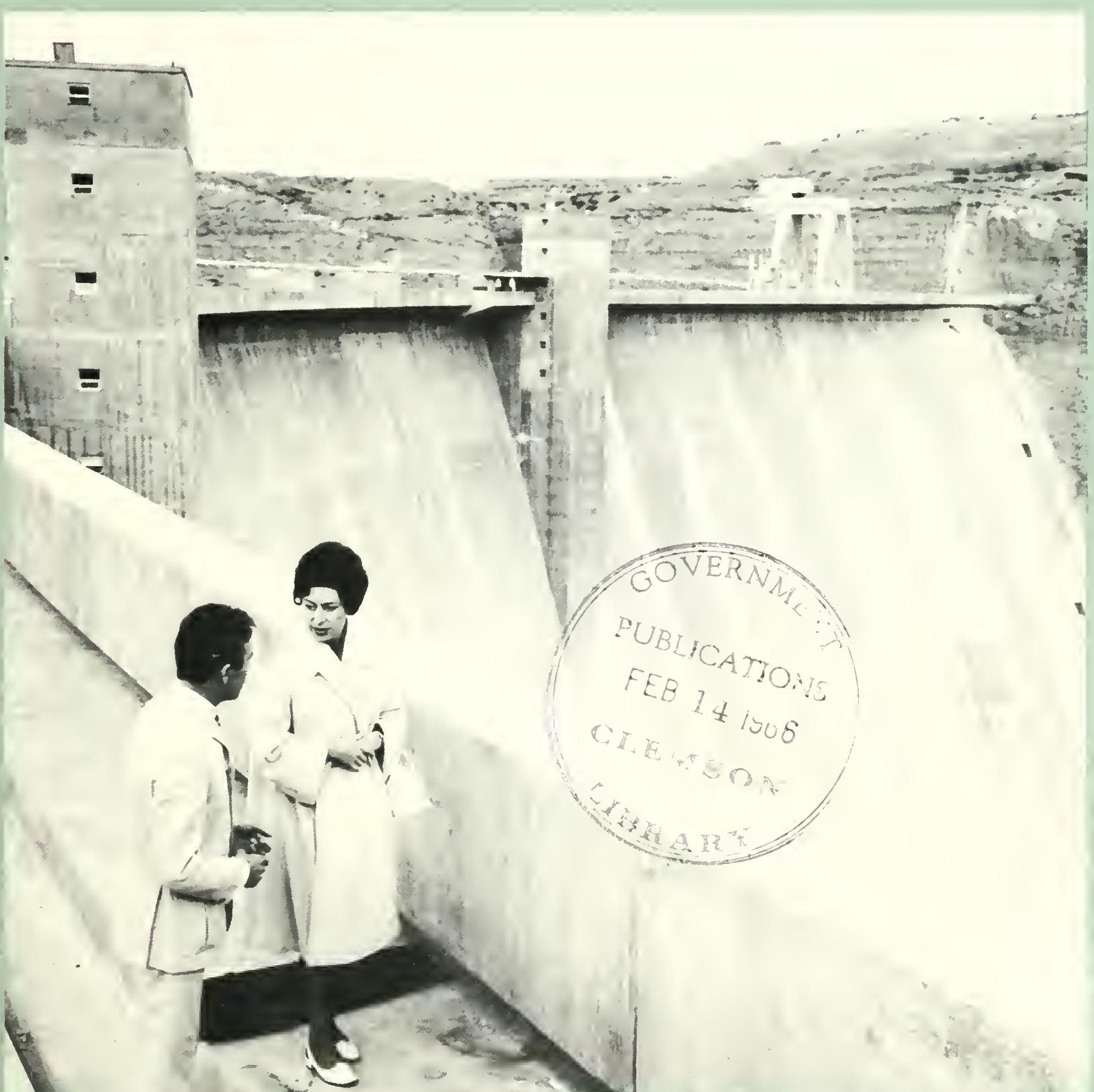
February 1966

RECLAMATION ERA



Historic Milestone: English Royalty Visits Glen Canyon Dam

Reclamation
ERA

FEBRUARY 1966
Volume 52, No. 1

OTTIS PETERSON, Assistant to the Commissioner—Information
GORDON J. FORSYTH, Editor

COVER PHOTO. Princess Margaret and her husband the Earl of Snowdon of British royalty take time out of their busy U.S. tour last November to relax at Glen Canyon Dam—an historic milestone and gratifying tribute to the recreational benefits of a Reclamation structure. See Mel Davis' other Princess photos at Lake Powell on page 6.

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Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C., 20240. Use of funds for printing this publication has been approved by the Director of the Bureau of the Budget, January 31, 1961.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

International Training Program *Proves its Worth*

by GORDON K. EBERSOLE

"Your efforts will be a vital part of the foundation for a stronger, more prosperous era of Turkish progress," said President Johnson on a visit to Ankara, Turkey, on August 28, 1962. He was then U.S. Vice President and was photographed with Mr. Demirel.

IN recent elections in Turkey, one of the Bureau of Reclamation's former trainees, Suleyman Demirel, was swept to power as Premier of that progressive country.

Mr. Demirel was one of the first two Marshall Plan participants sent to the United States in 1949 for technical training. He had received his B.S. and M.S. degrees from the University of Istanbul, and had become Project Manager of Turkey's Electric Power Resources Administration. Like many hundreds of other foreign nationals, this brilliant 25-year-old man was assigned to the Bureau of Reclamation where a specialized program was developed to fit his needs and the plans of his government.

Turkey, under the leadership of Mustafa Kemal Ataturk, decided in the early part of this century to break with the past and to begin an era of enlightened modernization. New schools and universities were built, women dropped their veils and were permitted to vote, resources planning and development were started with water and power basic to the needs of the nation.

Suleyman Demirel was an eager young technocrat who seemed to carry the ideals of the great Ataturk in building a modern Turkey. On his arrival in Denver, Colo., Suleyman was given assignments in the various major divisions of the Bureau. He also studied construction practices on visits to the Colorado-Big Thompson project in Colorado, the Central Valley project in California, and on the Columbia River works in Washington and Oregon.

Though Suleyman's alertness was evident from the first meeting, it is quite probable that his new associates in the Bureau of Reclamation gave little thought to the possibility that he would, in the near future, succeed to the position of Premier of Turkey. And now, in retrospect, Americans review a 15-year-old friendship, and recall a bygone foreign training program that was intended to instruct in technical development and to advance

Suleyman Demirel, Prime Minister of Turkey, once a Reclamation trainee. (Courtesy of International Engineering Co., Oct. 1965.)

international brotherhood. Such a program wisely includes contact with our country's best technical talent and neighborly relations with local and national leaders.

After his return to Turkey in late 1950, Suleyman was appointed Chief Bureau Engineer for the construction of Seyham Dam. Although little is known of his other assignments, in 1954, Mr. Demirel's outstanding abilities won him the first Eisenhower Exchange Fellowship to a man from his country. On arriving at the writer's office in Washington, D.C., his second U.S. Reclamation program was put into effect.

Demirel Was Eager

Since Suleyman already was familiar with Reclamation's water resources development programs in the West, it was not difficult to develop an additional schedule to suit his wishes. He was eager to get Reclamation's help on how water and power were marketed and how rates for these resources were established.

In addition to his receiving more technical orientation, Mr. Demirel and his wife, like other foreign participants, were invited to the homes of some Americans. We remember them as delightful company. Mrs. Demirel spoke very little English and Suleyman was careful to interpret for her. However, the most enjoyable international program of the evening was the refreshing understanding resulting from the sign language and the visual-aid vocabulary between Mrs. Demirel and me. Had I thought of Suleyman in terms of a future Premier of Turkey, however, perhaps out of deference I would have encouraged more of his able English-Turkish translations.

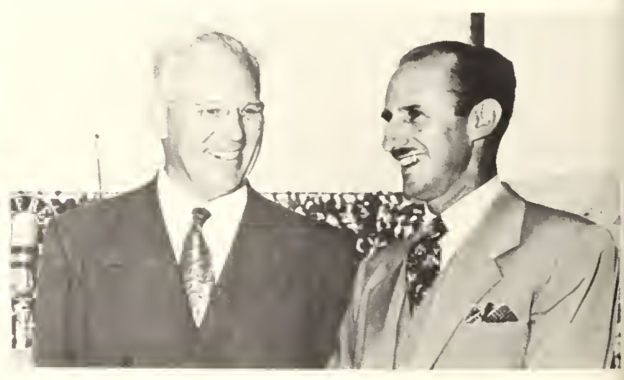
In 1958 Demirel was appointed by Prime Minister Menderes to the important post of Director General of the State (Turkey) Planning Office where he was an adviser on a broad program (including water resource planning) of the first 5-year plan.

After 1962 Demirel assumed a partnership with his two brothers in contracting and consultant engineering and in representing a large U.S. firm. He also taught a course in hydraulic engineering at the Middle East Technical University.

Demirel became involved in politics at the Justice Party's National Congress in December 1962, when he was elected to the party's 24-man Administrative Board. He was named Vice President General for the Organization, but resigned in 1963. In November 1964 Suleyman by a wide margin, was elected President General of the party at the national convention.

In heralding friendly relations with the United States, in the fall of 1962, Suleyman together with the 2,000*th* participant in the U.S. training pro-

At the dedication of Tracy Pumping Plant, California, on August 4, 1951, Chief Justice Earl Warren, then Governor of that State, is photographed with Adolfo Orive Alba, then a water official for the Mexican Government and a strong contender for Mexico's presidency. Alba was a Bureau trainee of 1928. A group of 30 representatives from 14 countries were remembered in entertainment at the dedication.



ram posed for pictures with Lyndon B. Johnson, hen Vice President of the United States on a tour f Turkey.

Prime Minister Demirel is one of many former echnical trainees who has risen to positions of minence in their organizations and in their counries. This brings up an important question:

o Be a Friend

How often do we miss opportunities to fellowhip and to be a real friend with a participant? t is quite possible that an interesting variety of erson-to-person experiences are as important to he participant as the technical aspects of his proram. To provide a liberal amount of both, might vell balance the scales for a favorable situation n years to come.

I remember a conversation I had with Julian Buendia, who for many years was Director of Public Works in the Philippines. Julian told of a train ride he had in the United States when he was a young trainee on the Kittitas project in Washington State. Sitting in front of him were a woman and her small child. Becoming restless, the child wandered down the aisle toward Mr. Buendia and they began a friendly chat. The mother, looking around and seeing her little one talking to a dark-skinned person, rushed back and snatched the child back to their own seat. This deeply hurt the sensitive young Buendia whose destiny was to include rising to top positions in the Philippine Government and become known internationally in his professional field of engineering.

Many years later an international conference on water developments was held in Manila, which was organized by Mr. Buendia and sponsored by the Economic Commission for Asia and the Far East

lany foreign specialists visiting this country have become better acquainted at friendly American square dances. The men shown this 1952 photo are from left, Mr. Buendia who is mentioned in this article, the late Frank Banks (then a Bureau consultant), the uthor Gordon Ebersole, and three foreign irrigation specialists: Luis J. Medina of Venezuela, Ezzat-Ollah Eskandari of Iran, and Amin amza of Iraq.

(ECAFE). A 12-man U.S.S.R. delegation of specialists and technicians was making a considerable impression upon the delegates of other countries by presenting a variety of technical films and publications on developments in the U.S.S.R. and inviting representatives to accept expense-paid observation trips to their projects.

Sensing the unmatched preparation of the two-man U.S. delegation, Mr. Buendia arose, and using the authority of his position as host to spare a burden of embarrassment for the United States, he publicly expressed appreciation and thanks to the United States for its help in the reconstruction of the Philippines after World War II and for its training and economic assistance efforts—no strings attached!

The man had risen above the train incident. How differently Mr. Buendia might have reacted if the racial slight of 20 years before had not been erased by later incidents of genuine American friendship.

It is very clear that a welcome to our country for foreign participants is an important responsibility. Just as it pays for neighbors to be friendly and hospitable to each other, real friendship to our guests from other countries pays off too.

The Bureau of Reclamation can be proud of its roles in bringing success to foreign training programs, and in helping foreign populations to become rejuvenated and rise up with pride and ambition. But just so you'll be on guard—you can never be sure that you don't have a potential Director of Public Works Julian Buendia, Prime Minister Sulleyman Demirel or other outstanding trainee and ally in your midst. # # #

GORDON K. EBERSOLE. Mr. Ebersole, a civil engineer, joined the Bureau of Reclamation as a "chainman" in November 1935 on the Columbia Basin project in Washington. He progressed to the position of Assistant Chief of Foreign Activities, Washington, D.C., then left Reclamation in 1959 for 2 years of service in Korea with AID. In 1961 he was appointed Staff Assistant for Area Redevelopment in the Office of the Secretary, Department of the Interior, where he pioneered on approaches leading to the Appalachian Act of 1965 and the Economic Opportunity Act of 1964. For almost a year before Mr. Ebersole's retirement from Federal service last December, he was on special detail as a consultant to the Office of Economic Opportunity. Continuing in his profession, he recently has been organizing the Human and Natural Resources Institute (HANRI), a nonprofit group of retired professional Federal employees whose skills will be of value in assisting the distressed areas of the Appalachian region.

Reclamation Commissioner Floyd E. Dominy and Congressman B. F. Sisk of California chat informally with visiting engineers, Luciano Decourt of Brazil, Najib Faquiri of Afghanistan, and Hilmi Yagcioglli of Turkey, following the dedication of Los Banos Creek Detention Dam on November 4, 1965.

Outstanding Allies in Our Midst

A few years ago an extensive tour of Northwest power and irriga- tion projects was given to four Afghan dignitaries included in group standing in front of the airplane. The men from Afghani- stan and the positions they held at that time are: His Excellency Hashim Maiwandwal, counselor of embassy and chargé d'affaires in Washington, D.C.; The Honorable Abdussattar Shalizi, honorary consul at San Francisco; His Excellency Abdullah Khan, general president of the Helmand River Valley Authority in his country; and Dr. A. Kayeum, vice president of the Helmand authority. The three American guides are Fred J. Huber, then vice president of International Engineering Co., Don Stoops, then a division chief in the U.S. Foreign Operations Administration; and Gordon K. Ebersole, then head of the Bureau's foreign training branch.

.. Rochanasiri "Rocky" Warindr, right, Administrative Officer of the Royal Irrigation Department of Thailand, stops while inspect- ing a dam to chat with Mr. Ebersole, author of the foregoing article.

A 6-month, in-service training program will be completed in early 1966 for Mrs. Parween Azize. Learning secretarial work at the Columbia Basin Project office in Ephrata, Wash., Mrs. Azize was bettering her qualifications as an employee in the Ministry of Finance in Kabul, capital city of Afghanistan.


TSEH-NANI-AH-GO-AT
WAHWEAP MARINA
CANYON TOURS, INC.

Royal Couple Thrilled by Powell Scene

ENGLAND'S beautiful Princess Margaret and her husband the Earl of Snowdon, while on he real vacation part of their official visit last November, took a good look at Glen Canyon Dam and boated for 5 hours on Lake Powell.

Perfect weather complimented the royal 2-day visit by remaining in the 80's. The sky was blue and slightly hazed by trailing cirrus clouds.

Warmly greeted when she arrived by plane at he Page, Ariz., airport on November 12, Princess Margaret and her official party were escorted without formal ceremonies to the upper floor suite of motel rooms commanding a breathtaking view of he surrounding countryside.

"I've been practicing for weeks what to say to her," recalls Lake Powell motel operator, Art Greene, who for nearly 30 years was a river boat guide on the turbulent Colorado River. "But all I ould think of when I met her was 'Howdy, ma'am'."

When walking over the top of the dam, the spirited Princess seemed deeply interested in the 710-foot-high structure, and at one time ran from one side of the dam to the other to look down, then commented to her husband. Lord Snowdon, placing his hands on the 4-foot-high concrete parapet, leaned to the edge for a better view of the river far below.

While dozens of photographers and television cameramen zeroed in from a boat ramp, the Princess boarded a 34-foot cruiser at the Wahweap boat docks. The boat pulled away into the grandeur of Lake Powell, as shown in the accompanying photograph, with the Princess standing in the shaded area in the stern.

Just outside the harbor, the VIP party received a unique *aloha* welcoming as they neared a rustic, flower decorated "Hawaiian Island." Near the water's edge, Page and Wahweap residents dressed in Hawaiian costumes danced a hula and sang to guitar music.

The 5 hours on the blue lake included trips into scenic side canyon's water skiing and a lunch stop near Kane Creek.

"That's fabulous," exulted the Princess as their cruiser explored the lake's scenic wonders. "That's just gorgeous."

On arriving back at the dock, the chestnut-haired Princess is shown carrying sprigs of desert plants which she had collected from along the shore areas. Bill Greene of Canyon Tours assisted her in leaving the boat.

"I want to tell you that we are coming back," the Princess promised Art Greene.

"Yes," added Lord Snowdon, "and next time I'll do a better job of water skiing." Lord Snowdon had earned a hearty round of applause and a bouquet for his stint on the skis.

Others making the Lake Powell tour with the renowned pair included actress Dorothy McGuire and her husband, famed photographer John Swope; actress Hope Lange and her husband, producer Alan Pakula, actor Roddy McDowall, and host for the royal stay in Arizona, former Ambassador Lewis E. Douglas and his daughter Sharman.

In informal presentations the Princess received a floral key to the town of Page. She also was presented with the bronze, copper-coated Utah State Medal and other gifts from Utah Supreme Court Justice J. Allan Crockett representing the Governor of Utah. ###

Reclamation's 11-City Water Pipe

by GORDON J. FORSYTH, Editor

THERE is no mistaking that recreation at the new Lake Meredith in Texas got off to a good start last summer. One of the reasons for the early enjoyment might have caused a catastrophe instead. The Canadian River had swollen dangerously because of heavy spring rains.

There are two other good reasons: A big new dam was in the right place at the right time to catch and store this water. And a good many townspeople stood ready for the starting day with boats and fishing tackle.

Suddenly it was *Opening Day* at Lake Meredith!

It was like the answer to a dinner bell. Even though the manmade lake opened to the public nearly a year earlier than scheduled, well-outfitted and eager residents sped to the reservoir from all directions. Roads and ramps were not yet complete, but hundreds of shiny new boats were brought to the water's edge and swished out on their maiden voyages.

On the first full weekend of use, in the middle of June, there were about 3,200 surface acres of majestic water available. The single boat ramp in the Sanford Yake Recreation area of the Canadian River project got a severe workout. The ramp was so burdened with the jam of traffic that it would rival any which New York City might create.

People also flocked to the new waters to ski and picnic. Many inlets and coves proved fine for fishing, since the lake also had been stocked early with catfish, bass, and crappie.

It is quite likely that this enthusiastic initiation of the new reservoir would have pleased the late A. A. Meredith, for whom the new body of water was named. As a most energetic backer of the Canadian River project since the dream stage, "Double A" Meredith, as he was called, worked undaunted for the project now in use. Not only were his many years of leadership climaxed by seeing construction of Sanford Dam start in 1962, but for his years of unselfish effort, he was presented with Interior's highest honor award, the Conservation Award by Secretary of the Interior Stewart L. Udall.

The 20-mile-long Meredith reservoir, when full, will have a 1.4 million acre-foot capacity—the largest in the Texas Panhandle. It will be confined by the almost 6,380-foot-long, Reclamation-built Sanford Dam. Approximately 15.3 million cubic yards of embankment materials were required to build this earthen structure up to its 200-foot height.

The dam and reservoir located on the Canadian River about 41 miles from Amarillo will supply the storage needed for the largest municipal and industrial water supply development in Reclamation history.

By July 4, there were two locations near the reservoir that had camping, picnic tables, shelters, water, and sanitation facilities. With continuous development, six other scenic sites will provide camping for a variety of outdoor use. All eight such public facilities will be operated by the National Park Service.

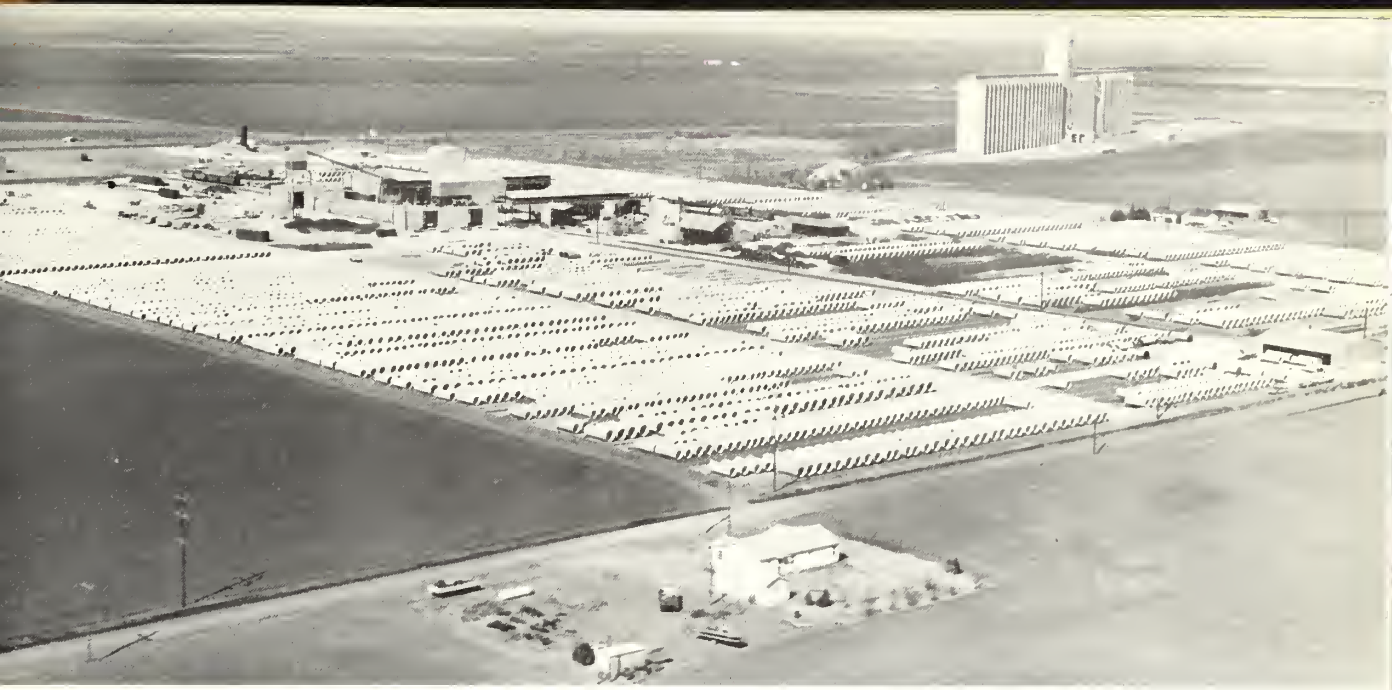
Having a tributary population of about 4 million residents within only a few hours' drive of the new dam and reservoir, plus additional tourists passing through the area, it is considered probable that the annual use of the facilities for recreation will be an impressive 1.5 million visitor-days.

Completed on Time

In keeping with Reclamation traditions, and with the cooperation of contractor H. B. Zachry Co., Sanford Dam's construction was on schedule. Even with the interruptions last spring, when men and machines were pulled off their jobs and moved to Colorado and Kansas to rebuild washed out railroads and highways, Sanford Dam was completed on time.

In the early planning, however, an unusual Texas-sized problem was imminent: the site for the Panhandle's prospective dam and body of water was in the heart of a major natural gas field.

To avoid damage to the rich gas production area, and still bring the advantages of water where it



ow upon row of large concrete pipe at this manufacturing plant and storage yard of Cen-Vi-Ro of Texas, Inc., near Plainview, were stalled in the 322-mile aqueduct.

ad been short for generations, required the most odern technology and considerable savoir faire. What started out as almost an insurmountable job, ecame an exciting challenge of engineering, negoation, and cooperation.

Setting its sights on obtaining satisfying results, e Bureau of Reclamation executed 46 contracts ith owners of gas pipelines and producing wells, nder which the companies relocated their pipenes and either capped wells and redrilled them ertically from outside the reservoir area—or they rilled the gas wells by means of slant drilling rom above the high watermark.

In the case of wells near the reservoir's edge, eclamation had portions of the shoreline diked f to keep well areas dry.

Waiting along the 322 miles of the new water tery for the first flows to come in early 1968 are e 11 member cities of the Canadian River Mucipal Water Authority: Borger, Pampa, Amallo, Brownfield, Lamesa, Levelland, Lubbock, 'Donnell, Plainview, Slaton, and Tahoka. When is big day arrives, water from the area's biggest atering hole will climb, via concrete aqueduct, to marillo and then begin its gravity fall south toard Lubbock and Lamesa.

As a water carrier of Lone Star State magnide this is the longest pipeline ever built by the ureau of Reclamation. The main aqueduct ranges up to 8 feet in diameter and has a capacity of 118 million gallons a day. The average size of the pipe at the different city outlets is about 20 inches in diameter.

The largest water user, Amarillo, will take its new supply—up to 41 million gallons daily—from the aqueduct and move it through a water treatment plant owned by the city. The quantity supplied to each city varies according to population.

Contractor Praised

One construction milestone was noted last September when the first reach of the aqueduct was completed. C. O. Crane, Reclamation's construction engineer for the project praised the firm of R. H. Fulton saying: the construction activity was pursued "diligently and in a workmanlike manner and completed 8 months ahead of schedule."

Fulton, in turn, applauded the Bureau of Reclamation for its cooperation in the project:

> "If all aspects of the Government were run on as economical a basis and businesslike manner as the Bureau of Reclamation handles its construction business," Fulton said, "the people of the Nation would be very proud of Government operation. In my opinion, in construction projects the Bureau of Reclamation is probably one of the best-engineered organizations in the world.

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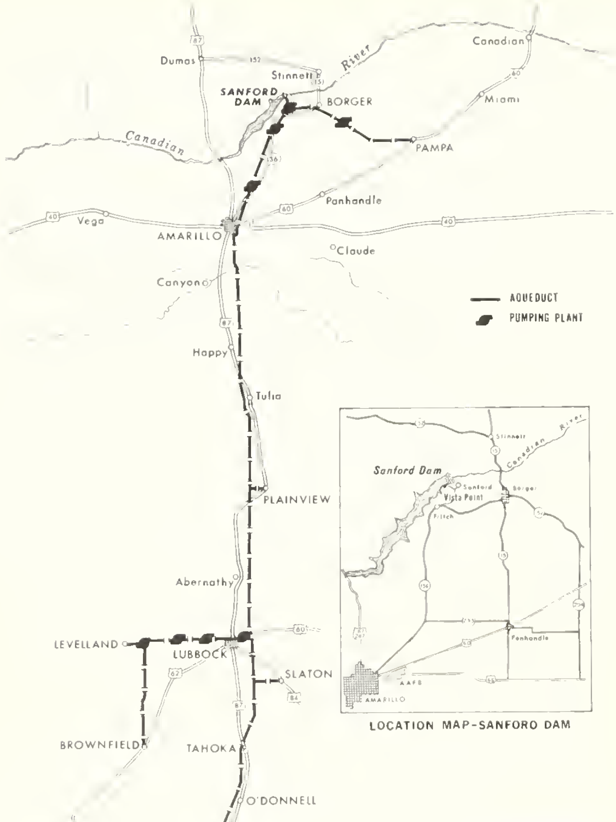


CANADIAN RIVER PROJECT
TEXAS

He added, "I definitely feel that the taxpayers are getting dollars received for all work supervised by the Bureau of Reclamation."

At various points in the system, other structures will assure complete operation. These include 10 pumping stations, 2 regulating reservoirs, and chlorination facilities.

Three of the four largest pumping plants located between the dam and the city of Amarillo will have a forebay to permit free discharge from the preceding section of the system. A surge tank will be erected near each pumping plant. These tanks will vary in height from 75 to 192 feet and will prevent damage along the line from high water pressures.

The pumping stations will be operated by remote control using a telemetering system.

The flood control outlet works at Sanford Dam are at the base of the left abutment and include a three-barrel conduit which will permit 36,400 cubic feet of flowing water per second. A 61-foot-wide morning glory spillway also will release water from Lake Meredith at the left side of th dam.

Of the total reservoir space, 462,100 acre-fee are for flood control levels. All floods of histori cal record will be controlled to nondamaging pro portions with discharges below the dam limited t 25,000 cubic feet per second. The greatest floo on record had a peak of 257,000 cubic feet pe second.

In the right abutment, water will be starte through the huge aqueduct and pumps.

