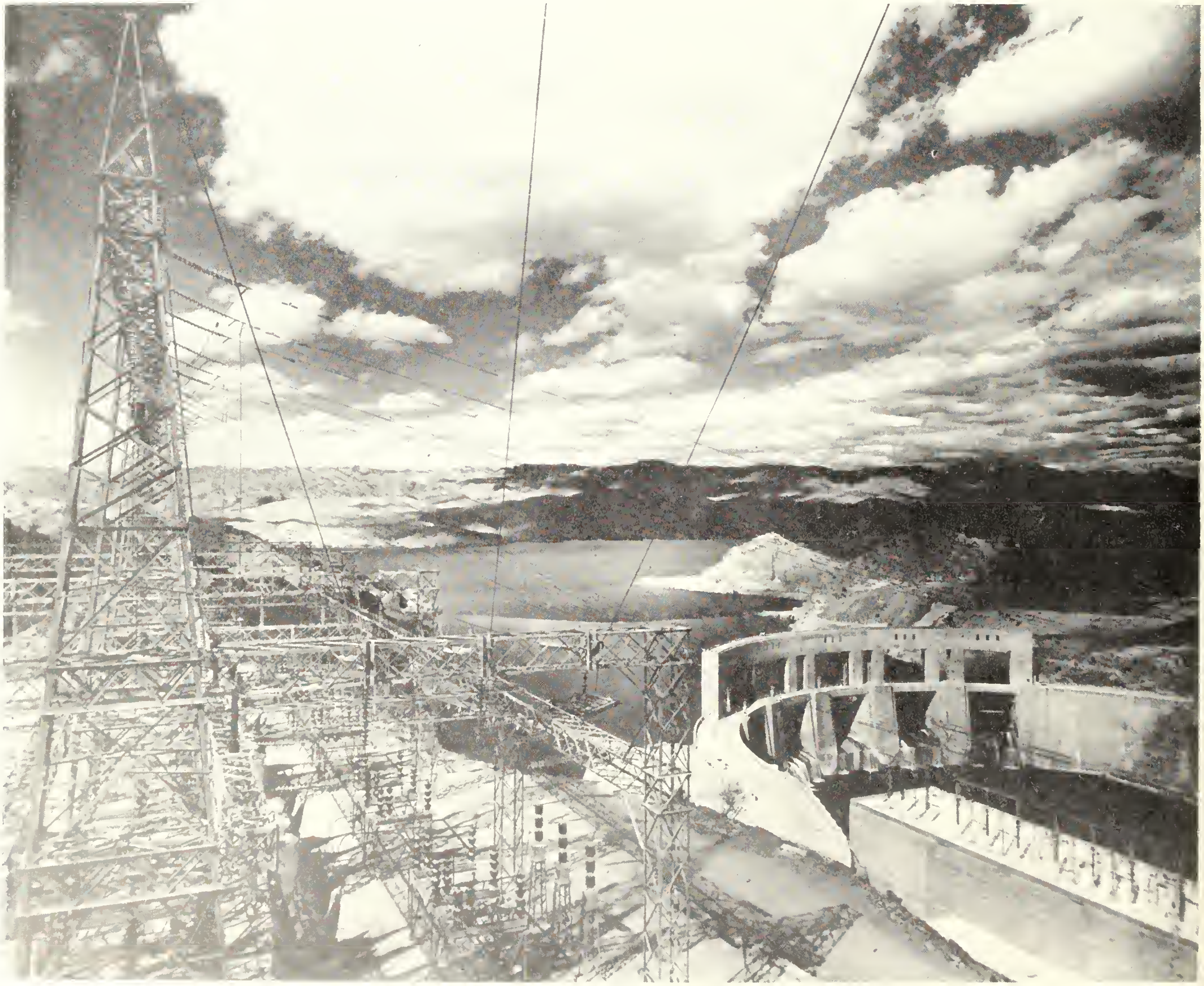
World Power Conference in London

Assistant Secretary of the Interior William E. Warne, and Cecil L. Killgore, of the Bureau of Reclamation's Office of the Chief Engineer, represented the Department and the Bureau at the Fourth World Power Conference in London the week of July 10–15. They inspected the British Power System during their stay.

Mr. Killgore also served as the official Bureau representative at the International Conference on Large High Tension Systems in Paris the first week in July. He also made a study tour of Swedish power installations prior to the Paris Conference.

Mr. Warne was one of the principal speakers at the World Power Conference. In his message he told how the development of electric power resources had contributed to economic and social progress in the United States and concluded with the statement. "Point Four and the technical assistance programs of the United Nations offer unparalleled opportunities for making progress in the long, hard job of transforming the underdeveloped areas of the globe. The development of electric power resources, abroad as in the United States, is basic to economic and social progress. By means of this and other technical assistance measures, including health, education, and agricultural development, underdeveloped areas will be aided in achieving full partnership in the world community."

In his summary of the growth of power production and use in the United States, he stated that between 1924 and 1948 electric generating capacity increased from 17,700,000 to 56,600,000 kilowatts, an increase of 220 percent, excluding capacity installed in industrial plants for their own use. He said about 70 percent of the U. S. A.'s current capacity is installed in steam-generating plants driven by coal, oil, or gas, and that four-fifths of the power capacity of the United States are installed in plants owned by private corporations,



". . . the key with which the priceless resources of our river valleys can be unlocked." Above, Parker Dam Power plant in California, one of the "keys" to future prosperity, referred to by Assistant Secretary Warne. Photo by Howard Fink and George O. Bonawit of Region 3.

one-fifth being installed in public plants owned by the Federal and local governments and consumer-cooperatives.

Assistant Secretary Warne also pointed out how rates for electricity have steadily declined over the last quarter of a century in the United States largely as a result of increased efficiency in production and distribution. As an example, he stated that the average cost of one kilowatt-hour in cities above 50,000 in population declined from 6.2 cents in 1924 to 3.6 cents in 1948, a reduction of nearly 42 percent. As rates have gone down, he said, the use of electricity has gone up, pointing out that domestic consumers use a large number of electrical appliances—Seattle, Wash., for example, a city of about 450,000 obtaining electric power from Grand Coulee Dam, has more electric ranges in use than any other city in the world. In that region, 96 percent of the farms are electrified, and widespread use of electric milking machines, poultry brooders, feed grinders, hay dryers, and other power-driven equipment has taken much of the drudgery out of farm life and made possible substantial increases in agricultural production, he said.

Despite the growth in power production in the United States, however, Mr. Warne asserted the United States is still suffering from a power shortage, and he quoted the retiring president of the Edison Electric Institute as stating that by 1970 the private companies would have to treble their present capacity, adding more than 130 million kilowatts. The publicity owned segment of the electric utility industry likewise plans additions to the national power plant, with the Federal Government planning for installing 6 million kilowatts in hydroelectric facilities within the next few years, and ultimately another 4 million kilowatts. "The river basins of the country have an indispensable role to play in the building of a national power plant adequate to meet the future power needs of the United States. Up to now, we have put to use only 18 percent of our potential hydroelectric resources," said the Assistant Secretary, adding, "The Federal Power Commission estimates that, if sound, multiple purpose methods are applied to their development, the rivers of the United States can be harnessed to provide nearly 77 million kilowatts of additional hydroelectric capacity."

Assistant Secretary Warne commented briefly on the outlook for harnessing the electric power potential of the sun, the atom, the wind, the tides, and of synthetic fuels.

The main portion of his address was devoted to the theme of river valley development, with power as the key to open up the vast resources of river basins, using the Tennessee Valley, and the Pacific Northwest, as examples of large-scale power production centers where remarkable regional economic and social progress has been and is taking place. Mr. Warne described the operation of the Northwest Power Pool, stating that the total output of the pool last year was nearly 23 billion kilowatt-hours—about 8 percent of the total electrical energy generated in the United States. He explained how the "postage stamp" rate policy for electric power sold wholesale by the Federal Government, is made possible by the backbone transmission network in the Pacific Northwest. Under this policy, he stated, the basic Federal rate for electricity is the same anywhere in the region, whether power is used a few miles from the dams or in the farthest corners of the area served by transmission lines. "Postage stamp rates," he said, "have encouraged the decentralization of industry and, as a result, have significantly influenced community development. This method of marketing electric power, along with greatly increased domestic consumption of electricity, is doing much to improve standards of living and the general well being of the people of the region."

"The United States," said Assistant Secretary Warne, "has found in power production the key with which the priceless resources of our river valleys can be unlocked. Revenues from power sales can be used to help pay the cost of achieving other vital conservation objectives—making water available for irrigating farms and for domestic water supply, controlling floods, improving navigation and opening up new channels of commerce, creating new recreational opportunities, and enhancing fish and wildlife resources."

He outlined the present policy of the United States Government intended to assure that the rights of the public in the development of publicly owned resources are fully protected, and that ample power supplies are made available at low cost to meet the needs of homes, farms and factories. •

"FARMERETTES" HELP WITH BURBANK LAND DRAWING

When the Bureau of Reclamation held a drawing for 13 full-time farm units near Burbank, Wash., on August 10, 1950, it was assisted by the "Farmerettes," a group of southeastern Washington girls representing that part of the State at agricultural affairs. The numbers of 265 World War II veterans were in the "goldfish bowl" and, as can be seen from the blackboard, among the first 13 drawn were the numbers of veterans as far away as Louisiana and Tennessee. Left to right, seated, are: Peggy Johnson, Dayton; Erma Lee Kessler, Waitsburg; Mary Anne Shaffer, known as the "fairest farmerette," Waitsburg; Lora Rothrock, Walla Walla; Carol Brown, Prescott; Loen Bailie, Mesa farmer and president of the Washington State Reclamation Association; Melvin McInturf, Mesa farmer and representative of the veterans' organizations; B. E. Kuhns, Chief of Land Settlement and Secretary of the Board of Examiners, of which Bailie and McInturf are the other two members. Standing by the board is Clinton Amo, Land Settlement Section, U. S. B. R., and standing behind Miss Rothrock is W. W. Johnston, project supervisor, who acted as master of ceremonies. *Photo by H. E. Foss, Region 1 photographer.*

ATTENTION.—Credit for the Denver Engineering Center photo which appeared in the September issue of the ERA, page 184, should have been given to Harry W. Myers, photographer, region 3, rather than Harry *Meyers*. We regret the misspelling of photographer Myers' name.—*Editor.*

First Concrete Poured at Canyon Ferry

R. H. Fifield, Chief Engineer for the Montana State Water Conservation Board, tripped the first bucket of concrete for Canyon Ferry Dam on September 14, 1950. It was poured from an eight foot mixing bucket that had been carried from the mixing plant 200 feet up the canyon wall by a cableway crossing the canyon 275 feet above bedrock.

Canyon Ferry Dam, one of the largest concrete structures in the Missouri Basin project, and the first major unit in Montana, is located 17 miles east of Helena. It will be 212 feet high, approximately the same height as the Pathfinder Dam on the Bureau's North Platte project in Wyoming, and will have a power plant with a capacity of 50,000 kilowatts. It will also provide major irrigation and flood control benefits. The structure will create a 2,000,000 acre-foot reservoir which will extend 25 miles upstream to the vicinity of Townsend.

Canyon Ferry power will be used to pump irrigation water, to feed REA lines, and to augment the available power supply in the area for municipal and industrial purposes. According to the plan, the Canyon Ferry plant will be interconnected with the Fort Peck system and ultimately with the proposed Yellowtail power plant which is to be constructed on the Big Horn River near Hardin, Mont. Commissioner Straus, in commenting on the development, said "right now, with the imminent need for power for national defense purposes, Canyon Ferry power would be invaluable and we plan to make it available as soon as possible."

Besides controlling flood waters now going to waste, and often damaging downstream agricultural developments, water from the dam will permit the eventual irrigation development of over 300,000 acres of new land and provide a supplemental water supply for almost 200,000 acres in other units of the Missouri Basin project upstream from Fort Benton, Mont. ●

SOILS NEED HELP

While adding chemical fertilizers to the soil to correct known deficiencies, do not overlook the need for humus building.

Your windbreaks, left to their natural bent, build better soils around them, as the leaves fall, decay, and work into the ground. Open field soils have to be helped if they are to grow better, not worse, under cropping. They need organic matter put back in—manure, and "green manure"—for nature to work on and put in shape for producing hardy and plentiful plant growth. Everybody knows it, but not everybody does something about it. (*From p. 4 of the July 1, 1950 issue, The Dakota Farmer.*)

NOTES FOR CONTRACTORS

Contracts Awarded During September 1950

Spec No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3043	Hungry Horse, Mont	Sept. 13	25 penstock stop logs and 1 lifting frame for Hungry Horse Dam	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	$88,114
3077	do	Sept. 15	1 main control board, 4 unit control boards, 1 recording board, and 2 annunciator cabinets for Hungry Horse power plant, schedule 1.	Taller and Cooper, Inc., Brooklyn, N. Y.	58,236
3100	Missouri River Basin, N. Dak	Sept. 21	Four 10,667/5,000-kilovolt-ampere transformers, two 75-kilovolt-ampere and two 50-kilovolt-ampere transformers, one 230,000-volt circuit breaker, three 230,000-volt lightning arresters, and 10 current and eleven potential transformers for Central North Dakota power system, items 1, 2, 4, 5, 6, 8, 9, 18, 20, 22, 34, 36, 46, 51, 61, 64, and 65.	Westinghouse Electric Corp., Denver, Colo.	416,438
3100	do	Sept. 19	8 current and 6 potential transformers, four 69,000-volt circuit breakers, and twelve 46,000-volt disconnecting fuses for Central North Dakota power system, items 3, 7, 14, 17, 19, 21, 28, 32, 35, 53, 63, and 66.	General Electric Co., Denver, Colo.	45,562
3100	do	do	Three 50-kilovolt-ampere transformers and one 69,000-volt voltage-regulating transformer for Central North Dakota power system, items 10, 37, 43, and 48.	Moloney Electric Co., St. Louis, Mo	59,338
3100	do	do	Two 115,000-volt interrupter switches, three 196,000-volt horn-gap switches, and two 196,000-volt disconnecting switches for Central North Dakota power system, items 24, 33, 54, 55, and 56.	Schwager-Wood Corp., Portland, Oreg	36,972
3112	Missouri River Basin, Nebr	Sept. 5	Construction of earthwork and structures, except bridge superstructures, for relocation of Chicago, Burlington & Quincy Railroad, Trenton Dam.	Perry McGlone Construction Co., Kansas City, Mo.	2,195,467
3113	do	do	Construction of superstructures for bridges for relocation of Chicago, Burlington & Quincy Railroad, Trenton Dam.	American Bridge Co., Denver, Colo.	541,305
3121	do	Sept. 22	Four 6-foot by 7-foot 6-inch high-pressure gates with four 173,000-pound hydraulic hoists, two 15,000-pound semiautomatic gate hangers, two hydraulic gate hangers, and eyebolts for spillway river outlets at Trenton Dam.	Hardie Tynes Mfg. Co., Birmingham, Ala.	53,425
3123	Davis Dam, Ariz.-Nev	do	Six 69,000-volt and eleven 14,400-volt circuit breakers for Phoenix substation, schedules 1 and 2.	Kelman Electric and Mfg. Co., Los Angeles, Calif.	214,641
3123	do	Sept. 25	Twelve 69,000-volt and twenty-two 15,000-volt disconnecting switches for Phoenix substation, schedule 3.	Memco Engineering and Mfg. Co., Inc., Commack, Long Island, N. Y.	61,254
3124	Central Valley Calif	Sept. 21	Four 115,000-volt and two 69,000-volt circuit breakers for Tracy switchyard, schedule 1.	Westinghouse Electric Corp., Denver, Colo.	138,220
3124	do	Sept. 20	Eight 115,000-volt and four 69,000-volt disconnecting switches for Tracy switchyard, schedule 2.	Memco Engineering and Mfg. Co., Inc., Commack, Long Island, N. Y.	32,377
3131	Missouri River Basin, S. Dak	Sept. 25	Construction of Angostura power plant	Barnes-Mattison, Inc., Minneapolis, Minn.	141,555
3133	Colorado-Big Thompson, Colo	Sept. 12	Construction of Rattlesnake tunnel, Estes Park-Foothills power aqueduct.	Gibbons and Reed Co., Salt Lake City, Utah.	1,294,312
3135	Central Valley, Calif	Sept. 20	Dismantling and removing existing bridge and construction of earthwork, foundations, and superstructure for new Sacramento River Bridge, Shasta Dam.	John C. Gist, Sacramento, Calif	288,911
3139	Provo River, Utah	do	Construction of earthwork and structures for Terminal reservoir, Salt Lake Aqueduct.	Peter Kiewit Cons. Co., Arcadia, Calif	1,259,940
3140	Central Valley, Calif	Sept. 29	Construction of earthwork and concrete lining for Friant-Kern Canal	Bent Construction Co., Los Angeles, Calif.	124,245
3143	Columbia Basin, Wash	Sept. 20	River improvements and repair of spillway face and spillway bucket at Grand Coulee Dam.	Pacific Bridge Co., San Francisco, Calif	2,662,866
3145	Kendrick, Wyo	do	Construction of Hanna substation	Flora Construction Corp., Estes Park, Colo.	34,945
3148	Missouri River Basin, Nebr	Sept. 8	20,000 barrels of portland cement for construction of structures for relocation of Chicago, Burlington & Quincy Railroad, Trenton Dam.	Ideal Cement Co., Denver, Colo.	58,000
3149	Missouri River Basin, Nebr	Sept. 26	Driving test piles at Ashton dam site	Raymond Concrete Pile Co., New York, N. Y.	17,716
3151	Grand Valley, Colo	Sept. 29	Construction of concrete lining for tunnel No. 3 on Main Canal	Kemper Construction Co., Los Angeles, Calif.	250,747