Like many other water reclaiming projects i our Nation, plans for the Canadian River projec survived their early years only on the stanchnes of strong and resilient men. But now, as the con struction era of the CRP nears its end, preciou water becomes available for long-term multipl uses including the growing municipal and indus trial needs. And another water project proves it worth in present and future opportunities.

# # #

E. L. White Appointed Planning Officer

A new Columbia-North Pacific Planning Offic has been established at Portland, Oreg., effectiv last November, to provide representation for th Department and the Bureau in that area, wit Elwyn L. White of region 1 as head. Mr. Whit leaves the position of Regional Project Develop ment Engineer in the Bureau headquarters a Boise, Idaho.

This is the second such full-time office created b Reclamation. A similar assignment is held b Bruce Johnson, the Missouri River Basin Plan ning Officer whose office was established at Omah in 1964.

The Miracle Leak Sealer

It has been said that "miracles are propitious ccidents."

Quite a miraculous discovery—one of good omen nd surely by accident—is a new technique for ealing of leaking concrete pipes in irrigation ystems.

Announcement of the discovery was made by [. V. Eastman, secretary-manager of the Chowilla Water District, Chowchilla, Calif. Eastian explained that through the use of the ferlizer, anhydrous ammonia (NH_3), seals in conrete pipelines are made economically and with elative ease.

Eastman indicated that his district, which reives its water from Friant Dam of the Bureau's entral Valley project, completed the construcon of many miles of concrete pipelines and other icilities.

When the pipeline was placed in operation in farch of 1964, several hundred leaks appeared alost immediately. He said that a survey of irriation district engineers and managers showed iat this was not uncommon when comparatively old water is carried in concrete pipes. Past exerience had been to patch pipes by hand, or utting fine sawdust in the water to stop most aks.

The experience of a large landowner with a milar problem has been reported and verified. he landowner used anhydrous ammonia for ferlizing certain crops; and this material had been pplied with irrigation water through a 30-inch onolithic pipeline (cast-in-place line). He noted iat the pipeline, which had been subject to severe aking, stopped leaking after the use of the amazig product. The pipeline has been used for 3 ıll years without any recurring leaks.

On April 1, 1964, Mr. Eastman's Chowchilla Vater District started an experiment with the ew technique in 3 miles of 30-inch and 36-inch ıonolithic concrete pipeline. The line was laid uring the previous year, employing the usual ractices.

There were 171 leaks in the 3 miles of line. Since iere was no information as to how much NH_3 as required, application was begun with 80 units an hour and cut to 40 units an hour after 3 days. After a period of 14 days all but 12 leaks had stopped completely. These 12 leaks were patched by hand after the lines were drained. Later experience, Eastman said, indicated that the leaks could have been sealed by continued application of the new leak stopper.

NH_3 was delivered to the Chowchilla District in pressure tanks, and the amount used could be determined at all times by the gages on the tanks.

Three Miles for $300

Eastman indicated that about $300 worth of NH_3 was used in the experimental repair work in the first 3 miles of line. It would have cost more than $1,000 to patch the particular lines by hand.

"Undoubtedly, good results can be obtained with the use of much smaller quantities of the product than were used in the Chowchilla experiments," Eastman declared. "In some cases as little as 20 to 40 units an hour will get good results, and water with a high content of calcium carbonate will reduce the quantities of NH_3 necessary for successful use."

In cases where the calcium content is not adequate in the water in the pipes, a means of adding proper amounts of calcium and NH_3 to the water is needed. Treatment at Chowchilla was extended to precast concrete lines running from 14 to 24 inches in diameter and in monolithic lines from 24 to 48 inches in size. These results were uniformly good, according to Eastman. Certain pipelines which had persisted in leaking after continuous hand patching were made tight with the new sealer. There was some concern as to whether any leaks would reopen due to waterflow or withdrawal of water from lines, but no difficulty was experienced.

For the benefit of those who may not be familiar with the pipeline terms: Precast pipe is concrete pipe which is made in various lengths and is then hauled to a construction location and installed to make a continuous pipeline. Millions of miles of this pipe are in use.

Monolithic pipe is made in the location where it is to be used. The process is to excavate a trench with the bottom rounded like the shape of pipe; and with the use of forms and equipment, concrete is poured into the movable form to make a continuous pipeline which may be a few feet long

(*Continued on page 25*)

STYLING FOR BEAUTY

by PAUL SELONKE, Editor of The "Current" News

This bank is graded for honeysuckle planting in the cooperative Scottsdale beautification program.

"*Salt River Project Assumes Major Role in Beautification Program in Phoenix, Arizona*"—"*Operation Facelift.*" This is how writers have described the Salt River project's new "Community Styling" program which was announced shortly after the White House Conference on Natural Beauty in Washington, D.C., last summer.

Actually, it is more than a "facelift." It might better be called the "new look of tomorrow" among Reclamation irrigation and power projects in the swift-growing metropolitan areas of the West.

As conceived by the Salt River project, "Community Styling" is the title of its all-out program to make its power and irrigation facilities more attractive and compatible with the natural beauty of a burgeoning Salt River Valley, which has the city of Phoenix as its hub.

The styling program wasn't triggered by the White House Conference. It had been under study for several years. With the studies completed, plus the availability of new methods and equipment, the Salt River project announced its "Community Styling" concept. It is a plan for the project to enlarge on the efforts of other groups to beautify Phoenix and the Valley areas. Specifically, it puts new emphasis on the appearance of Salt River project facilities during new construction and the modernization of the older facilities.

"We at the Salt River project have always emphasized low-cost power and water," Project General Manager Rod J. McMullin said in regard to the program. "We realize that the new styling program will impose much greater responsibility

This decorative stone facing makes the irrigation structure functional as well as pleasing to the eye and permanent. (All photos, by courtesy of the Salt River Project.)

This is a power transformer on a pad sitting neatly by the service entrance of an apartment being served by an underground electric power system. Some transformers are placed underground.

Precast slabs faced with flagstone give beauty to the superstructure of this underground lateral. The creations attract much favorable comment.

By cooperative agreements with builders during the past 4 years, there are 20 subdivisions in SRP areas served with underground distribution lines to enhance the skyline.

This new type of decorative, attractively painted Meyer pole supports the 230-kilovolt transmission line from Papago Buttes Substation into the Phoenix area.

in the fields of construction and maintenance, and yet we are not forgetting that service to the customer has first priority."

He emphasized, too, that this new styling program may not mean instant beauty in all areas of the Salt River Valley. "Many years were required to build our present system," he added, "and considerable time will be necessary to make adjustments in the appearance of our facilities."

Nonetheless, considerable progress has been made in improving design of new facilities and in modernizing those already in existence. The project breaks down "Community Styling" into two categories: "Power Styling"—improvements in power facilities; and "Hydro Styling"—beautification of irrigation structures.

Power Styling

With the recent growth in the Phoenix area, there has been a trend toward beautification. This includes a growing interest in reducing the number of overhead powerlines and in improving the appearance of substations within urban districts.

Salt River project has made a long-term study of these problems and has examined the various known methods of making improvements. Tradi-

Shrubbery placed around old-style, tall substation structures such as this, helps in beautification. However, by replacing them with more attractive low-profile substations, the old ones will become a thing of the past in SRP neighborhoods.

A conduit painted with light-color paint attracts no undue attention to the power going underground at the edge of a subdivision. Arrow points to conduit by pole.

tionally, need, function, and cost must be taken into consideration when appearance is a factor.

The project has been placing distribution lines underground in residential areas where cost is feasible. In fact, underground distribution service has been made for the last 4 years under a cooperative arrangement with home developers and builders. Twenty subdivisions and residential areas are now being served underground.

Such underground installations were not financially feasible a short time ago, but the Salt River project adopting various technological advances, has been able to serve residential and some commercial areas with underground conductors and related equipment.

Scientific technology has not reached the stage of permitting underground construction of relatively long distribution feeders and high-voltage transmission lines. Although it is economically impossible at this time, Assistant General Manager Glenn Brandow in charge of the project power operations, feels that the needed breakthroughs may be around the corner insofar as distribution feeders are concerned—that is, if research and scientific advancements can be accelerated.

"Underground high-voltage transmission, however, cannot be expected in the near future," Mr. Brandow predicted.

Meanwhile, the Salt River project is using every means to provide a more pleasing appearance to both transmission and distribution lines. This includes the use of gray steel and gray-stained wood poles which are fitted with similarly colored hardware so that they appear to fade into the sky.

To avoid congested appearance, crossarms are being eliminated whenever possible, and transformers are being mounted in ways that make them as inconspicuous as possible.

Old substations are being replaced with new low-profile gear which doesn't protrude conspicuously. In these cases, colored block fences rather than the old chain-link type enclose the substation, and trees and shrubery are planted around the wall to give the substation a parklike appearance and one that breaks the straight lines against the skyline.

These are a few of the many innovations in the Salt River project's styling program.

Hydrostyling

Hydrostyling of the Salt River project's water and irrigation facilities is a rather dramatic styl-

This kind of irrigation feature is a thing of the past on the Salt River Project.

ing concept. Eleven examples on both new and existing structures can be found in various parts of the valley.

For years the Salt River project's water and irrigation facilities were controlled by cost and efficiency alone. They were designed simply to fulfill the purpose of distributing water. Today, in order to cooperate with the community effort, the Salt River project is designing more picturesque structures.

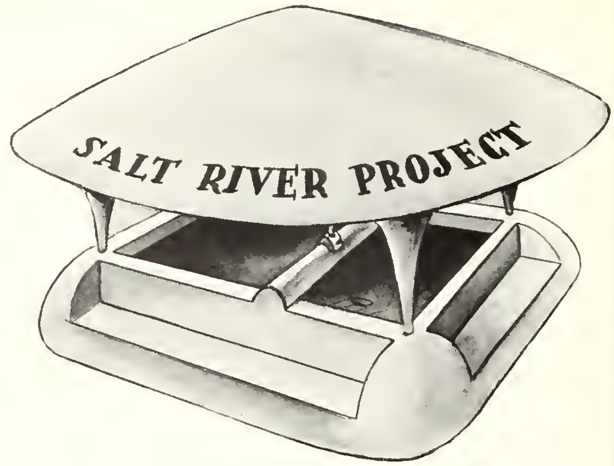
"From an engineering standpoint, we engineers were trained to consider first the functional characteristics of a concrete structure, placing very little emphasis on the aesthetic value," explained Assistant General Manager Henry Shipley, who is in charge of the Salt River project water operations. "However, with a little ingenuity and imagination we have been able to add considerable attractiveness to the conventional concrete irrigation structure. A dressing up of the outward appearance, costs, in some cases, only $35 a structure".

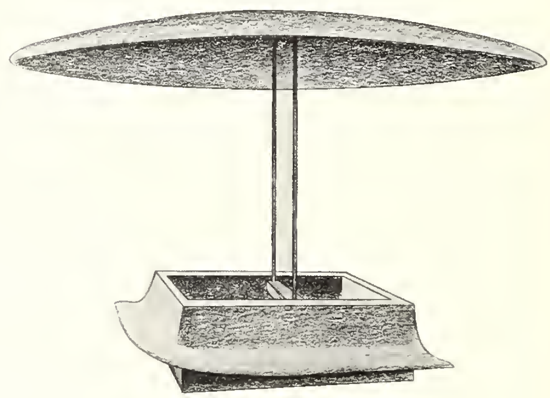
The present precasting of structures, using keyways, are the most modern types in use and it wasn't until late in 1964 that hydrostyling was included in the precasting effort. Decorative flagstones are cemented into that part of a slab which is exposed above the ground. These hydrostyled structures are attractive, and have resulted in considerable favorable public comment.

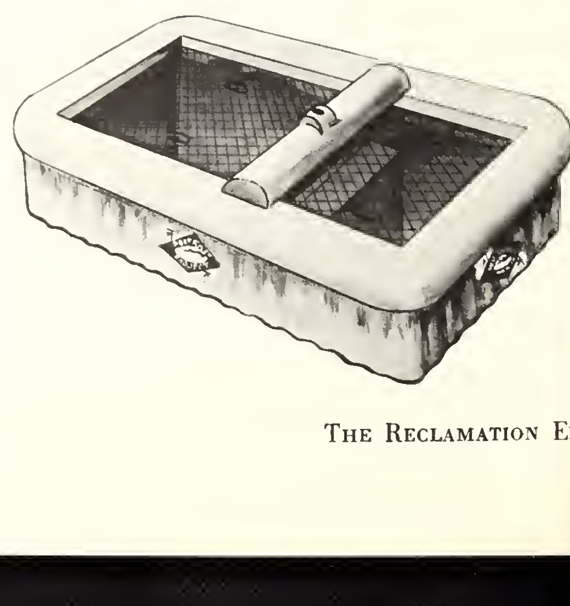
Salt River project is cooperating with various beautification committees. It has approved planting of trees and other forms of landscaping on some canal banks. In preparing for such a planting, the project first levels and shapes the banks.

One project of this kind was recently completed with the cooperation of the Salt River project, the Scottsdale chapter of DeMolay and Boy Scout Troop 241. At the request of the city of Scottsdale and the Valley Beautiful Citizens Committee, the Salt River project cleared and graded more than a mile of canal bank for a planting. Scottsdale purchased some 1,100 purple-stemmed honeysuckles and the boys set out the flowering vines under the skillful direction of Gwin Hendrix, head gardener for the Hotel Valley Ho in Scottsdale.

Beautification has become an important factor in the future of the Salt River Valley—and the Salt River project is playing its part in the many styling and modernizing efforts. # # #

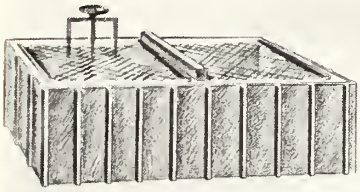






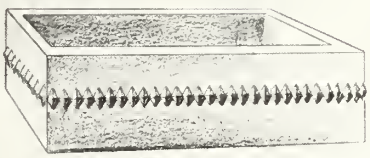
More Ideas for Face Lifting

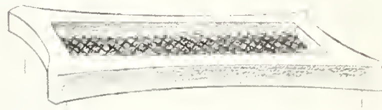
This group of drawings are suggested variations for lending a pleasing design to the aboveground portions of irrigation turnouts.



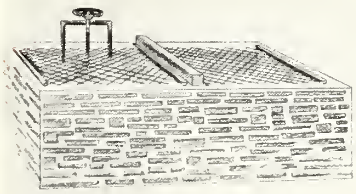
REDWOOD VENEER OVER EXISTING STRUCTURE
SCOTTSDALE SUGGESTED LOCATION

PRECAST
MONOLITHIC
MODULAR PANELS
VENEER PANELS
PRESTRESSED

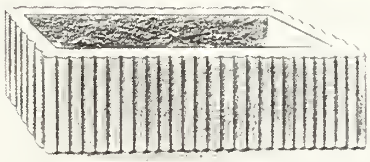


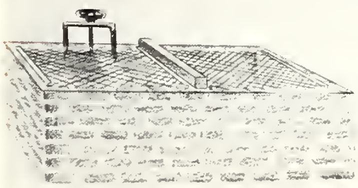


NEW STRUCTURE COVER WITH HINGED GRILL

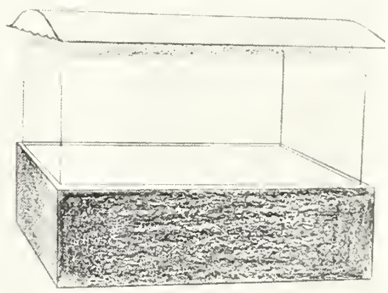


FLAGSTONE VENEER OVER EXISTING STRUCTURE

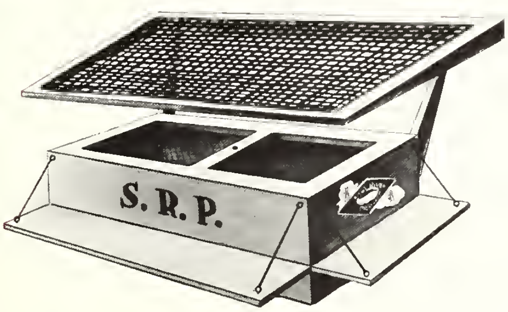


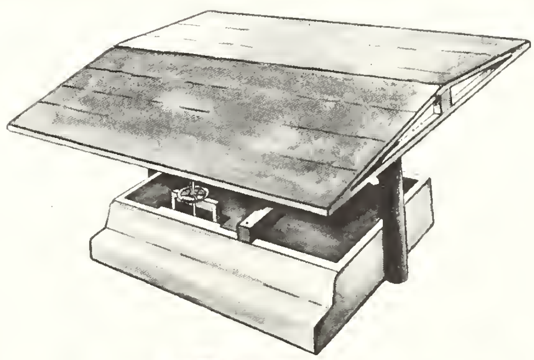


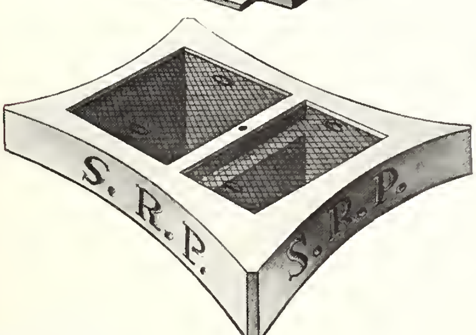
BRICK VENEER OVER EXISTING STRUCTURE

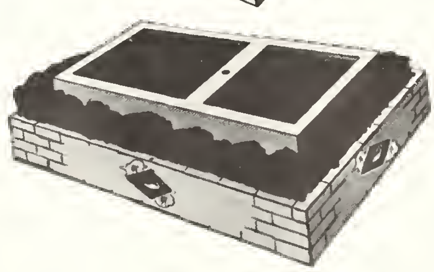


SHOWCASE FOR APPLIANCES ON EXIST. STR. NEAR
SHOPPING CENTERS.









On the Garrison Diversion Unit . . .

North Dakota's "Plan Ahead" Farm

by R. E. DOROTHY, Chief, Irrigation Division, Bismarck, N. Dak.

Since the operation started 6 years ago, research at the Carrington Station has supplied answers to many irrigation questions for farmers in the north-central part of North Dakota. The Carrington Research Farm is located in Reclamation's new 250,000-acre Garrison Diversion Unit area, which was authorized for construction in August 1965.

With the acreage of this new unit, which will be developed to support an additional 700 new farm families, irrigation know-how will be in even greater demand. The research farm's knowledge of a more varied farm production through irrigation than was possible before, will open the gates to more opportunities and profits for North Dakotans.

The Carrington Irrigation Branch Station is part of the State University's Agricultural Experiment Station. To find the most suitable site for the irrigation experiment farm, specialists from the Agricultural Station, with the aid of the Bureau of Reclamation, inspected 12 potential sites in 1957, all within the Garrison Diversion Unit area.

Since the proposed station would depend in its early years upon well water for irrigation, test wells were drilled. When results of the test wells at a site 4 miles from Carrington proved in 1958 to be more than adequate, this location was selected and the State of North Dakota purchased the farm.

A second factor that influenced the selection of the site was its excellent location. There are approximately 330,000 acres of potentially irrigable land within a radius of 60 miles of the station.

Containing 580 tillable acres, the section has 380 acres classified as irrigable. The soils are a Kief loam which, under dryland farming operations, rapidly show the effect of drought and a decrease in crop production.

At a cost of 17.5 cents per cubic yard, 155 acres were leveled for irrigation by a commercial contractor in 1959. An additional 50 acres were leveled during the fall of 1960 with station labor and equipment consisting of a rented 8-yard elevating scraper pulled by a 5-plow farm tractor. Additional land was leveled in 1961 by station forces

The irrigated sugarbeet crop, part of the research program at the Carrington Station is being inspected by Superintendent Olson, left, and a neighboring farmer.

and more will be as the needs increase at the station. At a cost of only 11 cents per cubic yard, this technique of leveling has impressed the irrigators as a potential for their offpeak work.

Well Water Supply

The irrigation water supply for the station is from two concrete cased wells, each slightly over 90 feet deep, having a static water level some 30 feet below ground surface and a drawdown of about 20 feet. The well in the southeast quarter of the section pumps 1,100 gallons per minute for 90 irrigable acres, while the well in the northeast quarter produces 1,700 gallons per minute for 150 acres. The southeast well is driven by a 34 horsepower gasoline engine and the other is powered by a 30 horsepower electric motor.

A third well added recently will provide a water supply for a self-propelled sprinkler system to be used on 120 acres of land not suited to gravity irrigation.

Faced with increasing demands for funds from all departments of the State government, the North Dakota Legislature has found it difficult to provide all of the requested funds for the station facilities as rapidly as may have been desired; however, the station is being developed in an orderly and logical manner.

To date the facilities include the superintendent's house, crop storage and laboratory building, machine shed, a combination crop-threshing and potato storage building and a well-equipped farm shop, representing an investment of nearly $120,000. Still to be constructed are additional housing for station employees, livestock feeding facilities and miscellaneous minor structures.

It is one thing to have the land, the facilities and the irrigation water, but the catalyst who can weld all of these elements into a successful research center is a good station superintendent. At Carrington, this is Howard M. Olson, a native North Dakotan who graduated from the State University with a degree in Agricultural Engineering. He completed his work for a Master's Degree in Irrigation at Utah State University. Howard's excellent background includes his former work with the Bureau of Reclamation at the Minot office. He also has been with the Agricultural Research Service Field Station in Mandan, and Superintendent of the North Dakota Williston Branch Station.

The discharge from this concrete cased well produces 1,700 gallons of water per minute.

At Williston Station, Howard was responsible for the small irrigation research program carried on along with the usual dryland farm research. The location of the Williston Station within the Garrison Reservoir site was a factor in prompting the establishment of the new Carrington Station.

The objective of the Carrington Irrigation Station is to determine which crops and crop varieties provide the greatest increase in yield and farm income from the application of irrigation water. This involves not only a study of crop varieties but also of tillage, seeding methods, weed control, fertilizer levels, and water requirements.

The questions the station operator hopes to answer are: "What crop varieties are best for irrigation in North Dakota?" "How does irrigated corn silage compare with forage sorghums in total yield and feed value?" "What specialty crops can be put under irrigation in this area?"

To make many of the crop yield measurements at Carrington, it is necessary to have comparison plantings of nonirrigated (dryland) and irrigated crops. The nonirrigated results can be considered typical of some of the surrounding area and form a basis for some of the decisions the dryland farmer will have to make on his own farm.

Specialty Crops

At the "plan ahead" farm specialty crops like safflower, peppermint and tame yellow mustard are being tried. An interesting planting of flowers, fruit trees and woody ornamentals was started in 1964 in cooperation with the Horticultural Department of the State University. This has created a lot of interest among visitors, especially women who tour the Station.

In 1963, trial plantings of five garden tomato varieties commonly known in North Dakota gardens were made. With irrigation water and fertilizer, three of the five varieties produced over 25 tons per acre, and the remaining two topped 20 tons.

Although it is not in the principal sugarbeet producing area of North Dakota, the station grows 30 to 40 acres of sugarbeets each year on an experimental basis through the cooperation of sugar companies and railroads. The beets are shipped by rail to Sidney, Mont., for processing. In spite of a handicap year in 1963, the yield was 14.4 tons an acre with a sugar content of 16.3 percent. Howard feels that yields of 20 tons or more an acre are possible.

While the accumulated data on crop varieties, yields and other factors are highly desirable, perhaps the most important research activity of the station has not yet started—livestock feeding.

Holum Said More Beef

Last October, Assistant Secretary of the Interior Kenneth Holum said in a speech at Grand Forks, N. Dak., about the greater potential in this part of the State: "The Garrison Diversion project, and similar units that follow will permit our high, semiarid prairie country to diversify its economy and our farmers to diversify their cropping patterns. The Nation's breadbasket will become an urgently needed new source of meat and animal products. We will raise less wheat and more beef."

The irrigation system of the huge new multipurpose unit includes construction of 1,865 miles of canals and laterals, 4 regulating reservoirs, 141 pumping plants, and about 2,813 miles of drains for this plains region. It also will bring long-awaited supplies of municipal and industrial water, enhance fish and wildlife resources, and provide recreation opportunities.

The livestock feeding program at the Carrington Station will relate forage and feed production to pounds of finished meat or dairy products. Because of climatic conditions and the short growing season, North Dakota irrigation farmers will, in a large degree, depend on producing livestock feed on their farms and marketing the feed through livestock. Approximately 60 percent of the irrigated land on the Garrison Diversion Unit will be devoted to growing feed crops, such as alfalfa hay, corn silage, and feed grains. For this reason the Carrington Station management is anxious to start the livestock feeding program.

Superintendent Olson has proposed that the station's feeder calves and yearlings be obtained from local dryland ranchers on a share basis, since the station is not interested in a breeding herd and would prefer not to use the feedlot stock. To experiment with the forage utilization in the feed lot as related to irrigated feed crops is preferred, believing that the share plan would also have advantages for the local ranchers.

The Agricultural Engineering Department of North Dakota State University is conducting tests on sections of concrete canal and buried concrete irrigation pipe to determine their durability to the climatic conditions of that region. Also the Agricultural Research Service of the Department of Agriculture is carrying out tests using sprinkler systems to determine the maximum crops possible from minimum amounts of water.

Annual Tours

Tours of the station are given to many groups and individuals. At the annual "Field Day," special demonstrations of irrigation methods, land


Howard mixes insecticide for field spraying, as his son, Paul, "supervises" operations.

leveling and well drilling supplement the usual station tour.

Commenting on what he thought were the most significant results of the first 4 years at the station, Olson said, "It has created an awareness and interest in irrigation by the people of North Dakota that did not exist before. Several farmers in this area alone have gone into irrigation since seeing this operation. A surprising number drive great distances each year to inspect it."

Two well remembered visitors were Congressmen Wayne Aspinall of Colorado and Walter Rodgers of Texas, who toured the station as part of a visit to the Garrison Diversion Unit.

"We have accumulated some basic data on irrigated crop varieties, yields, general water requirements, fertilizer levels and similar aspects of irrigation research," Olson continued, "but it will be a few years yet before the real value of the station will be apparent."

Everyone who knows Howard Olson and who is familiar with the work underway at the Carrington Irrigation Branch Station knows that tremendous strides have been taken in these first few years and are confident that greater progress will be made in the next five. # # #

THAT GORGEOUS FLAMING GORGE

The remote northeast corner of Utah has become quite a center of attention. It's because of that Gorgeous Flaming Mountain Gorge—Flaming Gorge. (A bit thickly poured on, you may say. But it's typical of the way many like to describe this beauty spot.)

Of course, the spectacular area of precipitous canyons has been there for several eons, but because of the new Flaming Gorge Dam, which blocks the Green River in awesome magnitude, more and more people go there.

They want to see the 502-foot-high concrete dam and the beautiful reservoir. They want to see the reason for naming that part of the Uinta Mountains, Flaming Gorge. In addition to the raving over the exotic views, people are amazed at how well known the area already is for its vast resources of fishing, camping, and boating.

Attesting to this has been the increasing stream of traffic on roads north from Vernal, Utah, or south from Green River, Wyo.

At the end of the drive, the visitors stop for a few minutes of welcoming and orientation at the new Visitor Center. This modern building is conveniently nestled near one end of Flaming Gorge Dam. It is the principal structure resulting from a unique interagency recreation program of handling visitors. Inside, are many visuals that heighten one's interest plus a sign explaining the recreational offering. The sign says:

> "YOUR FEDERAL AGENCIES, WORKING WITH THE STATES OF WYOMING AND UTAH, OFFER AN ENRICHED RECREATION EXPERIENCE CENTERING ON MAN-MADE FLAMING GORGE LAKE."

The sign sums up the recreational effort brought to fruition jointly by the Department of Agriculture's Forest Service and the Department of the Interior's National Park Service, Bureau of Land Management, Fish and Wildlife Service, and Bureau of Reclamation.

Flaming Gorge Dam has changed the scenic, but isolated, mountain valley into a summer haven for many thousands of outdoor sports enthusiasts. But its history is interesting too.

Outlaws used to hide out in the Flaming Gorge area because of the valuable protection of its remote wilderness. The settlers who moved into the valleys were hardy specimens able to slug it out with a severe winter climate, staggering transportation problems, and both wary and ferocious animals. In those early days, the six-shooter and the saddle-hung carbine were needed as much for life in this country as the pioneer axe and grubstake.

To Tame Wilderness

In helping to tame the Flaming Gorge wilderness, President Theodore Roosevelt established the Ashley National Forest, comprising much of the high Uinta Mountains, in 1908. The Grazing Service, later the Bureau of Land Management, established stock quotas on land outside the National Forest to control overgrazing. Roads were cut through the rock ridges and slashed through the forest. They weren't good roads by today's standards, but they were a boon to village folk.