NOTES FOR CONTRACTORS — Contracts Awarded During September 1950 (Continued)

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3153	Central Valley, Calif.	Sept. 15	Radio-communication equipment for communication system	Motorola, Inc., Chicago, Ill.	53,009
3154	Boulder Canyon, Ariz.-Calif.-Nev.	Sept. 20	Unmounted relays and control equipment for units A3, A4, and A9, Hoover power plant.	Westinghouse Electric Corp., Denver, Colo.	16,931
3160	....do	Sept. 25	Fabricated structural steel and sheave assemblies for units A3, A4, and A9, bank Y, and Nevada State extension, Hoover switchyard.	Bethlehem Pacific Coast Steel Corp., San Francisco, Calif.	31,106
3163	Missouri River Basin, N. Dak.	Sept. 22	Fabricated structural steel for Bismarck and Washburn substations	Bethlehem Steel Co., Bethlehem, Pa.	63,979
3166	Hungry Horse and Missouri River Basin, Mont.-Wyo.	Sept. 29	5 steel accordion doors for Hungry Horse valve house, Canyon Ferry power plant, and Boysen power plant	Macri and Hood Iron Works, Oakland, Calif.	12,547
R1-CB-66	Columbia Basin, Wash.	Sept. 1	Construction of warehouse building at Ephrata, Wash.	Matco Co., Inc., Seattle, Wash.	10,226
R1-95	...do	Sept. 20	Drilling Royal Slope experimental water-supply well No. 2	Frank L. Zimmerman, Moses Lake, Wash.	10,979
R1-CB-73	...do	Sept. 15	Construction of glazed partitions in main control room, left control bay, Grand Coulee power plant.	Riverman and Sons, Portland, Oreg.	11,033
R1-96	Deschutes, Oreg.	Sept. 13	Repairs to Arnold diversion dam.	A. Wilson Beuold, Bend, Oreg.	14,500
R1-CB-61	Columbia Basin, Wash.	Sept. 20	Fencing of right-of-way and building protective structures on Main Canal, East Low Canal station 574+16 and West Canal to station 351+72.	McWaters & Bartlett, Boise, Idaho	58,069
R2-117	Central Valley, Calif.	Sept. 1	Delta-Mendota Canal headworks, pilot fish screen structure and appurtenant works and 13.8-kilovolt distribution line.	Stolte, Inc. and the Duncan-Harrelson Co., Oakland, Calif.	213,262
R2-120	...do	Sept. 21	Erecting and completing prefabricated garage and car shelter for Government Camp at Shasta Dam, schedule 1.	John C. Gist, Sacramento, Calif.	195,295
R2-122	...do	Sept. 15	Rehabilitation of Government houses at Shasta Dam	C. T. Brayton & Sons, Escalon, Calif.	26,169
R2-121	....do	Sept. 19	Canal road surfacing station 3879+72 to station 5100+00 and station 5220+00 to station 5953+00, Friant-Kern Canal.	Gerale E. Brewster, Avenal, Calif.	73,162
R3-PX-48.	Parker Dam Power, Ariz.-Calif.	Sept. 14	Repairing five 50-foot by 50-foot regulating gates, Parker Dam spillway	Charles W. Alcott, doing business as Burkett Construction Co., and Bert Miller, Los Angeles, Calif.	39,622
R3-PX-42.	Davis Dam, Ariz.-Nev.	Sept. 6	Construction of 230-kilovolt structure for Prescott substation	Vyne Brothers Electric Co., Prescott, Ariz.	69,090
400-25	Ogden River, Utah	Sept. 20	Constructing protective fencing around laterals 13, 17, P, 25, and 25A equalizing reservoirs.	American Fence Co., Salt Lake City, Utah.	11,815
R5-22	Carlsbad, N. Mex.	Sept. 22	Repairs to Pecos River flume	Osage Construction Co., Oklahoma City, Okla.	18,841
R6-46	Missouri River Basin, Wyo.	Sept. 15	Clearing part of Boysen Reservoir site, schedules 1 and 2.	C. L. Hubner Co., Denver, Colo.	17,500
R6-46	...do	do	Clearing part of Boysen Reservoir site, schedule 3	Mid-States Construction Co., Chisholm, Minn.	168,716
R7-137.	Colorado-Big Thompson, Colo.	Sept. 7	Earthwork and structures for measuring devices for Fish Creek and Big Thompson River	L. J. Hesser, Greeley, Colo.	82,400
R7-150.	...do	Sept. 15	Bituminous surfacing for Green Mountain and Shadow Mountain Government Camps and access road to Alva B. Adams Tunnel	Colorado Constructors, Inc., Denver, Colo.	49,875

Construction and Materials for Which Bids Will Be Requested By January 1951

Project	Description of work or material
Boise, Idaho	Excavation of East Hartley Gulch drain near Caldwell, Idaho.
Boulder Canyon, Nev.	Construction of shop building, 8,000 square feet in area, and warehouse, 4,800 square feet in area, of reinforced concrete masonry construction with built-up roofs in Boulder City, Nev.
Cachuma, Calif.	Construction of Lauro Dam and regulating reservoir at Santa Barbara, Calif. Dam is to be a 446,000 cubic yard earthfill structure, 110 feet high and 535 feet long, to impound an area of 22 acres with 647 acre-feet of water and is to have an outlet works tunnel of 54-inch diameter steel pipe and a 33-inch diameter 860-foot long, 90 cubic feet per second capacity concrete pipe spillway.
Central Valley, Calif.	Construction of 48 miles of concrete pipelines for the Southern San Joaquin municipal utility district on the Friant-Kern canal distribution system near Delano, Calif. The system is to contain a series of small pumping plants with units not to exceed 20 cubic feet per second capacity and 9 equalizing reservoirs from a half acre to an acre in area.
Do.	Resurfacing streets and constructing curbs, gutters, and sidewalks at Shasta Dam Government camp near Redding, Calif.
Do.	Construction of a reinforced concrete building for offices at Tracy switchyard and pumping plant.
Colorado-Big Thompson, Colo.	Construction of Willow Creek Dam, an earthfill structure about 96 feet high and 1,000 feet long, on Willow Creek 8.5 miles from Granby, Colo. Appurtenant structures include an open chute-type spillway and tunnel outlet works.
Do.	Construction of Flatiron-Fort Collins-Cheyenne tap 115-kilovolt transmission line. Includes a 20-mile, 3-phase, single-circuit, H-frame line from Flatiron switchyard, 8 miles west of Loveland, Colo., to Fort Collins, Colo., and a 16-mile tap line extending east from Fort Collins to the vicinity of Ault, Colo., where connection will be made with the existing Cheyenne-Greeley 115-kilovolt transmission line.
Do.	Construction of a concrete diversion dam and 12.4 miles of North Poudre supply canal extending northeast from the Cache la Poudre River about 18 miles northwest of Fort Collins, Colo. Involves construction of the following components: (1) a concrete overflow weir-type diversion dam 74 feet long and 12 feet high with sluiceway, headworks, and Parshall flume; (2) 800 feet of 8- by 8-foot reinforced box siphon; (3) 9 miles of 250-cubic-feet-per-second capacity open canal including 2.2 miles of concrete lined canal; (4) four 250-cubic-feet-per-second capacity, 8-foot diameter, horseshoe-shaped, concrete-lined tunnels totaling 2.7 miles.
Do.	Construction of about 60 miles of 115-kilovolt, 3-phase, single-circuit transmission line between Salida and Gunnison, Colo.
Do.	Dispatcher's board for dispatcher's building at Flatiron power plant.
Columbia Basin, Wash.	Construction of 8,780-foot long concrete lined, steel-supported Low Gap Tunnel, about 7 miles north of Smyrna, Wash., to carry water through Frenchman Hills. Tunnel is to be about 14 or 15 feet in diameter and of 1,540-cubic-feet-per-second capacity.
Do.	Construction of 7 permanent-type houses with garages, 24- by 20-foot wood-frame office building, and streets and utilities at Adco operation and maintenance site near Adco, Wash.
Do.	Construction of a 25- by 60-foot greenhouse; combined office, workshop, garage, and warehouse 42- by 110-foot—and 18- by 116-foot storage garage; and laying about 500 feet of 36-inch diameter reinforced concrete culvert pipe.
Davis Dam, Ariz.-Nev.	Installing equipment and erecting steel structures for Cochise substation, 16,000-kilovolt-ampere capacity, southwest of Willcox, Ariz.
Davis Dam, Ariz.-Nev.	Construction of Knob substation; involving erecting structural steel and chain-link fence; grading plot and installing equipment for 169-kilovolt switchyard in West Yuma, Ariz.
Do.	Construction of a maintenance shop, a 100- by 100-foot steel structure requiring concrete foundation and installation of crane, at Phoenix, Ariz.
Do.	Furnishing and erecting a 75,000-gallon elevated water tank at Phoenix, Ariz.
Do.	Furnishing and installing pumps for seven water supply wells at Tucson, Coolidge, Phoenix, and Mesa, Ariz.; and furnishing and laying pipe lines for domestic water supply and fire protection at Mesa and Coolidge.
Fort Peck, Mont.-N. Dak.	Construction of 105-mile, 115-kilovolt, 3-phase, single-circuit, H-frame transmission line between Glendive, Mont., and Williston, N. Dak.
Grand Valley, Colo.	Construction of concrete siphons for Badger wash, East Salt wash, and Lateral 21AC on the Highline Canal.
Hungry Horse, Mont.	Galvanized fabricated structural steel for bolted switchyard structures and transformer circuit towers at Hungry Horse switchyard; and fabricated structural steel for riveted take-off structure at Hungry Horse power plant.
Do.	Line relaying switchboard for Hungry Horse power plant.
Kendrick, Wyo.	Construction of 3,750-kilovolt-ampere Rawlins substation, including foundations, erecting all structural steel, and installing electrical equipment furnished by the Government. The substation is to have one 34.5-kilovolt bay and one 2.4-kilovolt bay.
Do.	Stringing 142 miles of overhead ground wire on 115-kilovolt transmission line between Seminoe Dam and Cheyenne, Wyo.
Do.	Lining with buried asphaltic membrane about 0.6 mile of existing 600 cubic feet per second capacity Casper canal, about 32 miles southwest of Casper, Wyo.
Missouri River Basin, Mont.	Two 300 gallons per minute and two 2,500 gallons per minute, deep-well, turbine-type water pumps; one 20 gallons per minute and one 50 gallons per minute gear-type oil pump for Canyon Ferry power plant.
Missouri River Basin, N. Dak.	Construction of 4-mile Garrison (Fort Peck tie) 115-kilovolt transmission line connecting Williston-Garrison and Garrison-Bismarck lines at Garrison Dam, N. Dak.
Do.	Two 8,500-gallon oil storage tanks for Bismarck substation.
Missouri River Basin, S. Dak.	Construction of 60 miles of 115-kilovolt, 3-phase, single-circuit transmission lines between Sioux Falls and Brookings, S. Dak.
Missouri River Basin, Wyo.	Construction of 6,000 kilovolt-amperes Sinclair substation, involving constructing of foundations, erecting structural steel, and installing electrical equipment furnished by the Government.
Do.	Construction of 20 miles of 69-kilovolt, 3-phase, single-circuit transmission line between Garland and Lovell, Wyo.
Do.	Clearing about 2,200 acres of Boysen reservoir site, 18 miles south of Thermopolis, Wyo.
North Platte, Wyo.-Nebr.	Placing 1,180 feet of concrete pipe and 2,800 feet of concrete lining for lateral 98.1 and 3,700 feet for lateral 98.1 C, Fort Laramie canal, about 7 miles south of Morrill, Nebr.
Rio Grande, N. Mex.	Construction of Lucero Arroya dike about 5,000 feet long and 17 feet high at maximum section, including installation of 36-inch-diameter concrete discharge pipe.
Riverton, Wyo.	Application of approximately 46,000 gallons of asphalt undersealing to 11,500 square yards of concrete canal lining of Wyoming canal, 30 miles northwest of Riverton, Wyo.

U. S. GOVERNMENT PRINTING

THE RECLAMATION AREA

The Reclamation ERA

December

1950

Official Publication of the Bureau of Reclamation

The Reclamation ERA

December 1950
Volume 36, No. 12

Issued monthly by
The Bureau of Reclamation
United States Department of the Interior, Washington 25, D. C.

The printing of this publication has been approved by the Director of the Bureau of the Budget, May 25, 1950

CONTENTS

FEATURE ARTICLES

SHORT FEATURES

Ruth F. Sadler, *Editor*

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, and Bureau of Reclamation employees.

OUR FRONT COVER

A Merry Christmas To All!

Children of Bureau employees at the Hungry Horse project enjoy a Christmas treat that is denied most youngsters these days. Living in the heart of one of the Nation's largest Christmas tree producing areas, Hungry Horse children bring in their own. More than 2,500,000 trees from northwestern Montana brought joy to homes throughout the United States this past Christmas. Here, Harrel Yadon, Bureau clerk, and 9-year-old son, Mervin, take care of this important event of the year. *Photo by A. E. McCloud, Region 1 photographer.*

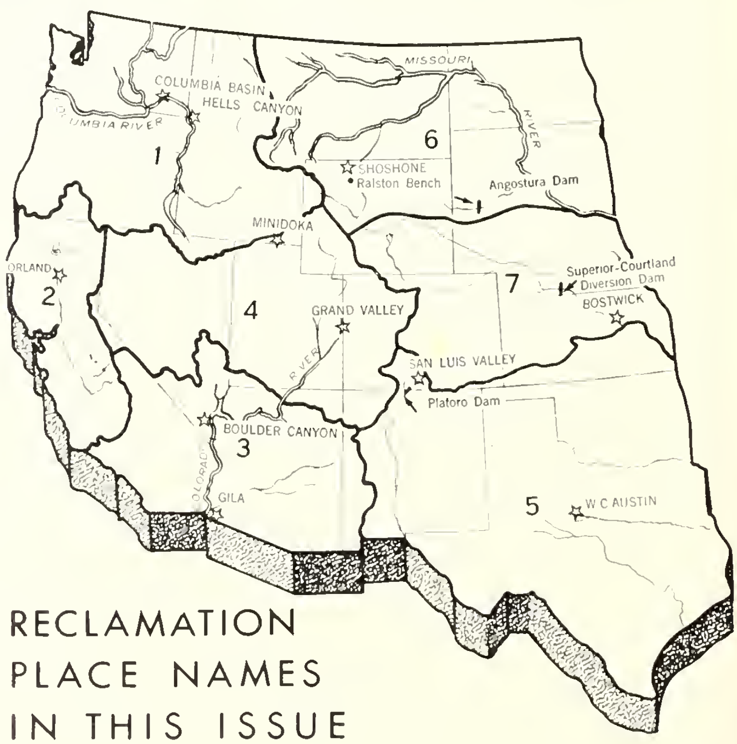
30 YEARS AGO IN THE ERA

From a number of our projects come reports of phenomenal yields. In each of these reports there is a story of genuine human interest, but how are we going to get them for the Record*?* * * *

Bill Jones or Brown, at whom you were very much inclined to sneer because he persisted in puttering about on a 10-acre tract raising onions for seed by hand, suddenly jumps into notoriety by producing a crop which sells for $600 an acre and buys a seven-passenger car with which to flaunt you. Don't you want him to tell you all about it? * * *

Every one of our projects has its stories of this and other kinds. Please will somebody start telling them in the Record*?*—(From p. 559, December 1920 issue of the Reclamation Record, predecessor to the Reclamation Era.)

Editor's Note: We had not come across this item until we had already published the Any Questions? plea for similar copy on page 205 of last month's issue. Evidently editors' minds run in the same channels, and 30 years ago, even as today, people wanted to read about people, and the how, when, where, who, what, and why of life in the Reclamation area.



RECLAMATION PLACE NAMES IN THIS ISSUE

THE WHITE HOUSE

November 13, 1950.

My Dear Mr. Polk: It is my pleasure to extend greetings to the National Reclamation Association on the occasion of your nineteenth annual convention.

As you well know, the economic ceiling of the West is governed to a large degree by the development of its water resources for irrigation, power production, and related purposes. The progress that has been made in recent years through the Reclamation program is highly gratifying.

It was my privilege, last May, to participate in the dedication of the Grand Coulee Dam on the Columbia River in Washington and the Kortes Dam on the North Platte River in Wyoming. Several other great multi-purpose reclamation structures are now under construction or have been authorized by the Congress. It is my hope that they may be completed and placed into useful production as rapidly as funds can be made available with due regard for the Nation's obligations for security and other equally vital activities.

The recently completed census shows the phenomenal population growth in the Western States. Only by continued and orderly progress on the Reclamation program can this expansion of human resources be matched by the agricultural and industrial opportunities so essential to their sustenance and well-being.

Very sincerely yours,

Harry Truman

Mr. Harry L. Polk, *President,*
National Reclamation Association,
% Davenport Hotel, Spokane, Wash.

Department of the Interior

November 10, 1950.

My Dear Mr. Polk: The annual meeting of the National Reclamation Association is always important in the development of the water resources of the West and I want to take this opportunity to extend my best wishes on the occasion of your nineteenth annual convention.

Reclamation has made its greatest strides in the last 18 years under the matchless leadership of Franklin D. Roosevelt and Harry S. Truman. While much has been accomplished, there is still a great work ahead before we can fully utilize the rich resources of our Western rivers and streams.

To maintain progress, we must keep closely attuned to the concept of carefully planned basin-wide multi purpose development.

Only by the fully integrated use of the available water for irrigation, power, and the many other benefits resulting from reclamation development can the economy of the West keep step with its remarkable population growth of recent years.

Sincerely yours,

Oscar L Chapman
Secretary of the Interior.

Mr. Harry L. Polk, *President,*
National Reclamation Association,
% Davenport Hotel, Spokane, Wash.

The following statement by the Secretary Manager of the National Reclamation Association was published in the October 18, 1950, issue of the NRA Bulletin:

Future Reclamation Will Require Our United Support

The continued development of our reclamation projects of the West requires, perhaps more than any other time since our association was founded 18 years ago, the united support of our members and the entire West. We believe it is our duty as patriotic citizens of the West and the Nation to do all within our power to carry forward reclamation development in an orderly and systematic manner. Our population is growing, our topsoil is being depleted, our standard of living must be maintained. Our increasing responsibilities as a Nation require that we remain strong—but to remain strong we must continue the orderly development of our natural resources. WE NEED RECLAMATION!

Reclamation is encountering difficulties today. Those who do not understand reclamation are talking about farm surpluses, the unbalanced Federal budget, and the need for manpower and materials for our defense program and—sad but true—the West is not united. The basin-wide reclamation program for the Columbia Basin proposed in the O'Mahoney amendment to the omnibus bill is a concrete illustration. Only five of eight Pacific Northwest Senators voted for this amendment. More Senators from the 17 Western States voted against it than for it.

It is not our purpose to say whether this amendment was properly drafted or whether the principles proposed in the amendment were correct and should be approved by our association, but we do repeat, that if reclamation is to continue to move forward, the West must be united. Reclamation is a western institution—if the West is not united behind reclamation, how can we expect the support of the Congress and the Nation as a whole?

Our remaining projects are extremely costly. There must be a greater recognition of the public benefits of reclamation. There must be a liberalization of our present reclamation law. There must be a program approved under which reclamation will continue to go forward. People of the West and the Nation want our natural resources developed. They are looking to us for leadership. The obstacles confronting us are not insurmountable. Our association must accept this responsibility. We must accept this challenge. We in the West must continue to move forward toward our ultimate goal—the orderly development of our reclamation projects. Ours is a responsibility which we cannot and must not evade. Our job in Spokane is clearly defined.

Wm. E. Welsh,
Secretary-Manager.

ELECTRIC LIGHTS BY CHRISTMAS * * * "let the hearts and minds of the settlers enjoy the peaceful sanctuary of the abodes they built, and the security of the soil they till." Aerial view of Ralston Bench taken by Jack Richards, publisher of the Cody, Wyo., Times.

LOOKING FOR SANTA is Kathryn Cox, daughter of Mr. and Mrs. Charles F. Cox, project engineer at Coulee Dam. Although F. B. Pomeroy's photo was not taken at Ralston Bench we used it here as a fitting and typical illustration of the spirit of Christmas at Ralston Bench.

The Miracle of RALSTON BENCH

by

OGDEN ROCHELLE, News Editor

Cody Times, Cody, Wyoming

Five miles northeast of Heart Mountain, between Cody and Powell, Wyo., is Ralston Bench, latest and greatest of the success stories that make Shoshone project a land of romance, promise, and wealth.

Ralston Bench bloomed from virgin sod this year with three-quarters of a million dollars in cash crops from 108 farm units, averaging 114 irrigable acres.

As it happens, five of these farmers were on available units in the previous summer. Water was on the bench by mid-July 1948, too late for crop planting that year, but in time for some fall irrigation and fallow plowing to build a better 1949 season.

These tillers of the soil are solid citizens. Veterans of World War II, and lucky drawers of homesteads, their average net worth was $7,500 when they brought in their equipment, and 90 of them borrowed additional operating capital from the Farm Home Administration. Thus, they were enabled to invest more than a million in the first year's operations.

But, it is farm knack and know-how that really paid off. Seed peas, in most areas a specialty crop, were recommended by the Bureau of Reclamation. Five million pounds were marketed to Powell, and the homesteaders got adequate operating cash for them.

The story of Glenn A. Ball is typical. He is 23, a Marine veteran of World War II from Quincy, Ill. He was lucky enough to draw unit No. 182. He married Beverly then, a girl who had waited for him, and they were on the homestead in January. They had time to get in about 38 acres of seed peas and 34 acres of barley, with the help of Mr. and Mrs. Fred Ball, his parents. The cash returns will be well over $5,000, and 72 acres are yet to be farmed another year. Another 18 acres is nonirrigable pasture.

With $1,000 and their labor they have built, too, a fine farm home, making good use of the barracks from the nearby War Relocation Center, as have their neighbors on Ralston Bench. The kitchen is something that any city housewife might envy; the bedrooms are complete. Work is yet to be done in the other rooms, but with even better crops next year, the future looks good for young Mr. and Mrs. Ball of Ralston, Wyo.

Two tons of seed peas to the acre is considered good, but some do more. Robert Van Dyke's farm yielded an acerage of 4,590 pounds of seed peas on his 34 acres, or a total of 156,060 pounds, which brought him $6,242.40. Besides, he harvested 9,600 pounds of red clover seed from 24 acres. At 50 cents a pound, this added $4,800.00 to his income. To top the season off he averaged four tons of alfalfa hay to an acre for a total of 152 tons which, valued at $20.00 a ton, gives a total of $3,040.00. This gave Mr. Van Dyke a nice return of $14,082.40 on this year's crop on his Ralston homestead.

Lyle Baker is getting an average of 4,768 pounds of seed peas per acre off 28 acres, and Vachel W. Olson, who made news with bumper crops last year, is getting 4,183 pounds of seed peas on a 41-acre tract. B. L. Fulton's 20-acre tract runs about 4,426 pounds of seed peas to the acre.

Following the advice of the Wyoming Extension Service, the Bureau of Reclamation and other agencies has been an important factor in bumper production. Most settlers saw the wisdom of using plenty of fertilizer, of fall plowing, and fall irrigation. As a result, many older farmers on the older Shoshone project divisions are beginning to wonder how they can get the same per-acre value from their farms.

Ralston Bench was a dark uninhabited upland range, 2 years ago. Now, there are lights—the lights of farm kitchens at dusk, of cars shuttling around on the many good roads as farmers go to town or community meetings at nights.

The lighting now comes from farm plants, but by Christmas this year the bench expects to have electric power, generated by the Bureau of Reclamation and REA, delivered from the Garland Power Co. As this issue went to press, surveys were being completed, and the feeder lines were being constructed.

The settlers already plan a community center, for which the Bureau has furnished 5 acres of land. Near here, enterprising Farmer Harvey J. Adams has set up a community store.

Many of the farmers find time and opportunity to engage in side lines, often occupations in which they were formerly engaged. There is, for example, Charles A. Nunley, formerly of Oklahoma, who teaches on-the-job farm practices through the State veterans' program.

In fact, the settlers have developed a penchant for helping each other. When Mr. and Mrs. Jamie Hash were burned out of their home last spring, the Bureau gave them another barracks and the neighbors pitched in and helped rebuild their home. Prominent among the builders was Oscar House of Ralston, retired lumberman, whose labor has been made available, free, to many a homesteader in the construction of built-in kitchens and other carpentry.

House says he likes to help these veterans who were overseas fighting while he was back home making a living.

Actually, the crops aren't all peas, although that is considered best for the first year, solving the legume and cash-crop problems. Also, there is more acreage (5,060) in barley than seed peas (2,300), and 3,200 acres of alfalfa, 1,000 of clover, 85 in beans, 747 in oats, 310 in wheat, 350 in reseeded pasture, 100 in specialties like safflower, and 4,243 acres fallow.

These farmers have few farm animals now, but with greater working capital they plan to bring in dairy stock and pigs.

One of the advantages of the Ralston Bench settlement is that it is bounded ,north and south, by successful units already under the Shoshone project. It is a new agricultural development in an area where farming has been proved feasible and profitable.

What was, but 2 years ago, a bleak and arid sage brush bench, fit only for seasonal grazing, worth not more than $10 an acre, became with the completion of canals and ditches carrying Wyoming "liquid gold," virgin land with a value of $50 an acre. Then, with the arrival of the settler and the cultivation of the land the per acre value increased to $100 or more. A homestead of 114 acres in cultivation jumped in value from the arid land appraisal of $1,140 to the cultivated land value of $11,400 or more, with a corresponding increase in the taxable wealth of the State. By the same token, the productive capacity of the one time arid land increased under irrigation to many times its original productive potential in terms of number of cattle or sheep grazed, or produce grown.

The Bureau of Reclamation has once again, on this project, demonstrated the wisdom and feasibility of adding increased resources to the all-important national economy. Moreover, the hopeful young veterans on the Shoshone project are the recipients of these homesteads from a Nation grateful for the service rendered as members of the armed forces in World War II.

So, let the beacon lights in farm homes continue to glow brightly, and let the hearts and minds of the settlers enjoy the peaceful sanctuary of the abodes they built, and the se-

AT HOME ON THE BENCH—Top photo shows what can be done with a remodeled barracks building. Mr. and Mrs. Lyle Baker, formerly of Irvine, Calif., are justifiably proud of the modern panelled interior. Center photo is the attractive farm home which William M. Jackson, formerly at Greeley, Colo., made out of former barracks buildings occupied by Japanese evacuees during World War II. At bottom, Glen Ball and his wife, Beverly, enjoy a a spot of tea in their cozy kitchen, once part of the Heart Mountain Relocation Center. *Photos by John K. Black, settlement agriculturist of Region 6.*

TEN YEARS' PROGRESS IN ONE YEAR—Above is the raw land of the Heart Mountain Division, with which the Ralston Bench settlers, with proper cultivation, and wholehearted teamwork with Federal, State, county and local agencies and people, made the miracle of abundant production, with 100 percent of the land in crops after 1 year of intensive development. At upper right, Sidney C. Blair, formerly of Pawhuska, Okla., harvests a field of barley, and at right, can be seen Elwyn L. Thawley's farm with his specialty crop of seed peas. *Photos by John K. Black, settlement agriculturist of Region 6.*

curity of the soil they till. The once arid acres in America are being converted into productive havens to add to the health, wealth and happiness of veterans who, in the crucible of battle, earned the right to peaceful pursuits in a land of freedom and opportunity.

The increasing westward tide of population—an increase of 50 percent in the past few years in some sections of the West—is a constant challenge to the Nation to keep abreast of this demand for a home in the West. The crowded East is bulging at the seams and must look more and more to the West to absorb the overflow of industry and populations.

What can be done by new settlers on new land when water is provided for thirsty acres is clearly reflected in the accomplishments of the settlers under the guidance of Reclamation officials on Ralston Bench. THE END

Angostura Dam Power Contract

Officials of the Black Hills Power & Light Co. and the Bureau of Reclamation signed a contract on September 19, 1950, for the sale of approximately 12,000,000 kilowatt-hours of power to the company annually, based on maximum water conditions.

The power will be generated at the Angostura Dam power plant, in South Dakota, a 1,200-kilowatt unit now under construction which is scheduled for completion by July 1951 at which time it is hoped power delivery can begin.

The contract calls for the company's purchase of the entire output of the plant to assist in providing electricity for approximately 50 communities, cooperatives, industrial, and domestic consumers along its system. The rates for the power will be generally in accordance with the rate being charged by the main stem plants on the Missouri River basin.

Power will be available from the dam only at such times as water is released for irrigation and other purposes. Thus, the output of the plant must be integrated with a system providing firm power. In general, the Angostura plant will help the company to give the public more and better power service at times of peak demand. The contract, which was drawn up and executed well in advance of the availability of power, is typical of arrangements made by the Bureau of Reclamation to make electric energy, produced as part of its multiple-purpose water-conservation program, available to the public as rapidly, efficiently, and inexpensively as possible. •

Grand Valley Rescue Job Nearing End

The last chapter of the sensational Grand Valley rescue (see RECLAMATION ERA, June 1950) is now being written. When the 36-year-old Grand Valley tunnel collapsed last March, it attracted the attention of the Nation. Particularly concerned were the farmers in the area who stood to lose more than a million and one-third dollars in crops if repairs could not be made in record-breaking time.

July 1 was the deadline set for this feat if water were to reach the farms in time to save the crops. An army of steel-helmeted drillers and muckers, battling 'round the clock in a miniature, domestic, Korealike operation, scored the victory and "holed through" shortly after midnight on April 27, saving the crops, well ahead of schedule.

The Kemper Construction Co. of Los Angeles won the contract for putting the finishing touches on the tunnel job which involved lining the 2,240-foot-long, 12-foot-high horseshoe-shaped tunnel. Special provisions are included in this particular contract which guarantee the continued delivery of water to the lands during the irrigation season which normally extends from March 20 to October 30 each year. •

TODAY—DELAY and DANGER. TOMORROW—PROTECTION and PRODUCTION. *Photo by Fred Finch, Region 5 photographer.*

Wintertime At Platoro

THE CONTRACTOR'S CAMP at Platoro dam site of the San Luis Valley project in Colorado, will undoubtedly look like this by mid-December if last year's cold weather and snow are any indicator of things to come. The snow will spell the cessation of all activities on the dam, about 50 percent complete, for an estimated period of 5 months and will also constitute a possible flood menace to the lands in the area. However, once the dam is completed, not only will the flood menace be removed but life-giving water will be stored for the thirsty acres in this section of the San Luis Valley project.

As this issue went to press the contractor's crew was busy drilling out the cavities in the dam foundation until they were smooth enough for grouting or filling with fine cement—a mammoth dentistry operation which also required capping or covering the fillings with cement—called a "grout cap"—to prevent water losses. Draglines were carving the spillway, spillway bridge, and crest wall; bulldozers were stripping back or clearing all loose rock formations in the dam foundation, and huge trucks were moving earth to be placed in the four sections of the dam. In addition, other truck crews were busy hauling riprap or tons of rock to be placed in the dike section which will serve as a bulwark at the side of the main structure.

All of this will stop once Old Man Winter moves in, but another winter and spring should see the structure finished. It is scheduled for completion in 1952. ●

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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)

Investigating HELLS CANYON

by
RAYMOND G. LEONARD, Information Specialist
Region 1, Boise, Idaho

THIS TREACHEROUS GORGE is one of the last remaining great damsites in the United States. Today, the vacuumlike gap, deeper than the Grand Canyon, is a menace to mankind, but in spite of the hazards, Bureau of Reclamation engineers calmly take topography for a proposed project. *Photo by Phil Merritt, Region 1 photographer.*

When Congress appropriates money for "investigations," the word itself may sound very prosaic and commonplace. The actual work, however, is often far from that. Take the Hells Canyon investigations, for example.

If the early pioneers who came West and saw the spectacular Snake River Gorge were on earth today and heard about the Bureau of Reclamation's plan to build Hells Canyon Dam, no doubt they would sadly shake their heads and mutter, "Fools rush in where wise men fear to tread."

For the deepest chasm in America gave them a rough time. It thwarted an attempt by Lewis and Clark to pass through its turbulent and churning water. The John Jacob Astor expedition lost three men, and a fourth went mad trying to ride the rough Snake through this gorge. The rest of the party were at death's door before they managed to stagger out of the abyss.

No wonder even our hardy forefathers, upon seeing this playground of Satan for the first time, decided it was a one-way ticket to the hereafter instead of a passage to the green valleys of Oregon. They avoided it like a plague.

The Bureau of Reclamation, however, in spite of the past record of the canyon, is investigating the possibilities of building a dam that is worthy of all the Hollywood-type adjectives imaginable. The height of this concrete giant would be a lofty 742 feet, or the equivalent of a 70-story building. It would be situated in one of the few remaining primitive areas in the United States—a region of breath-taking ruggedness.

Each abutment would touch the base of part of a mountain range in a different State—the Seven Devils of Idaho and the Wallowas in Oregon. It is one of the greatest remaining dam sites on the North American continent. To top it all off, the undertaking would rank as one of the greatest engineering feats since the Bureau entered the dam-building business in 1902.

The huge development would make available 900,000 kilowatts of hydroelectric energy to a power-hungry Pacific Northwest, where industrial expansion is stifled by lack of generating capacity. Besides power, the dam would provide flood control and aid navigation of the lower Columbia and Snake Rivers. It would also provide financial assistance to future irrigation developments in the region.

Last summer, the Bureau sent a seven-man survey party into the Hells Canyon area to survey possible routes for access roads, and to make a reconnaissance study necessary for the preparation of a planning report in connection with legislation to authorize construction of the project.

At present, the only way into this region of primitive beauty and desolation, unsullied by bill boards, hamburger stands, and filling stations, is over a so-called one-way road to Eagle Bar on the Idaho side of the canyon, sixteen miles downstream from Homestead, Oreg. This road, strewn with boulders, basalt fragments and full of chuck holes, is a rugged route to travel even for the most experienced driver, and few cars escape damage.

Building access roads down precipitous grades and along the sheer canyon sides would be the first big job the Bureau would have to tackle before starting actual construction on the dam.

The Hells Canyon surveyors suffered all the discomforts not found at home as they worked along the slopes or on the rim of the canyon, thousands of feet above the river. Mother Nature keeps the gorge mighty warm during the summer months, the average peak temperature being 102 degrees. Some days it is not uncommon for the mercury to soar to a blistering 117°.