When the Bureau of Reclamation moved in to build Flaming Gorge Dam in 1957, we didn't find many people packing six-guns. But, we found individualists to the core—strong, resilient, and resourceful. Some of the friendliest people in the world. Not many lived there year-around. And Daggett County was populated with only about 500 people, about half of whom lived in the county's only town, Manila.

When planning the story to be told at the Flaming Gorge Visitor Center at the dam, one must take into account the tremendous changes that were caused by the building of the dam. The important role of the structure in the Colorado River storage project is only part of the picture. The introduction of about 2,000 construction workers

Some boaters take a wind-powered ride for a quiet, pleasant change on the glistening waters of Flaming Gorge reservoir.

and families to the area was an event of major proportions.

A serene Red Canyon was rent by the roar of blasting, the noise of bulldozers and shovels, and later by the rumble of concrete mixers and pounding of air compressors. New paved highways enabled heavy trucks to carry equipment and supplies from all parts of the Nation.

Before anyone could think that the region would settle back into its old ways after the dam was finished in 1963, they reckoned with Flaming Gorge Lake. Fortunately, both the Forest Service and the National Park Service prepared for great numbers of visitors to come to the lake. Recreation development on the downstream 30 miles of the lake, bordered by Ashley National Forest, was logically the responsibility of the Forest Service.

Lake-oriented recreation north of the forest, about 60 miles (mostly in Wyoming), was assigned to the National Park Service. Both agencies began construction of boat ramps and campgrounds even before the lake was formed. After eliminating trash fish in the Green River, the Fish and Wildlife Service, working with the States of Utah and Wyoming, planted some 6 million trout in the lake and in the river below the dam.

Visit the Lake

Recreation facilities didn't go in a minute too soon. The gates of the diversion tunnel of the dam were closed in November 1962. In 1963 there were 400,000 visitors to the young, rising lake; in 1964 there were 571,000.

The year, 1965, saw a phenomenal 743,000 visitors at the dam and on the lake. On the last July Fourth weekend, there were more than 40,000 people on and around the lake. Campgrounds were chock full. Ranchers and townspeople around Manila helped out in a neighborly fashion by letting visitors camp in their yards. Many tourists simply gave up looking and camped in unimproved areas. All agencies had worked long and hard to make recreation as successful as hydropower generation and other multipurpose river regulation.

Early in the joint-agency planning of the exhibit for the Visitor Center it was agreed that a large relief model of the lake and adjacent areas would be the central exhibit. To tell the story of the combined facilities, three large wall panels were painted, and titled: "YEARS OF PLANNING, YEARS OF BUILDING, and YEARS OF SERVICE."

About 59,000 people in 1965 received guidance information at the Flaming Gorge Visitor Center shown in the center of the photo.

Expert exhibit builders at the National Park Service's Western Museum Laboratory in San Francisco constructed the panels. Artist Ernest Norling of Seattle painted a 6- x 10-foot mural-montage depicting the activities of Indians, fur trappers, Government explorers, outlaws, settlers, and others. When his effort exceeded the highest expectations, we again called upon Mr. Norling to show the naming of Flaming Gorge in the graceful, vermilion-colored canyon. Below the painting appears a quotation from Major John Wesley Powell's diary on his naming the gorge on his 1869 river exploration:

> "The river glides on in a quiet way as if it thought a mountain range no formidable obstruction to its course. It enters the range by a flaring, brilliant, red gorge, that may be seen from the north a score of miles away . . . This is the head of the first canyon we are about to explore . . . an introductory one to a series made by the river through this range. We name it Flaming Gorge."

It is perhaps unimportant to the casual visitor, but the well-qualified guides at the Visitor Center carry no agency identification. But they do supply interesting identification of the area's points of curiosity. Their service is provided by the Forest and the National Park Services.

By taking a few minutes at the Visitor Center last year, nearly 59,000 people were aided in reaching special scenic areas and campgrounds, and were given an appreciation for the Flaming Gorge reclamation project. # # #

(*Continued from "The Miracle Leak Sealer," page 11.*)

or extend for miles. The equipment is moved forward constantly so that the pipe is generally made without joints and is a continous structure. Cast-in-place pipe is generally less expensive than other pipe and is used in larger sizes, generally from 30 to 48 inches in diameter.

Eastman explained that the addition of NH_3 to water precipitates or frees the calcium carbonate, gives it a milky look and carries it to the cracks and seals them. "Nothing further is done to apply the material. The practice of draining the pipelines after treatment to permit the calcium carbonate in the cracks 3 or 4 days to dry up and harden, may or may not be a necessary precaution," said Eastman.

Some of the product covers the entire inside of the pipeline and will cure large cracks as well as small ones.

Well Water Used

It was explained that in the Chowchilla experiment, river water was used at first, but it became necessary to use water from wells because of shortage of canal water at the time, and the amount of calcium available varied from different wells. Treatment with water from one well could cure all leaks in 12 hours, it was reported, and from other wells it would take 3 or 4 days, and no sealing could be obtained with water from two wells.

The best results were obtained using water which carried 85 parts NH_3 per million of calcium, but satisfactory cures also were made with smaller amounts of calcium.

One ton of NH_3 has 1,640 pounds of ammonia and 360 pounds of water. A pound of this mixture is called a unit. As little as 20 units an hour at a cost of $1 has been used, by the Chowchilla District. The district's use of 80 units cost $4.

Either the quality of water or the efficiency of the treatment can be determined by running a trial treatment for 24 hours. However, it is more practical to get a half gallon of the water tested for calcium content in a laboratory. Generally, water commonly called "hard" water will contain adequate calcium, while "soft" water does not.

It is desirable to move water through the lines at a constant but moderate rate in order to obtain sealing throughout. Caution was necessary in draining lines or permitting farmers to use the drain water because of the high amount of nitrogen present, which can damage some crops. Most of the drain water was used on crops which needed nitrogen and no difficulty was experienced in disposing of all treatment water.

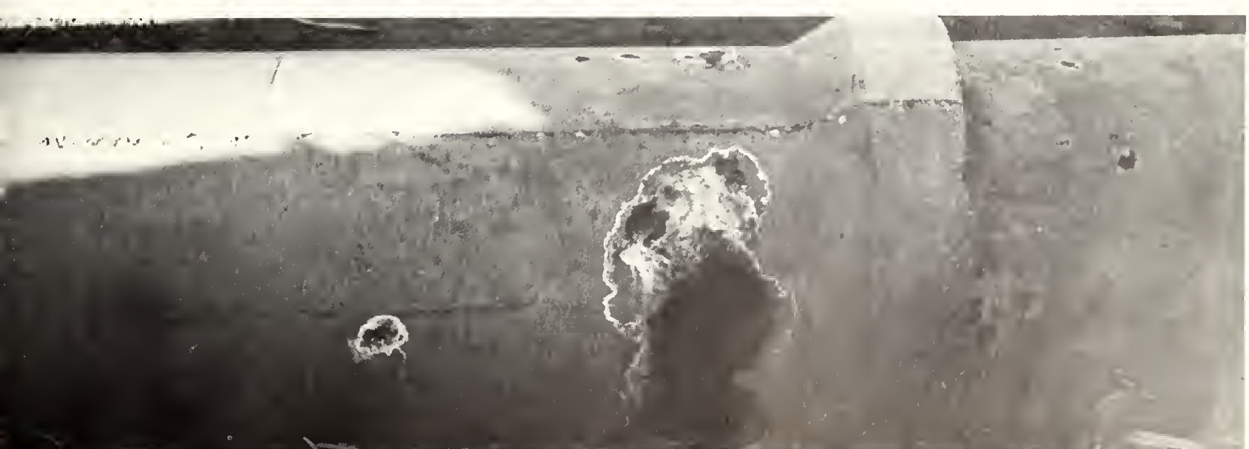
Eastman says that quicker action will result if the pipeline is treated in short sections, no more than one-half mile long. The NH_3 supply tank should be moved and the material put in at the higher end of each new length. Delivery from the supply tanks into pipelines is through short pressure hoses into standpipes or other elevated pipe connections.

"We have been asked whether use of the new sealer will damage the pipelines, and we have been assured by chemists that this treatment will not deteriorate the concrete in pipelines in any degree," he said. "Possibly there may be some strengthening of the pipe; however, it is assumed that cracks may occur in new places if conditions are such that the pipe would normally crack.

"The pipelines being treated should be completely filled with water so that the top as well as the sides and bottom will be contacted by the calcium. Then a thin coating, not much thicker than paint or whitewash, will cover the entire inside of the pipeline," he said.

Because of NH_3's liquid state and strong ammonia odor, a person should exercise care in entering large pipelines after treatment. # # #

Leaky water pipes can be repaired economically before they get as bad as this, as is told in this article.



Diver Checks Spillway Bucket at Grand Coulee Dam

The annual subsurface check on the spillway "bucket" and the riverbed immediately on the downstream side of Grand Coulee Dam in Washington was made last fall by Seattle diver, Harley King. As shown in the photograph, he is helped into his diving gear by tender Ed Snyder of Grand Coulee. The depth of the inspection is about 75 feet. In spite of the estimated 10,000 tons of pounding water that plunge into the bucket during summer releases, wear has been minor.

Col. A. E. Howse Gets Conservation Award

Col. A. E. Howse, former mayor of Wichita, Kans., was presented the Department's Conservation Award last November by Regional Director Leon W. Hill of the Region 5 headquarters at Amarillo, Tex. Col. Howse earned the award for his leadership in planning for Cheney Dam and Reservoir in Kansas. He is shown on the left in the accompanying photograph receiving congratulations from Mr. Hill.

In a letter to the awardee, Secretary of the Interior Stewart L. Udall said: "During the past several years you have been a key figure in developing a sound, long-range water program for the Wichita area. You played a major role in nearly all the important decisions and negotiations."

Photograph by the Wichita Eagle.

Fifth Job Corps Center Is Dedicated

The Marsing Job Corps Conservation Center—the fifth such Reclamation-operated center—was dedicated on December 11, 1965. An audience of about 600, which exceeded expectations by about 200 persons, attended the ceremonies. On the program were officials of the community, the State of Idaho and the Federal Government. Cleve Bolingbroke is director of the center.

As a memento of the dedication, each of the 112 Corpsmen were given a copy of a county newspaper, "The Owyhee Nugget," which devoted its entire front and back pages to articles about the center's programs and goals, and printed the name and hometown of each enrollee.

The Marsing High School band, playing for the ceremonies, was one example of the considerable community participation in the event.

CALIFORNIA FLOOD WORK NOMINATED FOR 1966 OUTSTANDING AWARD

One Example
Before Rehabilitation

After Rehabilitation

The Northern California Flood Rehabilitation Vork, in which the Bureau had a major role, has een entered in the competition for the 1966 Outtanding Civil Engineering Achievement. The nnual contest is sponsored by the American Society of Civil Engineers, a 55,000-member proessional society.

Won by Glen Canyon Dam in Arizona in 1964, he award is given "to the project which demontrates the greatest engineering skills and repreents the greatest contribution to civil engineering progress and mankind." Six additional projects lso will be considered by a committee composed of eading engineering magazine editors.

The Northern California Flood Rehabilitation Vork followed the disastrous Christmas floods of December 1964 which wrought great damage in he northern half of the great Central Valley and long northern California coastal streams. Flood ontrol works in the Central Valley prevented vhat might have been one of the Nation's worst atural disasters. Approximately $200 million vorth of damage was done in a six-county area. The 5-day storm was marked by precipitation otals as high as 30 inches, and exceeded 20 inches over large areas.

Rehabilitation work, organized and conducted y civil engineers in every level of responsibility, was a key effort in the unparalleled work that had to be done to revive the stricken region.

Other projects which have been nominated in the competition to name the Outstanding Civil Engineering Achievement are: the Harris County domed stadium at Houston, Tex.; Complex 39, the Apollo-Saturn V assembly and launch facility at Kennedy Space Center, Fla.; the Trans-Sierra Freeway Project between Sacramento, Calif. and the Nevada State line; the Chicago Circle Campus Development of the University of Illinois; the Seattle metro comprehensive sewerage program; and the hurricane barrier at New Bedford Harbor, Mass.

The winner of the 1966 award will be announced by the American Society of Civil Engineers following its national meeting early in February.

By honoring projects themselves the top award recognizes the part played by all who are associated with the project.

Previous winners of the award are: The Chesapeake Bay Bridge-Tunnel, 1965; the Glen Canyon Dam, 1964; the Ohio River Valley clean streams program, 1963; the intercontinental ballistic missile program, 1962; John F. Kennedy International Airport, 1961; and the St. Lawrence Power and Seaway Project, 1960.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6298	Central Valley Calif	Nov. 12	Spare impeller for pumps for Tracy pumping plant. (Negotiated contract.)	Worthington Corp. Denver, Colo.	$169,500
DC-6302	do	Oct. 29	Construction of 23.5 miles of pipelines, 1.2 miles of canal, five reservoirs, and five pumping plants for Colusa County Water District, Unit 1A, Tehama-Colusa canal distribution systems.	Wittman Contracting Co., Phoenix, Ariz.	3,831,362
DC-6333	do	Oct. 27	Construction of seven turnouts, canal drain, and pump sump covers for San Luis canal, Reach 1.	Syblon-Reid Co., Granby, Colo.	529,885
DC-6335	Missouri River Basin, Kans.	Oct. 14	Construction of 39.3 miles of Almena Main and Almena South canals and laterals, and 6.7 miles of drains.	Bushman Construction Co., St. Joseph, Mo.	1,619,082
DS-6340	Parker-Davis, Ariz	Oct. 28	One 54,000/72,000/90,000-kva autotransformer for Coolidge substation, stage 04.	Legnano Electric Corp., New York, N.Y.	136,630
DC-6342	Colorado River Storage, Colo.	Dec. 2	Completion of Blue Mesa powerplant and construction of Blue Mesa switchyard.	Eagle Construction Corp., Loveland, Colo.	1,245,423
DC-6343	Mann Creek, Idaho	Nov. 17	Construction of Spangler dam	Murphy Brothers, Inc., Spokane, Wash.	2,146,782
DC-6344	Central Valley, Calif	Nov. 17	Construction of 20 miles of concrete-lined San Luis canal, Reach 5.	Granite Construction Co., and Gordon H. Ball Enterprises, Watsonville, Calif.	15,608,556
DC-6345	Fryingpan-Arkansas, Colo.	Nov. 5	Construction of Sugar Loaf dam and roads	Colorado Constructors, Inc., and A. S. Horner Construction Co., Inc., Denver, Colo.	5,282,853
DC-6346	Lyman, Wyo	Oct. 28	Construction of utilities, streets, walks, and laboratory and field office building for temporary Government camp near Mountain View, Wyo.	Harold Newland, Contractor, Evanston, Wyo.	123,608
DC-6350	Chief Joseph Dam, Wash	Dec. 9	Rehabilitation of Main canal	A&B Construction Co., Helena, Mont.	885,986
DC-6355	Baker, Oreg	Dec. 9	Construction of Mason dam	Osberg Construction Co., Seattle, Wash.	2,539,385
DC-6359	Central Valley, Calif	Dec. 1	Construction of 23 miles of pipelines for Colusa County Water District, Unit 1B, Tehama-Colusa canal distribution systems.	United Nations Constructors, Inc., Santa Monica, Calif.	1,108,633
DC-6360	Columbia Basin, Wash	Dec. 9	Construction of Wahluke Branch canal and White Bluffs wasteway, Schedule 3.	R. A. Heintz Construction Co., Portland, Oreg.	2,893,600
DC-6361	Office of Emergency Planning, Colo.	Nov. 15	Construction of Plum Creek and Sand Creek siphons for High Line canal, utilizing precast concrete pipe for Plum Creek siphon barrel, for city and county of Denver, Board of Water Commissioners, Schedule 2.	Clarke-Pacific, Inc., Denver, Colo.	437,251
DC-6369	Central Valley, Calif	Dec. 17	Construction of 62.1 miles of piplelines for Westlands Water District distribution systems, Laterals 1, 2, and 3.	Granite Construction Co., Watsonville, Calif.	5,316,783
DS-6383	Boulder Canyon, Ariz.-Calif.-Nev.	Dec. 23	Turbine model and model tests and replacement turbine runners for Units N1 to N4, Hoover powerplant. (Negotiated contract.)	Allis-Chalmers Mfg. Co., York, Pa.	940,650
100C-798	Columbia Basin, Wash	Oct. 1	Gravel protection for erosion control on Potholes, Wahluke Branch, Eltopia Branch, East Low, West, and Royal Branch canals.	S & S Sand & Gravel, Inc., Ephrata, Wash.	270,379
100C-803	do	Oct. 15	Construction of 21.7 miles of buried pipe drains for south part of Block 46.	George A. Grant, Inc., Richland, Wash.	368,002
100C-808	do	Oct. 22	Drilling and grouting behind concrete lining of Main and East Low canals.	Federal Construction Co., Spokane, Wash.	107,182
100C-819	do	Nov. 15	Construction of 8.6 miles of buried pipe drains for Blocks 44 and 45.	Sandkay Construction Co., Inc., Ephrata, Wash.	153,569
200C-614	Central Valley, Calif	Oct. 6	Remodeling Upper Vista house at Shasta dam	Robert S. Bryant, General Contractor, Inc., Redding, Calif.	185,725
200C-618	do	Nov. 12	Construction of two field office and laboratory buildings, and other buildings for Tranquillity and Huron, Calif., Westlands Water District distribution system.	Lloyd Pipes Construction Co., Fresno, Calif.	308,971
200C-622	do	Dec. 1	Modification of Doney Creek and Charley Creek bridges	Mountain States Construction Co., Concord, Calif.	233,325
300C-238	Colorado River Front Work and Levee System, Ariz.-Calif.	Dec. 1	Construction of 7.1 miles of roads and bank protection structures A-14, A-15, and C-9 through C-14.	Dispatch Contractors, El Monte, Calif.	595,426
500S-216	Lower Rio Grande Rehabilitation, Texas.	Nov. 10	222,000 linear feet of unreinforced concrete pressure pipe, 32,400 linear feet of reinforced concrete pressure pipe.	W. T. Liston Co., Harlingen, Tex.	750,434
500C-217	Canadian River, Texas	Dec. 17	Construction of roads and parking areas for recreation facilities for Fritch Fortress and Sanford-Yake areas, Lake Meredith.	E. D. Baker Corp., Borger, Tex.	151,811

U.S. GOVERNMENT PRINTING OFFICE: 1966 O—794-585

Major Construction and Materials for Which Bids Will Be Requested Through February 1966*

Project	Description of work or material
Central Utah, Utah	Constructing Starvation Dam, an earthfill structure about 170 ft high, 2,670 ft long, containing about 4,800,000 cu yd of material, an outlet works, and a spillway. Work will also include constructing about 2 miles of access and service roads. On the Strawberry River, about 4 miles northwest of Duchesne.
Do	Constructing the 7-ft-diameter, 5,000-ft-long Starvation Feeder Tunnel. Near Duchesne.
Central Valley, Calif.	Constructing Contra Loma Dam, an earthfill structure about 85 ft high and 1,000 ft long, three small dikes, and appurtenant features. The spillway is to be an uncontrolled chute with a stilling basin in the right abutment. Costa Canal, about 2 miles south of Antioch.
Do	Constructing about 82 miles of 8- to 84-in.-diameter pipelines for heads varying from 25 to 200 ft. Pipe alternatives will include precast concrete pressure pipe, asbestos-cement pipe, or prestressed noncylinder pipe. Westlands Pipelines, Laterals 4-6, near Fresno.
Do	Constructing 13 floatwells at various locations along the Corning Canal and installing electrical cable and controls between the floatwells and check structures; constructing precast concrete pipe overflow bypasses at 3 existing check structures; adding a second barrel to 1 siphon consisting of about 270 lin ft of 42-in.-diameter precast concrete pipe; and enlarging about 0.4 mile of canal from a 10-ft bottom width to a 16-ft bottom width. Near Corning.
Do	Cleaning and filling longitudinal and transverse contraction grooves in the San Luis Canal, Reach 1, which is about 16 miles long and will involve about 600 miles of grooves. Work will include removal of plastic form from the grooves prior to filling. Grooves are to be filled with round rubber rod and mastic cover. Near Los Banos.
Do	Reconstructing 11 bridges including piers, caps, sills, stringers, and decking. Along Friant-Kern Canal, near Bakersfield.
Do	Constructing about 1 mile of relocated county road including earthwork, structures, and surfacing. Near Antioch.
Do	Supervisory control and digital telemetering equipment for remote control from Tracy Switchyard to Forebay Pumping Plant and 13 checks and 3 wasteways on Delta-Mendota Canal.
Colorado River Front Work and Levee System, Arizona.	Constructing two bridges across the Colorado River, one a 500-ft-span timber deck and timber foundation piles, the other a 500-ft-span timber deck and timber foundation piles with structural steel removable center span. Work will also include earthwork for road approaches. Near Parker.
Colorado River Storage, Colo.	Constructing Crystal Dam, an earthfill structure about 220 ft high, 730 ft long, containing about 1,900,000 cu yd of materials, and outlet works, and a spillway. Work will also include constructing a powerplant, to house one 28,000-kw generator, and a switchyard, contractor to furnish all equipment. On the Gunnison River, 21 miles east of Montrose.
Do	Constructing about 87 miles of single-circuit, 3-phase, 230-kv, Poncha-Midway Transmission Line. Work will consist of clearing right-of-way; constructing footings; furnishing and erecting steel towers; and furnishing and stringing three 1,272 MCM, ACSR conductors and two ½-in.-diameter high-strength, steel strand, overhead ground wires. Extending from Salida to vicinity of Midway.
Colorado River Storage, Colo.	Constructing about 85.3 miles of single-lane, unsurfaced access roads, including culverts, a bridge, and fence gates. Along the Curecanti-Shiprock Transmission Line, between Cortez and Cimarron.
Do	Furnishing, installing, and testing two 66,667-kva, 0.9-pf, 180-rpm, vertical-shaft generators with either direct-connected exciters or static excitation at Morrow Point Powerplant.
Columbia Basin, Wash.	Earthwork and structures for about 19 miles of Wahluke Canal of which about 15 miles will be lined with compacted earth with a 32-ft bottom width and about 4 miles will be lined with unreinforced concerte with a 10-ft bottom width. Near Othello.
Do	Constructing about 28 miles of laterals and wasteways of which about 12 miles will be lined with concrete with 6- and 5-ft bottom widths and about 11 miles will be lined with compacted earth with bottom widths varying from 10 to 3 ft. Blocks 36 and 55, near Othello.
Do	Constructing about 550 lin ft of 14-ft-8-in.-diameter monolithic concrete siphon barrel crossing a future highway location. Weber Coulee Siphon, near Warden.
MRBP, Iowa	Additions to the Sioux City Substation will consist of constructing foundations; furnishing and erecting steel structures; and furnishing and installing three 13.2-kv, 12-mva reactors, one 14.4-kv circuit breaker, and associated electrical equipment. About 2 miles southwest of Hinton.
MRBP, Kansas	Constructing the earthfill Downs Dike, Section 2, about 40 ft high, 15,000 ft long, containing about 2,400,000 cu yd of materials, an outlet works, and a drain system. Work will also include additions to the Downs sewage system and miscellaneous roadwork. Near Downs.
Do	Constructing the earthfill Cawker City Dike about 50 ft high, 15,100 ft long, containing about 1,870,000 cu yd of material, and a small combines outlet works and pumping plant. Work will also include relocating about 4.5 miles of Mitchell County Road C-705. Near Cawker City.
Do	Constructing about 2.6 miles of canals and laterals. Near Scandia. (Courtland, Pumps 3A and 3B.)
MRBP, Montana	Constructing the Yellowtail Dam Visitor Center will consist of constructing a one-story reinforced concrete masonry and precast Mo-Sai panel building and a parking area for about 100 cars. Southeast of Hardin.
Pacific Northwest-Pacific Southwest Intertie, Ariz.-Nev.	Constructing the Mead Substation will consist of clearing right-of-way, construeting concrete footings, and furnishing and erecting steel structures for the taplines in the substation; constructing a service building, major items of which will be Government furnished; and grading and fencing the substation area. Near Boulder City, Nev.
Pacific Northwest-Pacific Southwest Intertie, Nevada.	Four 23-kv, 1,200-amp, 500-mva power circuit breakers for Mead Substation.
Parker-Davis, Ariz.	Additions to the Coolidge Substation will consist of constructing concrete foundations; furnishing and erecting steel structures. North of Coolidge.
Weber Basin, Utah	Constructing about 4 miles of 6- to 24-in.-diameter pipelines for heads up to 225 ft. West Farmington Pipelines, near Ogden.

*Subject to change.

In its assigned function as the Nation's principal nature resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. Department of the Interior
Bureau of Reclamation

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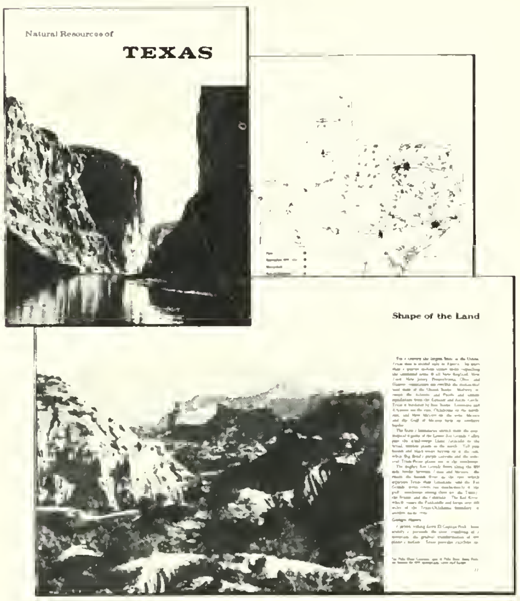

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RECLAMATION ERA

May 1966

Our Friend at a Fountain

(See page 56.)

MAY 1966 • Vol. 52, No. 2

RECLAMATION ERA

GORDON J. FORSYTH, Editor

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United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy
Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C., 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

Commissioner's Page

FOR *ALL* TO USE

The Bureau of Reclamation hails the new endeavor for total conservation and wise use of our natural resources. We continue our work with a keen awareness that water, in any nation, is the giant heart muscle of civilization—and is basic to health and wealth.

It is good that the values and problems of water conservation and development are being illuminated for all to see. The voices of leaders and men of good will are being heard. The country is ready and impatient for water resource plans to move ahead.

The Bureau of Reclamation has kept pace with today's great technical advances and, indeed, has set the pace in massive development in the arid Western States where water supply has been a perpetual problem. As a practical working model, this water development agency has been eagerly studied for decades by thousands of experts from more than a score of foreign countries.

Creating multiple benefits in Reclamation's various project areas are tireless structures of earth, rock, concrete, and steel. Our dams and other works constructed of these materials provide storage for 135 million acre-feet of water, enough to cover the State of Massachusetts with 27 feet of water.

To people of the West, these 143 cooperative water control projects mean maximum uses. To the Nation they mean a vast increase in wealth productivity and economic stability.

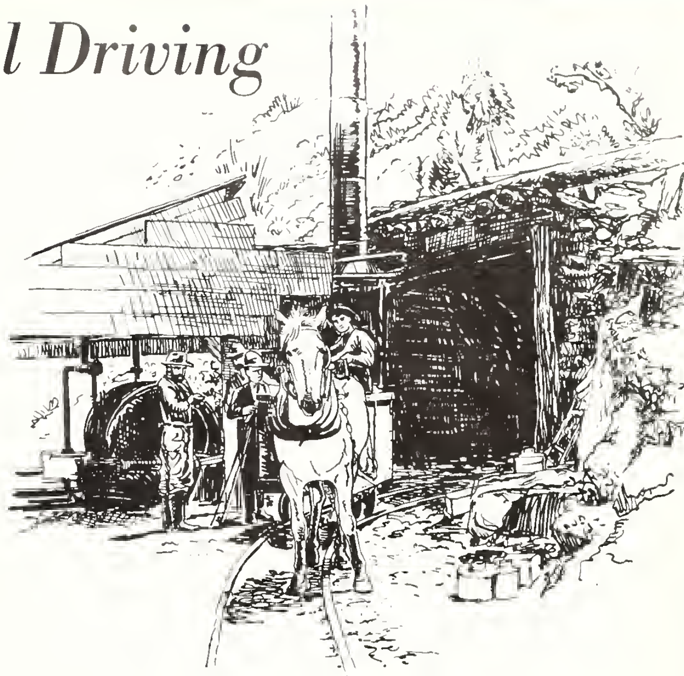
Though no country ever made more efficient use of water or produced food and goods in such abundance, we feel that prospective conservation needs are unlimited. We and fellow human beings the world over need water for our very lives. The challenges are monumental. To avoid accepting them would be inviting disaster.