Transportation on the job was by horseback or foot. Both men and animals found climbing along the rocky and narrow ledges on the canyon wall a gruelling ordeal. The horses developed ugly, running saddle sores, because saddles constantly shift back and forth as the animals make their way over the rocks without trails.

Mountain goats had nothing on the surveyors when it came to scaling the sides of the canyon. In places the rim of the chasm is several thousand feet above the river. A fall is certain death. When working along these precipitous slopes, the men often raised and lowered their instruments by rope.

Not only is surveying in Hells Canyon dangerous to life and limb, but it is equally severe on clothing and shoes. Most footwear must be replaced every 10 days.

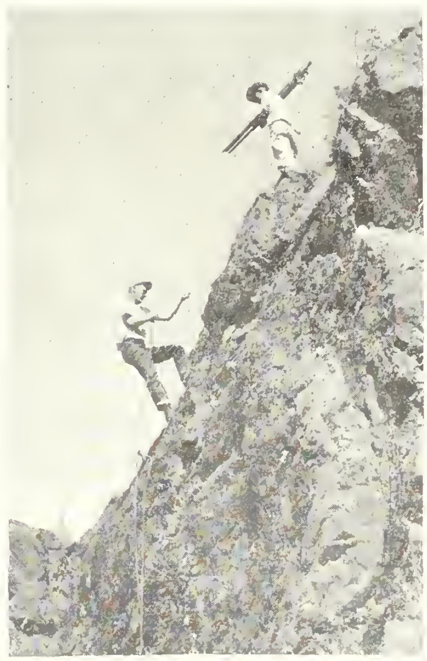
Lurking rattlesnakes were an ever-present danger. Nineteen have been killed to date and the crews saw dozens of others. Then there was always the poisoned oak which is unusually prevalent throughout the area.

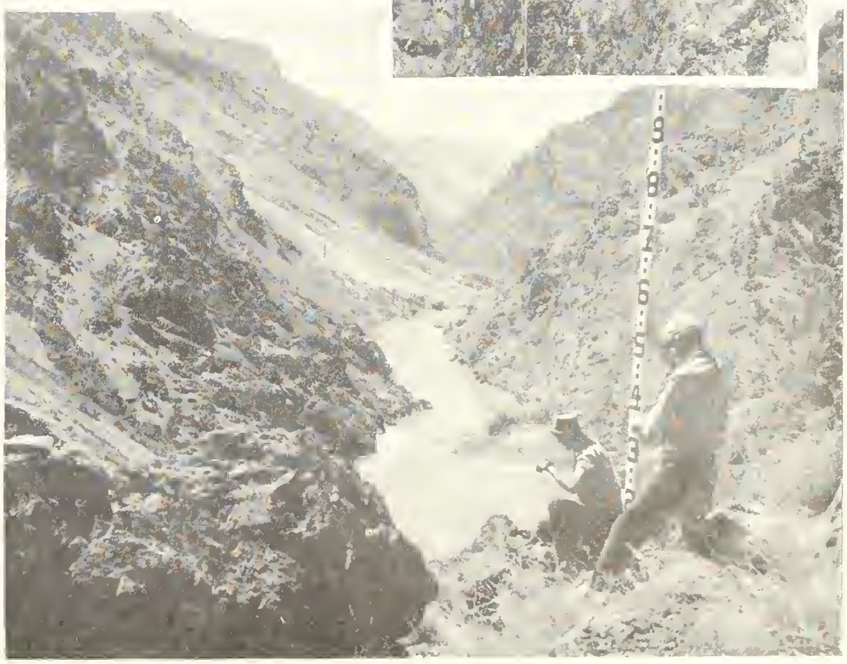
During off-hours the surveyors fished for sturgeon in the Snake River. The largest catch was a 200-pounder. On real hot days the men took to the river to keep cool. The party slept in sleeping bags and cooked its own meals. All supplies were brought in by horse or boat.

The first casualty has already been chalked up to Hells Canyon. On July 31, Photographer Phil Merritt of the Bureau's Regional office in Boise was pinned to the canyon wall by a one-half yard rock while on a photo assignment. Merritt would have been the first fatality had he been alone, but fortunately the surveyors were on the scene to lift the rock off him. Luckily, there were no bones broken. Phil escaped with a few bruised muscles in his right knee.

If built, Hells Canyon Dam would resemble Hoover Dam. A concrete arch-gravity type structure is contemplated, with a maximum base thickness of 674 feet, tapering to 45 feet at

NO WORK FOR A SISSY. At right, Ted Sather lawers himself dawn the precipitaus canyan wall by rape, as Dean Ellis, with survey instruments, laaks an calmly. Belaw, a slip far these twa men, at the axis af the proposed dam, would mean a plunge af several thousand feet to the flaar af the canyan. Belaw, at left, Lynn Brown and Dean Ellis try to figure aut a gaad place far a road. Scaling and descending the heights, plus the excruciating heat, really make this a man's job. *Photo directly below by Phil Merritt, others by Stanley Rasmussen, both Region 1 photographers.*





ON TOP OF THE WORLD! At extreme left, Regional Director H. T. Nelson, Ivan Tuescher, survey party chief, and Francis Hart, planning engineer, ponder possible locations for access roads.

AT THE BOTTOM OF HELLS CANYON surveyors make their weary way by boat. *Photo at left by Stanley Rasmussen, at right by Phil Merritt, both Region 1 photographers.*

the crest. The roadway across the top would be 1,740 feet long and the elevation of the crest would be 2,082 feet above sea level. The structure, third largest in the world, would contain 6,200,000 cubic yards of concrete.

Construction would take 6 to 7 years. At the peak of activity 5,000 to 6,000 men would be employed.

The multiple-purpose project would cost the Government approximately $333,000,000. This entire amount, including interest, would be paid back to the Federal Treasury through the sale of power.

The dam would also save thousands of dollars in flood damages to the lower Snake River and Columbia River areas by impounding spring run-off in its 4,400,000 acre-feet reservoir. Furthermore, the structure would also be a boon to navigation. It would increase channel depths in the lower Snake and lower Columbia Rivers during the low flood periods.

Irrigation would not be one of the benefits from the dam, but revenues would help make economically feasible future irrigation developments in the Upper Snake Basin and other parts of the Pacific Northwest which otherwise could not be constructed.

Situated as it is in one of the most isolated spots in the country, which never before has been available to the general public, the dam should prove to be a tourist attraction capable of luring half a million visitors a year to the canyon rim, with resultant benefits to business in the neighboring Idaho and Oregon towns and in the Pacific Northwest.

Congress has not yet authorized the project, but if and when it does, many similar investigations by reclamation engineers will provide the necessary data to help pave the way for the Bureau of Reclamation to add still another masterpiece to its long list of spectacular engineering achievements.

THE END

POUNDS OF COMPENSATION—100 pounds, to be exact, in this sturgeon caught by Bob Bond. For recreation at day's end, Bureau engineers swim in the Snake River or fish for wild denizens of the deep like this one. LUCKY FIND was a pioneer miner's cabin (below) handy to water—a "must" for the roving surveyors. SURE-FOOTED STEEDS are essential in Hells Canyon. At right, Ivan Tuescher talks over the day's work with Lynn Brown. *Photos by Stanley Rasmussen, Region 1 photographer.*

SUPERIOR COURTLAND DIVERSION DAM. *Bureau of Reclamation photo by R. L. Boyce taken from a spot looking south from top of north structure*

SUPERIOR-COURTLAND DEDICATION

A "MILLION-DOLLAR-DAM" WAS DEDICATED in Nebraska, on August 17, 1950, a little more than a year from the date it was begun.

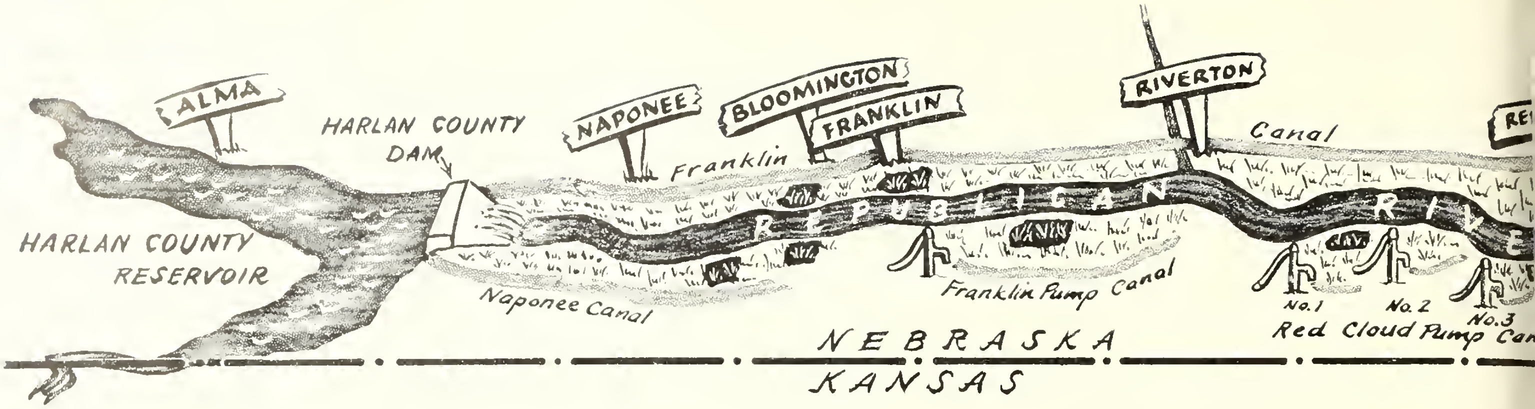
The Superior-Courtland diversion dam, 3 miles west of Guide Rock, Nebr., one of the three diversion dams in the Bostwick unit of the Missouri River Basin project (the other two are Scandia and Republican), became the focal point for about 3,000 people on the day of the dedication. Nebraska's Governor Val Peterson; United States Senator Hugh Butler; United States Representative Carl T. Curtis; the Bureau of Reclamation's Regional Director from Denver, Colo., Avery A. Batson; District Manager H. E. Robinson; chief engineer for the Bostwick unit, Paul Strause; Nat Tolman, irrigation superintendent, and many other important personages, including Miss Republican Valley, Kilie Sprage of Red Cloud, Nebr., gathered to celebrate the virtual completion of the structure. Construction started on June 22, 1949, and the official completion date was September 15, 1950. (See page 105, May 1949 RECLAMATION ERA for story of the Bostwick unit.)

In addressing the crowd during the dedication ceremonies, Regional Director Batson urged wise use and conservation of the water resources and facilities made available through the Missouri River Basin plan, and said, "For the past 5 years several agencies of your Federal Government, many agencies of the State and local governments within the basin, and numerous local organizations and individuals have been engaged in refining the plans and in the actual construction of this vast Missouri Basin project dedicated to the purpose of the conservation, control and beneficial use of the water resources of that basin.

"The Missouri River Basin is a huge inland empire more than 1,500 miles long and 700 miles wide. It constitutes one-sixth of the area of the whole United States. Within this empire is all of Nebraska and portions of nine other States, including your neighbors of Kansas, Colorado, Iowa, Wyoming, Montana, North and South Dakota, Missouri, and Minnesota. The basin extends from the top of the snow-capped Rocky Mountains in the west to the flat plains in the east and from the Canadian border on the north to the divide of the Arkansas River to the south. In between are found isolated tracts of bad lands, the sand hills of Nebraska, the flat prairie of the Dakotas, a lonesome mountain range or two such as the Black Hills, thousands of square miles of rolling hills, and eroded buttes and the many valleys of meandering streams that constitute the waterways of the Missouri River system.

"These lands are used for range for cattle and sheep in the west, for highly developed diversified farms in the east, and hazardous dry-land farms in between. Nestled in the valleys of the basin are millions of acres of intensely cultivated irrigated farms of great productivity. Under these lands, particularly near the boundaries of the basin, lie vast deposits of minerals of great economic value to the region and to the Nation; some of which, though of low grade but of high strategic value, have not been found elsewhere.

"This is some of the land that in 1803 became a part of the United States through the Louisiana Purchase. President



Bostwick Unit

Thomas Jefferson negotiated that purchase with the French Government for a price of about 27 million dollars or about 4 cents an acre. Of those millions of acres of virgin wilderness of that time over one-half million square miles, or about one-third billion acres, are within the Missouri River Basin. Some people of the time were convinced that President Jefferson had lost his mind, or something, for purchasing a worthless wilderness for any price. That 4-cents-an-acre land which he added to the United States was destined to contribute beyond measure to the economic growth and wealth of the young Nation. Within the span of a century, a wilderness became a land of great productivity, gaining for itself a recognized place as the Nation's pantry. But its vast total potential has not nearly been reached.

"The basin is cursed by the vagaries of the weather—the winter blizzards, the summer droughts, and the unpredictable storms of great intensity which produce destructive floods. When we use the water that falls on the basin to realize the full productive potentials of our fertile land; when we control that valuable water so intelligently that none wastes to the sea; when we develop our minerals on a sustained basis to add their value to the economic wealth of the Nation, then and only then can we say we are realizing the full value of that purchase. Then and only then can we claim to be worthy sons of brave fathers who toiled and died to settle this land.

"Much work has been done in the Missouri River Basin in these past 5 years. Much more work remains to be done. The work that most of you people in the Republican Valley have seen at Enders, Medicine Creek, Bonny, Trenton, Cambridge, Harlan County, and here near Guide Rock is repeated in greater or lesser intensity in every valley of the basin. Even more spectacular work is under way by the Corps of Engineers on the main stem of the old Missouri. But when dams are built, canals are finished, and power plants are installed, the job is not done. The job is not done until you and the people of the whole Missouri Basin use intelligently the products of these physical works—the water stored in the reservoirs and the electricity on the line.

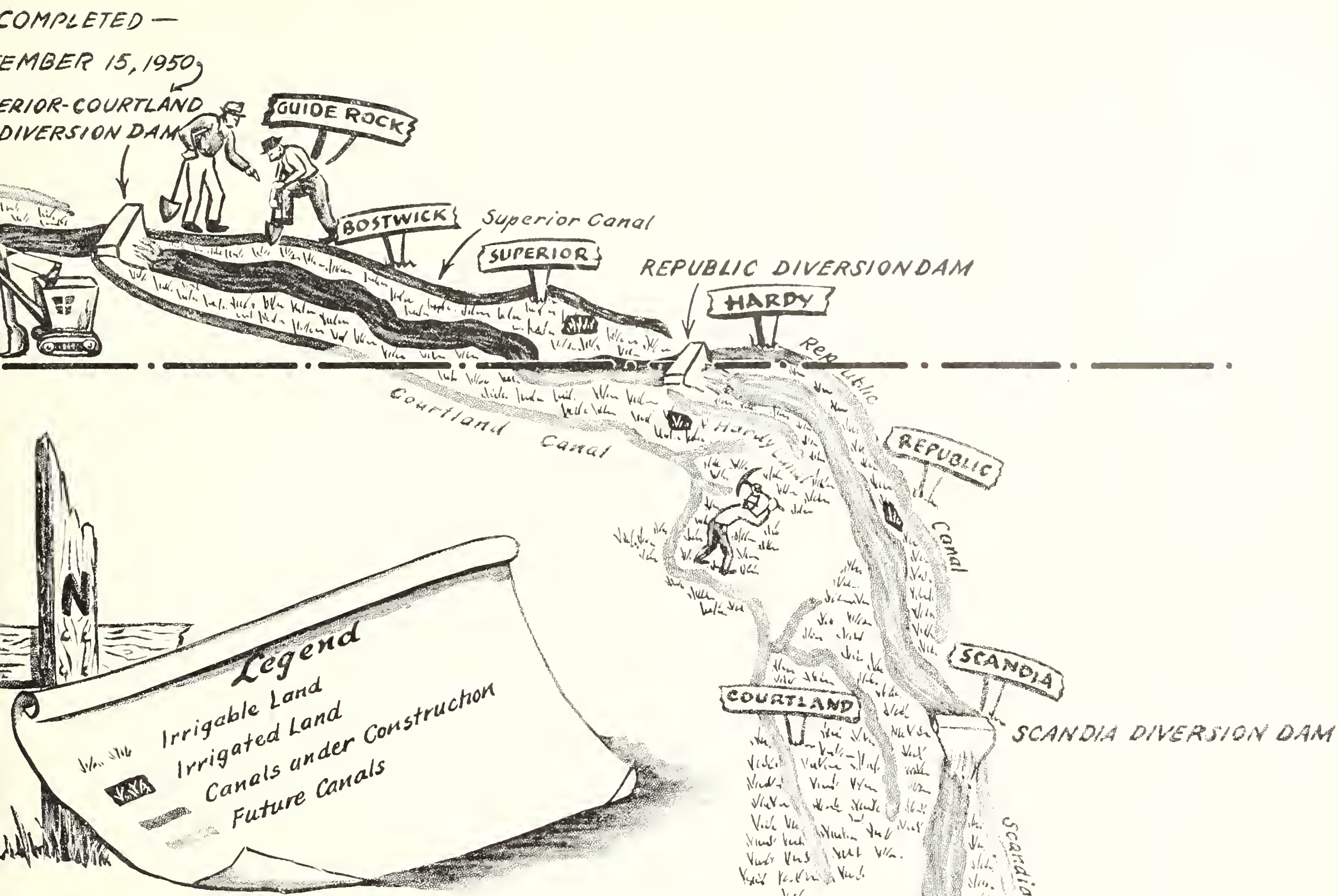
"This Superior-Courtland diversion dam, which we dedicate today in its relationships, is a good small-scale example or the coordinated program for the development of the water resources of the Missouri River Basin.

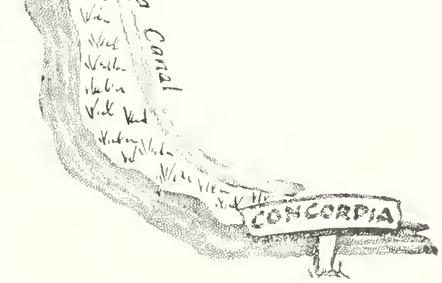
"Harlan County Reservoir will store the destructive flood flows of the Republican River to prevent flood damages as far down the valley as Kansas City. Other upstream developments will protect the upper valley. Harlan County Reservoir will store the flows of the Republican until it is needed to water the crops on your lands. Harlan County Reservoir will provide recreational opportunities of a type not found in this part of the country. It will provide good fishing and attractive environment for both fish and wildlife.

"But Harlan County Reservoir is an integral part of the whole system of river control on the Republican River. Our operation studies show that operating all the reservoirs on the river as a system will regulate the erratic flow of the river better than by operating each reservoir as a separate unit. Hence, we conclude that water for your lands may not be stored exclusively in Harlan County. It is conceivable that such water for use here may be stored in reservoirs of the system as far west as Bonny Reservoir in Colorado.

"When water is needed on your lands, it will be released from the system and diverted into the main canals by this Superior-Courtland diversion dam. It will flow through the canals to the laterals, and be released from the laterals to your farm ditches in amounts to satisfy your needs. A drainage system will be constructed to carry away all excess amounts of water over and above your needs We hope you will keep such excess at an absolute minimum through efficient irrigation on your lands.

"Now those are the physical works and those are the proposed methods of operation. Those works have been designed for permanency and to serve you well. All have





been completed, or are under construction, or contracts are about to be let. The proof of a great portion of their value rests in your hands. That value will be great if you use that water and your land wisely. Our studies indicate you can triple your production on each acre of your land. The value of that production average per acre on the basis of 1939–44 prices was $13. It can be, on the same price base, $33.

"To attain those increased values you must modify your methods of farming and diversify your operations. You will raise and fatten more livestock. You will irrigate every year, year after year, according to good irrigation-farming practices, which is a specialized type of operation. You will not use stored water to supplement rainfall deficiencies on dry-land crops. If you follow those approved practices, the memory of the misery and droughts of the 1930's will remain memories.

"Prices may fluctuate. But no man is poor or hungry who has many fat cattle, adequate supplies of feed, good land, and plenty of water.

"This job will not be easy. Good things do not come easy. Irrigation is hard work, but it pays off. You must learn new ways of farming. We will help you every way we can. Your agricultural agent, your soil-conservation districts, and your State agricultural college can help you most. I am sure they are ready, willing, and able to do so.

"It is not beyond speculation that you people of the Republican Valley will be called upon again to produce food for war. During World War II, we were fortunate in enjoying during the war years an unusual cycle of adequate rainfall and our crops were bountiful everywhere. We have no assurance that the cycle will be repeated. This development built for your use is a hedge for that bet.

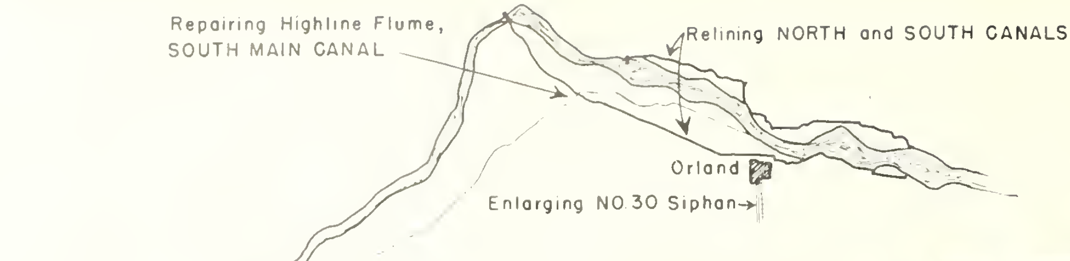
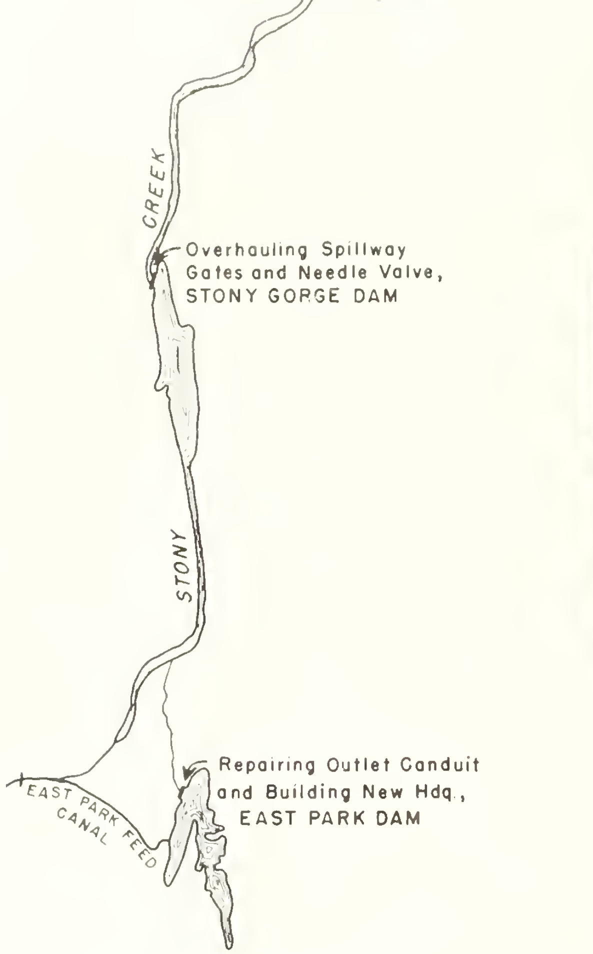
"Irrigation means stability—stability of income year after year, both on the farm and in the communities.

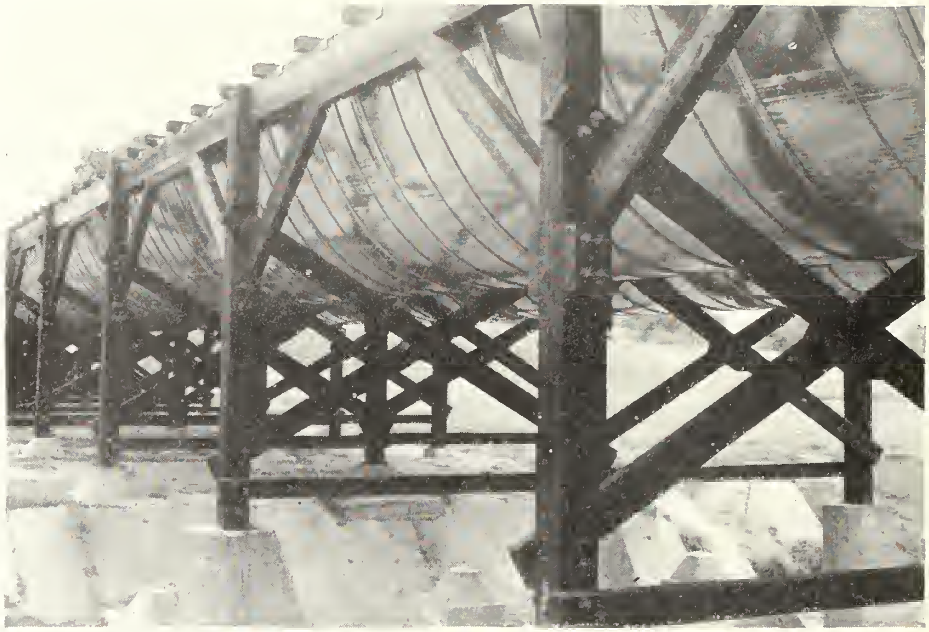
"Experience elsewhere has demonstrated that irrigation can and does build prosperous communities. Prosperity assures security. Both are essential to democratic way of life.

"Prosperous living, abundant living, joyful living is not a good breeding ground for communism. Few "isms" flourish in lands of plenty.

"Today, in dedicating the Superior-Courtland diversion dam to the service of the people, let us devote ourselves to the best use of these facilities to increase our production of needed crops to keep our Nation strong in peace and war."

THE END.



ACCENT ON BETTERMENT typified the rehabilitation and betterment work at the Orland project in California. Above, the rebuilt Highline Flume, complete with new timber supports and concrete footings, plus an expanded capacity. Major features of the rehabilitation program are located on the simplified map at right and above. Drawing by the Bureau's Graphics Section in Washington, D. C.

ORLAND'S NEW LOOK

by

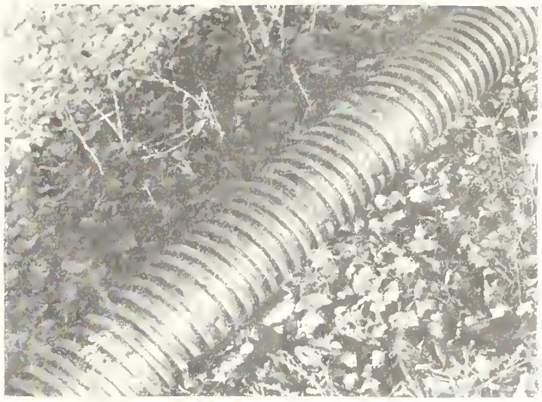
MARSHALL YOUNG, Chief, Irrigation Operations Section
Sacramento Valley District, Chico, Calif.
Region 2 (headquarters at Sacramento, Calif.)

California's Orland project looks younger every day.

Recent renovations have actually improved its appearance and usefulness, and a 3-year improvement campaign promises to increase the amount of water available to the irrigation farmers who belong to the Orland Unit Water Users Association, and who have taken advantage of the Bureau of Reclamation's current Rehabilitation and Betterment program, authorized under Public Laws 335 and 451. (See p. 239 of this issue for complete text.)

Orland, the oldest Bureau of Reclamation project in California, was one of the few to receive consideration from the Government as early as 1902, when the Reclamation Service (now the Bureau of Reclamation) began investigations in the Sacramento Valley soon after the Service was established. J. C. Clausen of the Service submitted a report in 1903 involving 40,000 to 50,000 acres located on Stony Creek on the west side of the Sacramento Valley close to the town of Orland. Without encouragement from the Reclamation Service, a committee of citizens took the initiative in getting a Reclamation project started. They obtained signatures to a petition which they presented to the Secretary of the Interior in May 1906 stating that they were willing to comply with the Reclamation Act, and asking for an irrigation development. An engineering board was appointed which presented a detailed feasibility report in November 1906 recommending the building of a dam at the East Park site. The Secretary of the Interior authorized the project on October 5, 1907, construction began on August 27, 1908, and the first water was available during the season of 1910. Later, other features were constructed. Water is now stored in two reservoirs, the East Park Reservoir, located on little Stony Creek about 40 miles southwest of Orland, and the Stony Gorge Reservoir, on Stony Creek about 4.5 miles west of Fruto, Calif. The map on this page shows the various features of the project.

Orland was opened to the public in 1916, and has been serv-



SAND-BLASTING the autlet tube at East Park Dam, abave, preparatary to painting an July 19, 1949. DANGEROUS GATE STEM af Stony Garge Dam, center phata, shaws the braken screw threads which made it hazardous to aperate the gate even partly, and absalutely impossible ta aperate it fully. FROZEN ROLLERS at left, fram the Stany Garge spillway coaster gate, shaw the rigidity af the raller train caused by carrosion and lack af clearance an pins.

icing 20,000 acres of land for the past 34 years. During that time the farmers grew alfalfa, small fruit, citrus fruit, nuts, olives, and Ladino clover. They pastured their livestock, fed them on irrigated pasture and feed, and developed a thriving dairy industry.

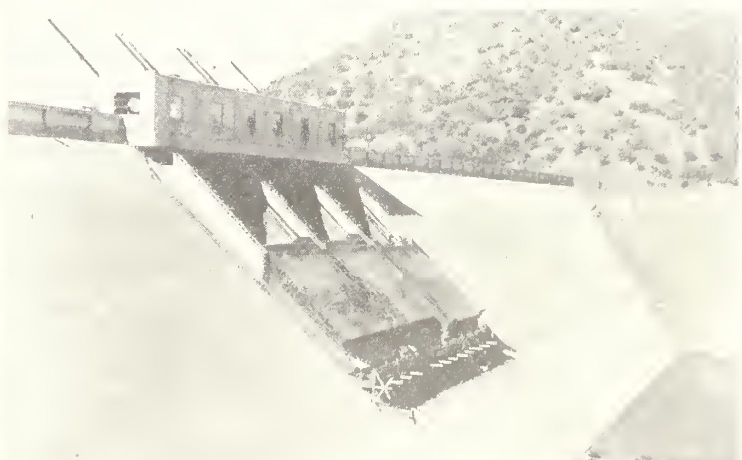
After 30-odd years, however, even the best of spillways, gate structures, canals, flumes, siphons, and laterals begin to show their age. During the depression years, the Orland farmers, along with many other farmers throughout the country, considered themselves lucky if they could raise and market a crop without taking a loss, let alone investing time and money in repairing or renovating worn-out structures. As soon as they got on their feet again, financially speaking, along came World War II, with a shortage of labor, supplies, and material, keeping maintenance activities down to the minimum.

Orland was not alone in this situation. The Commissioner of Reclamation realized that many of the older projects were in dire need of repair, even overhauling in some instances, and in 1946 ordered a survey of all the projects built by the Bureau, including those turned over to the water users.

At the time the Orland project was built, simplicity of design and established practice led to the predominate use of wooden structures in irrigation systems.

Members of the 1946 survey party saw many unsatisfactory and unsafe conditions within the Orland project, and as their survey was of a cursory nature, they recommended a more thorough study of this particular 34-year-old project. When the fine-tooth comb survey was completed, the estimate for work necessary to rehabilitate the project was so high that the water users could not raise enough money to pay for it themselves.

STONY GORGE SPILLWAY—frant and back. Belaw an afficial inspectian graup checking up an the impraved gate aperatian at Stany Garge in May 1950. Fram left ta right, W. M. Biggs, Regianal Branch af Design and Canstructian, Sacramenta, Calif.; Marshall Yaung, chief, Irrigatian Operatians Sectians, Sacramenta Valley District, Chica, Calif.; Smith A. Ketchum, Regianal Branch af Design and Canstructian, Sacramenta; R. W. Hallis, watermaster, Orland praject; G. R. Carrall, Regianal Branch af Operatian and Maintenance, Sacramenta; J. Manrae, vice president, Orland Water Users Assaciatian; F. Laurenca, member af baard, Orland Water Users Assaciatian; C. W. Lemley, reservair superintendent, Stany Garge Dam, Orland praject; and L. H. Kristaf, Regianal Branch af Design and Canstructian, Sacramenta. At lawer right, the ather side af the dam, when the spillway gates were being averhauled and impraved in Navember 1948.



Because so much of the work had to be done without delay on the Orland, as well as other projects which had been similarly surveyed, the Bureau inaugurated a rehabilitation and betterment program (see RECLAMATION ERA, p. 179, August 1949 and p. 28, February 1950), under which the Orland project and other projects in need of rehabilitation could finance the necessary work on a deferred payment plan, in accordance with their ability to repay their obligations.

At Orland, the most dangerous situations had to be corrected first. The three spillway gates at Stony Gorge Dam were in bad shape. They had to be forced open with brute force and a gasoline motor. When the gate-tender wanted to close them, they "froze" open until they could be forced down again. When he wanted to open them, they stuck closed. Needless to say, this did not make it easy to store water or control the releases over the spillway. The rollers between which the gates slid up and down were badly corroded. In addition, the gate stem on the north spillway gate was almost useless. The threads were badly worn. As if that were not enough, at the beginning of the 1948 storage season, the gate-tender had so much trouble moving the other two spillway gates that the shear pins in the main power shaft of the gate control were snapped off.

At first, the Orland water users planned to overhaul one gate each irrigation season, but, when the shear pins snapped, they contracted for a complete overhaul of all three gates. The workmen removed the damaged gate stem, installed a new one, overhauled the gates, removed the roller trains, ground the rollers, repaired the gate guides, and put everything back in place again.

To pry the 30- by 30-foot north gate open, they installed two steel hairpinlike hangers under the dam walkway, looped a double sling of cable through them, and hitched it to a double set of cable blocks fastened to each of the upper corners of the gate. They disconnected the two gate stems and the overhead cables kept the gate from sliding down the sloping wall of the dam. Each time the gate was raised a foot or two, they tightened the cable until jacks and timber supports could be put in place for a further lift.

When the rollers and the roller trains were hauled out for inspection, the workmen were surprised to discover that, although the mechanism was frozen solid, and the rollers had not rotated for an unknown number of years, they were not flattened or damaged. Consequently, the Orland water users were able to save the cost of turning down the rollers, as provided in the contract. Instead, they arranged to have an extra work order made out to turn and groove the $1\frac{1}{4}$-inch bronze pins, which serve as axles for the rollers, and connecting cotter pins for the roller train. Once this was done, the rollers turned again, and when everything was reinstalled, the spillway gates at Stony Gorge worked more smoothly than ever before in the history of the project. A dangerous nerve-racking condition which might have eventually caused severe damage to the 22-year-old structure, as well as human lives and property below the dam, had been corrected.