Floyd E. Dominy

FLOYD E. DOMINY,
Reclamation Commissioner.

Sixty Years of Tunnel Driving

by JOHN DeWITT, Washington, D.C.



This drawing shows the removal of diggings by a horse-drawn mining car from the East Portal of Gunnison Tunnel in 1905.

ENTHUSIASM ran high among the citizens of Montrose, Colo., as the Bureau of Reclamation's first tunnel construction job—the Gunnison Diversion Tunnel, begun in 1905—at last neared completion. It was 1909.

Irrigation water would soon be flowing under the mountainous ridge separating the water-rich Gunnison River from the comparatively dry Uncompahgre Valley.

As with most pioneering works, construction of the tunnel had been beset with difficulties. High temperatures, gas fumes, shattered rock, and water collecting in the tunnel had caused many delays. But on September 23, 1909, the welcome banners were flying for President William Howard Taft, who was arriving to dedicate the opening of the Gunnison Diversion Tunnel.

Posters told of the dawn of a new agricultural era. The potato yield of $225,000 in 1909, the signs said, was expected to exceed $1 million in 1910 "with Gunnison water." Fruit and vegetable crops and livestock in the Uncompahgre Valley would grow in proportion. The promised bounties of plentiful irrigation water were soon to be a reality.

Water imported through the 5.8-mile tunnel from the Gunnison River—the key link in the Uncompahgre Project, then considered one of the wonders of the New West—would irrigate more than 100,000 acres of dry lands at a cost of $25 an acre.

Although the Gunnison Diversion Tunnel was the first to be started by the fledgling Reclamation Service—as the Bureau of Reclamation was then called—it was not the first to be completed. That honor went to the 3.29-mile Corbett Tunnel in Wyoming, which was begun late in 1905 and completed in 1907. The Corbett Tunnel, together with other Shoshone Project works, brought a reliable water supply to 150,000 acres for irrigable lands in Bighorn County, in northern Wyoming.

144 Major Tunnels

Now, 10 decades after these pioneering tunnels were started, the Bureau of Reclamation has added 144 major tunnels to its project works for a total of 879,835 feet—more than 166 miles. This total excludes outlet tunnels associated with Reclamation dams.

During 1965, the 60th anniversary of Reclamation's first tunnel driving work, construction started on two major tunneling jobs—one for the $170-million Fryingpan-Arkansas Project in Colorado; the other for the $135-million Navajo Indian Irrigation Project in New Mexico.

The Fryingpan-Arkansas work involves three separate tunnels, all being drilled about 2 miles above sea level.

Two of the tunnels, with a combined length of 5.7 miles, will divert water from Colorado River tributaries high up on the western slope of the Continental Divide to a point where the water can flow into the major tunnel of the three: a 5.3 mile tunnel piercing the Divide to bring badly-needed water supplies to the Arkansas River valley on the eastern slope of the Rockies.

On the Navajo Indian Project, a giant mechanical "mole" was put to work last summer to drill a 20-foot diameter tunnel through 2 miles of sand-

It was a happy day of celebration at Montrose, Colo., in 1909, when President William H. Taft dedicated Gunnison Tunnel of the Uncompahgre project, one of the first projects to be constructed under the Reclamation Act of 1902.

stone, guided by a lasar beam. The tunnel will be part of a 152-mile system of tunnels and canals that will eventually convey 508,000 acre-feet of water a year from Navajo Reservoir to Navajo Indian lands in northwestern New Mexico. The 280-ton mole, most powerful horizontal drilling machine of its kind in the world, applies about 1.4 million pounds of force to its cutting head which chews into the sandstone at a rate up to 10 feet per hour.

This historic 1905 photo shows a booted and brave crew of rugged tunnel workmen in Gunnison Tunnel, Colo. Note the work dirt on their clothes and the lack of safety helmets, now essential. Some of the men are holding small lighted candles and some are wearing stylish mustaches of that day.

A similar machine, though smaller, was put to work in 1964, to drill a 12.7-mile, 13 foot diameter tunnel on Reclamation's San Juan-Chama Project, also in New Mexico. In 1 month, it pushed itself through as much as 4,000 feet of sandstone. It is expected that both these tunnels will be completed more quickly, and for less money, than would have been possible by conventional drilling methods.

The rock hungry monster is pretty difficult to photograph because of the cramped area at its business end, but the accompanying photographs are evidence that there has long been a high interest in men going in at one side of a mountain and coming out the other.

Roman Work

The basic idea of tunneling remains the same as in the days of the Romans: to break up the rock by one means or another, remove it by hand or machine, supporting unstable sections of roof and sides as you go along, provide ventilation and drainage when necessary, and repeat the process until you break through into daylight again. The Romans used slave labor to build fires against the rock face and then douse water against the heated rock to shatter it. How many slaves succumbed to the smoke and fumes is not known to us.

Early-day American tunnels were driven by hand-held drills, chipping with hand tools, and blasting with black powder. The first real step forward came with the advent of dynamite and power drills during the latter half of the 19th century. But even with such aids available, it was mainly back-breaking labor for the miners who built the Gunnison Diversion Tunnel and the other tunnels of early Reclamation days. Commonplace tunneling terms of today—such as slusher train, jumbo, California switch, cherry picker rock bolts—would be meaningless to diggers of that era.

Low-cost ammonia powders are now replacing gelatin dynamites; and long solid steel drills are giving way to tougher detachable bits. Timber and steel are being replaced with rock bolts for supports. Diesel-powered locomotives and trucks with scrubbers to purify exhaust gases now move large volumes of rock underground in places where internal combustion engines would have created intolerable exhaust fumes a few decades ago.

Today's engineers and designers use highly technical rock mechanics studies and are familiar with faults, fractures, popping, and other rock characteristics.

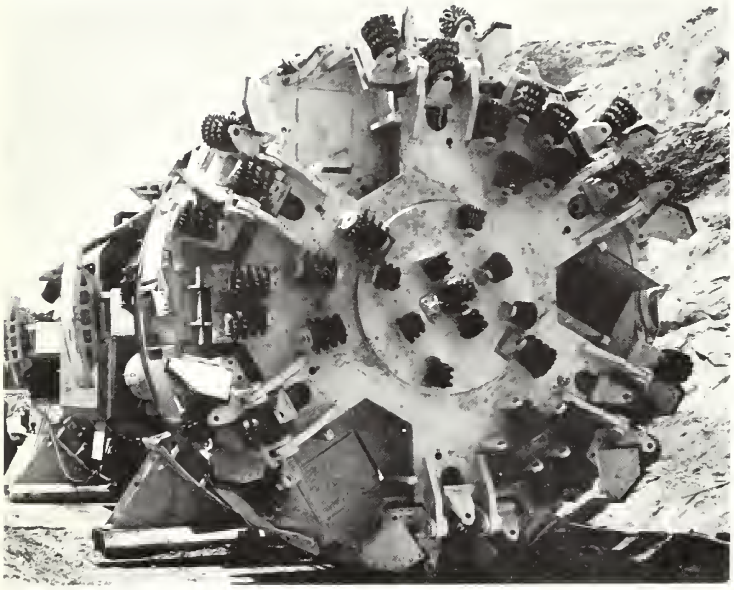
They anticipate dangers and conditions ahead by seismic methods; whereas the men of the Gunnison tunnel era had to rely on surface geology and, at best, some diamond-core drilling.

Such new methods and techniques, unheard of a few decades ago, have drastically reduced the accident and mortality rate among tunnel workers today. But tunneling remains a hazardous occupation. Dangers are ever-present from dust, falling rock, incursions of gas and water, squeezing ground, and other unpredictable conditions.

No two of the Bureau of Reclamation's tunnels are alike. Nor are foundation conditions in any single tunnel the same throughout its length. The watchword of a tunnel digger is always to expect the unexpected. Naturally enough, the history of Reclamation's tunneling jobs is packed with drama.

The inflow of hot water at Tecolote Tunnel caused so much difficulty that drillers could only work in very short shifts and were then hauled in and out of the tunnel in mine cars filled with cool water.

By 1912 residents in the Uncompahgre project area could be proud of their new land development as a result of tunnel water. (Original from Uncompahgre Water District, Montrose, Colo.)



Tecolote—A Battle

Digging the 6.3-mile Tecolote Tunnel on the Cachuma Project in California, proved to be a protracted battle between man and the elements. Begun in 1950 to bring irrigation and municipal water supplies from the Santa Ynez River through the coastal mountains to the region around Santa Barbara, the tunnel was not completed until 1956.

The tunnel had to pass through the notorious Santa Ynez fault where treacherous shales and sandstones, weighted and weakened by water, brought on the collapse of heavy supports. Then at 9,000 feet into the mountain, seepages of methane gas caused an explosion that hospitalized 11 men. Work was suspended for 3 months while the contractor drilled a 700-foot ventilation hole down to the shaft for removal of the poisonous gas.

After work was resumed considerable underground water was encountered. Over 9,000 gallons a minute flowed from the rock at high pressures and at temperatures reaching 113 degrees. Work stopped again—this time for 6 months. Grouting operations were performed to seal off some of the inflow, and 20 pumps were installed to take water out of the shaft. Bigger compressors were placed in service to push more—and drier—air up near the hearing, to make working conditions more bearable.

When work resumed again more inflows of hot water were encountered, this time at temperatures as high as 117 degrees, producing air temperatures of 108 degrees.

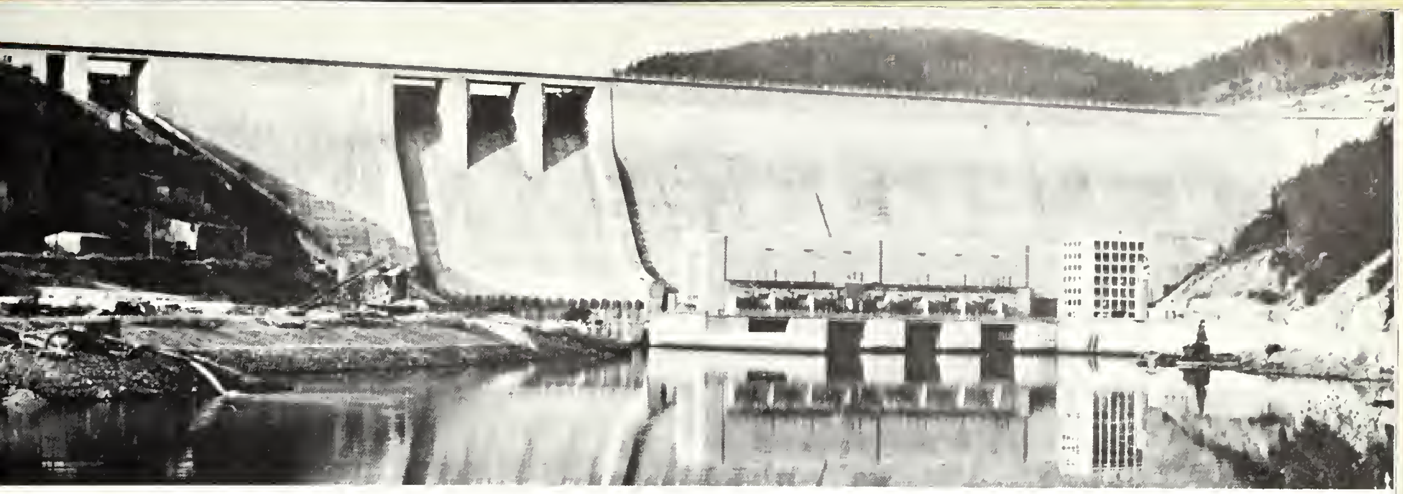
Conditions were so difficult the drillers could work only in very short shifts, and were then hauled in and out of the tunnel in mine cars filled with cool water. These unexpected conditions,

Continued on page 53.

Believe it or not, this tunnel-boring machine is "taking a walk" toward the tunnel portal. It moves by setting down alternate sets of jacks connected to intersliding frames. It is on the Navajo Indian Irrigation project.

The reinforcing steel rods being installed along the sides and top of this tunnel are important in strengthening the concrete that later was poured around them and hardened to serve as the tunnel lining. The pipe which is supported by scaffolding in the center of the picture carried fresh concrete to the "hardhat" workmen near the left wall. This is a large gate chamber on the Navajo Indian Irrigation project in New Mexico.

This photo, taken in 1965 on the Navajo Indian Irrigation project, shows that tunnel work is still strenuous.



Czechs Plan 26 Dams for the 60's

by RECLAMATION COMMISSIONER FLOYD E. DOMINY

WATER supplies in any land are essential for people, for industry, and for crops. And because Czechoslovakians know this, they are very concerned with developing water resources to support their plans for progress and growth. In 15 years they have achieved record development, and they ambitiously plan for 26 dams for the 1960's, as shown in the chart on page 35.

With progress as a primary objective, a delegation of Czech engineers asked our State Department for permission to visit the U.S. Bureau of Reclamation and see pertinent dams in this country.

In early 1965, the Bureau of Reclamation conducted a Czech delegation on a 10-day tour of Reclamation and Corps of Engineers dams. We discussed technical problems associated with dam construction, and in cooperation with the Corps of Engineers showed them several structures at first hand. These included Barkley Dam on the Cumberland River in Kentucky, Dardenelle Dam on the Arkansas River in Arkansas, Big Bend on the Missouri in South Dakota, Yellowtail Dam on the Big Horn in Montana, Flaming Gorge on the Green River in Utah, Morrow Point Dam on the Gunnison River in Colorado, and Glen Canyon and Hoover Dams on the Colorado River in Arizona and Nevada.

The visitors saw major construction operations still underway at Morrow Point and Yellowtail Dams. Also a visit was made to the Engineering Design and Research Center of the Bureau of Reclamation in Denver, Colo. Here the Czech engineers were able to discuss with our experts their problems in design of dams.

In exchange for this U.S. tour, the Department of State made arrangements through its cultural and technical exchange program, for a U.S. delegation to visit Czechoslovakia. This delegation included Edward Soucek of the Corps of Engineers, F. Stewart Brown of the Federal Power Commission, and T. W. Mermel who is on my staff as Assistant to the Commissioner—Research. With myself as Chairman of the group, we studied Czechoslovakian water resource developments last September after I had attended a meeting of the International Commission on Large Dams in Switzerland.

Czechoslovakia is one of the most industrialized countries in eastern Europe. Before World War II it had a nearly balanced and self-sufficient economy. A Socialist Republic since 1948, Czecho-

Power supply is the main purpose of Orlik Dam. It has four transformers which generate 90,000 kilowatts each.

Many water development works caught Commissioner Dominy's eye and were photographed by him for later examination as a result of last September's study tour of Czechoslovakia.

slovakia has nationalized its industry, trade, banking, transportation, and services. With its population of 14 million people, there is a strong labor force and high employment of women, many of whom are married and have children. The Czechs are traditionally skilled and efficient.

The U.S. delegation was officially and warmly received at the Ministry of Construction in Prague, the capitol city, where our impressive study-tour started.

Institute in Prague

Prague is Czechoslovakia's largest city having close to 1,100,000 inhabitants. In that center is the hydraulic Research Laboratory, where many scientific tests are underway. Their specialists were using several models of spillways and outlet works, and a large model of a river channel for making studies of river regulation. Even though the natural resources of that Nation are quite abundant, there are major river channel problems, and their rivers flow through flat valleys and deposit silt. Their laboratories were well equipped and showed ample evidence that they are pursuing scientific investigations of some magnitude. Several technical reports were given to us, and their library contained many technical publications on water resources from various sources throughout the world.

Slapy Dam is on the Vltava River about 25 miles south of Prague. This dam, a concrete gravity type, is 218 feet high with a central overflow section controlled by gates. Completed in 1956, the structure's design reflects considerable advanced practice for that time.

Since Slapy Dam is in a steep-walled canyon, almost all of its width is required for the ski-jump spillway of the type originally designed by Andre Coyne of France. An outstanding feature of the spillway at this project is that the powerhouse and high voltage transformers are located under it.

Paper-insulated cables extending from the 110-kilovolt transformers to the switchyard on the left bank are underground.

Large splitter blocks are at the bottom of the spillway to split and dissipate the force of the cascading water. The water strikes the blocks and disintegrates into a spray.

Located 20 miles downstream from Slapy is Orlik Dam, a concrete gravity-type dam 277 feet high. This structure backs up the largest reservoir of the entire Vltava Cascade area. The lake is approximately 35 miles long and has a capacity of 720 million cubic meters, which is of slightly less capacity than our Lake Havasu on the Colorado River.

The powerplant at the foot of Orlik Dam contains four turbine-generator units with a total output of 360,000 kilowatts. This dam was completed in 1962. The upstream face of the dam is protected by hand-placed precast hexagonal blocks which formed excellent alignment and appearance. Arrangements are underway for the passage of boats over this structure by an inclined railway which will be capable of lifting vessels weighing up to 300 tons.

13 Dams Planned

Orlik and Slapy Dams are but 2 of 7 completed and 13 planned for the Vltava River Cascade which flows northward from the southern border of the country, through Prague, and into the Lauve River at Melinck some 15 miles north of Prague. The dams in operation have a total capacity of 750,000 kilowatts of power and an annual energy production of 1,100 million kilowatt hours.

Important in considering the height of the reservoir behind Orlik Dam, was the preservation of two castles dating back to the 14th century. Orlik Castle, now a museum, occupied a spot on a sheer wall some 230 feet above the river level. To prevent damage from the reservoir as it filled, extensive protection had to be performed on the foundation rock. Now the castle and its impressive setting is protected from any possible damage as a result of project operation.

Another castle, named Zvihov, required similar protection.

Spanning Orlik reservoir a short distance upstream from the Orlik Castle is a steel arch highway bridge, with a span of about 1,100 feet, which was still under construction. It is claimed to be the longest of its type in the world, an indication of the advanced bridge technology in Czechoslovakia.

Nechranice Dam, now under construction, is on the Ohre River near the town of Kadan. The primary purpose of this project is to provide a reservoir to serve as a source of boiler and cooling water for several steam-electric generating plants which are being planned for this region. This is a highly developed industrial area, with many existing power plants operating on steam produced by a plentiful supply of brown coal. Such plants demand large amounts of water for cooling.

One of the largest earthfill dams in Europe, Nechranice Dam is 10,500 feet long and 245 feet high. The embankment volume is 9 million cubic meters, which approaches the volume of Palisades Dam in Idaho. The outlet works are of unusual design employing a circular intake tower about 35 to 40 feet in diameter located in the reservoir area. A powerplant is located in the base of the intake tower and contains two turbines of 6,000 kilowatts each.

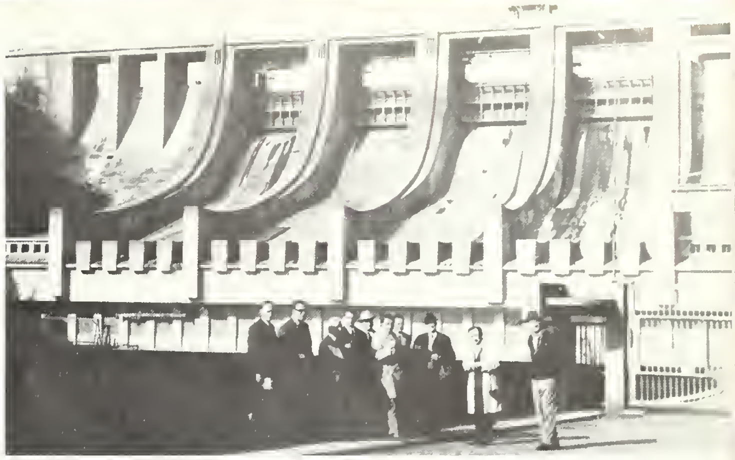
The River Vah Cascade, in the Slovakian part of Czechoslovakia, is highly developed and provides that country's most important source of hydropower.

A complex of some 30 dams will be built, 15 of which are already in operation, with a combined installed capacity of 600,000 kilowatts and an average yearly production of 1,600 million kilowatt hours. We inspected Hricov and Nosice Dams and saw Miksova Dam from a distance. Future plans include installation of locks to make the river navigable.

Danube River Project

Czechoslovakian engineers rated their Danube River Project next in importance. This project was designed to prevent flooding of the Danube Valley near Bratislava. (Bratislava is the third largest city with 250,000 people.) Here the river flows through alluvial deposits, causing the riverbed, in some areas to be higher than the adjacent valley land. For a short distance near Bratislava, the Danube River is entirely in Czechoslovakian territory and further below, it forms the boundary between Czechoslovakia and Hungary. Because of this location, the development of the Danube will be an international undertaking.

Two international projects—one above Bratislava with Austria, and one below, with Hungary—are planned for construction within the next few years. The projects will involve dams, levies, and powerplants.

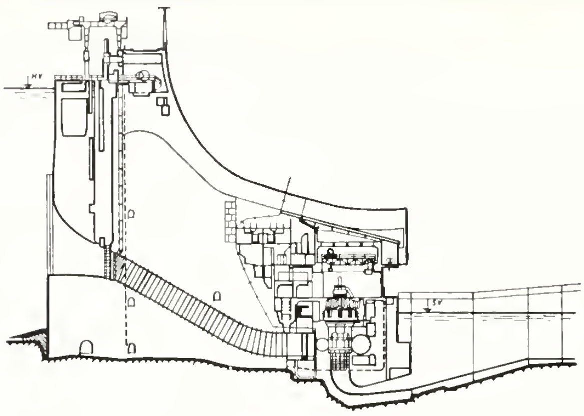


The powerplant with its three transformers of 60,000 kilowatts each is located under the ski-jump spillway of Slapy Dam, seen directly behind the tour group. Behind the dam, Slapy Lake is used considerably for recreation.

PROGRESS OF DAM CONSTRUCTION IN CZECHOSLOVAKIA

Period	*Total dams*	*Dams with hydropower*	*Total storage capacity (acre-feet)*	*Highest dam of the period (feet)*
Prior to 1920	17	2	32, 400	82
1921–1930	6	1	9, 730	121
1931–1940	10	7	163, 760	184
1941–1950	2	1	8, 920	72
1951–1960	27	12	934, 750	256
1961–1970*	26	10	1, 353, 880	299
Total 1970*	88	33	2, 503, 440	
Planned for 1971–1975	10	3	731, 260	

*Completed or in progress.



The right side of this drawing shows the lower end of the ski-jump spillway over top of the powerplant, a cross-section view of Slapy Dam. Water enters the powerplant from the left through the sloping conduit shown by the shaded stripe.

The only hydraulic turbine factory in Czechoslovakia, at Blansko, is renowned throughout the world by engineers, because the first conception and development of the Kaplan turbine occurred there. The plant is very busy, with much work underway and much to be done. Not only are Czechoslovakians noted for their skills in handling machine tools, but they also pride themselves on their turbine factory and their turbine technology. Many of the turbines are built for export. Founded in 1698, the Blansko factory recently celebrated its 260th anniversary.

In the 20 years since World War II, about half of the 25 dams constructed have been the earthen type, and the remainder concrete gravity. The Czechs expect to construct about 26 additional dams by 1970.

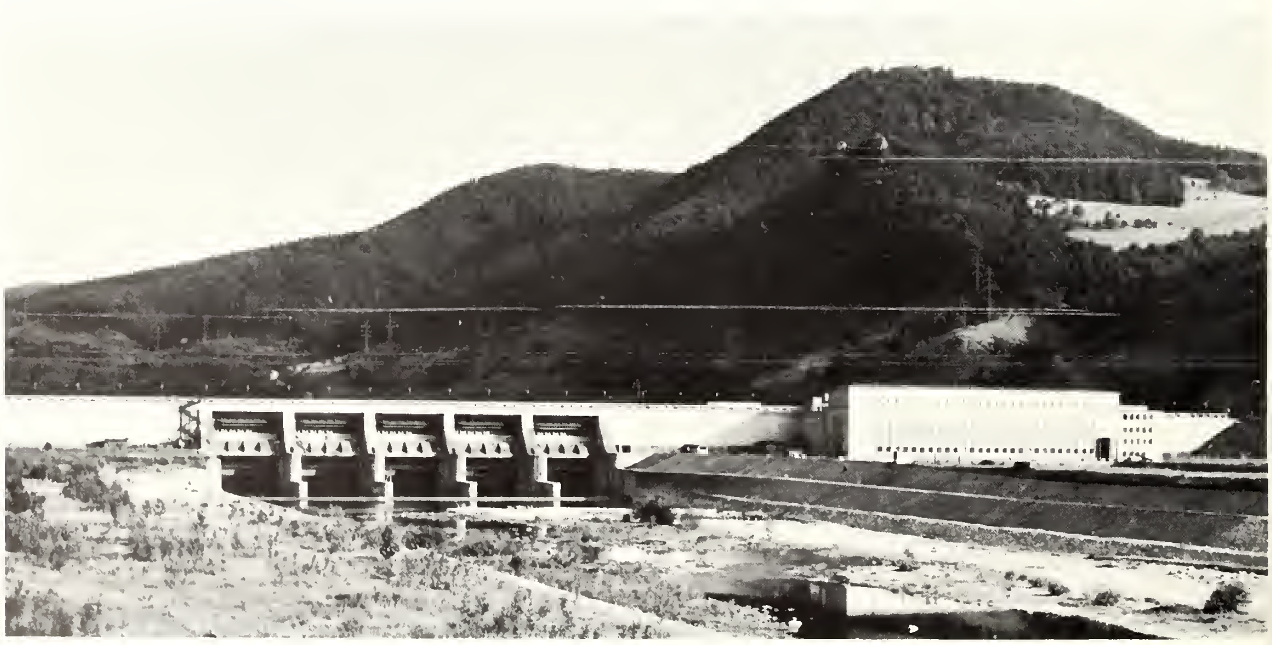
Construction of high dams is carried out by specialized national enterprises, Vodnistavvy and Ingstav and Vahostav. These firms also provide engineering services to Ghana, China, Ceylon, Egypt, Iraq, Brazil, and other countries. Research on construction problems is carried out mainly by the Research Institute of Engineering Structures in Bratislava, and at the Hydraulics Institute in Prague.

Czechoslovakia's land area is 49,000 square miles, somewhat larger than the State of New York. About one-third of the land is agricultural, with grain crops predominating. It is famous for hops and the export of Pilsen beer. Coal, iron, and oil resources are in considerable quantity and that country's uranium deposits are Europe's richest.

Our delegation was cordially received at every turn, and on the concluding day of the inspection tour, U.S. Ambassador and Mrs. Outerbridge Horsey joined us in our travel along the Vah River valley from Zelina to Bratislava.

With continued cooperation and additional exchanges of technical specialists from one nation to another, I believe the outlook is optimistic for increasing prosperity and freedom. # # #

This is Nosice Dam, one of the most important structures on the Vah River. The large building at right is the powerplant.



The Assault on Salt in the PECOS

by GEORGE L. LOOMIS, Agricultural Economist at Amarillo, Tex.

This photo made in the summer of 1965 shows some of the encrustation of salt that has been pumped from the brine aquifer.

THERE seems little chance that a spring of murky salt brine is soon to be in popular demand. At least not by irrigation farmers in west Texas.

For 30 to 40 years they haven't enjoyed an abundance of fresh water from the Pecos River because of a malady a few miles north at Malaga Bend, N. Mex. An aquifer there has been discharging up to 370 tons of concentrated sodium chloride brine daily into the river. Needless to say, this would have an adverse effect on the quality of irrigation water.

The dissolved brine rises through sand, silt, and clay from depths of about 200 feet. It has only been because of an assault of technical cooperation for several years, and a construction program by the Bureau of Reclamation from 1962–63, that downstream farms have prospects of again getting reasonably good water for irrigation.

As early as 1937, studies by the U.S. Geological Survey in cooperation with various other concerned agencies have pinpointed the problems. From 1951 to 1954, the USGS and the Pecos River Commission completed measurements showing the magnitude of the problem. The 1937 to 1938 effort with the New Mexico State Engineer revealed that the source of salt at Malaga Bend was not leakage from Laguna Grande de la Sal (a nearby salt lake), but rather it was discharge of an artesian brine aquifer. Additional studies from 1939 to 1941 were published in the "Reports of the Participating Agencies, the Pecos River Joint Investigation." This report prompted other studies and presented some preliminary computations and suggestions on eliminating the salt contamination from Malaga Bend.

In 1958, an experimental salinity alleviation program was authorized by Congress under Public Law 85–333. The plan was to lower the head of the brine aquifer below river level by pumping. This required experiments: (1) To determine the effectiveness of a pumping system; (2) to determine the effects on the quality of water in the river; and (3) to evaluate the effectiveness of the disposal system.

The floor of a 94-acre field, the Northeast Depression, was compacted with large machinery in 1963, and test plots were sprinkler-irrigated to examine the permeability of the soil for holding salt brine.

One of two possibilities was to inject the brine back into the ground into deep-lying aquifers. But tests showed that brines from the two different aquifers would form chemical precipitates plugging an injection well which was not treated with an expensive chemical.

The other plan, and the one adopted, was to divert the brine into a natural surface depression where the water would evaporate leaving a solid salt residue.

Doubt was expressed as to whether the earthen disposal area would retain the pumped brine long enough for an appreciable amount of evaporation to take place, because of the high permeability of the soil in the area.

There also was a possibility that the brine would make the soil much more porous.

Construction

The Bureau of Reclamation started a 2-year construction program of the salinity works in May 1962. The first contract covered the rehabilitation of an observation well drilled in 1939. This well, located about 100 feet from the terrace forming Malaga Bend and proving to be the only one satisfactory for brine production was enlarged.

In developing the well, the brine aquifer was protected by pulling a 5-inch liner from the bottom 30 feet, filling that section with gravel and sealing it off with clay. The old well casing was then pulled and the hole reamed to a diameter of 16 inches to the clay seal. A 12-inch plastic casing was inserted and the annular space outside the casing filled with grout.

The bottom 30-foot section was then redrilled to 11-inch diameter and a 43-foot length of 8-inch diameter perforated steel liner was installed to the bottom of the well.

After packing this annular space with pea-sized gravel, the well was tested for a capacity of at least 600 gallons per minute. The well casing was then extended from the ground surface to the elevation of the adjacent terrace.

The plastic casing is expected to last at least 20 years.

A second contract was for constructing the brine-disposal system, including mainly the pump and pipeline to a disposal area. The pump installed at the well was a submergible-type capable of pumping a minimum of 450 gallons per minute. However, when this pump failed after only 10 months of operation, it was replaced with a turbine pump with a 50 horsepower electric motor, bowls set at 70 feet, 5 impellers, and a 10-foot suction. Capable of pumping in the range of 300 to 600 gallons per minute, this pump is still performing satisfactorily.

The 2-mile pipeline is an 8-inch-diameter, asbestos-cement, epoxy-lined type. Through this pipe the brine is pumped to a terminal structure on the rim of the disposal area.

It then flows by gravity through a 6-inch flexible plastic pipe, into the disposal area. The terminal is an open concrete box that allows gasses (mainly nitrogen) associated with the brine to escape.

Because of the uphill grade and continuous pump pressure, there is no need for air relief valves and aboveground structures of any type. By avoiding contact with the air the salt does not plug the line.

A third contract included clearing and compacting the floor of a natural depression, locally known as the Northeast Depression, to be used as the brine-disposal area.

To Retard Leakage

An 18-inch blanket of compacted earth lining was placed in the Northeast Depression to retard leakage. It was estimated that the natural capacity of the reservoir of about 1,300 acre-feet and a surface area of about 94 acres, would be filled sometime between the third and seventh year of operation depending on the pumping rate and the leakage. If dikes were constructed in low points of the rim, the volume of the depression could be increased to about 1,700 acre-feet. Present storage of salt and brine is at about 500 acre-feet.

Total cost of the project, completed in June 1963, was about $276,000, exclusive of land acquisition and operation and maintenance costs.

All necessary rights-of-way for the project were furnished by the State of New Mexico, with reimbursement of these costs made by the Red Bluff Water Power Control District of Texas. The District, as the principal beneficiary of the project and in accordance with terms of a contract executed by it with the New Mexico Interstate Stream Commisison and the United States, assumed responsibility for operation and maintenance of the salinity works after completion of construction. The experiment is being evaluated by the Geological Survey and the Pecos River Commission.

Operation and Maintenance

Pumping at 560 gallons per minute was started in July 1963. The rate was decreased to 325 gallons per minute in November and continued at about this rate to March 23, 1964, when the rate was increased to about 450 gallons per minute, for experimental reasons.

Meanwhile at Malaga Bend, samples from upper and lower ends of the bend indicate that the gain in chloride in the Pecos River, originally over 200 tons per day, was reduced to about 100 tons per day. By October 30, 1964, the head in the brine aquifer had been lowered 8.2 feet and the inflow of salt into the river decreased about 70 percent. Before pumping began, the brine springhead was 10.8 feet above river level.

Measurements at the depression showed by the end of September 1965, about 1.545 acre-feet of brine containing 571,650 tons of salt had been pumped in, covering an area of 60.5 acres.

The salt crystals, 98.6 percent pure, encased the bottom and sides of the depression with a thick, hard encrustation. The crust varied from 1.6 to 11.7 feet thick.

With the annual operation and maintenance estimated at $10,000–$15,000 a year, the District hopes to pay these costs by selling the huge valley of salt.

In the summer months of the second year of operation, the brine solution in the Northeast Depression developed a reddish hue which deepened as the season progressed. This color was caused by a red algae or "bloom." During the fall, winter, and spring months the color faded out but

A view of the highly salty Malaga Bend of the Pecos River in 1963.

reappeared again late in 1965. A report from the White Sands area of New Mexico explains the phenomenon this way:

> "RED LAKES—Stockmen in the vicinity of White Sands have for many years had knowledge of the fact that their waterholes and the rainwater lakes sometimes turn red as blood. This usually happens in the fall of the year. Spanish legends recount the anniversaries of bloody battles while the more scientific minds apply various reasons for the strange phenomenon. It was not until the United States Park Service chemists came along a few years ago, that the mysterious stranger who turns these waters red was identified as an alga or microscopic plantlife which thrives on sulphur water. The usual appearance in the fall of the year indicates that he waits for the lakes and waterholes to evaporate down to the right consistency of sulphur to his liking . . ."

Still being watched with considerable interest is how well the earthen depression retains the brine, particularly since the filling is now above the compacted earth level. Other items to be determined are: Will the pipeline and pumping plant resist the salt corrosion; will the precipitate build up on the inside of the line eventually plugging it? What results will continued pumping have on the aquifer and how pure can the Pecos River be made, also are questions that can only be answered through continued experimentation.

Since the present collection of salt is already of considerable quantity, it is evident that new disposal sites eventually will be needed, or the present one emptied to make more room.

Though this salinity alleviation program has been a pioneering effort, it is restoring usefulness to the Pecos River, and may prove valuable in solving other such problems. # # #

Beach and camping facilities were rushed at Brandy Creek Beach by Whiskeytown Lake, Calif., to take care of enthusiastic recreationists.

Recreation Use Soars at New Reservoirs

RECREATION areas on newly created Reclamation reservoirs attracted nearly 70 percent more visitors in the 1964 season than in 1963. When statistics are compiled for the 1965 season they are expected to show another large gain.

Nearly 2.4 million persons fished, boated, swam, camped, picnicked, or just enjoyed the scenery and unpolluted air at eight manmade lakes that have been established since 1960. In 1963, visitors to the same spots numbered about 1.4 million.

Visitors to the 202 older recreation spots on Reclamation areas throughout the 17 Western States totaled about 32 million last year. In all, the Bureau provides nearly 1.4 million acres of water surface and approximately 10,000 miles of shoreline for outdoor recreation.

The rapid increase in visitors to the eight newest reservoirs indicates the growing importance of Reclamation projects in providing recreation opportunities as a supplemental benefit to their basic purposes of harnessing water for irrigation, power production, flood prevention, and municipal and industrial purposes.

One of the youngest of the reservoirs rapidly is becoming a most popular recreation area in the West. It is beautiful Lake Powell, behind Glen Canyon Dam on the Colorado River in northern Arizona. Lake Powell drew 688,000 visitors in 1964, compared with 443,000 in 1963.

Two other reservoirs developed at main units of the Colorado River Storage Project are proving to be major magnets for the tourist trade.

These are Flaming Gorge, behind the dam of the same name on the Green River in northern Utah, and Navajo Reservoir, impounded by Navajo Dam on the San Juan River in New Mexico. The 1964 visitors to Flaming Gorge totaled 571,000 up from 410,000 the year before. At Navajo, 197,000 persons participated in outdoor sports, while in 1963 some 132,000 visitors were recorded.

The largest increase in recreation use at a new Reclamation reservoir occurred at Whiskeytown Reservoir on Clear Creek in northern California. The number of visitors to this area of blue water and green, wooded hills, multiplied six times. In 1963, only 63,000 traveled to the reservoir; last year, 390,000 visited.

Nearby Clair Engle (formerly Trinity) Lake on the Trinity River supplied outdoor recreation opportunities for 323,000 in 1963 and 388,000 in 1964. At Lewiston Lake, a few miles south on the same river, 60,000 visitors were recorded in 1963 and 107,000 in 1964.

Recreation use of Twin Buttes Reservoir on the Concho River in Texas more than tripled in the 1963–1964 period, the number of visitors swelling from 8,500 to 26,700.

And in 1963 hardly anyone penetrated into the rough country above Yellowtail Dam, which is being built across the steep-walled canyon of the Bighorn River in Montana. But, with a few access roads completed in 1964, about 17,400 persons made their way to the area where the reservoir will form. Set in some of the world's most spectacular scenery, this manmade lake is sure to become a prime tourist attraction. # # #

Moving Ahead in Weather Research

THE Bureau of Reclamation is accelerating its atmospheric water resources research program to find ways to increase the water supply in arid Western States. The program is essentially a coordinated attack on the problems of augmenting snow and rainfall on Reclamation project watersheds in chronically water-short areas.

Much of the West now has water shortages, not just periodic droughts. The Bureau's role in the field of weather modification is "practical research" to determine how the "pure research" already done by other scientific groups can be utilized to effect an actual increase in precipitation.

Pure research in cloud formation and behavior is a necessary foundation on which to base research looking toward methods to milk those clouds of additional moisture.

Reclamation's atmospheric water research program began in 1961, when Congress appropriated $100,000 for modest studies in this field. Pioneering the new program was a small group of Bureau scientists headed by Walter U. Gartska, who subsequently retired and was succeeded in January 1966 by Dr. Archie M. Kahan, the new Chief, Office of Atmospheric Water Resources in the Office of Chief Engineer at Denver, Colo.

Dr. Kahan, nationally known expert in the atmospheric sciences relating to water supplies, joined the Bureau in February 1965, as general research scientist in the Office of Atmospheric Water Resources which had been established in September 1964. Previously, Dr. Kahan was Executive Director at the University of Oklahoma Research Institute.

His academic background includes a B.A. degree in mathematics and chemistry from Denver University in 1936; an M.A. degree in mathematics from the same university in 1940; an M.S. degree in meteorology from the California Institute of Technology in 1942; and a Ph. D. in meteorological oceanography from Texas A & M College in 1959.

$3 Million for 1966

During its first session, the 89th Congress appropriated $2,980,000 for the Atmospheric Water Resources Research program during fiscal 1966. Contracts with seven colleges and universities, five private firms, one State, and five Federal Government agencies provide for field studies at strategic locations. A minimal Bureau of Reclamation staff in Denver is concerned primarily with administering the program and evaluating the results.

The Bureau's program is not aimed at causing rain to fall on croplands during drought, since under drought conditions, there would not be enough moisture-bearing clouds in the vicinity. Rather, the goal is to enhance precipitation when the atmosphere contains large quantities of water vapor.

This can be accomplished by introducing nuclei into the clouds—usually silver iodide from ground

Zinc sulphide tracing material is inserted in the top of this machine and kept as a light powder in the upper sections by the action of electric fans. After the tracing material is forced out through the tubular protrusion at right, scientists are able to detect the drifting materials as far as 15 miles away.

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Specialists in atmospheric research cover difficult terrain by wide-track snow vehicles in order to check snow-rate measuring instruments (one in foreground) at isolated stations.

or airborne generators. The procedure is known as artificial nucleation, commonly called "cloud seeding." Increasing precipitation at the headwaters of streams, by nucleation during winter and early spring storms when atmospheric conditions are most favorable, would yield more runoff water to store in reservoirs for release and use during dry periods.

Only about a dozen winter storms a year feed the headwaters of the Colorado River. If each could possibly be induced to drop 5 to 10 percent more moisture than it naturally does, it would assure the Colorado River Basin of much-needed additional water for its farms, cities, and industries. Experiments are being conducted to ascertain the practicability of seeding the clouds of these storms and the outlook is said to be "encouraging."

Programs Named

The *Colorado River Basin Research Program* is being carried on in the Park Range area, near Steamboat Springs, Colo., where mountains rise from a valley floor elevation of 6,800 feet to heights from 10,000 to 12,500 feet.

Silver iodide nucleation experiments are being conducted by the firm of E. Bollay and Associate, Inc., under contract with the Bureau. Other Federal agencies and Colorado State University are conducting supporting experiments in this area.

In another section of the Colorado Basin, near Flagstaff, Ariz., studies are being made by Meteorology Research, Inc., of the behavior of mountain-induced convective clouds. These are cumulus clouds formed downwind of isolated peaks by converging air.

At the University of Wyoming, a Cap Cloud Research program of several years' standing is continuing. The cap cloud is a persistent stationary formation which gives the appearance of being stationary, but which rarely produces precipitation naturally. Thus, it is a most satisfactory site for seeding studies. Experiments already carried on by the university, in cooperation with the Bureau of Reclamation, have demonstrated that cap clouds can be more easily manipulated than most. On Elk Mountain, west of Laramie, Wyo., a natural laboratory, well-suited to studying various techniques for seeding of cap clouds, has been established.

The Bureau's *Interior Basin Program* is being carried on by the University of Nevada and Utah State University. The University of Nevada is conducting experiments ranging from theoretical studies of cloud physics to actual weather modification and the development of an instrumentation and data acquisition system. At Utah State, preliminary work is underway to develop a statistically designed seeding experiment in the Wasatch Mountain to determine the effect of seeding from high-and-low altitude, ground-based generators.

Under the Bureau's *Southern Sierra Program* a mathematical statistician at Taft College in California will develop an experimental design for evaluating seeding efforts conducted by Bureau collaborators in the area. The Bureau has also retained Fresno College to study whether it is feasible for seeding groups in the area to coordinate their work.

In the *Pacific Northwest Program*, an entirely different study is being undertaken.

There, under a contract with the Weather Modification Board of the State of Washington, planning has begun on a program which seeks to develop techniques for shifting precipitation from areas of surplus to areas of deficit. A group of meteorologists is being organized to work on the necessary experiments to determine if such diversion is possible.

Under the *Northern Great Plains Program* the South Dakota School of Mines and Technology is working on climatological studies, numerical model studies, cumulus cloud penetrations by aircraft, and random seeding methods.

"All these projects comprise a concerted drive," Reclamation Commissioner Floyd E. Dominy said, "to find practical answers to the many questions confronting the Bureau in its efforts to increase water supply by weather modification."

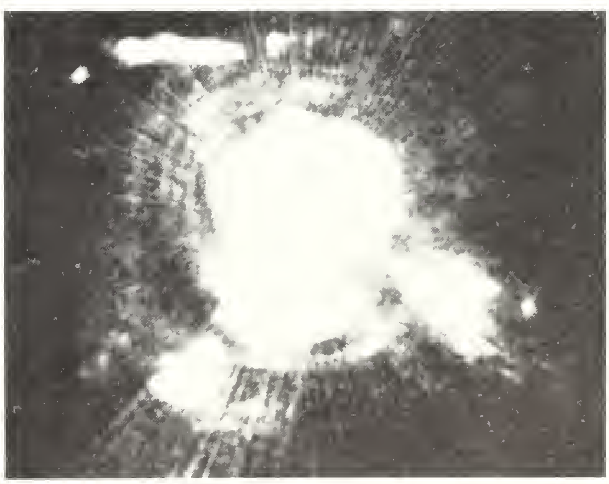
An advisory committee on Atmospheric Water Resources has been established to assist in the program.

It is composed of experts in the fields of cloud physics, engineering, meteorology, hydrology, snow surveying, and forestry. Members include: Chief Engineer B. P. Bellport, Bureau of Reclamation, Chairman; Dr. Vincent J. Schaefer, Director of Research, Atmospheric Sciences, Research Center, State University of New York; Dr. Thomas Bates, Science Adviser to the Secretary of Interior; Dr. John C. Calhoun, Jr., Vice Chancellor for Programs, Texas A & M University; Dr. Walter Orr Roberts, Director, National Center for Atmospheric Research; Dr. Earl G. Droessler, Head of Atmospheric Sciences Section, National Science Foundation; Dr. Charles Anderson, Environmental Science Services Administration, Department of Commerce; Max Kohler, Chief Weather Bureau Hydrologist; Jack S. Barrows, Director of Forest Fire Research, U.S. Forest Service; and William G. Shannon, Head of Snow Survey and Water Supply Forecasting, Soil Conservation Service, Department of Agriculture.

# # #

Seeded Clouds Produce R-Shaped Snowstorm

Considerable control and precision is resulting in the production of desired patterns of snowfalls in Nevada. Made with the help of radar, the photograph on this page shows a Morse code "R", dot-dash-dot, at top left. The effort is evidence of the success of recent cloud seeding experiments in the Reno-Lake Tahoe areas of Nevada. The photo was shown to the U.S. Senate Subcommittee on Water and Power Resources during hearings, by Wendell A. Mordy, Director of the University of Nevada Desert Research Institute.



From the Fifth Annual Irrigation Operators' Workshop

Real Economies From Rehabilitation

by B. A. PRICHARD

Irrigation structures which are old and in poor condition generally become problems to the system. The irrigation districts operating these systems are faced either with a continuing expensive maintenance program and piecemeal structure replacements or an extensive rehabilitation program.

Some older projects also have had changes in land use, in methods of irrigation, and in types of of crops raised. Such projects may benefit not only from rehabilitation of deteriorated structures but also from modernization.

An example of rehabilitation and betterment work may be found on the North Platte Project in Nebraska and Wyoming. The Fort Laramie Division of this project is operated by two irrigation districts—Goshen Irrigation District in Wyoming and the Gering and Fort Laramie Irrigation District in Nebraska.

In 1963, Goshen Irrigation District irrigated 51,076 acres; Gering and Fort Laramie Irrigation District irrigated 51,904 acres. With the major crops of beans, sugar beets, alfalfa hay, and corn, the project's average crop value was about $132 per irrigated acre.

Construction of project facilities was completed in the early 1920s and the district has operated them since 1927.

Goshen Irrigation District has recently completed a rehabilitation and betterment program placing about 92 miles of its 245-mile lateral system in precast concrete pipe. The flow capacity of most of these laterals is 20 cubic feet per second or less. The nominally reinforced mortar-joint pipe, which the district manufactures in its own plant, is 30 inches or less in diameter.

Gering and Fort Laramie Irrigation District has a rehabliitation and betterment program in process under which they are replacing about 95 miles of their 270-mile lateral system with precast concrete pipe or asbestos-cement pipe. The district is using 8- to 16-inch-diameter, asbestos-cement pipe, and 18- to 30-inch-diameter, commercially made precast concrete pipe.

Each district is lining a considerable portion of their canals and large laterals. The lining used is primarily buried asphaltic membrane. Both of these rehabilitation projects have been financed under the Rehabilitation and Betterment Act of 1949 Federal Reclamation Laws.

Other R & B

Some of this same type of R & B work is being done in almost every Reclamation region.

The Salt River Project in Arizona now has about 270 out of 870 miles of laterals in pipe, much of which is cast-in-place.

The South San Joaquin Irrigation district in California is improving about 120 miles of unlined laterals with cast-in-place concrete pipe. The Lower Rio Grande Rehabilitation Project in Texas has a major construction program for canal lining and placing laterals in pipe.

The Mercedes Division of the latter project, which has 68,000 irrigable acres, is more than 50 years old. It now has replaced over 200 miles of open lateral with precast concrete pipe, with rubber-gasket-type joints, ranging in diameters from 15 to 36 inches. Unreinforced pipe was used up to 30-inch diameter and heads up to 20 feet.

The district also placed about 50 miles of unreinforced concrete lining in laterals with capacities from 22 to 187 cubic feet per second. Of the district's 300 miles of laterals, only about 9 miles remained unlined at the end of June 1965. There will be little, if any, unlined or unpiped laterals when this job is completed.

On new construction, the Bureau of Reclamation generally has found it appropriate to provide an unlined open lateral system, which has the least first cost. Lining or pipe have been used only in those reaches where soils investigations have indicated such measures are required to reduce water loss and seepage.

Growing concern with potential water shortages and the continuing change in construction and operation and maintenance procedures have caused the Bureau to take another look at conventional practices. As a result, improved procedures have been developed for determining case by case whether or not to line or place a particular system in pipe. It is not believed that a pipe distribution system is justified for every project.

The intention is to provide for each project the system which meets as nearly as possible the needs and economic limitations of the irrigation district.

An older project in need of rehabilitation and betterment should be examined in the same economic terms as a new project to determine whether one should consider lining or piping an open lateral system.

In preparing for rehabilitation of his distribution system, each district manager should consider the cost aspects of:

1. Water Conservation
2. Land Utilization
3. Operation and Maintenance
4. Other Considerations

Water Conservation Economics

Assuming that the district has adequate measuring devices and keeps good records of diversions and deliveries, one can readily determine water losses. For example, the Gering and Fort Laramie Irrigation District determined that of 105,600 acre-feet diverted to their laterals, 17,700 acre-feet, or roughly 17 percent, was lost to seepage and evaporation.

The amount of water savings will be the difference between the measured water losses in the present open laterals and the estimated losses in the proposed pipe system. The amount of seepage from a pipe system is about 2 to 3 percent. As the average canal measuring device does not measure that accurately, for practicable purposes these losses in a pipe system will be negligible.

Having estimated the amount of water saved, one then estimates its value. This, of course, will vary greatly among projects. In instances where water is purchased under a service contract, the saving can be easily determined. Other determinations will require an estimate of the benefits derived by using this water for irrigating additional lands. In some instances the benefits and costs for irrigating additional lands can be combined with those for lining the system in determining the feasibility of the project.

In any case, water savings will be one of the major benefits derived from conversion to a pipe system. For example, the Gering and Fort Laramie District estimated that its rehabilitation would salvage 10,700 acre-feet of the 17,700 acre-feet of measured losses.

Goshen Irrigation District installing cast-in-place concrete pipe on the North Platte project, Wyo., in 1959—financed by Rehabilitation and Betterment Funds.

The value of water was determined by using the established $1.90 per acre-foot irrigation water service rate at Glendo Reservoir, a short distance above the project. By this yardstick, the estimated value of water saved was $20,330 per year, or about $200 per mile per year for the 95 miles of pipe and 8 miles of lining to be installed.

Land Utilization

Land utilization after conversion of an open lateral to pipe may include farming of the right-of-way and increased crop production. On North Platte and Lower Rio Grande Rehabilitation Projects, for example, new pipe laterals parallel county roads; hence operating roads are not required. Here crops also are being produced directly over some of the pipe.

In one instance at least, on the North Platte Project, a farmer's head ditch runs directly over the pipe lateral. A few project managers indicate that there have been some problems with roots entering pipe joints when orchards, vineyards, or alfalfa are produced too close to or directly over the pipes.

However, one manager suggests that bare copper wire placed in the pipeline seems to alleviate the root problem. This is probably because copper is toxic to many plants.

Land utilization may also involve reclaiming drainage areas. On the North Platte Project, the Goshen Irrigation District has reclaimed a number of seeped acres adjacent to laterals or canals by backfilling some deep drains no longer required. Some of the water saved by lining the laterals may be utilized to irrigate these reclaimed areas or other nonirrigated lands.

Benefits probably are best measured by cropping experiences on adjacent lands. Wyoming Agricultural Experiment Station Bulletin 310, shows the net profit per acre per year of irrigated farmlands in Goshen County to be $32.14. This value has been used to determine benefits derived from land utilization on the Fort Laramie Division of the North Platte Project.

Operation and Maintenance Costs

Lateral cleaning and weed control are common to all projects. However, the methods of accomplishing this required work and the costs for doing it vary greatly among projects. There are O & M road maintenance, cleaning of drains, pest control, repair of ditch breaks, and structure repair and replacement.

Although these items are easy to identify, it is often difficult to determine from your records the actual expenditures. If you were to conduct an economic study of the project you probably would find it helpful to know what percentage of the laterals you clean each year and the average rate of accomplishment. Then, you will want to know the hourly costs for equipment.

Similarly, one may need to segregate average weed control costs of laterals from canals, the frequency and cost of maintaining roads, and others.

A pipe system may also save in operating time or increase the length of the ditchrider's beat over an open system. One manager estimates an increase of roughly 33 percent in size of ditchride. He attributes this difference to the increased speed of delivery and the reduced time for weed and trash removal. However, some other districts have indicated no change in their ditchrides.

On a rehabilitation project, funds that would have been spent for replacement of old structures that have outlived their usefulness can be spent on the betterment program.

There are undoubtedly some types of maintenance expenditures for a pipe or lined system that would not be experienced on an unlined open system. Pipe-joint leaks are the most common. The North Platte Project, however, reports no joint repair expenditures on their mortar-joint lines.

On the Mercedes Division of the Lower Rio Grande Rehabilitation Project, it has been estimated that a minimum of five leaks per mile per year have been repaired in the mortar-joint pipe

BIOGRAPHICAL SKETCH

BENJAMIN A. PRICHARD *received his B.S. degree in Civil Engineering from Montana State University in 1944, and after 2 years in the Navy, he started work for the Bureau of Reclamation. The first 15 years of his Bureau service was spent in designing canal and lateral structures, and since that time, he has worked in the Division of Irrigation Operations in the Chief Engineer's Office in Denver, Colo. Mr. Prichard recently completed a study similar to this to determine the economics of pipe and open lateral irrigation systems.*

but essentially no leaks in the joints which utilize round rubber gaskets.

Repair of concrete lining involves repair of cracks or ruptures. Operation and maintenance costs for open ditch and pipe laterals vary greatly among projects. It was estimated that the Gering and Fort Laramie Irrigation District's rehabilitation of small laterals would reduce annual operation and maintenance costs about $170 per mile.

Other Cost Considerations

There are, of course, many other minor benefits which are more difficult to evaluate. Nevertheless, they are real and should be evaluated if at all possible. There will be a reduction in weed seed distribution, pest damage, weed chemical contamination, and damage claims. There will also be improvements in safety, farm operation, appearance, and tax base.

Examples of these benefits may be found on the Owyhee Project in Idaho and Oregon where some laterals have been improved by placing them underground. Generally speaking, these improvements have been initiated by landowners wanting to eliminate a lateral or to change it from meandering through a field.

The pipe is purchased by the individual farmer who considers some of the above-mentioned benefits of sufficient magnitude that he is willing to buy the pipe and contract its laying. The district usually does the excavation and backfill.

Most of the type of work in this discussion is beyond the district's means of financing from their O & M budgets, and has been financed under the Rehabilitation and Betterment Act or the Small Reclamation Projects Act. Inquiries about financing a water improvement project under either of these plans may be made at Reclamation Regional Offices.

Under either program, the need for the particular work must be shown and an economic evaluation made of the district's capability to repay the loan. In general, it will be necessary to indicate the savings from water utilization, better land utilization, reduction in O & M costs, and other benefits to show the repayment capability. # # #

A Conservation Story at Lewiston

WORKING AND LEARNING JOB CORPSMEN

by RANDY MILLER, of the Lewiston Job Corps Staff

THE first job corpsmen began to arrive last April at Lewiston, Calif., in the heart of Trinity National Forest. This Bureau of Reclamation center, which for years had been home base for thousands of construction employees, was to begin a new era of construction—that of building the talents, minds, and attitudes of another important resource, the young men of America.

Corpsmen helped keep roads clear of trees that fell during heavy January snows. Many hours of work in the cold were credited to the Lewiston and other Centers during last winter's emergencies.

Clair Engle Lake Vista House will be in even a more beautiful setting as a result of these hole-digging Corpsmen. The two on the right are making postholes for a guard rail, the others are installing a sprinkler system on the bank, which on another day they planted with ivy to prevent erosion.

Any staff member present in those first formative days and weeks of the Lewiston Conservation Job Corps Center will admit his apprehension. There was introspection and many questions. It was one of those wonderful ambiguous times when a person could ask honestly "How are we going to do it?", knowing inwardly that somehow the program *would* take shape.

As the staff began living with the young men and their problems day and night, they found answers to some questions daily. They are still looking for some.