The old Highline Flume of the South Main Canal which had been in service on the project since its completion in 1916 was also given priority. This 306-foot, double channeled, metal flume was supported on timber footings which were rapidly rotting away, threatening to flood the surrounding lands and cause great water losses.

Replacing the flume also brought about an improvement. Previously, the maximum amount of water which the flume had been able to carry was 250 cubic feet per second. In addition to replacing the rotting 8- by 8-inch wooden sup-

ROTTING TIMBERS (at left) typical of the condition of 30-year-old wooden structures on the Orland project in February 1949 before the reconstruction program started. Below, reconstructing the Highline Flume, a job which resulted in better water service and averted the threat of collapse.

ports with new wooden trestles, and supplying new concrete footings, the structure was redesigned so the capacity of the flume was enlarged to about 290 cubic feet per second. The new structure means water security for two-thirds of the project and should pay for itself many times over.

The Orland project's rehabilitation program among other items also included repairing the needle valve at Stony Gorge, sandblasting the outlet conduit at East Park Dam, and enlarging the No. 30 siphon under the Southern Pacific Railroad main line tracks, under Highway 99-W and an adjacent secondary road one-half mile south of Orland. This improvement will provide a supplementary supply of irrigation water to 1,400 acres which in the past had suffered from insufficient water. This work, too, will more than repay the cost of construction.

Future rehabilitation work will consist of constructing a new residence and headquarters building at East Park Dam, replacing a small dwelling more than 50 years old, constructing sluicing control facilities at Rainbow Dam (shown on map at extreme lower left—formerly called East Park Feed Canal Diversion Dam), partial drainage control of the project lands by development of wells and pumps, and repair and replacement of lining in the North and South Main Canals. This last item will prove to be the most costly single feature of the rehabilitation work; but when completed it will remove a serious bottleneck of one-fourth mile in the upper North Canal, and two smaller bottlenecks in the South Main Canal.

Cost of the 3-year program will amount to $250,000 and will be repaid by the water users at the rate of 67 cents per acre annually for 20 years. At the conclusion of the 20-year repayment period, the construction charges also will have been paid up, and the Orland project will be turned over to the water users. In all of the proceedings, the Sacramento Valley District Office at Chico, representing the Bureau, had the complete cooperation of the Orland Unit Water Users Association. In addition to being in complete agreement with Bureau engineers, water users offered proposals which have been carried out to the benefit of the project.

Through an investment of $250,000 the Orland project, which cost $2,410,000 originally, will have been brought up to proper operation standards, and a water distributing capacity greater than the original installation. THE END

[PUBLIC LAW 335—81ST CONGRESS]

[CHAPTER 650—1ST SESSION]

(H. R. 1694)

AN ACT

To provide for the return of rehabilitation and betterment costs of Federal reclamation projects

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That expenditures of funds hereafter specifically appropriated for rehabilitation and betterment of irrigation systems on projects governed by the Federal reclamation laws (Act of June 17, 1902, 32 Stat. 388, and Acts amendatory thereof or supplementary thereto) shall be made only after the organizations concerned shall have obligated themselves for the return thereof in installments fixed in accordance with their ability to pay, as determined by the Secretary of the Interior in the light of their outstanding repayment obligations, and which shall, to the fullest practicable extent, be scheduled for return with their construction charge installments or otherwise scheduled as he shall determine. No such determination of the Secretary of the Interior shall become effective until the expiration of sixty days after it has been submitted to the Committee on Interior and Insular Affairs of the Senate and the Committee on Public Lands of the House of Representatives. The term "rehabilitation and betterment", as used in this Act, shall mean maintenance, including replacements, which cannot be financed currently, as otherwise contemplated by the Federal reclamation laws in the case of operation and maintenance costs, but shall not include construction, the costs of which are returnable, in whole or in part, through "construction charges" as that term is defined in section 2 (d) of the Reclamation Project Act of 1939 (53 Stat. 1187). Such rehabilitation and betterment work may be performed by contract, by force-account, or, notwithstanding any other law and subject only to such reasonable terms and conditions as the Secretary of the Interior shall deem appropriate for the protection of the United States, by contract entered into with the organization concerned whereby such organization shall perform such work.

SEC. 2. This Act shall be deemed a supplement to the Federal reclamation laws.

Approved October 7, 1949.

[PUBLIC LAW 451—81ST CONGRESS]

[CHAPTER 47—2D SESSION]

(H. R. 7220)

AN ACT

To expedite the rehabilitation of Federal reclamation projects in certain cases

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the second sentence of the Act entitled "An Act to provide for the return of rehabilitation and betterment costs of Federal reclamation projects", approved October 7, 1949, is amended by striking out the following: "except that, any such determination may become effective prior to the expiration of such sixty days in any case in which each such committee approves an earlier date and notifies the Secretary, in writing, of such approval: *Provided*, That when Congress is not in session the Secretary's determination, if accompanied by a finding by the Secretary that substantial hardship to the water users concerned or substantial further injury to the project works will result, shall become effective when the chairman and ranking minority member of each such committee shall file with the Secretary their written approval of said findings."

Approved March 3, 1950.

The Rehabilitation and Betterment Program

Program item	Total estimated cost	Cost to June 30, 1950	Fiscal year	
			1951	1952
Arizona-Salt River project	$6,000,000	$398,278	$1,445,998	$1,000,000
Arizona-Yuma project	6,500,000		200,000	325,000
California-Orland project	250,000	134,868	115,132	
Colorado-Grand Valley project	1,900,000	672,353	621,197	256,262
Colorado-Uncompahgre project	233,000			
Idaho-Boise project	300,000			45,000
Idaho-Minidoka project	43,000			
Montana-Bitter Root project	37,928	37,928		
Montana-Milk River project	660,000	106,615	148,250	125,000
Montana-Sun River project	100,000	13,574	34,000	25,000
Nebraska-Wyoming-North Platte project	8,175,000	454,258	506,000	359,500
Nevada-Newlands project	431,000			
New Mexico-Texas-Rio Grande project	4,025,000		50,000	900,000
Oregon-Idaho-Owyhee project	200,000			36,000
Oregon-Vale project	50,000	23,422	26,578	
South Dakota-Belle Fourche project	373,000	119,331	125,669	102,807
Utah-Moon Lake project	88,000			
Utah-Sanpete project	75,000			
Utah-Weber River project	95,000			
Washington-Okanogan project	25,000		21,000	4,000
Washington-Yakima project	846,000	529,750	48,674	223,431
Wyoming-Riverton project	1,950,000	303,500	535,486	634,000
Wyoming-Shoshone project	395,000	102,355	228,645	64,000
Additional projects	6,700,000			
Total obligations	39,451,928	2,887,242	4,106,629	4,100,000
Prior years unobligated balance			1,106,629	
Appropriated			3,000,000	
Allotment requirements				4,100,000

O & M Meets at El Paso

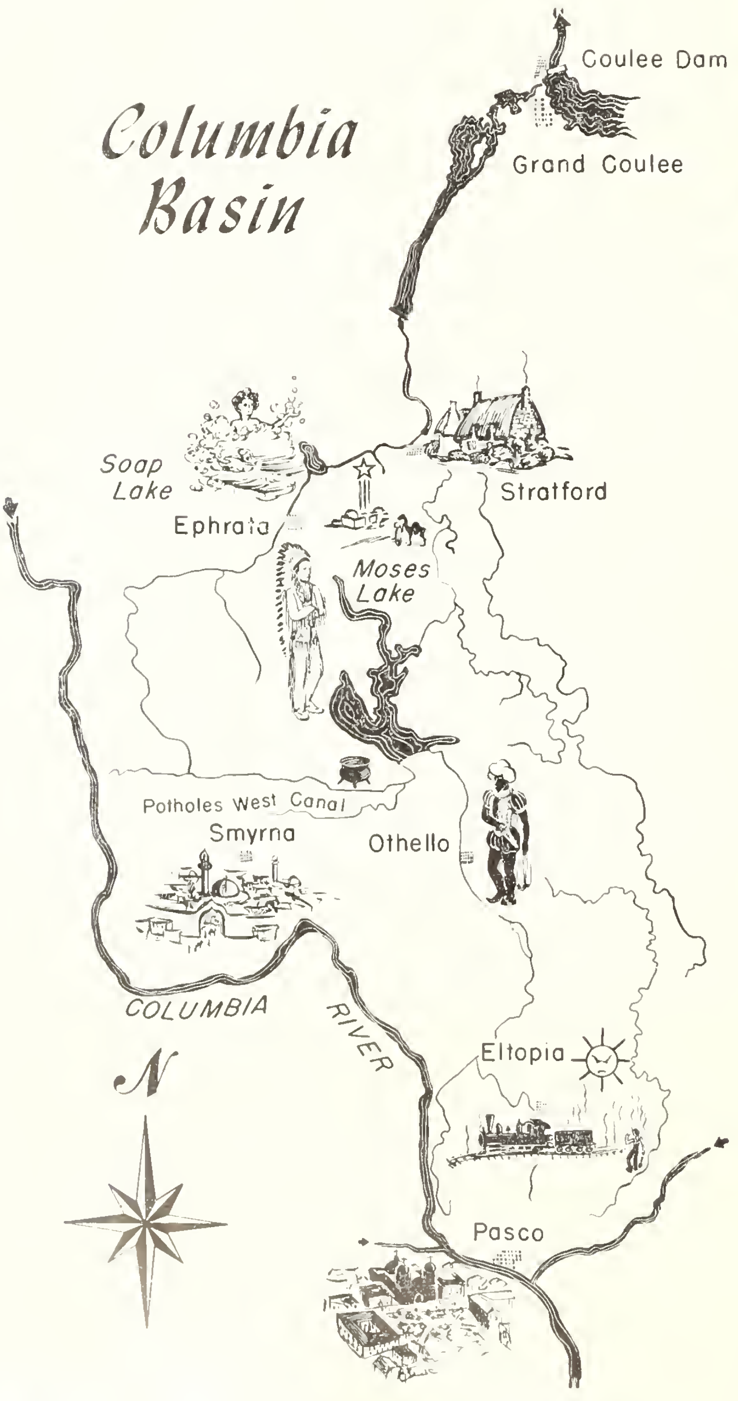
During the week of December 4, a small group of regional and Washington office Operation and Maintenance officials will meet at El Paso, Texas, with the newly appointed Director, E. D. Eaton. On the agenda will be such important matters as O & M costs, repayment, land settlement and transfer of projects to water user management. •

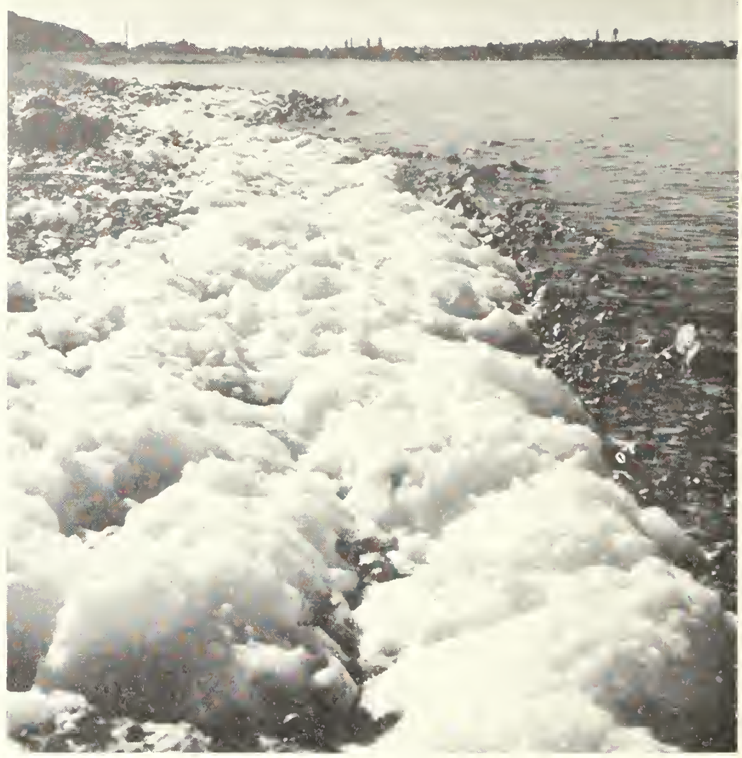
"What's in a Name?"

by

ELMA HILL NEAL

EDITOR'S NOTE: We welcome Elma Hill Neal again as a contributor to the RECLAMATION ERA. Wife of Ed Neal, who heads up Columbia Basin project's irrigation operations division, mother of four children, and an active worker at home and in the community, we are glad she found time in her busy life to prepare this, another of her memorable word-pictures of the reclamation area which she knows so well.





"SOAP SUDS" is the popular term for this scene at Soap Lake, Wash. It's the result of high velocity winds churning the water all night. *Photo by Harold E. Foss, Region 1 photographer*

ONCE UPON A TIME the Columbia River had no name. The great Columbia Basin project that is cradled in its giant bend in the present State of Washington was nameless too, save perhaps for the gutteral syllables that were applied to it by wandering Indian tribes. But white men struggled their way westward and with them came the names on the land; amusing names, inspirational names, and names profane. Some of them were sacred too.

The adventurous Americans who paused by a cottonwood-lined stream or green-sodded spring lingered to build homes. They spoke mostly in the English language and so we find a heritage of names rich in English or Eastern Shore culture. Stratford, Othello, Quincy, and Winchester mark them. But sprinkled throughout were smatterings of other lands, echoes of the French trappers and Catholic Fathers. The Grand Coulee itself bears out their influence, for the French word "coulee" is applied generously through eastern Washington to all the dry stream beds.

Designations reminiscent of the Spanish cowboys who followed their herds through the tall bunch grass left with us the town names of Mesa and Trinidad. There are picturesque names that described the spot, as witness Soap Lake with its sudsy water and the black lava rock sinks of Crab Creek which early settlers named "The Potholes."

The Bureau of Reclamation built a tremendous earth and rock dam in the Potholes area that by act of Congress had its name changed from Potholes Dam to O'Sullivan Dam, thereby honoring one Jim O'Sullivan, an early and persistent enthusiast for the Columbia Basin project. Of course, Indian names lie thick and cling to the land, such as the Wahluke Slope or Moses Coulee and Moses Lake, the latter being encampment sites of Chief Moses and his band of braves. Most of all, one cannot discount the influence of the railroads and the names that were given, hit or miss, to a siding or a way station by some location engineer, munching his lunch in the shade of a tall sagebrush, or by a vice president in his plushy office in Chicago or Minneapolis.

Many are the conflicting stories told by old-timers about the way some of the towns received their names. It is said that Pasco, at the time a flat, hot, dusty, and disagreeable place near the confluence of the Snake and Columbia Rivers, was named by a location engineer of the Northern Pacific Railroad for a somewhat similar place in Mexico. He never dreamed that it would one day become a pleasant productive farming area, an important county seat and railroad center. Another version has it that one of his associates named it by way of contrast with Cerro de Pasco, Peru, the highest, coldest place in which he had ever found himself. One can take his choice of legends with little hope that an exact and accurate version will come to light.

One yarn relates that an eastern official of the Northern Pacific, upon his arrival in the Esquadzel Coulee (Indian origin) promptly named a siding located in a particularly bosky dell, "Utopia." Remaining a few days and subjecting himself to the blazing sun and searing winds, he reluctantly but frankly changed it to "Eltopia."

A much more likely story, however, is reported in the Washington Writers Guide. It states that, "* * * during grading of the Northern Pacific line, in 1889, a freshet resulting from heavy rains washed out the grade, undoing weeks of labor. A disgusted Cockney worker commented that there would be 'ell to pay!' The construction crew nicknamed the camp 'Hell to Pay.' Railroad headquarters accepted the name, but when the finished map of the surveyed district was returned, the 'H' had been dropped and the word written 'Eltopay.' Later the name was converted into the more soothing 'Eltopia'."

Though somewhat obscured by the crudeness of daily living, the pioneers nevertheless brought with them their heritage of religion. Scattered throughout the project are names that are plucked straight from the map of the Holy Land, from Smyrna, and Jericho, Corfu, and Ephrata. It is suggestive of Old Testament passages, the hot productive "well watered plains of the Jordan" that Lot selfishly took from Abraham; or yet again, the land of Canaan, "a good land and large, flowing with milk and honey," in which there was a village called Ephratah. It was here in the early beginnings of religious history that Rachel died at the birth of Benjamin. The local townspeople later blessed Ruth and Boaz at Ephratah and asked for a benediction of "fruitfulness." Much later, the town's name was changed to Bethlehem, sometime before the birth of Christ.

How the boxcar siding on the Great Northern came to be named Ephrata is lost in the mists of time and obscurity. Many are the conjectures. But the oldest old-timers in Ephrata, I. N. McGrath and W. Gale Matthews, say that Lord Blythe, the most mysterious and glamorous character of the early cattlemen, did not name it, though he was its first postmaster.

Dale C. McMillen, a Bureau engineer in Denver and a resident of Ephrata when a boy, quotes Sigal Steiner, an early-day homesteader, as attributing the naming to Lord Blythe. I do not dispute these stories but it is undisputable that up on the dry hills to the west of the tracks was the Beasley Ranch, well watered with good springs. Fruit trees and a garden and alfalfa fields indicated its "Fruitfulness," hence the name, "Ephrata." McGrath and Matthews believe that the name of the person who first said, "Let's name this place Ephrata" is not known.