You ask yourself, "What is a corpsman?" and answer that he is a unique individual, but defies generalization. He is a high school dropout, but he is different because he is asking again for help with his education. He is unskilled, but instead of walking the streets feeling sorry for himself, he seeks to be trained.

A corpsman may be undisciplined, yet he chooses the Job Corps environment where social discipline is necessary and self-discipline is the basis of the entire program.

He is sometimes a loner, but now has to face the facts of teamwork and getting along with others, regardless of race and background, religion and ability.

Sometimes he is sullen and withdrawn, but hopes desperately that his worth will be recognized.

While the emphasis is on vocational training, a great deal of the program is devoted to group living and character development. In order to realize success in any one of these areas, there must be balance in all three.

Conservation Projects

Most of the work program so far has been in the area of Lewiston. Landscaping, construction, soil-erosion prevention, and beautification, in different combinations, have been the basic instructional aim of each project.

In October 1965, the corpsmen completed the landscaping of the Clair Engle Lake Vista House in cooperation with the Forest Service.

They spread top soil, planted hundreds of trees and shrubs, installed a permanent sprinkler system, dug drainage ditches, and seeded the steep slopes to prevent erosion.

The physical aspect of the project was completed successfully and beautifully, but there was much more to it than a grateful visitor sees. Some of the corpsmen learned to follow directions, others to show their initiative. Some became leaders, others learned not to gripe even when the temperature rose above 100 degrees. The boys found satisfaction in seeing the project through from beginning to end. They knew the work they were doing was good and was going to be beautiful in the spring.

One corpsman asked the work foreman, "What color will the blossoms be on the Chinese pistachio trees?" On a lunch break, another corpsman sat on the hill overlooking the lake below and enjoyed the beauty around him.

All this must have been a change in awareness for a boy who comes from a big-city slum. Such incidents, however small, seem to mark success for a project.

All of the corpsmen, of course, do not understand nature at first. The presence of a deer in the forest is as strange to them as it would be in the heart of Los Angeles or Chicago. He begins to appreciate such life around him when the work foreman's job doubles with the role of instructor. The planting of a tree, the digging of a run-off ditch, the building of a fireplace, the gathering of roadside beer cans, and the construction of a fire break must be given true significance.

Since the work and the results of most conservation projects are separated by the course of time, it is often difficult for the corpsmen to get excited about work that never appears to be completed. He must be helped to the realization that the main results of his work are not immediate.

Several projects have been completed in the short history of the work program. Thousands of trees have been planted on local hillsides being eaten by erosion; several campsites have been completed; almost 20 miles of roadside have been cleared of debris; a thousand picnic tables are being built; many fire hazards have been eliminated in addition to destroying rodent habitat; and the center itself has been developed to provide better working and living conditions.

Wintertime Emergencies

The results of some projects are immediately apparent.

The center awoke last January 4, for instance to find that overnight a storm had dumped over 12 inches of snow and it was still falling. Power and telephone lines were down all over Trinity County. At Lewiston, the Job Corps Center was without heat, lights, or a workable kitchen.

The center's cooks prepared a good meal on gas camping stoves, and eating was by candlelight. Fortunately, only 21 of the center's 200 corpsmen had returned from their Christmas vacations.

After breakfast, reports began funneling in of the seriousness of the snowstorm. A group of corpsmen was already helping out. They returned from an all-night stint on a local mountain road helping motorists put chains on their vehicles as a courtesy of the center. They were cold, wet, tired, and hungry. After breakfast, they volunteered to go right back out.

Following lunch, word came that the roof of the supermarket—the only source of food in the community—was about to collapse from the weight of almost 18 inches of wet snow. Within 15 minutes, corpsmen and staff members were shoveling the heavy snow to prevent a collapse. A hermit in the community had been caught without food. Several of the boys took him groceries. One staff member loaded a pickup with groceries and fuel to play a belated Santa to others in the community who were caught short.

With it still snowing hard, the center's heavy-equipment operator continued to open streets and roads in the area wherever he could.

Since many local people depend on electricity for their cooking, the center decided to prepare a meal for the community with the cooperation of the Moose club. With the help of Moose Lodge's wood-burning stoves, over 90 people were fed, including Job Corps staff families and local residents.

Shortly after six, electrical power returned, but it was still snowing. The center provided a corpsman crew to help remove fallen trees from a highway. The men returned late at night. One corps-

When this project is finished, a firm blacktop will provide the Center with an improved area for outdoor sports and physical education.

man worked almost 18 hours on the grader clearing roads and streets with barely a stop. He made no complaint and probably never considered stopping until he was finished. Another appeared inconspicuous because he was in so many places. Seeing one job completed he moved on to the next. When the emergency was over, it was discovered he had worked almost 48 hours straight without a rest.

A staff work instructor stayed with the road crews from the early to the late hours.

As residents at the center finally dropped on their beds, a satisfying sleep came quickly, but first they still were hearing soft rain falling and the occasional noise of the grader at work.

It had been a long day and a rewarding one. This timely extension of Job Corps effort into the life of the Lewiston community was appreciated and won't soon be forgotten by the corpsmen or the local residents.

Learning in Class

The instructors in the educational program are faced with many of the same problems that confront the work staff. The main emphasis may be on reading and mathematics but to sink in, classroom work must be related to everyday problems. As in the field, there must be encouragement toward self-confidence and a great deal of patience.

A young man drops out of high school for many reasons—social, economic, and emotional. Each corpsman's reason is different, but each story has the same sense of tragedy. Generally, he thinks that his academic weakness is the main reason for his failure to get a job and lead a normal adult life.

He often blames his former teachers or school system for not meeting his specific problems in learning. Sometimes he brings his disillusionment and mistrust of teachers with him to the classrooms of the Job Corps.

Approximately 30 percent of the Lewiston corpsmen were nonreaders on arrival. It is more than inspiring to see a young man of 18 or 19 again learning to read, working desperately and enthusiastically to destroy this greatest single barrier to his leading a normal, useful life.

The majority of the academic training is programed; the student, for the most part, teaches himself. He completes problems presented to him in a systematic and meaningful sequence, and checks the answers himself. Cheating is practically nonexistent.

Though the educational personnel are still finding more and better ways to meet the academic needs of the corpsmen, the program has already been very successful. In addition to the basic program of reading and mathematics, other courses are presented that prepare the corpsman more fully to find a job and keep it.

He receives training in job interviews, for instance, and in filling out a job application form. Work attitudes are discussed, and the concept of responsibility is made more meaningful.

Basically, the program is designed so that corpsmen from many backgrounds and with a wide difference in abilities can fit into it comfortably with a minimum of frustration. Perhaps upon finishing the program, the boy will not be a scholar; but, he will be able to read a newspaper, a magazine, a work manual, compute his income tax, and face a new job with confidence.

Learning from Each Other

At Lewiston, there are approximately six or seven corpsmen to each dormitory. Since no consideration is given to race in the makeup of each dorm, it is the first time in the lives of many that they are forced to understand a human of another color or religion. There has been extremely little conflict, and a great sense of tolerance and comradeship has developed.

This fact becomes particularly significant when one considers the wide variation in ethnic backgrounds of the corpsmen.

The men take pride in the upkeep of the dorms and compete each week for honors for the cleanest and best-kept dorm. The winners are generally given a small reward, such as a special trip to go camping, or a special privilege. The dorms are supervised by the resident counselor staff, who act as big brothers, fathers in some cases, to the corpsmen. Some of the corpsmen, the younger ones particularly, become homesick and discouraged at times and need the special attention and guidance of a counselor they have learned to trust.

Finally, there is that large and important block of time when the corpsmen are not sleeping, working, or going to class. Fortunately, Lewiston has good facilities for recreation. In the center, there must be enough things to do to involve almost every corpsman in an area of his specific interest.

If interest does not exist, then the program must be adapted to draw him to it. Some of the staff and their wives, for instance, run an arts and crafts program on a volunteer basis in the evenings. Their program is tremendously successful. When one considers the life some of the corpsmen led such a short while ago, it is even more amazing to see them painting a delicate plaster cast, stitching a wallet in leather class, working with skill in the photo lab, or transferring their love of cars to the scale models on the center's slot car track.

The center has a baseball and a softball field, volley ball court, archery range (both indoor and outdoor), weight-lifting and boxing facilities, and a recreation hall for ping-pong, pop records, snacks, and conversation. Almost all of the instruction and supervision of these areas is done voluntarily by the staff as well as the corpsmen.

Challenge of Center Life

The Job Corps life has to be a complete one as much as possible. New standards of living must be accepted by the corpsmen. In some cases, better health and moral standards must be provided by example and guidance. Little can be forced upon them, but a great deal can be given. Their friendship cannot be taken for granted, but is the product of sensitive understanding on the part of them and the staff. The staff constantly faces the responsibility of setting an example and showing understanding.

There is an intensity in a Job Corps Center that requires constant self-appraisal, and a realization of human limits when one is working desperately to alleviate inadequacy. The human drama, the interplay of personalities, and the heroic efforts generally go unnoticed. Yet the staff has the reward of seeing progress and the presence of ability that was once just latent potential.

Director John C. Schaumburg has coined the phrase for the Lewiston Conservation Center: "You come to the Job Corps a boy, you graduate a man."

The change in the boys as they become men is evident to the staff members and to their families. The mother of one of the Lewiston Job Corpsmen wrote to the staff over the holidays to wish the members a Merry Christmas and to thank them for what they were doing for her son.

"Our son, who once couldn't write his own name, now writes to us," she said. "When we talk to him on the phone, we notice the improvement in his speech, his attitude toward his fellows, and we thank God for folks like you who care enough to help a boy whose parents could not help him financially and otherwise." # # #

Take 15 Seconds For Safety—
Wind Socks Fly at Lake Cachuma

During the 11 years of operation of the Lake Cachuma Recreation Area by the county of Santa Barbara, Calif., five persons have lost their lives in boating accidents on the lake. A major cause of these accidents is the high winds which frequently sweep across the lake. The winds are strong in all coastal valleys and particularly in Santa Ynez River Valley because of its proximity to the cool ocean.

In an effort to prevent drownings due to boats capsizing in the heavy winds, the county has installed a storm-warning system which has proven very effective. The system is briefly presented on a sign at the boat-launching ramp. The sign is headed: "*Take 15 Seconds To Save Your Life. Reading The Following May Do The Trick*," and it is followed by safety instructions and a drawing of the lake.

Three storm flags (large yellow wind socks) are hoisted to the top of poles when the wind exceeds 20 miles per hour. One of the flags is at Tequepis Point, one is at the launching ramp, and one is on the Tecolote Tunnel inlet tower. At least one of the flags is visible from nearly any position on the lake. When the storm flags are flying, no boats are allowed to leave the dock area and those boats on the lake are warned to seek shelter in coves or proceed to the dock area with extreme caution.

Regarding boats which might already be on the lake when the signals are raised, the flag system also helps avoid liability responsibility.

A recent storm front at Lake Cachuma caused a seaward flow of air in excess of 25 miles per hour, making it necessary to raise the flags from 9 a.m. to 3 p.m. Some fishermen had been able to get out on the lake prior to the hoisting of the flags, and they gradually made their way back. However, the gate at the launching ramp was locked against boats leaving.

Upon request or in an emergency, a boat coming in can be escorted to the dock by the park-patrol vessel.

The county managing agency of the Lake Cachuma Recreation Area, Cachuma Project, has done a commendable job in establishing this system and seriously attempting to make this water surface safer for boaters. # # #

When the windsocks are raised, such as the one being raised here, no boats are allowed to leave the dock and those on the lake are warned to seek safety.

Golden Eagle Support Means Funds for More Recreation

Approximately 7,000 Federal recreation areas throughout the country are, or will be posted with a sign like this one, which means that the area is in the *Operation Golden Eagle* program. A wallet-sized permit called "Golden Passport" may be purchased for $7 entitling the purchaser and everyone in his car to enter the designated areas an unlimited number of times during the 12-month valid period—from March 1966 to March 1967.

Wide support of the program is urged, inasmuch as revenues from sale of the passports go into a fund for more recreation. "Golden Passports" are on sale at many Bureau of Reclamation offices, national parks, monuments, wildlife refuges, other Federal offices, and the American Automobile Association.

The cutter head of the 20-foot diameter tunnel-boring machine is shown here as it completed "holing-through" Tunnel No. 1 on the Navajo Indian Irrigation project, N. Mex., on March 19, 1966.

"Sixty Years of Tunnel Driving"

Cont. from page 32.

and the emergency measures taken to surmount them, raised the cost of the tunneling from $44 a cubic yard of excavation to $447 a cubic yard.

Another dramatic tunneling job, operation "Grand Valley Rescue," involved a race against time to save some orchardists on the Grand Valley Project in Colorado from an impending $2 million loss of their 1950 fruit crop. A landslide had demolished 500 feet of an old diversion tunnel that conveyed irrigation water to the threatened orchards.

In early March, a few days after the slide, Reclamation negotiated a contract for a 2,240 foot tunnel around the damaged section. Two construction firms, operating as a joint venture, set to work with a 72-day deadline for completion. The tunnelers met with no adversities, beat their deadline by 24 days, and water was delivered in time to save the orchards.

Usually tunnels are driven from as many faces, or headings, as access and economy permit, through auxiliary shafts or adits excavated from the surface. But Reclamation's longest tunnel to date—the 13-mile Alva B. Adams Diversion Tunnel through the Continental Divide in Colorado—was driven with no auxiliary adits or ventilation shafts at all. The 9.75-foot diameter tunnel had to traverse the entire width of the Rocky Mountain National Park, and any shafts from the surface would have marred the park's natural beauty. The job was completed successfully without them, though it took longer.

In closing its 61st year as a tunnel-building organization, the Bureau of Reclamation has over 40 miles on eight major tunnel jobs in progress or under contract on four water resources development projects in California, Colorado, and New Mexico. As the years pass, and as Reclamation must look to more distant sources of water supplies to meet the increasing needs of the arid and semiarid Western States, the Bureau's tunneling activities can be expected to grow in size and complexity. # # #

Livestock Increase in the Columbia Basin

The young lady smiling beside the spotted calf is Jannette Pearce of Moses Lake, Wash., in the center of the Columbia Basin project irrigated area. A couple of years ago, Jannette was crowned Washington State Dairy Princess, the first chosen from the project area.

Miss Pearce found the lucky calf on her grandparents farm where 180 cows produce about 10,000 pounds of milk a day. In the last few years the Columbia Basin project has become an important dairying area, and a good producer of other livestock as well. Just over 103,000 cattle were counted on the project farms last fall, a full 26,000 head over 1964's count. This sharp increase was due to a technical change in census procedures as well as the year-by-year increase in cattle.

More than 50 percent of the cattle fattened on the project were shipped to the coast, while 15 percent were sold locally. Cattle for slaughter usually average 1,060 pounds each.

Rubinoff and his violin—a Stradivarius insured for $100,000—has set the Lake Powell wonderland behind Glen Canyon Dam, Ariz., to music. The Lions Club of the town of Page recently sponsored the famous violinist to play at the high school auditorium. In the concert following a tour of the area, Rubinoff told how impressed he was at the beauty of the area.

I. J. Coury Receives Conservation Award

Secretary of the Interior Stewart L. Udall presented the Department's Conservation Service Award on March 15, to I. J. Coury, Chairman of the New Mexico Interstate Stream Commission and director and one of the organizers of the New Mexico State Reclamation Association. He also represents his State on the National Reclamation Association Board of Directors.

Mr. Coury, who is from Farmington, is well known in the field of reclamation for his liaison work. He was successful in a variety of water-use negotiations and was praised for "outstanding service as a leader in water resources development and conservation."

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MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-6300A	Pacific Northwest-Pacific Southwest Intertie, Calif., Oreg.	Feb. 8	Construction of the 94-mile Malin-Round Mountain 500-kv transmission line No. 2.	Power City Construction and Equipment, Inc. and Meva Corp. Spokane, Wash.	$9,160,465
DS-6348	Missouri River Basin, Iowa.	Jan. 3	Three 10,000-kva trailer-mounted mobile autotransformers for Region 6, Schedule 1A.	General Electric Co., Denver, Colo.	243,525
DS-6362	Pacific Intertie, Nev.	Feb. 14	Fifty-three 230-kv disconnecting switches for Mead substation, Schedule 2.	H. K. Porter Co., Inc., Electrical Division-Chicago Works, Chicago, Ill.	231,734
DC-6364	Office of Emergency Planning, N.Mex.	Jan. 24	Reconstruction of Ponil diversion dam, Antelope Valley Irrigation District.	Severino E. Martinez Construction Co., Espanola, N.Mex.	314,867
DC-6365	Central Valley, Calif.	Jan. 3	Construction of fish diverter, settling basin, and check and fish barrier for Tehama-Colusa canal.	Purtzer and Dutton, Reno, Nev.	1,446,513
DC-6368	Fryingpan-Arkansas, Colo.	Jan. 3	Relocation and improvements for 9.84 miles of county road 104, Section 2, Ruedi reservoir.	Schmidt Construction, Inc., Arvada, Colo.	1,070,040
DC-6370	Pacific Intertie, Nev.-Ariz.	Jan. 17	Construction of the 238-mile Mead-Liberty 345-kv transmission line.	Power Line Erectors, Inc., New York, N.Y.	13,602,662
DC-6374	Eden, Wyo.	Jan 21	Modification of Means canal and West lateral and sublaterals	Brasel and Sims Construction Co. Lander, Wyo.	461,981
DC-6380	San Juan-Chama, Colo.	Feb. 1	Construction of the 5-mile Oso tunnel, two diversion dams, and appurtenant structures with 8-foot 7-inch diameter circular ditch section for tunnel and monolithic-concrete pipe siphons, Schedules 2 and 5.	Boyles Brothers Drilling Co., Salt Lake City, Utah.	6,340,987
DC-6381	Colorado River Storage, Colo.	Feb. 8	Construction of the 86.7-mile Poncha-Midway section of Curecanti-Midway 230-kv transmission line.	Dominion Construction Co., Scottsbluff, Nebr.	4,563,700
DC-6385	Columbia Basin, Wash.	Feb. 9	Construction of the second barrel of Weber Coulee siphon for East Low canal.	Paul E. Hughes Construction Co., Inc., Pasco, Wash.	248,746
DC-6387	Central Valley, Calif.	Mar. 14	Modification of Corning canal and installation of controls	Myers Construction Co., Redding, Calif.	215,400
DC-6389	Front Work & Levee System, Calif-Ariz.	Mar. 14	Construction of two timber bridges	Clifford C. Bong & Co., Arcadia, Calif.	447,490
DC-6390	Missouri River Basin, Mont.	Mar. 10	Construction of Yellowtail dam visitor center, parking areas, and retaining wall.	Brezina Construction Co., Inc., Minot, N. Dak.	527,976
DC-6392	Central Valley, Calif.	Mar. 17	Construction of Contra Loma Dam	Parish Brothers, Inc., Benicia, Calif.	1,781,626
DC-6399	Milk River, Mont.	Mar. 23	Construction of Paradise Diversion Dam	A. H. Sandall and Don Francis, Spokane, Wash.	298,191
100C-820	Columbia Basin, Wash.	Jan. 7	Construction of 4.9 miles of buried pipe drains, 0.6 mile open ditch drain, and pumping plant, Blocks 13, 16, and 20.	B & B Contracting Corp., Anacortes, Wash.	142,231
100C-822	Baker, Oreg.	Jan. 21	Clearing Mason reservoir area	MacGregor Triangle Co., Boise, Idaho.	103,840
100C-830	Columbia Basin, Wash.	Feb. 8	Construction of 7.1 miles of buried pipe drains for DW81 drain system, Block 87.	A. G. Proctor Co., Inc., Aurora, Colo.	121,999
200C-628	Central Valley, Calif.	Jan. 25	Rehabilitation of 11 timber bridges along the Friant-Kern canal	Kaweah Construction Co., Visalia, Calif.	135,987
300C-243	Front Work & Levee System, Ariz.-Calif.	Jan. 7	Construction of roads and bank protection structures	Dennis Construction Co., Inc., Yuma, Ariz.	569,233
500C-223	Canadian River, Texas	Mar. 11	Construction of 163 picnic shelters and 170 fireplaces for recreation areas for Lake Meredith.	High Plains Building Co., Amarillo, Tex.	134,611

Major Construction and Materials for Which Bids Will Be Requested Through May 1966*

Project	Description of work or material
Bostwick Park, Colo.	Constructing Silver Jack Dam, an earthfill structure about 140 ft high, 1,100 ft long, containing about 1,100,000 cu yd of materials, and appurtenant features. The spillway will be an ungated concrete structure with a stilling basin in the right abutment. On Cimarron Creek, about 35 miles east of Montrose.
Bureau of Indian Affairs (Blackfeet Indian Irrigation project), Montana.	Constructing Two Medicine siphon, a 96-in.-diameter siphon about 375 ft long with either precast concrete pipe or monolithic concrete barrel for heads up to 75 ft. Work will also include constructing concrete transitions at each end of the siphon and about 100 ft of 20-ft bottom width canal connecting each end of the siphon to the existing canal. Near Browning.
Canadian River, Texas	Constructing water and sewer systems for Fritch Fortress Recreation Area. Near Fritch.
Central Utah, Utah	Constructing Starvation Dam, an earthfill structure about 155 ft high, 3,000 ft long, containing about 4,500,000 cu yd of materials. The spillway will consist of a "bathtub" type intake structure, a chute, and a stilling basin in the right abutment.
Central Utah, Utah (cont.)	The outlet works will consist of an intake structure, a 7-ft-6-in. diameter pressure tunnel upstream, a gate chamber and shaft with elevator, a modified horseshoe free-flow tunnel and stilling basin all in the left abutment. Work will also include constructing 1.2 miles of service road. On the Strawberry River, about 4 miles northwest of Duchesne.
Central Valley, Calif.	Earthwork and structures for about 12 miles of unreinforced concrete-lined Tehama-Colusa Canal, Reach 3, about 5 miles of which will have a 52-ft bottom width and about 9 miles will have a bottom width of 24 ft. Near Orland.
Do.	Constructing about 22 miles of 12- through 72-in.-diameter pipeline, including a water screen and recirculating structure and other appurtenant control facilities. Westlands Laterals 6, near Fresno.
Do.	Constructing eight buildings of exposed structural steel, split-faced concrete block, precast concrete panels and glass. The approximate size of the buildings will be: administration building—6,900

See footnote at end of table.

COVER PHOTO. A. G. D'Alessandro caught this shot of a thirsty young deer which had familiarized itself with the visitors' drinking fountain at the Shasta Dam Visitor's Center, Calif. He (or she) is from a herd that grazed on the lawn early this year, to the delight of many visitors.

U.S. GOVERNMENT PRINTING OFFICE 1966 O—205-385

Major Construction and Materials for Which Bids Will Be Requested Through May 1966*—Continued

Project	Description of work or material
Central Valley, Calif. (cont.)	sq ft, general maintenance headquarters—6,000 sq ft, general maintenance warehouse—8,000 sq ft, vehicle storage building—3,350 sq ft, mobile equipment storage building—5,270 sq ft, heavy equipment storage building—2,360 sq ft, electrical shop and warehouse—6,710 sq ft, water treatment building—1,560 sq ft. San Luis Dam headquarters buildings, about 12 miles south of Los Banos.
Colo. River Storage, Arizona.	Constructing a reinforced concrete, air-conditioned visitor building, having an area of 3,450 sq ft, with observation and concession areas and an elevator tower. A structural steel covered walkway will connect the existing right abutment walkway with the top of the elevator tower. The plaza area will contain concrete walks, benches, and reflecting pool with fountain. Glen Canyon near Page.
Do	Furnishing material and placing 0.5-in. bonded terrazzo finish on floors and stairs in powerplant; furnishing and applying polyurethane resin coating to walls in elevator tower and some powerplant walls. Glen Canyon Powerplant.
Do	Designing, furnishing, installing, and testing a floodlighting system for illuminating the downstream face of Glen Canyon Dam.
Colorado River Storage, Colorado.	Constructing Crystal Dam, an earthfill and rockfill structure about 220 ft high, 750 ft long, containing about 1,900,000 cu yd of materials, with a 26-ft-diameter radial gate controlled spillway in the right abutment, steel pipelined pressure tunnel; powerplant consisting of a reinforced concrete substructure and intermediate structure and a steel-framed superstructure; a switchyard; communications and telemetering systems. On the Gunnison River, 21 miles east of Montrose.
Colorado River Storage, New Mexico.	Constructing a cofferdam, unwatering, cleaning, modifying and extending the outlet works stilling basin as required. Work will also include constructing a cofferdam, unwatering, examining and possibly rehabilitating the spillway stilling basin. Navajo Dam, about 39 miles east of Farmington.
Columbia Basin, Wash.	Constructing about 28 miles of laterals and wasteways of which about 12 miles will be lined with concrete with 6- and 5-ft bottom widths and about 11 miles with compacted earth with bottom widths varying from 10 to 3 ft. Blocks 36 and 55, near Othello.
Do	Constructing about 33.5 miles of buried pipe drains. Block 46, east of Othello.
Do	Constructing about 16.3 miles of buried pipe drains and 0.9 mile of open drain. Block 78, south of George.
Do	Constructing about 16 miles of buried pipe drains. Block 15, north of Pasco.
Do	Constructing about 12 miles of buried pipe drains and deepening existing drain for about 1 mile. Block 20, west of Mesa.
Crooked River, Oreg.	Constructing six small pumping plants and 22 miles of 4- to 2-ft bottom width laterals. Near Prineville.
Fryingpan-Arkansas, Colo.	Clearing about 775 acres of Ruedi Reservoir area. About 13 miles east of Basalt.
Do	Constructing roadbed and structures for about 16 miles of relocated Denver & Rio Grande Western Railroad. Adjacent to and west of Pueblo.
MRBP, Colorado	One 110/69/12.47-kv, 20,000/26,667/33,333-kva autotransformer for Sterling Substation, Stage 06.
MRBP, Kansas	Constructing a 500-ft-long bridge with four-span continuous-welded steel girders and concrete deck slab on concrete piers and abutments. Work will also include some channel excavation and embankment for bridge approaches. Mitchell County Road C-705, near Cawker City.
Do	Constructing about 2.6 miles of canals and laterals with bottom widths of 4 and 3 ft; and constructing two pumping plants, one with three units of 3.34-cfs capacity each and one unit of 6.68-cfs capacity, and the other plant with three units of 3.34-cfs capacity each. Courtland, Pumps 3A and 3B, near Scandia.
Do	Constructing the earthfill Cawker City Dike about 50 ft high, 15,000 ft long, containing about 1,870,000 cu yd of material and a small outlet works and pumping plant. Near Cawker City.
MRBP, North Dakota	Stage 07 additions to Jamestown Substation will consist of constructing concrete foundations; furnishing and erecting steel structures; and furnishing and installing one 230/115/13.2-kv autotransformer, three 230-kv and two 115-kv circuit breakers, and associated electrical equipment. About 2 miles southeast of Jamestown.
Do	Three single-phase, 220/115/13.2-kv, 20,000/26,667/33,333-kva autotransformers for Jamestown Substation, Stage 07.
MRBP, South Dakota.	Constructing Stages 05 and 06 additions to Huron Substation will consist of constructing concrete foundations; furnishing and erecting steel structures; and furnishing and installing two 115-kv circuit breakers, and associated electrical equipment. About 8 miles northwest of Huron.
Pacific Northwest-Pacific Southwest Intertie, Arizona.	Constructing the Liberty Substation will consist of constructing concrete foundations and a concrete masonry unit service building; furnishing and erecting steel structures; installing one 345/230-kv, 3-phase, 450/600-mva autotransformer, six 230-kv and four 23-kv breakers, 12 miles of double circuit transmission line. Near Liberty, to a point near Estrella.
Do	Two 230-kv, 1,600-amp, 20,000-mva power circuit breakers for Liberty Substation.
Pacific Intertie, Nevada.	Four 23-kv, 1,200-amp, 500-mva power circuit breakers; and twelve 25-kv, 8,000-kva, single-phase, Type AA shunt reactors for Mead Substation.
Do	Detailing, fabricating, and testing steel towers for the Oregon Border-Mead 750-kv, d-c Transmission Line. The work will include preparing and furnishing shop detail and erection drawings; fabricating and erecting test towers; furnishing all equipment for and performing all required tower tests; and preparing and furnishing copies of comprehensive test reports.
Do	Designing, detailing, fabricating, and testing a guyed aluminum tower for the Oregon-Border-Mead 750-kv, d-c Transmission Line. The work will include preparing and furnishing shop detail and erection drawings; fabricating and erecting a test tower; furnishing all equipment for and performing all required tower tests; and preparing and furnishing copies of a comprehensive test report.
Pacific Intertie, Arizona-Nevada.	Constructing the Mead Substation will consist of clearing right-of-way, constructing concrete footings; and furnishing and erecting steel structures for the taplines to the substation; constructing a service building. Near Boulder City, Nevada.
Pacific Intertie, Nevada.	One 345-kv, 15,000-mva power circuit breaker for Mead Substation.
Do	Modifying six 287.5-kv power circuit breakers for Mead Substation.
Do	One 135-mva transformer for Mead Substation.
Do	One voltage and phase shifting 230-kv, 135-mva regulating transformer for Mead Substation.
Parker-Davis, Arizona	One 115-kv, 20-mvar shunt capacitor and equipment for Coolidge ED-4 Substation.
Seedskadee, Wyo.	Replacing about 100,000 cu yd of embankment materials for repair of existing Fontenelle Dam. About 24 miles southeast of La Barge.
Do	Constructing a cofferdam, unwatering and cleaning the outlet works stilling basin, excavating slide material from the channel, replacing backfill, and repairing eroded concrete surfaces. Work will also include erecting safety fencing. Fontenelle Dam, about 24 miles southeast of La Barge.
Washoe, Calif.-Nev.	Constructing Stampede Dam, an earth and rock fill dam about 230 ft high and containing about 5,000,000 cu yd of materials, and appurtenant features consisting of a spillway and an outlet works. On the Little Truckee River, about 11 miles northeast of Truckee.
Weber Basin, Utah	Completing Lost Creek Dam, a portion of which has been constructed under another contract. The principal item of work will be placing about 1,225,000 cu yd of materials in the embankment. Other work will include completing roadwork, constructing concrete outlet works shaft house, and cleanup and installation of metalwork and miscellaneous items of cleanup. On Lost Creek, about 30 miles east of Ogden.
Do	Enlarging Woods Cross Equalizing Reservoir 1.8 will consist of removing one bank and extending the length of the reservoir from 180- to 595-ft base length and 160 ft wide, concrete lining, and appurtenant facilities. Near Salt Lake City.

*Subject to change.

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August 1966

RECLAMATION ERA

AUGUST 1966 • Vol. 52, No. 3

RECLAMATION ERA

Gordon J. Forsyth, Editor

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United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy
Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C., 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing)

Commissioner's Page

Water, People and Conservation

We in the Bureau of Reclamation readily share the viewpoint that the preservation of much scenic land and water in their natural state is desirable. However, conservation for useful purposes also is essential to economic growth, national strength and security. The problem is to determine when conservation and use of a vital water resource becomes more important than merely having it on standby.

It is a matter of being a true conservationist. We cannot afford to be only dedicated preservationists, refusing practical facts and figures about human needs and ways of meeting those needs.

When we look at the growth and the continued migration of people to the larger cities, our present-day problems appear small in comparison to what we will face in just a few years.

The population of the United States approximately doubled from 1900 to 1960. During this period the water used for all purposes increased about six times. With the population expected to again double in only 35 years and the rate of water use to continue high or even increase, it is plain that development of some areas will be severly restricted unless measures are taken now.

It is obvious that we must not delay Reclamation's practical water projects which are clearly necessary and clearly feasible under policies enunciated by the Congress. No possible means of increasing our useable water supplies should be overlooked. Desalinization and pollution correction also will play key roles.

These things we must do within a framework of preserving and enhancing a beautiful America for the enjoyment and well-being of future generations.

Floyd E. Dominy

FLOYD E. DOMINY
Reclamation Commissioner

Two Top Awards for Commissioner Dominy

Photos by Jim Aycock

He probably does not have Spanish ancestry—not Nebraska-born Floyd E. Dominy. But the amenity and hearty responsiveness between him and the personable people of Spain make it look like he is one-of-the-family. It seemed so at the Spanish Embassy last June 2.

Because he is like the Spanish—convinced that water developments are vital to a growing nation, Reclamation Commissioner Floyd E. Dominy is in the same corral with water officials in the Government of Spain.

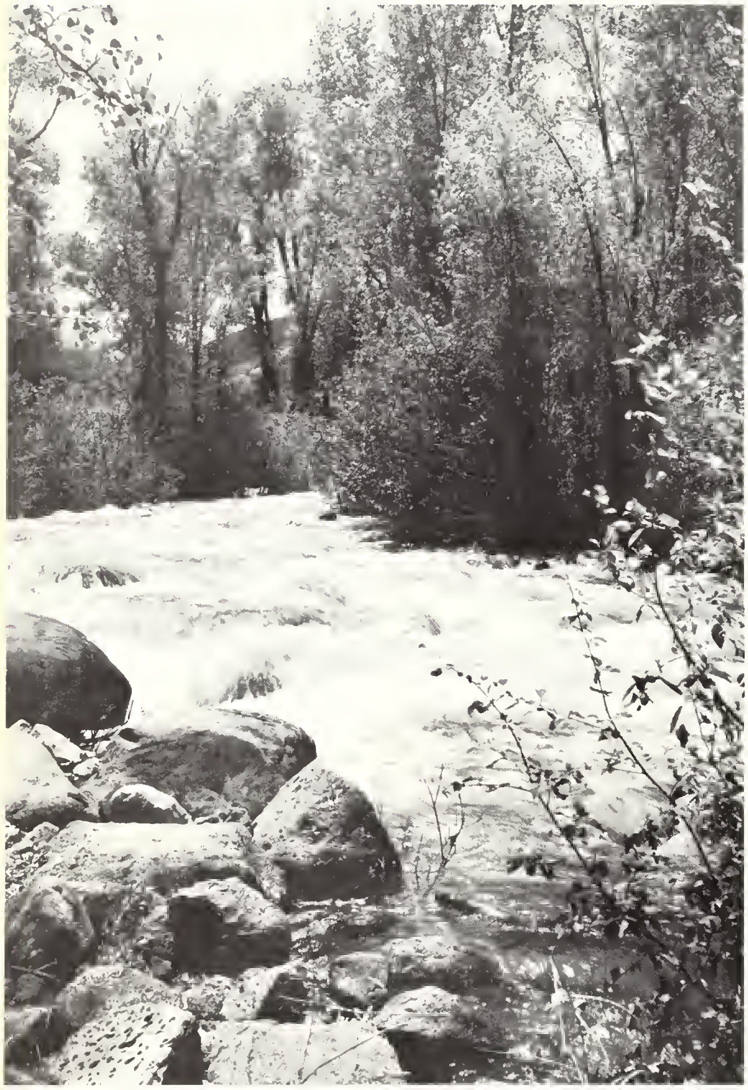
Ever since his welcoming in Madrid and successful study-tour of Spain's important dams and water developments in 1964, even the language barrier seems minimized.

When he left at the end of his one-week stay, the Spaniards said: "Mañana." Not Goodbye. One day soon, they would meet for a fiesta.

This was what led to the honoring event in June; one of the capstones in Mr. Dominy's life. At a reception at the Embassy, he was decorated with the highest civil order in Spain, the *Comendadas de la Order de Isabella Catolica.* The Great Cross was pinned on him by the Ambassador, the Marquis de Merry del Val, while Jose Toran, President of the Spanish Commission for Great Dams and his traveling companion in Spain, looked on.

This was the second high honor in a 3-week period for Commissioner Dominy. On May 13, he was announced as one of the Top Ten Public Works Men-of-the-Year. The award is sponsored by Kiwanis International and the American Public Works Association.

Commissioner Dominy was the only Federal employee of the 10 who received the award.



Reclamation To Help, Says Sec. Udall

Pollution Control Agency Welcomed to Interior

THE FEDERAL Water Pollution Control Administration has a new home in the Department of the Interior.

The pollution control agency was born 10 years ago in the Department of Health, Education, and Welfare where it had grown to 1,500 employees. It was transferred to the Department of the Interior as a result of President Lyndon B. Johnson's reorganization plan announced in February and was welcomed by Secretary of the Interior Stewart L. Udall at a press conference on May 10.

Appearing at the Interior Building himself on May 20, President Johnson commended Secretary Udall and challenged the Department with vigorous water related responsibilities. Pertinent parts of the President's speech follow:

"I am proud to be here today with a Department whose mission I applaud and whose Secretary I so greatly admire . . .

"The work is now your work more than ever. The transfer of Water Pollution Control to this Department gives you new responsibility and opportunity. I hope you are excited by that prospect. Your President is. Your Congress is. I know your Secretary is—and that he will give every ounce of his great energy and imagination to this new challenge.

"But it is you who must meet it and surmount it. It is your energy, your imagination, your minute-by-minute enthusiasm that will decide whether we master change, or are mastered by it.

"The tides of change are running deep and swift today. There are questions which you must help to answer. Must our progress engulf us? Shall we choke

This stream typifies the kind of clean, fresh water the new Interior antipollution agency is striving for all over the Nation. It is Plateau Creek, downstream from Vega Dam in Colorado. Photo by Stan Rasmussen.

on our own success? Does our society have to tolerate filthy rivers, poisoned air, strangled cities, tangled roads? Too few parks? Too few beaches? Too little wildlife? Too much ugliness? Too little beauty?

"There is only one answer. No—we must not. No—we will not.

"That answer has already been affirmed . . ."

Secretary Udall Concerned

Secretary Udall has had an active concern for the Nation's water values and problems—both as a Congressman and Cabinet officer. He was appointed Chairman of the President's Water Resources Council in 1965. Since that time, he headed a task force to find solutions to the Eastern drought situation, and has been working closely with Governors and Mayors in the East.

Secretary Udall said that Reclamation's anti-pollution work and that of other Interior agencies will be fully coordinated with existing and future pollution control programs under the FWPCA.

"The Bureau of Reclamation, with its multiple purpose water resources development program covering the Western half of the United States, has a tremendous opportunity to help out in this effort," said the Secretary.

Under Secretary Udall's administration, the basic attack on the water pollution crisis in this country will be to prevent pollution before it starts and to clean it up where it already exists, he said. The program of the new agency will relate closely not only to Interior's continuing efforts of water conservation and wise use throughout the Nation, but also to the total conservation of all natural resources.

To Urban Areas

"In updating conservation, we have had a new philosophy of not just protection", said Secretary Udall, "but to taking conservation into urban areas. We have kept on with reclamation, building dams, and power facilities. But it is raising the quality of the environment for all people that now has become one of the main issues of the country."

In launching the agency, Secretary Udall—

- Invited the Governors of Maryland, Virginia, West Virginia and Pennsylvania to discuss plans for an interstate agency to map pollution control steps for the Potomac River.
- Planned a similar meeting with Governors of the Delaware River Basin States on that river's water quality.
- Sent to Governors of all 50 States general guidelines for use in drawing up water quality standards by June 30, 1967.

The Water Pollution Control Act, passed in 1956, was established to combat water pollution through grants to communities to help build waste treatment works, enforcement actions, long-range planning for river basin pollution control, and research.

In 1965 the Federal Water Quality Act was passed enlarging and strengthening the former act. At signing ceremonies President Johnson said:

> "This moment marks a very proud beginning for the United States of America. Today, we proclaim our refusal to be strangled by the wastes of civilization. Today, we begin to be masters of our environment."

FWPCA Operations

Now in Interior, the FWPCA will operate laboratories, regional program offices, headquarters of river basin studies, and projects located throughout many States. More than 1,500 engineers, chemists, biologists, mathematicians and workers in many other scientific fields will carry on the work of the Administration.

The Commissioner of the agency is James M. Quigley—a former Congressman from Pennsylvania who also had been Assistant Secretary of Health, Education, and Welfare for 5 years.

One key section of the new Water Quality Act provides, as previously noted, for the establishment of Federal standards of water quality, which are to be set up in consultation with State and local agencies and groups. It authorizes an $80 million program to develop ways of correcting the pollutional effects of old-fashioned combined storm and sanitary sewers. A third provision increases the Federal Government's financial assistance to communities which need to build sewage treatment facilities.

The New Federal Program

The expanded Federal water pollution control program includes six main activities.

Aid to Communities.—United States cities are spending an average of $700 million annually on new, enlarged, or modernized treatment plants. To help, the Federal Government can pay up to $1,200,000 for a single project, and $4,800,000 for a multi-municipal project. It can pay even more if the State contributed an equal share.

Secretary Udall, right, and FWPCA Administrator Quigley discuss the awarding of the first contract for pollution correction under Interior.

It is also authorized to spend $20 million a year during fiscal years 1966 through 1969 to help public and private groups find better ways of combatting pollution from storm water that overflows, carrying with it the wastes from streets and sanitary sewers.

Enforcement.—Because water respects no political boundaries, interstate law enforcement is necessary. A poor neighbor upstream can pollute and contaminate a river miles below. If pollution from one State endangers the health or welfare of people in another State, the Secretary of the Interior can, on his own, take Federal enforcement action.

Any Governor can request Federal enforcement assistance to deal with pollution problems which are completely within his State. Federal enforcement actions have now involved more than 7,500 miles of rivers, 1,200 municipalities, and a like number of industries.

Research.—To find out what pollutants are dangerous and how they can be kept out or removed from our waterways, much more research is needed. Federal scientists are studying ways of renovating waste water, of transforming it into pure clean water again. Twelve new laboratories are being built or planned to meet regional and national water quality problems.

Conducting River Basin Programs.—Water uses and water pollution problems vary in the different river basins. This is one factor that makes river basin water pollution control programs and comprehensive studies necessary.

Federal projects in 10 major river basins are now seeking to preserve water quality there, not only for the present but for years to come. In the years ahead, these long-range river basin programs will be developed in all of this country's major basins.

Other Major Activities

Establishing Water Quality Standards.—Such standards make it possible for municipalities, industries, and other water users to know in advance what their responsibilities are for keeping clean waters clean, and for restoring polluted waters to a reasonable degree of purity. Standards are set by the Federal Government only after affected States have failed to establish them, and after they and all other affected interests have had full opportunity to be heard. When municipal, industrial, or other wastes reduce the quality of water below the adopted standards, the Secretary of the Interior can take remedial action.

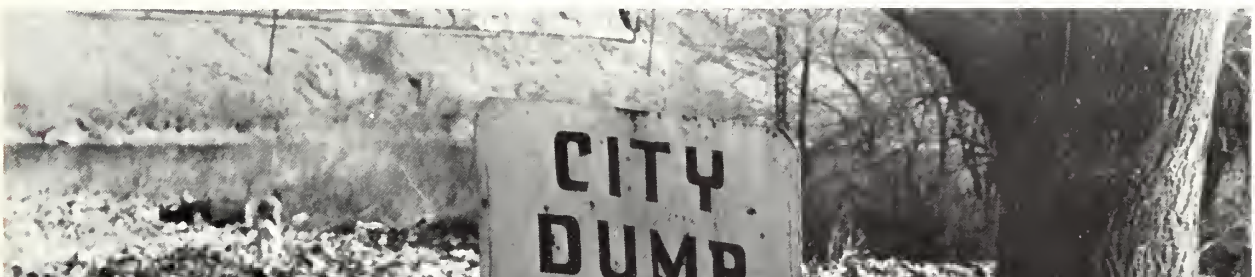
Technical Assistance.—Each year, hundreds of communities, industries, State and interstate agencies call upon Federal scientists to provide them with technical assistance to prevent or abate pollution. To meet these demands, the scientists engage in a wide variety of activities, ranging from solving the complicated problems required for cleaning up tidewater estuaries to determining the cause of widespread fish kills or monitoring a stream after an accidental industrial spill.

In addition to these six major activities, the Federal water pollution control program includes the collection of basic data, the awarding of demonstration grants, and the advanced training of scientists either through university fellowships or through classroom instruction in Federal laboratories.

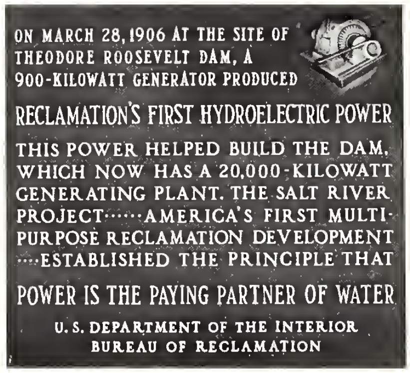
These activities make up the Federal program. For truly effective pollution control, citizens, communities, and States must not only take advantage of the Federal aids available but must take action on their own—in the fields of public works construction, enforcement, planning, and research.

# # #

"The clear, fresh waters that were our national heritage have become dumping grounds for garbage and filth," said President Johnson on Oct. 2, 1965. The scene typifies what the FWPCA is working to correct.



A Look at History
and a Look Ahead



60 YEARS OF PRODUCING POWER

by RECLAMATION COMMISSIONER FLOYD E. DOMINY

NINETEEN-SIXTY six is a real milestone year in the generation of electric power. In fact in only an 8-month period this Federal Reclamation agency marks four major anniversaries of early kilowatt production, and for good measure, adds on a couple of new research milestones besides.

These are the anniversaries that have led to meaningful growth and wealth productivity to our Nation:

60th Anniversary of Power Generation—March 28 (1906)

30th Anniversary of Hoover Dam Power—October 26 (1936)

25th Anniversary of Grand Coulee Power—March 22 (1941)

10th Anniversary of authorization of the Colorado River Storage Project—April 11 (1956)

The two significant plusses in power research are the proposal for a $30 million research fund on underground transmission, and the invention by a Bureau engineer of "Schleif's black box." More will be told about these further on.

Meanwhile, back to the historic first generation of power. Actually it was a modest event in 1906 which the Nation paid little attention to at the time and did not get headlines anywhere outside of Arizona. However, to meet an emergency need for power, a 900-kilowatt hydroelectric unit was put into operation on the Roosevelt Power Canal in a rocky, isolated canyon 79 miles east of Phoenix. This first small hydro unit was installed by the Bureau to help construct what was destined to be, and still is, the world's largest masonry dam.

Provision Corrected

There was no provision in the basic Reclamation

This is Roosevelt Dam in January looking like it wanted to operate at top capacity to celebrate its and Reclamation's six decades of powermaking history. Other dams being commemorated with shorter but significant anniversaries are Hoover, Grand Coulee and Glen Canyon Dams. Photo by E. E. Hertzog.

These junior-sized people are learning that the junior-sized electric generator is like the giant generators that improve their living conditions as it has their parents, grandparents, and millions of others for about the last 60 years. The children are fifth graders from Lasley School, Lakewood, Colo., and the model is at the Denver power laboratories. Photo by Friend Slote.

Act of 1902 for the utilization of the energy potential of stored waters. This deficiency was corrected in amendatory legislation of 1906 to authorize the fledgling Reclamation Service to develop feasible hydroelectric energy on its projects.

As a result, the permanent plant at Roosevelt Dam today has a generating capacity of almost 20,000 kilowatts, and the huge Salt River Project area is flourishing.

Honors for the first commercial production of Reclamation power, however, did not go to the first plant of the still-expanding Salt River system. The Upper Spanish Fork Powerplant about 3 miles from Spanish Fork, Utah, on the Strawberry Powercanal took credit for this in 1908, and the unit is still operating today. First commercial power from the Theodore Roosevelt Powerplant was generated that fall, for sale to the Phoenix Gas & Electric Company.

Although the 900-kilowatt powerplant in a riverside cave was vital to operate a cement mill, to hoist the giant blocks of stone to be quarried by the Apache Indians, and to operate the tramway and other construction equipment, this is not its greatest claim to fame.

Its primary importance lay in its use of the energy of the river and as the first utilization of hydroelectric power in a federally built multipurpose water resource development program for the West. And that fast-growing section of the Nation ultimately would come to rely heavily upon the whirring turbines as "cash registers" to help repay the capital costs of the internationally-known water development programs.

Today, the Bureau of Reclamation operates 47 powerplants with a total capacity of 6,470,800 kilowatts. These plants produce more than 34 billion kilowatt-hours of electricity annually, for transmission over a system of nearly 14,000 circuit miles of transmission line. Gross power revenues recently exceeded $100 million annually.

But more significantly, some two-thirds of the revenues required to return to the Treasury the reimbursable capital costs of the $7½ billion investment in Reclamation facilities will come from hydroelectric power revenues. This explains why hydroelectric power is described as Reclamation's "paying partner."

Hoover Dam Power, 1936

Commercial power generation in the Hoover Powerplant was begun in 1936 when the first generating unit was placed in operation to serve the Los Angeles metropolitan area. The last of 19 generating units was installed in 1961, giving the plant a total generating capacity of 1,344,800 kilowatts, and making it one of the world's largest powerplants.

Annual energy deliveries during the past 15 years have averaged 4 billion kilowatt-hours. During its first year of operation, it was estimated that Hoover energy resulted in a saving of $1,320,000 to the consumers in the Los Angeles metropolitan area. This one plant saves the country annually about 6 million barrels of oil that otherwise would have to be used for the generation of electrical energy. Tremendous other contributions in flood control, municipal and industrial water supply for 8 million residents of the Pacific Southwest, defense production, recreation, and other benefits have accrued from this structure, a renowned man-made wonder of the world.

Grand Coulee Dam, 1941

Also still regarded as one of the man-made wonders of the world, Grand Coulee Dam has produced 250 billion kilowatt-hours of electric energy during the past quarter century, making it the world's largest total power producer. Completion of the powerplant was timely; America was on the threshold of World War II, during which Grand Coulee contributed to the war effort more than 15 billion kilowatt-hours—the equivalent of a million men working an eight-hour day for 78 years.

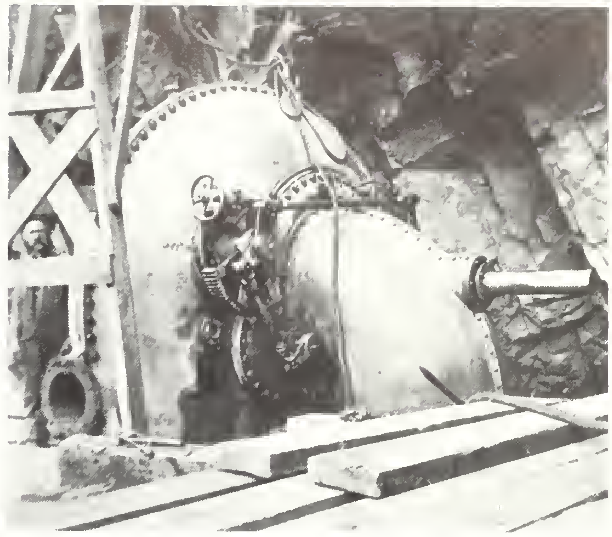
PRESIDENT SIGNS THIRD POWERPLANT BILL

President Johnson's signing the law authorizing construction of a third powerplant for Grand Coulee Dam on June 14 is of major significance to this review of the history of Bureau power. It happened after the printer was at work on this issue of the Reclamation Era.

Speaking of the several years of productivity of the dam and the Columbia Basin project, the President said: "New industries have been created. New towns have been established. Thousands of homes and farms have been modernized with modern electricity. Tens of thousands of new jobs have been created.

"All this came as a surprise to some people who originally opposed the concept of Grand Coulee Dam. There is a famous quotation from one of those early skeptics. 'Up in the Grand Coulee country,' he said, 'there is no one to sell power to except coyotes and jackrabbits, and there never will be.'

"Today, the two powerplants of the Grand Coulee are straining to full capacity. This third powerplant (is) . . . desperately needed." Ed



This small hydroelectric generator in a cave at Roosevelt Dam 60 years ago was the Bureau of Reclamation's first powerplant.

This giant plant also pumps water from the Columbia River into a water distribution system that has converted a half million acres of sagebrush desert into fertile farmland.

The Columbia Basin project, of which the dam is the keystone, has produced crops with a gross value of $407 million since 1948. It also has created tremendous recreation values. Earlier this year, Congress was considering authorizing a third powerhouse for Grand Coulee Dam which would once again make that facility one of the

Commissioner Dominy unveils the bronze plaque marking the 60th anniversary of power generation. Victor I. Corbell, president of the Salt River project, Arizona, is assisting. The celebration was held April 7, 1966, at Phoenix. A closeup of the plaque is at the head of this article.

Ferber R. Schleif, right, is receiving a cash award and hearty commendation from his boss, Chief Engineer B. P. Bellport, for the "little black box" invention, partly in view just under the inventor's arm. His invention has proven itself just in time for Reclamation's big power year.

largest hydropower installations in the world by adding 3,600,000 kilowatts of capacity to its existing 1,974,000 kilowatts.

Authorization of CRSP, 1956

Last February, the 900,000-kilowatt powerplant at Glen Canyon Dam, largest of the hydropower installations in the 5-State Colorado River Storage project, was placed in commercial operation. Even though this great multiple-purpose water resource development only reached its 10th birthday this year, it has already contributed major infusions in the economic life of the area. Some $500 million has been invested in dams, reservoirs, powerplants, transmission lines, and other facilities. First commercial power was produced at Flaming Gorge in 1963 and total project power revenues have recently topped the $10 million mark.

Construction is proceeding on the Bureau's first major underground powerplant at Morrow Point Dam on the Curecanti Unit in Colorado, on extensive recreational facilities, and on 12 "participating" irrigation developments. The water and power to be produced from the diverse developments of this billion dollar CRSP project insure continued population and economic growth in a region larger than New England.

Schleif's Black Box

In appreciation for his invention having far-reaching benefits in the transmission of electric power, Reclamation engineer Ferber R. Schleif at

Continued on page 69.

"THE FARM OF TOMORROW" WORKS

by LIONEL HARRIS, Superintendent, Scotts Bluff Experiment Station

Farmers had not been able to make a living on the 78-acre tract of land. It was rough, steep and badly eroded. But like thousands of acres in western Nebraska, it is fertile.

Taking over the tract in 1956, was a new owner who believed that even this farm—because of reclaimed Platte River water—could be made to produce. By the next year a young 4-H Club member, Alex Hoff, Jr., of Mitchell won a contest and a cash prize for naming the spread "The Farm of Tomorrow."

The next few years would prove whether or not the farm would be suitable not only to produce, but to demonstrate wise methods for irrigating slopes.

The farm is located in the Tub Springs Basin area of the 335,000-acre North Platte project which had first received Reclamation irrigation water in 1908.

Many parts of the huge project are reasonably level and not seriously affected by erosion. But about 40 percent of the steeper Tub Springs area was not prepared for permanent agricultural irrigation and needs to be benched.

Each year approximately 19,000 acre-feet of water from reservoir and canal seepage, and from overirrigation of the land had been draining back to the North Platte River.

Hardly noticeable at a first look, "The Farm of Tomorrow" was chronically eroded and the top soil had gradually worn thin.

The alfalfa and bromegrass crops in the foreground are worth the "Farm of Tomorrow's" experimental efforts. Corn and alfalfa are growing on the level bench terraces in the background.

This kind of gully erosion on the "Farm of Tomorrow" has been corrected and crops are growing instead.

Corrective Program

On a corrective irrigation program, the new owners, the Scotts Bluff Soil and Water Conservation District spent about $19,000. With the help of Bob Boecking of the Soil Conservation Service, they constructed level bench terraces on the east and west sections, leveled the center steep rolling land, installed 4,700 feet of 12-inch irrigation pipe lines; lined 1,500 feet of main irrigation laterals with concrete, and built 1,700 feet of grass waterways. When the rolling center section was ready, the district and the SCS also seeded it to alfalfa and bromegrass.

University Operated

The demonstration farm has been operated on a rent basis by the Scotts Bluff Experiment Station of the University of Nebraska, which conducts farm-size research projects. Herb Ullrich is the capable farm manager.

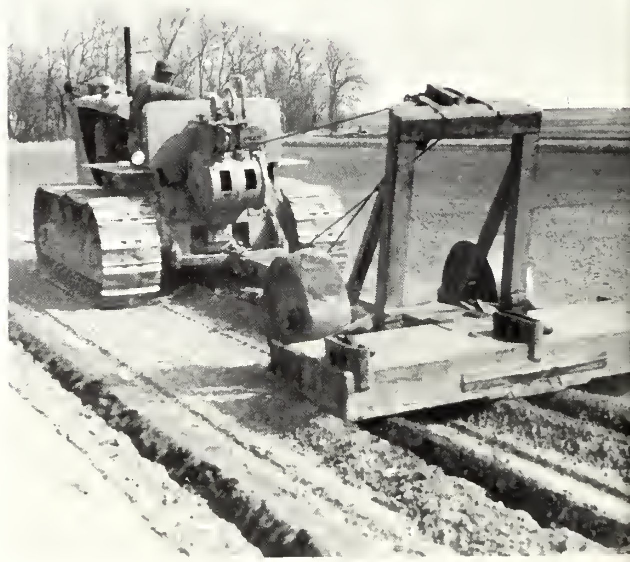
Before plants would grow on "The Farm of Tomorrow" the top soil had to be loosened up. The stepped benches, particularly on the fill side, had become tightly compacted.