Today, it is very irritating to a citizen of Ephrata to have his thriving and booming town miscalled "Euphrata." But it is a common mistake, for both words stem from the original Sanskrit root. From the Euphrates River region where the Garden of Eden was supposed to have been located, we get the idea of great fertility and beauty. A labyrinth of irrigating canals was in existence there, perhaps during the very earliest beginnings of civilization.

The great railroads drove through dry wastelands to the Pacific coast in the early days. Prophetic in its suggestion of the new Garden of Eden that will be superimposed when the vast Columbia Basin project gets in full swing, is the name "Ephrata." Bounded by the East Low and the West Canals, the great heart-shaped area will furnish fertile, fruitful acres for countless thousands in a not too distant day.

THE END

GREEN ACRES have replaced barren lands in this now fruitful basin thanks to the Bureau of Reclamation irrigation system.

YUMA HOMESTEADERS "DE-BUG" WATER

Two years ago the Yuma Mesa homesteaders on the Gila project in southwestern Arizona first looked out across their sun-scorched desert farms. But a welcome sight greeted them—cool clear water flowing in the irrigation ditches. This water nourished the crops which had been growing on their land for several years prior to their entry. In some instances it was destined to be their domestic water supply, because well drilling was not always practicable on the high sandy mesa. Sometimes well water was not suitable for drinking, and the only other way to get drinking water was to haul it from Yuma, 7 miles away.

Water in the Yuma Mesa irrigation ditches starts out high in the Rocky Mountains as pure rain or snow. It flows down the Colorado River into Lake Mead, above Hoover Dam, then is released to downstream areas, stopping briefly in the reservoirs behind Davis, Parker, Headgate Rock, and Imperial Dams. From Imperial Dam it is diverted into the Gila Gravity Main Canal and is lifted upon the mesa by huge pumps. Then through a lined distribution system it flows to some 6,840 acres under irrigation, 4,940 acres of which made up the Bureau's 1940 land opening.

Along the approximately 1,400-mile descent from the Rockies to the Yuma Mesa, the water loses some of its purity, at least to the point where it is not considered safe for drinking until the bacteria that may cause typhoid, dysentery, or other dangerous diseases has been removed.

Some of the homesteaders are solving their problems with the technical advice of Reclamation Engineer Joseph P. Collopy, operation and maintenance supervisor for the Lower Colorado River district and his staff. They run the water through sand filters, then treat it with germicidal lamps.

Althought the water as it comes out of the ditches is fairly clear, the homesteaders would rather run the water through a filter on each installation. These filters remove any traces of silt, and purify the water to a large extent, although the water is not considered safe even at that point without further purification.

Chlorinators are usually regarded as standard equipment for water supply systems of any size. Although effective and dependable, they require some skilled supervision and prove expensive when one is needed for each user, as on irrigation projects.

Mr. Collopy and his staff studied several commercial devices of various designs, using different chemicals. They chose a method of purifying water by ultraviolet rays, for a few trial installations under operating conditions, using a germicidal lamp developed by the General Electric Co. as a source of energy. Results of the first installation, which was in the Yuma Mesa pumping plant building, were quite satisfactory. The Thomas Laboratories, a commercial firm in Yuma, tested the water before and after the ultraviolet ray treatment. In its raw state, the water carried a heavy count

PROUD OF THEIR WATER PURIFIER are Mr. and Mrs. Gerald L. Didier as they point to part of the water system that they have installed on their homestead on the Yuma Mesa Division, Gila project. The system includes the water softener to Mr. Didier's right, the germicidal lamp purifier in the middle, and the automatic water heater to Mrs. Didier's left. ***Photo by M. N. Langley of the Bureau's Region 3.***

of bacteria of the Coli-Aerogenes group which causes typhoid and dysentery. After water passed through the purifier, the biological tests showed, without exception, that these bacteria were not present.

According to the tests, bacteria count dropped from 3,000 per cubic centimeter before entering the lamp chamber to 180 cubic centimeter upon discharge from the germicidal lamp installation.

Because of the high chemical content of the water, amounting to about 990 parts per million, the researchers could not definitely determine the size of lamp required for the purifier. The 15-watt lamp used in the initial installation probably was larger than needed for a drinking fountain, but certainly it was better to use too large a lamp rather than one that was too small. A local concern later manufactured several of these germicidal units, which the homesteaders then purchased and installed.

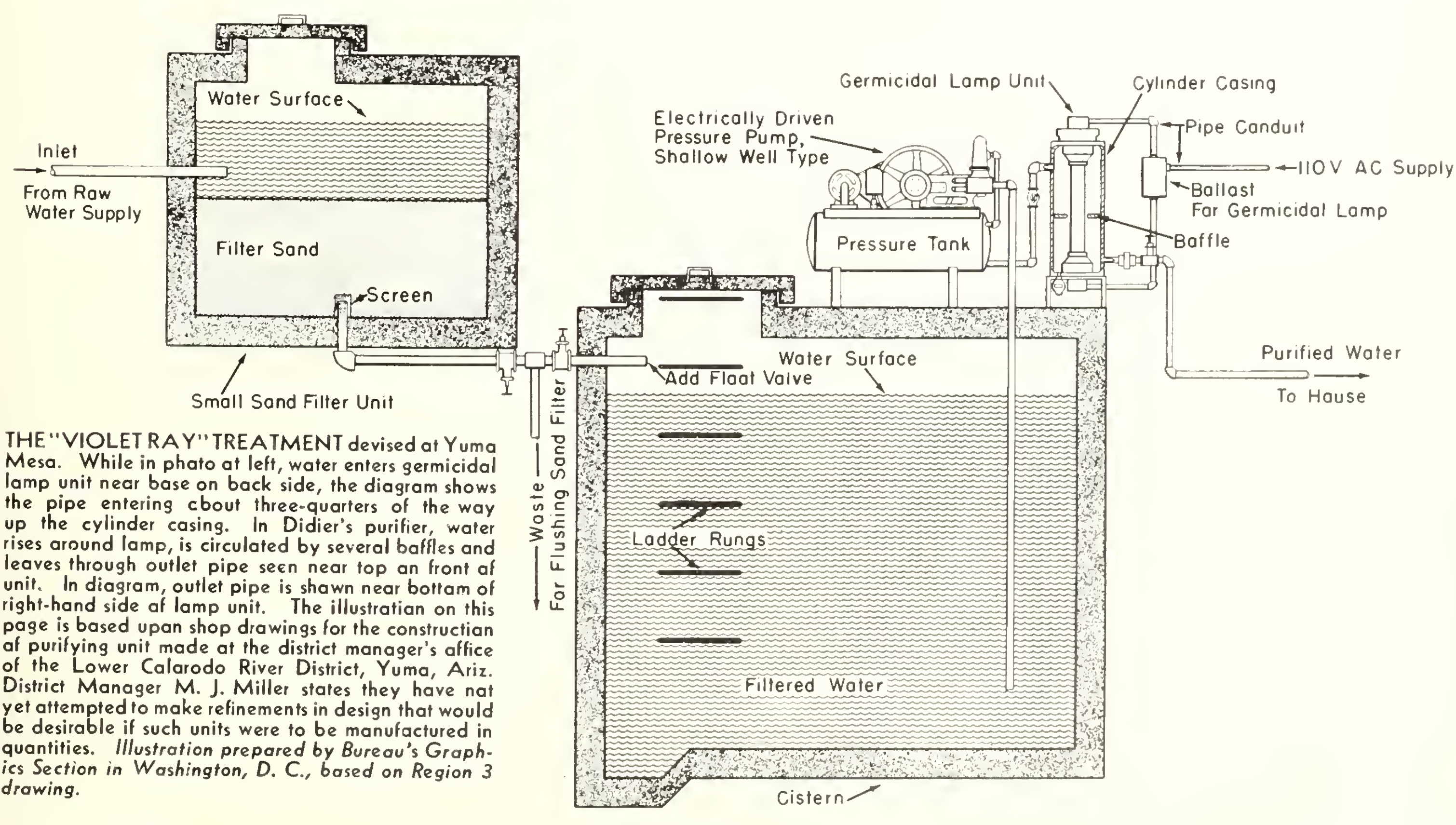
The lamp burns continuously in the Gila pumping plant building, while most of the units on the farmstead installations burn only while the electric pump motor is operating.

The capacity of these germicidal lamp units, or the amount of water they are capable of purifying within a unit of time, depends upon the temperature, turbidity, chemical content, and other factors. It is roughly estimated that 300 gallons can be purified per hour by a 15-watt unit. All installations are checked by frequent biological analysis, especially those that are operated near the estimated full capacity.

A new slim lamp which has been developed recently is more efficient than the first units used, and is also longer lived. One of these lamps burning continuously will have a much longer life than one burning intermittently. If the lamps are turned on and off only once or twice a day they will last from 500 to 6,000 hours, but when they are turned off and on frequently, their estimated life is about one-half of this time. A local dealer has been manufacturing and selling the purification units to the mesa homesteaders for $35 for the 15-watt units and $75 for a 40-watt size, exclusive of installation. With energy selling at $0.05 a kilowatt-hour and the 15-watt unit burning continuously, the cost of operation approximates $0.55 a month. The larger units operate for about $1.16 per month. If the unit is connected so that it goes into operation only when water is flowing through it, the cost of current is nominal.

In the original installation, a 1-inch inspection window was installed for observation purposes. Observations indicated the desirability of incorporating a wiping mechanism into the unit for the purpose of keeping the lamp clean. This feature is especially desirable in cases of high chemical content or turbidity. As an added precaution, the user should take the lamp out of the purifier once each month and clean it to remove any algae or sediments that might impair its efficiency. Other additions could be made, such as an automatic device for shutting off the supply line if the lamp fails to burn. However, the units as described have been operating quite satisfactorily for over 2 years.

Mr. Collopy, in reporting on the Yuma Mesa water purification systems, cautioned farmers on other projects who are considering similar installations to consult first with Public Health or other qualified authorities. The system which works on the Yuma Mesa may not work in other areas where factors are very different. Diagrams of the system may be obtained by writing the District Manager, Bureau of Reclamation, Post Office Building, Yuma, Ariz. THE END.



THE "VIOLET RAY" TREATMENT devised at Yuma Mesa. While in photo at left, water enters germicidal lamp unit near base on back side, the diagram shows the pipe entering about three-quarters of the way up the cylinder casing. In Didier's purifier, water rises around lamp, is circulated by several baffles and leaves through outlet pipe seen near top on front of unit. In diagram, outlet pipe is shown near bottom of right-hand side of lamp unit. The illustration on this page is based upon shop drawings for the construction of purifying unit made at the district manager's office of the Lower Colorado River District, Yuma, Ariz. District Manager M. J. Miller states they have not yet attempted to make refinements in design that would be desirable if such units were to be manufactured in quantities. *Illustration prepared by Bureau's Graphics Section in Washington, D. C., based on Region 3 drawing.*

Third Sale of Columbia Basin Full-Time Farms Announced

Assistant Secretary of the Interior Warne on November 24 announced that 30 full-time farm units, comprising 2,505 irrigable acres, on the Columbia Basin project in the State of Washington were to be sold. These units are all located in Irrigation Block 40 of the project, in Grant County. They range in size from 73 to 125 irrigable acres. The deadline for submission of applications to the Bureau of Reclamation, Ephrata, Wash. is 2 p. m., January 8, 1951.

This announcement marks the fourth post-war sale of lands on the Columbia Basin project, and the third postwar sale involving only full-time farm units. Requirements for applicants in this latest sale are substantially the same as those for the other sales of full-time units. Complete details pertaining to the present sale, including the price of the land and additional charges, are contained in Columbia Basin project Public Announcement No. 4 which, together with application forms, may be obtained from the Bureau of Reclamation, Ephrata, Wash. •

Reclamation Funds Slashed

A reduction of $63,828,000 in funds for the 1951 Reclamation program was recently announced by Secretary of the Interior Oscar L. Chapman. The cuts were made in compliance with stipulations by Congress in the General Appropriation Act of 1951 for a reduction of not less than $550 million dollars in nondefense appropriations and instructions by the Bureau of the Budget for the establishment of reserve funds in the interest of national defense.

The cuts fall into three specific categories.

The first (amounting to $50,209,000) represents construction funds not programed for expenditure during the 1951 fiscal year.

The second is a definite cutback of $6,741,000 in construction, investigation, and general administration funds scheduled for the 1951 fiscal year.

The third cut amounts to $6,878,000, earmarked for programing, which is being withheld in accordance with the President's specific directive to curtail all projects not contributing directly to national defense.

NOTES FOR CONTRACTORS

Contracts Awarded During October 1950

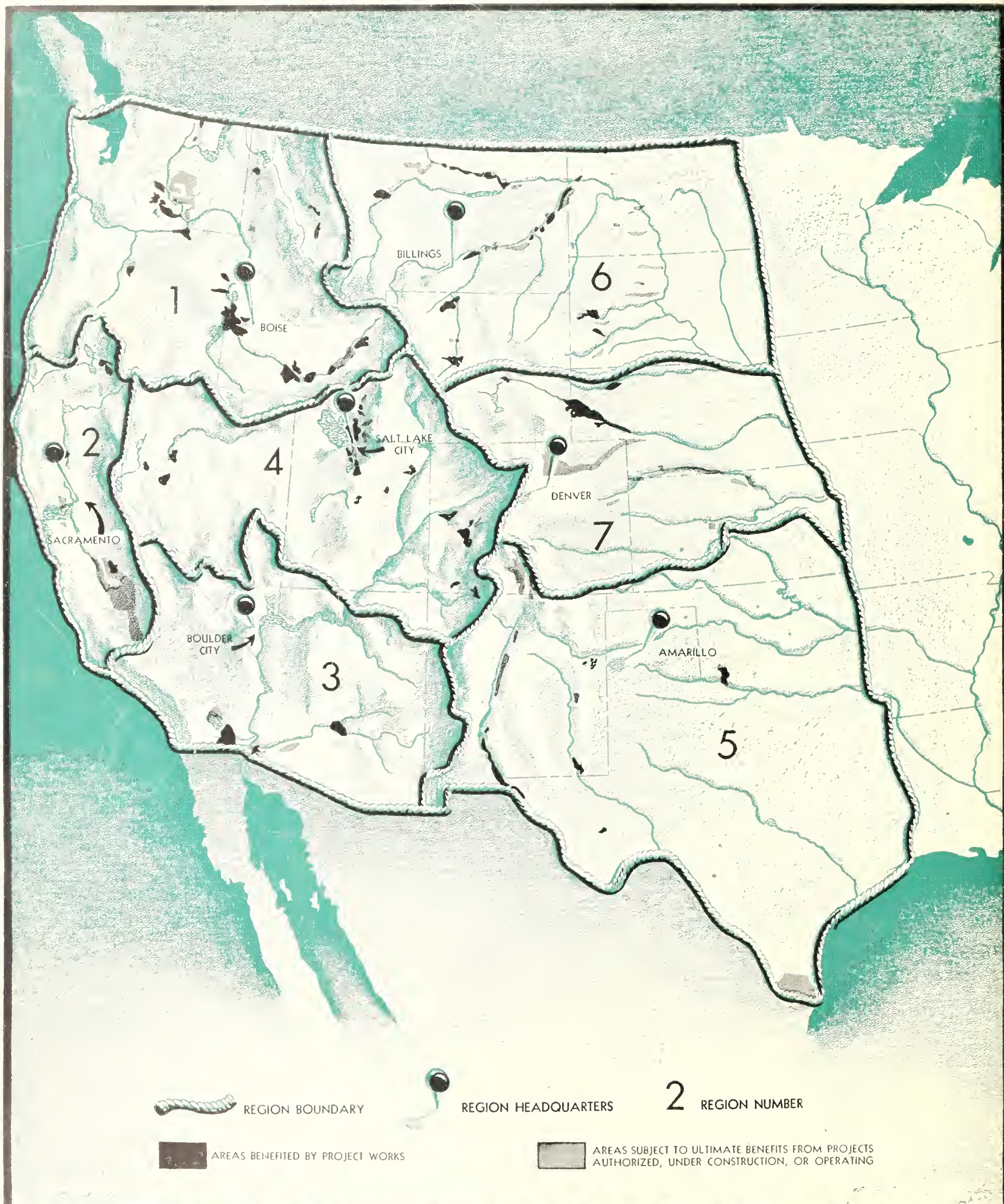
Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
3106	Colorado-Big Thompson, Colo	Oct. 4	Three 35,000-kilovolt-ampere transformers for Pole Hill and Flatiron power plants, schedules 1 and 2A.	Pennsylvania Transformer Co., Canonsburgh, Pa.	$340,915
3123	Davis Dam, Ariz.-Nev	Oct. 18	8 current and 11 potential transformers for Phoenix substation, schedule 5	R. E. Uptegraff Manufacturing Co., Scottdale, Pa.	16,875
3127	Missouri River Basin, S. Dak	Oct. 6	1 complete package-type outdoor switchyard, equipment, and structures for Angostura switchyard.	Westinghouse Electric Corp., Denver, Colo.	16,725
3137	Boulder Canyon, Ariz	Oct. 23	Installation of turbines, transformers, and appurtenant equipment for units A3, A4, and A9; relocation of transformer bank "Y"; and construction of additional transformer circuits and terminal facilities for Hoover switchyard at Hoover power plant.	C. M. Elliott and John C. Gist, Redding, Calif.	1,777,241
3144	Rio Grande, N. Mex	Oct. 6	One 13,000/16,250-kilovolt-ampere transformer with three 46,000-volt lightening arresters for Albuquerque substation.	Westinghouse Electric Corp., Denver, Colo.	116,336
3146	Columbia Basin, Wash	Oct. 18	Three 230,000/196,000-volt circuit breakers for Grand Coulee 230-kilovolt right switchyard, schedule 2.	General Electric Co., Denver, Colo	321,450
3152	Missouri River Basin, N. Dak	Oct. 3	2 control boards for Washburn and Bismarck substations	Wolfe & Mann Manufacturing Co., Baltimore, Md.	24,215
3155	Colorado-Big Thompson, Colo	Oct. 10	Construction of 35,000-kilovolt-ampere Pole Hill power plant, diversion and afterbay dams, and access road, Estes Park-Foothills power aqueduct.	Adler Construction Co., Dickinson, N. Dak.	741,740
3156	Columbia Basin, Wash	Oct. 2	Two 9- by 9-foot high-head radial gates for Potholes East canal headworks	Southwest Welding & Manufacturing Co., Alhambra, Calif.	11,460
3158	Paonia, Colo	Oct. 4	Construction of earthwork and structures for enlargement of Fire Mountain Canal.	Gardner Construction Co., Glenwood Springs, Colo.	232,392
3159	Missouri River Basin, Wyo	Oct. 3	Construction of suspension footbridge for relocation of Chicago, Burlington & Quincy R. R., Boysen Dam.	Charles M. Smith, Thermopolis, Wyo.	14,455
3162	Davis Dam, Ariz.-Nev	Oct. 24	Installing overhead ground wires on the 115-kilovolt Phoenix-Tucson No. 1 transmission line.	Malcolm W. Larson, Denver, Colo	48,484
3164	Missouri River Basin, Wyo	Oct. 3	Installation of heating and ventilating system for Kortes power plant	W. H. Reller Co., Boise, Idaho	17,400
3165	Missouri River Basin, N. Dak	Oct. 20	Construction of 32,000-kilovolt-ampere Bismarck and 7,500-kilovolt-ampere Washburn substations.	Valley Engineering & Construction Co., Grand Forks, N. Dak.	253,415
3167	Colorado-Big Thompson, Colo	Oct. 27	One 100-ton traveling crane for Pole Hill power plant	Cyclops Iron Works, San Francisco, Calif.	53,511
3171	Missouri River Basin, Wyo	Oct. 18	Construction of 28 miles of Seminoe-Sinclair 115-kilovolt transmission line, schedule 1.	R. N. Campsey Construction Co., Denver, Colo.	252,900
3172	Cachuma, Calif	Oct. 13	60,000 barrels of bulk portland cement for construction of Cachuma Dam, schedule 1.	Monolith Portland Cement Co., Los Angeles, Calif.	144,000
3172	do	do	2,800 tons of bulk pozzolan for construction of Cachuma Dam, schedule 2	Airox Co., Los Angeles, Calif	39,928
3174	Fort Sumner, N. Mex	Oct. 24	Construction of earthwork, pneumatically applied mortar lining, and structures for main canal: and earthwork and structures for main canal laterals and wasteways.	Macco Corp., Paramount, Calif	336,264
3179	Central Valley, Calif	Oct. 11	132,040 feet of precast-reinforced-concrete pipe for Ivanhoe irrigation district and Lindmore irrigation district, unit 3, Friant-Kern Canal distribution system.	Concrete Conduit Co., Colton, Calif.	237,341
3180	Grand Valley, Colo	Oct. 12	Construction of 6 concrete flumes on Highline Canal	James Construction Co., Seattle, Wash	285,382
3181	Columbia Basin, Wash	Oct. 24	Construction of earthwork and structures for west canal	J. A. Terteling & Sons, Inc., Boise, Idaho	484,923
3189	Riverton, Wyo	Oct. 19	Construction of bridge over Five Mile Creek near Wyoming Canal siphon and bridge over Muddy Creek, schedule 1.	Charles M. Smith, Thermopolis, Wyo	21,025
3189	do	do	Construction of earthwork, canal lining, and structures for Wyoming Canal; Badger lateral; laterals W48.59 to W61.56; sublaterals; and Cottonwood drain, schedules 2 and 5.	Sharrock and Pursel, Casper, Wyo	729,629
3190	Columbia Basin, Wash	Oct. 24	Construction of earthwork and concrete lining for main canal	J. A. Terteling & Sons, Inc., Boise, Idaho	1,043,274
3191	Central Valley	Oct. 26	Construction of 20 miles of Tracy-Contra Costa 69 kilovolt transmission line	Wismer and Becker, Sacramento, Calif	69,056
DC 3207	Colorado-Big Thompson, Colo	Oct. 27	Grouting temporary outlets at Spring Canyon and Dixon Canyon Dams	Continental Drilling Co., Los Angeles, Calif.	22,425
R1-97	Deschutes, Oreg	Oct. 5	Construction of pneumatically applied mortar canal sealing, mile 2 to mile 10, north unit, Main canal.	Pioneer Sand & Gravel Co., Inc., Seattle, Wash.	15,585
R1 CB-74	Columbia Basin, Wash	do	Floor and wall coverings, left powerhouse, Grand Coulee Dam	Seldens, Inc., Tacoma, Wash	13,900
R1-CB 67	do	Oct. 11	Earthwork, pipelines and structures, Burbank part-time farm units laterals area B-1.	John Klug and Co., Yakima, Wash	32,731
R1-101	Minidoka, Idaho	Oct. 26	Construction of laterals from wells, north side pumping division	Holmes Construction Co., Heyburn, Idaho.	34,821

NOTES FOR CONTRACTORS—Contracts Awarded During October 1950—(*Continued*)

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
100C-104	Hells Canyon, Idaho-Oreg	Oct. 13	Drilling test holes at Hells Canyon damsite	L. L. Jeffries, Richmond, Calif	$13,100
R2-131	Central Valley, Calif	Oct. 18	New roofing on Shasta power plant	B. W. Harlan, Redding, Calif	10,846
R2-132	do	Oct. 24	Constructing warehouse, repair garage and storage garage for Government camp at Lindsay.	da Roza-Rihal, Inc., Monterey, Calif	45,845
200C-128A	do	Oct. 30	Clearing Shasta Reservoir, Pit River area	W. C. Smith, Redding, Calif	40,625
R3-PX-51	Davis Dam, Ariz.-Nev	Oct. 13	Construction of ED-5 substation	Newbury Electric Corp. of Arizona, Phoenix, Ariz.	47,948
R6-47	Fort Peck, Mont	Oct. 18	Construction of warehouse for Havre substation	O'Neil Construction Co., Havre, Mont.	17,392
R6-HUR-5	Missouri River Basin, S. Dak	Oct. 5	Construction of access road to Angostura Dam station 50+37.9+ station 120+48.2, culvert, station 39+74.3 and cattle guard, station 28+43.	H. F. Emme Construction Co., Rapid City, S. Dak.	11,979
R7-149	North Platte, Wyo.-Nebr	Oct. 9	Partial reconstruction of timber bridge across North Platte River at Whalen, Wyo.	Etlin E. Peterson, Casper, Wyo	32,790

Construction and Materials for Which Bids Will Be Requested By February 1951

Project	Description of work or material
Boise, Idaho	Construction of about 2.3 miles of 4.16-kilovolt, 3-phase, single-circuit, wood-pole transmission line from Anderson Ranch Dam to Anderson Ranch Government camp.
Boulder Canyon, Ariz.-Nev.	Construction of steel frame warehouse, 9,600 feet in area, with corrugated iron siding and roof at Boulder City, Nev.
Cachuma, Calif	Construction of Glen Anne Dam and regulating reservoir on the west fork of Glen Anne Canyon about 4 miles northwest of Goleta, Calif. The dam is to be a 75-foot high, 100,000-cubic yard earthfill structure forming a reservoir of about 500 acre-foot capacity. Structures to include either a small concrete pipe or reinforced concrete chute spillway and a stilling pool.
Central Valley, Calif	Excavation of river channel below Pacific Gas & Electric Co. dam and power plant and excavation for penstocks and foundation of Folsom power plant on the American River near Folsom, Calif.
Do	Construction of 8.5 miles of welded steel pipelines for the Lindsay-Strathmore irrigation district on the Friant-Kern Canal distribution system 2 miles east of Lindsay, Calif. The contractor is to fabricate and lay the 12- to 48-inch diameter pipe. The entire system to have an average head of 125 feet.
Do	Construction of 42 miles of 12- to 54-inch diameter reinforced concrete and concrete irrigation pipelines for the Ivanhoe irrigation district on the Friant-Kern Canal distribution system near Ivanhoe, Calif., to irrigate 11,000 acres. The system is to operate under various heads with a maximum head of 25 feet, and there will be no pumping. The Government is to furnish all pipe.
Do	Construction of the 120 cubic-feet-per-second capacity Trauger pumping plant for Lindsay-Strathmore irrigation district on Friant-Kern Canal distribution system, 2 miles east of Lindsay, Calif. The building is to be a 150- by 70-foot steel superstructure with metal paneling and is to house pumps, control equipment, offices, and machine shop. Includes installing 7 vertical-shaft pumping units of 120 cubic-feet-per-second total capacity with outdoor-type motors and 2 horizontal-shaft booster pumps of 23 cubic-feet-per-second total capacity, and constructing an 800-foot long, 72-inch diameter, reinforced concrete intake pipeline.
Do	53 motor-driven vertical shaft water pumps, 2 to 16 cubic-feet-per-second capacity, for third unit, southern San Joaquin municipal utility district.
Do	2 steel surge suppressors for Trauger pumping plant.
Colorado-Big Thompson, Colo.	Construction of Flatiron power plant and pumping plant building to house two 35,000-kilovolt-ampere generators and two-motor-driven, 125 cubic-feet-per-second capacity, 310 foot head centrifugal pumps. Construction of 90,000-kilovolt-ampere Flatiron switchyard and the 400-acre-foot capacity Flatiron afterbay, a rolled earthfill dam 60 feet high and 1,200 feet long. The work is located on South Cottonwood Creek about 9 miles west of Loveland, Colo.
Do	Construction of 51 miles of 115-kilovolt, 3-phase, single-circuit, H-frame, wood-pole transmission line with overhead ground wires between Salida and Gunnison, Colo.
Do	Construction of 18.5 miles of 34.5-kilovolt, single wood-pole, pin-insulated, triangular construction, 3-phase, single-circuit, transmission line between Gore substation and Muddy Pass substation near Kremmling, Colo.
Do	1 main control board, 1 annunciator relay cabinet, 1 recording board, one 460-volt unit substation, one 460-volt power distribution board, two 460-volt heating control centers, one 460-volt motor control center, one 240/120-volt lighting distribution cabinet, one 125-volt direct current distribution and control board, two 5-kilowatt battery charging motor-generator sets, and 75-kilovolt-ampere lighting transformer for Flatiron power plant.
Do	One 12,500 horsepower 300 revolutions per minute generator motor unit for Flatiron pumping plant.
Do	1 vertical-shaft pump turbine of about 400 cubic feet per second capacity and 200- to 300-foot head range for Flatirion power and pumping plant.
Do	2 vertical-shaft centrifugal water pumps, 200 cubic feet per second capacity at 172-foot head, for Willow Creek pumping plant.
Columbia Basin, Wash	Construction of a 17-mile unlined reach of East Low Canal and about 0.5-mile of unlined Lind Coulee wasteway near Quincy, Wash. Structures include 4 monolithic concrete siphons and transitions, 1 concrete check and transition, and Lind Coulee wasteway turnout. The wasteway is to have 1 concrete chute, stilling pool, and transition.
Do	Construction of a 1-story, reinforced-concrete vista house at Grand Coulee Dam, Wash. The building is to contain an auditorium, model room, and lobby with an outdoor viewing platform and is to be 20,000 square feet in area.
Do	Construction of a general purpose shop, storehouse, and 2 Government garages at Quincy, Wash., and a warehouse and 3 Government garages at Othello, Wash. All buildings to be constructed of reinforced concrete columns and lintels with concrete curtain walls and built-up roofs on wood and steel trusses.
Columbia Basin, Wash	Grading streets, sidewalks, and lots; paving streets; constructing sidewalks, curbs, gutters, and storm drainage facilities; installing ornamental street lighting; relocating medical office building; and removing 13 houses in the commercial area of Coulee Dam, Wash.
Davis Dam, Ariz.-Nev	Erecting steel structures and installing electrical equipment for 20,000 kilovolt-ampere Maricopa substation near Maricopa, Ariz.
Do	Grading plot, erecting chain-link fence and structural steel, and installing equipment for 169-kilovolt Knob switchyard, about 10 miles west of Yuma, Ariz., in California.
Do	System map for the dispatcher's building at Phoenix, Ariz.
Eklutna, Alaska	Construction of 11 miles of 115-kilovolt, single-circuit, 3-phase, wood-pole, H-frame transmission line without overhead ground wires between Eklutna power plant and Eklutna tunnel, about 30 miles northeast of Anchorage, Alaska. The Government is to furnish major equipment.
Do	Construction of 13 miles of 69-kilovolt, single-circuit, 3-phase, wood-pole, H-frame transmission line without overhead ground wires between Eklutna tunnel and Palmer, Alaska. The Government is to furnish major equipment.
Do	Construction of 5,000-kilovolt-ampere Palmer substation, 69-kilovolt primary voltage, including installation of Government-furnished equipment, near Palmer, Alaska.
Do	Construction of Government camp including construction of 12 houses, a warehouse, and garage about 16 miles from Palmer, Alaska.
Fort Peck, Mont	Construction of pole top extensions and stringing two ⅜-inch galvanized steel overhead ground wires for the 50-mile Fort Peck to Wolf Point section of Fort Peck-Glendive 115-kilovolt transmission line.
Gila, Ariz	Construction of 15-mile concrete-lined Wellton Canal, 300 cubic-feet-per-second capacity, near Wellton, Ariz.
Do	Construction of a 10-mile reach of 900 cubic-feet-per-second capacity concrete-lined Mohawk Canal, near Taena, Ariz.
Hungry Horse, Mont	Completion of 285,000-kilowatt Hungry Horse power plant at Hungry Horse Dam, near Columbia Falls, Mont. Includes completion of structures and installation of equipment in the Hungry Horse switchyard; installation of four 105,000-horsepower turbines to operate under 400 foot head; installation of pumps, compressors, fire protection facilities, piping for oil, water, and air, and all accessory electric equipment except generators; completion of all architectural finish work; laying bonded concrete floors; installation of handrails, interior doors, and heating and ventilating equipment.
Do	250,000 pounds of galvanized fabricated structural steel for bolted switchyard structures and transformer circuit towers at Hungry Horse switchyard.
Do	Line relaying switchboard for Hungry Horse power plant.
Kendrick, Wyo	Construction of 35 miles of double-circuit open wire telephone line from new Casper substation to Alcova Dam.
Missouri River Basin, Mont.	Clearing the first part of Canyon Ferry Reservoir site, about 20 miles east of Helena, Mont.
Missouri River Basin, Nebr.	Construction of 27 miles of unlined laterals and sublaterals on the Superior lateral system, 18 to 6 cubic-feet-per-second capacity, west of Guide Rock and Hardy, Nebr.
Missouri River Basin, N. Dak.	Construction of 4-mile Garrison (Fort Peck tie) 115-kilovolt transmission line connecting Williston-Garrison and Garrison-Bismarck lines at Garrison Dam, N. Dak.
Missouri River Basin, Wyo.	Construction of Anchor Dam, a 66,000-cubic-yard concrete arch structure, 200 feet high and 550 feet long on the South Fork of Owl Creek, 40 miles northwest of Thermopolis, Wyo.
Do	Construction of 100 miles of 34.5-kilovolt Thermopolis-Lovell transmission line.
Do	Clearing about 8,600 acres of Boysen Reservoir site, about 18 miles south of Thermopolis, Wyo.
Do	Clearing the first portion of Keyhole Reservoir site, about 18 miles northeast of Moorcroft, Wyo.
Do	Construction of 15,000-kilovolt-ampere Boysen switchyard, 21 miles south of Thermopolis, Wyo.
Do	Relocation of 6 miles of U. S. Highway No. 14 at Keyhole damsite.
Do	Construction of concrete floor and foundation and erection of 60- by 100-foot prefabricated metal building, furnished by the Government, for garage and machine shop, North Platte River district headquarters, 2 miles west of Casper, Wyo.
North Platte, Wyo.-Nebr	Placing 1,200 feet of concrete lining and 6,000 feet of concrete pipe for laterals 98.1, 98.1-B, and 98.1-C on Fort Laramie Canal, about 7 miles southwest of Morrill, Nebr.
Paonia, Colo	Enlargement of 10 miles of Fire Mountain Canal near Paonia, Colo.
Do	Reconstruction and enlargement of 3.4-mile Overland Canal to an initial capacity of 140 cubic feet per second, near Paonia, Colo.
Rio Grande, N. Mex	15,000 pounds of fabricated galvanized structural steel for bolted structures at Albuquerque substation.
Riverton, Wyo	Placing asphalt lining of 17 miles of Wyoming Canal, 565 cubic feet per second capacity, 25 miles north of Riverton, Wyo.
Do	Placing asphalt membrane lining of Wyoming laterals.



THE RECLAMATION AREA