By working the compacted areas with a chiseling machine, the soil was cut in 24-inch rows, 36 inches deep, allowing free penetration by plant roots and water. After applying zinc sulfate at 35 pounds per acre, plant growth was rapid.

Most of the farm was then operated under a 5-year crop rotation plan.

1st year—Corn + Alfalfa
2d year—Alfalfa
3d year—Alfalfa
4th year—Field Beans
5th year—Sugarbeets

Alfalfa and bromegrass sown in corn each year on one part of the farm or another has been an important and always successful practice. The corn is seeded to obtain a population of 20,000 plants per acre in rows spaced 42 inches apart. When the corn is 12 to 16 inches tall, in about the last week in June, a mixture of bromegrass and



This machine chisels 36 inches deep to break up the compacted soil on bench terraces.

The first growth of alfalfa seeded on the previous year's cornfield is coming up. Irrigation water is supplied by the Pathfinder Irrigation District on the Bureau of Reclamation's North Platte project.

alfalfa is broadcast in the corn. Alfalfa and grass seed germinates and grows rapidly after the first irrigation and during the warm July weather. Corn plants provide a protective environment for the young seedlings during early growth. Later on the corn overshadows the alfalfa and grass, but not before they are established perennials.

Manure for Crops

Farm manure—12 tons per acre—is applied to the bean and sugarbeet crops annually. Phosphorus and nitrogen are applied annually on the basis of soil test information and plant growth and production records.

During the 5-year period from 1961 to 1965, the average annual yield of sugarbeets increased to 19.4 tons per acre from 13.2 tons over the first period starting in 1956. It was a 47 percent gain.

The yield of corn increased 20 percent to 90 bushels from 70; and the yield of beans, 50 percent to 33 from 22 bushels per acre.

Alfalfa remained a steady 4 tons per acre during the 10-year period. The yield of alfalfa on bench terraces has been higher than on the unbenched center section of the farm. In 1964 and 1965 alfalfa yielded 3.2 tons per acre on the hill, and 4.9 tons on the bench terraces.

In contrast to the previous revenues, the sale of harvested crops also has been an encouraging plus. The annual income during the first 5-year period was $6,440 gross. During the second period it increased 15 percent to $7,410.

With its improving record, "The Farm of Tomorrow" has turned out to be a successful demonstrator of slope irrigation and permanent agriculture. Though the university feels that its increases will continue, it already has shown the way for other potential "farms of tomorrow" to make gains in production. # # #

"60 Years of Producing Power"
(Continued from page 66)

the Chief Engineer's Office at Denver, Colorado, was awarded a Special Act award of $3,000 last May. The invention establishes harmony and usability not otherwise possible when interconnecting steam and hydrogeneration systems.

Mr. Schleif's principal discovery has become known as "Schlief's black box." Shaped like a 10-inch cube, the box is hooked up to the electrical control system of a powerplant near the governor of a turbine.

When construction of the Colorado River Storage project's generating and transmission system opened up the attractive prospect of interconnecting the northwestern and southwestern power pools through the CRSP facilities, Schleif began an intensive research program to solve the problem of incompatible oscillation frequencies and enable CRSP power to be marketed either way, north or south, over a fully integrated power system.

The fringe control development enabled Reclamation to increase power revenues by $455,800 in 1965.

Schleif, a Reclamation Bureau employee for 30 years, has been Chief of the Electric Power Branch since 1962.

Underground Power Report

Meanwhile, back in Washington, D.C., on May 3, Secretary of the Interior Stewart L. Udall transmitted a report to President Johnson recommending a $30 million, 5-year research and development program to advance the technology of placing high-voltage electric power transmission lines underground.

"Our objective," Secretary Udall said, "is to provide creative leadership in a closely coordinated and cooperative effort with all segments of the power industry, so that important new beautification steps can be taken around our cities and in the countryside and the burden of enormous extra costs to both the power industry or consumers can be reduced."

The research program grew out of President Johnson's instructions to Cabinet members to review recommendations of the 1965 White House Conference on Natural Beauty for possible Federal implementation.

With the successful results of power as the "paying partner," the Bureau of Reclamation continues to look forward to applying its technical know-how to solving water supply problems under our increasing population pressures, and looks ahead to whatever new challenges and anniversary mileposts may be encountered in the third portion of an eventful century. # # #

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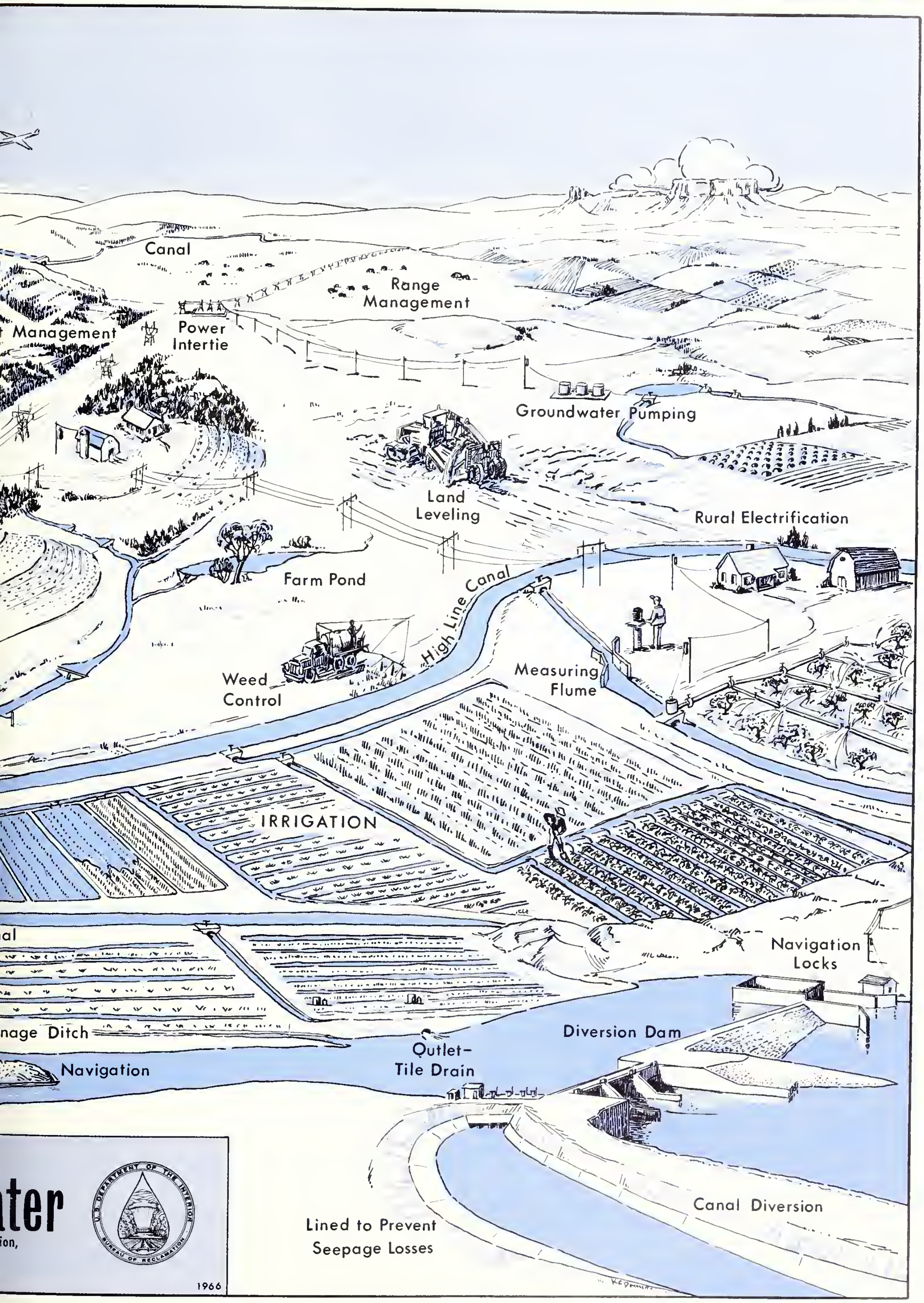
Conservation and Full Utilization o

AVAILABLE SEPARATELY A slightly larger size of this drawing in 2 colors may be obtained in quantity at no charge from the
U.S. Department of the Interior, Washington, D.C. 20240



Canal
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Land Leveling
Rural Electrification
Farm Pond
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This Corn Is Sweet Not Surplus

They're Still Improving Delicious Sweet Corn

Art Walz and D. F. Franklin in a field of hybrid sweet corn seed on the Wesley Schober farm. Two rows of pollen parents are planted to six rows of seed parents. (Union Pacific Railroad photo.)

One truly American food is sweet corn—the mouth-watering kind that they eat right off the cob.

Even though this delicious vegetable (not produced in surplus like field corn for livestock) has enticed most of us, it probably seems that growers are trying to make it taste sweeter and juicier every season. Well, they are succeeding. So what can the captive corn-lover do?

He starts salivating up again at the thought of even more lip-smackin' servings in the future. (May I have a napkin, please?)

And a lot more people will undoubtedly get hooked too.

Like many other food crops, improvements in sweet corn are made by the growers who mass produce seed. And it is just possible the corn ears one knows to be delicious got their start in the irrigated Caldwell, Idaho, area, or the adjoining area in Oregon.

For 50 years sweet corn seed production has been a growing enterprise in those lower areas of the Snake River Valley. It is reported that now over 90 percent of the Nation's requirement is produced in that section.

(*Continued on page 74*)

NUCLEAR PROBE

Saves Time and Money

The Bureau of Reclamation is saving both time and money with an underground nuclear probe to survey moisture-spread in unstable soils where canals need to be built.

According to Chief Research Scientist Graydon Burnett, the new method saved $108,000 on an underground survey of just one 16-mile length of canal right-of-way. Comparable savings have been achieved through use of the instrument in construction surveys for San Luis Unit canals in California. The probe will continue to prove valuable as Reclamation's network of irrigation and municipal and industrial water canals continues to take shape in the West.

In some semiarid areas, certain types of soil are subject to definite subsidence, or settling, when saturated with water and have heavy construction built on the surface. In severe cases, this can be as much as a 13-foot drop. If a canal were built across such areas—without first stabilizing the soil—it would be liable to severe damage.

Soils which have been deposited in loose layers over the centuries—and had a minimum amount of moisture—are frequently unstable and unsolid.

Reclamation engineers stabilize such soils by "ponding." A continuous stretch of shallow pond along the canal right-of-way is kept filled with water. As the soil becomes saturated, it settles.

But it is a preconstruction necessity to also know a number of details about the moisture and soil settlement alongside the canal's path.

Previously, it would have been necessary to survey this area by drilling 50-foot-deep holes at intervals and checking a soil sample every few feet for moisture content. Periodically, over the months, new sets of holes would have had to be drilled to examine new samples—to know when the canal-side underground soil was stable. This is an expensive and time-consuming process.

Looking much like a parking meter is the Bureau's much-used nuclear moisture probe. Resting atop the pipe is the heavy protective case made of lead. The supporting pipe is for lining test holes in the ground. B. A. Callow is a technician from a Reclamation unit at Denver, Colo., who is demonstrating the instrument, typically, near a body of water.

Nuclear Method

With the nuclear moisture probe method, only one hole need be drilled at each chosen site and used again and again. Moisture-content readings at periodic time-intervals at various soil depths can be taken in a matter of minutes.

The radioactive source in the 1½-inch by 15-inch probe is a small amount of radium-beryllium. When not underground, the "hot" end rests in a safety shield of lead and paraffin.

However, when the sensitive end is lowered for work under the surface, here is what takes place. The radium-beryllium continuously emits millions of fast neutrons per minute—which travel about 15 thousand miles a second. The detector at the opposite end of the probe counts only slow neutrons—traveling 1 mile per second.

Water in soil contains hydrogen—but the soil itself does not. When a fast neutron collides with a hydrogen atom, it loses energy and after a few collisions becomes a slow neutron and is reflected back to the detector aboveground and counted by a technician reading a "scaler."

The more water, the more slow neutrons. The more slow neutrons, the higher the moisture content of the soil. When the slow-neutron count does not increase between periodic time-checks, the soil is known to be saturated and stable and ponding is stopped.

This knowedge is taken into account before construction begins on that particular ground surface.

# # #

They're Still Improving Delicious Sweet Corn

(Continued from page 72)

Practically all sweet corn seed is of hybrid varieties. The first commercially important hybrid was named "Golden Cross Bantam" and was introduced by the late Professor Glenn M. Smith of Purdue University. This hybrid is still a favorite by the users of sweet corn seed for the ultimate in yield, uniformity, and quality.

Requires Irrigation

The five seed companies who operate in the area furnish the contract farmers with foundation seed. This seed, grown under contract, requires about 7,000 acres of irrigated land. In the vicinity of Caldwell are four large sweet corn nurseries which handle the greatest selection of sweet corn seed ever assembled in one place.

Many of the strains are derived from some obscure parent which showed a particularly good trait. The seed parents are planted at the rate of four seed rows to one pollen row. Local youths do most of the detasseling of the plants which supplements their summer income.

Harvesting is done mechanically and the high-moisture seed is rushed into forced-air dryers operated by technical men of the seed companies. New studies in seed vitality have shown that seed produces the highest vitality at 8 percent moisture.

Like the Midwest

The processing consists of sizing, sorting, and treating in much the same manner as major corn crops of the Midwest.

A crop failure, as such, has never been experienced in a half century of operation, and present-day knowledge and methods continue to minimize the production risk. Many new exciting developments are on the horizon for better sweet corn for the future. Kernels with higher sweetness and greater retention of that sweetness is one of the major breakthroughs.

Sweet corn appears on most menus in the United States. It could have been growing any place, but in all likelihood the seed was produced in western Idaho or eastern Oregon where the climate and soil are favorable and irrigation water is in good supply.

This favored American crop has not reached any sizable proportion for export, but the uses of sweet corn have approached year-round availability and have found favor as a frozen product for multi-season consumption in both kernel and whole ear markets.

# # #

(Adapted from an article by E. Boyd Baxter in "Tracks Ahead," Nov.-Dec., 1965. Union Pacific Railroad. Mr. Baxter is Agricultural agent for UP in Boise, Idaho.)

MISSION SAFETY–70 A plan to cut the accident rate by 30 percent among Government employees by 1970.

A Plan for Accomplishment and . . .

WHITTLING AWAY WORK INJURIES

A few hundred members of a working force can—when they find out how—whittle down work injuries to rock bottom. With production and all-out efficiency in mind, an accident frequency rate (number of disabling injuries per million man-hours worked), has been trimmed to zero in 7 years and then kept at zero for 2 additional years.

That is the kind of progress that everyone looks forward to, and it is whittling in the prescribed place—among part of the Federal employee force.

President Johnson's challenge is for the Federal force to reduce work injuries 30 percent by 1970. This is the Mission SAFETY–70 program.

Needless to say, the Parker-Davis project—the group that made the 7-year record above—is more than well on its way. During the 2 additional years after the 7—from March 1964 to March 1966—this organization in the Arizona, Nevada and California area worked 1,400,000 man-hours without a disabling injury.

The elements of need and design in a safety program are basic, according to Hubert S. Jerrell, safety officer for the project. "But the real challenge for a safety effort," says Jerrell, "is the implementation: breathing life into a program . . . taking raw printed material and converting it to a way of life for employees . . . to their physical and mental well-being."

Must Appeal

The basic aspects of motivating employees must appeal to personal emotions:

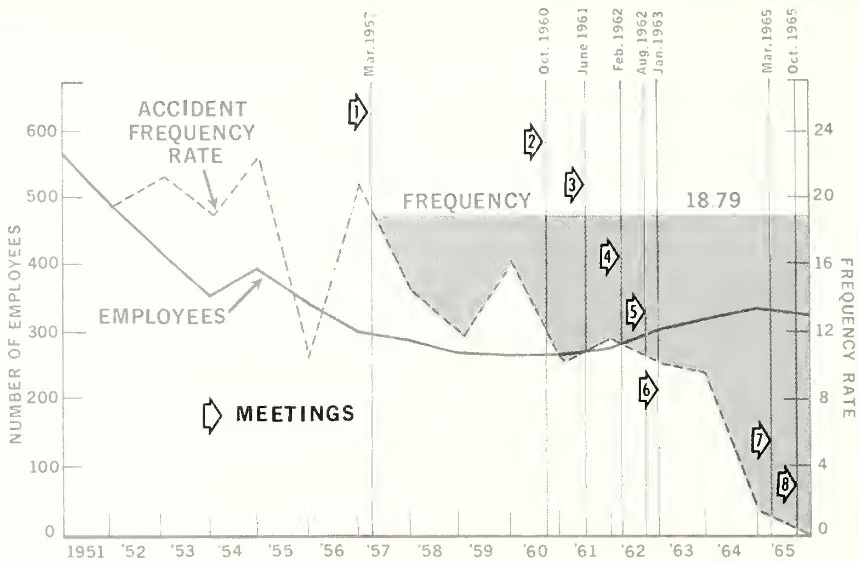
1. *Social Favor.* Approval for working safely.
2. *Conformity.* Accidents can call unwanted attention to you.
3. *Achievement.* A winner gets favorable publicity.
4. *Security.* Being safe results in continued maximum earning power.
5. *Belonging.* The safety program belongs to the employees. It is their program.
6. *Self-expression.* Employees like to express themselves and display their abilities, some in "toolbox" meetings, some in various other ways.
7. *Interest.* One's off-the-job interests can be associated with accident-free operations.
8. *Prestige.* Successes are recognized with safety awards and commendations.

Although the safety officer works behind the scenes, he tackles the program in the areas where it is measurable, such as man-hours, dollar costs, injury figures and accident frequency rates.

Time Period on Chart

During the period of time shown on the chart (on next page), the eight actions which were most significant to the safety program are marked with numbered arrows.

Arrow 1—March 1, 1957.—An Administrative Safety Committee was formed. Not yet being familiar with the operation of a dynamic program, progress was slow for a few years. In fact, they



Action Meetings Marked With Arrows Caused the Injury Line To Fall.

met three or four times a year at times when members were "not too tied up." Copies of the minutes were sent to each member only.

Arrow 2—October 11, 1960.—At this time, the chairmanship only was changed from the safety officer to the division heads on a rotating basis, but the safety officer still prepared an agenda for meetings. However, the chart line shows the stepped up safety efforts were beginning to pay off.

Arrow 3—June 1961.—Tool-box safety meetings were initiated by each field and shop crew.

Arrow 4.—Documentation of all tool-box safety meetings was initiated. Minutes were to be routed to the branch chiefs and division chiefs for information and reply or action, then to the safety officer.

Arrow 5.—The safety officer was reassigned from the personnel branch to the project manager's staff.

Arrow 6.—A permanent chairman was established in the Administrative Safety Committee. Changes in Committee policy resulted in a copy of the more interesting and detailed minutes of each meeting being distributed to each project employee.

Arrow 7.—All 41 of the first-line supervisors were brought in from the project's 3-State area for 16 hours of intensified training in "Safety and Supervision." Now that the chart line was low, there was a great deal of importance in keeping it low.

Arrow 8—October 28, 1965.—All employees who supervised the action of others declared in writing and in their own words, to the Regional Director, their intent to further the safety effort. The program had caught on. The safety motivating forces had triggered the milestone dates on the chart, and resulted in an encouraging accident-free record.

Concentration of Effort

The shaded area on this chart delineates the project record. The sharp reduction to a zero frequency rate was due to the stepped-up concentration of effort. The project's average annual frequency rate prior to 1957 was 18.7. Had there been no emphasis added to accident prevention and the frequency rate had remained the same, the project would have experienced 104 disabling injuries between February 1957 and March 1966, rather than the actual 52 such injuries—exactly half of the project total.

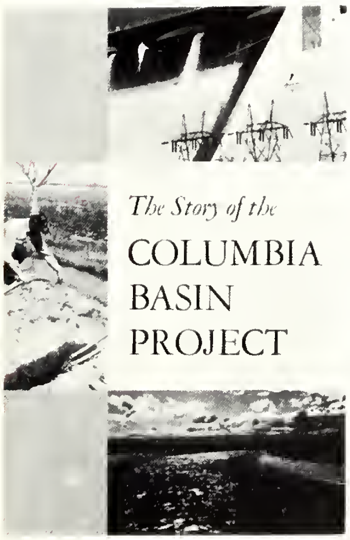
Now, how about cost? This could be another "motivator" in a safety program. Fifty-two injuries multiplied by a direct cost estimate of $671 per unit results in a direct saving of $35,000. When assuming an average indirect saving of 3 times the direct saving, the reduction to 52 injuries is equal to a combined savings of $140,000. This figure does not represent a profit—safety is not a business of profit. But it does indicate a very effective method of reducing the cost of doing business.

The most important "cost" however, has not been charted. It has to do with human suffering, anguish, hunger, etc., which often result from accidental death or severe injury. Human emotions are not well shown in numerical values but they are meaningful.

Neither as individuals or as a Nation, can we allow ourselves the needless loss of life and dollars of ineffective safety programs.

# # #

(Adapted from a speech by Mr. Jerrell, entitled, "Men and Motivations," to the Safety Congress and Exposition in Phoenix, Arizona, February 24–25, 1966.)



BOOKSHELF

for water users

The Story of the Columbia Basin Project

This 65-page booklet describes and illustrates the story of the Columbia Basin Federal Reclamation Project, Grand Coulee Dam and Powerplant, and the 1-million-acre-plus irrigation development in the State of Washington. The 6 by 9-inch publication describes the start of the project and which developments have been completed. In addition to turning the arid region into a fertile farming area, the project is a prime outdoor recreation and vacation land. Cost 45 cents.

Aquatic Pests on Irrigation Systems

This pocket-sized, water resources publication is an identification guide primarily for field personnel. Some of its 72 pages include full-color drawings and narrative descriptions of some of the commonly observed organisms that become pests in irrigation systems in the Western United States.

It includes *Submersed Aquatic Weeds:* Sago pondweed, Leafy pondweed, American pondweed, Curlyleaf pondweed, Richardson pondweed, Whitestem pondweed, Giant pondweed, Horned pondweed, Waterweed, Waterbuttercup, Coontail, Watermilfoil, Waterplantain, Holly-leaved waternymph, Waterstargrass, Watercress and True moss. *Algae:* Filamentous green algae, Bluegreen algae and Stoneworts. *Floating Aquatic Weeds:* Duckweeds, Waterhyacinth and Alligatorweed. *Emersed Aquatic Weeds:* Cattails and Bulrush. *Woody Plants:* Tamarix or saltcedar. *Invertebrate Aquatic Animals:* Fresh-water sponge, Pipe moss, Fresh-water clam and Black fly.

N. E. Otto and T. R. Bartley, plant physiologist and chemist, respectively, in the Office of Chief Engineer, Denver, Colo. are authors. Cost is $1.75; 1965.

Central Valley Project

In addition to including the 1965 annual report of this huge joint-State and Federal project in

California, this 28-page booklet describes and illustrates progress of construction. It is the 25th Anniversary of the CVP, and the completed works already have had use of a variety of recreational activities.

Color drawings show the overall plan as well as the details of the Auburn Dam and Reservoir areas and the Folsom South Canal. No charge.

Copies Available

The Story of the Columbia Basin Project, *Acquatic Pests on Irrigation Systems* from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402, and from the Chief Engineer, Bureau of Reclamation, Denver, Federal Center, Denver, Colo., 80225.

Central Valley Project from the latter address.

MOTION PICTURE NOTES

Great River

The spectacular scenery of the Pacific Northwest provides a colorful backdrop for this presentation of how the whole Columbia River System is put to work serving the needs of the people of the region for power, irrigation, flood control, navigation, recreation, and fish and wildlife protection.

Water for the Valley

This film tells the story of the Central Valley Federal Reclamation project in California, depicting the early beginnings of irrigation in the Central Valley and showing the need for large-scale conservation and utilization measures, and the manner in which the project fulfills these needs.

Power for a Nation

The picture recalls the birth of the incandescent lamp in the laboratories of Thomas A. Edison in New Jersey and follows through to recent major developments including the Columbia Treaty with Canada which will enhance the already rich hydropower resources of the Pacific Northwest and Pacific Southwest in which public and private utilities and the Federal Government are participating. Narration is by Frederic March and an original music score is played by the United States Air Force orchestra.

Flaming Gorge

The Flaming Gorge is a red canyon on the Green River in northeastern Utah. It is also the name of a new concrete dam and a new lake, both of which have caused substantial changes for the people that live in an adjacent valley. This remote valley, a deep canyon, and a small village are backdrops to the dramatic construction of Flaming Gorge Dam. The film story is told through the eyes of an "old timer" who witnessed both the long and slow development of his valley and the sudden and dramatic change wrought by the construction of Flaming Gorge Dam. Mrs. Lyndon B. Johnson is shown dedicating the dam, and the late President Kennedy is depicted on his last visit to the West in September 1963, when he threw a switch starting the first generator at the powerplant.

To Obtain Films

These 28-minute, 16 mm., color films may be borrowed free from the Bureau of Reclamation, Film Management Center, Building 53, Denver, Colo., 80225.

Large Water System in California Receives First Water

The first delivery of water through the $46 million Arvin-Edison distribution system in California's San Joaquin Valley was made on July 8 near Bakersfield.

It was the largest such system ever financed under the Distribution System Loans Act (Public Law 130) administered by the Bureau of Reclamation.

As part of the Central Valley project, the Arvin-Edison Water Storage District includes some of the richest farmland in the Nation. But over the years, ground water levels have been dropping until pump lifts of 600 feet and more have become necessary. The receding water table has allowed intrusion of water with a high boron content resulting in the removal from production of some of the rich agricultural lands.

Facilities already completed will allow the district to accept delivery of 40,000 acre-feet of water this year.

After the system is completed, water deliveries will also be made to another spreading ground and through 200 miles of laterals for surface irrigation. Eventually, 113,000 acres of Arvin-Edison land will be served by the distribution system.

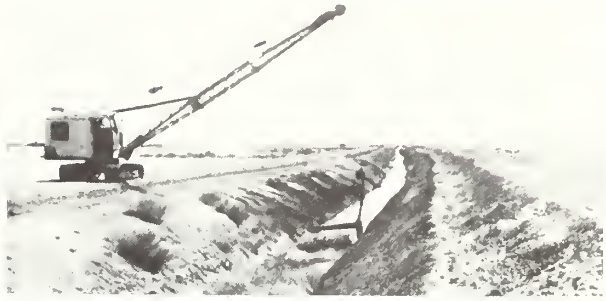
Better Than Buckets

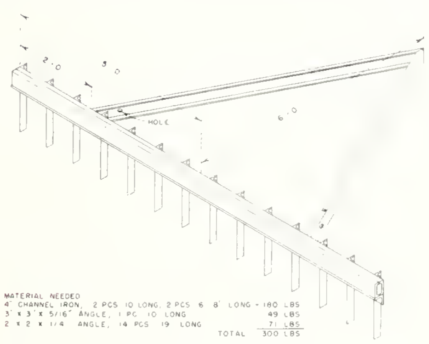
Dragline operators are enthusiastic about a simply constructed implement that has been used since 1964 as an effective canal weed rake. Shown on this page, the 10-foot wide tool resembles a considerably oversized garden rake operated with a small dragline.

Though weed-killing chemicals have their advantages, the use of this rake eliminates coping with unsolved chemical problems in water.

The 300-pound weed rake clears canals in much less time than the bucket that is in common usage. In 1964, using the bucket, 15 days were required to remove the weeds from 4 miles of a drain in the Truckee-Carson Irrigation District, Nevada. With the rake, it took approximately 3 days to clear pondweeds from 1 mile of canal resulting in 85 to 90 percent effectiveness.

Again in 1965 the rake removed weeds from 5 miles of a drain and ½ mile of an adjacent canal in 4½ days, and has since been used where both weeds and other debris need to be removed.





Clearing when the plant growth is near maturity is most effective, and it can be used with the water still in both lined and unlined canals.

In the spring of last year, after a very windy winter, it was decided to try the rake on a drain that had caught an unusually large amount of alkali weeds. The rake operation was dramatic in pulling the weeds out on the bank where they could be burned. It also has proven effective in ripping up silt bars that are holding quantities of weeds in the bottom canals.

Originally, it was built from scrap iron on hand, but with field trials revealing weak points, it was rebuilt with heavier metal as shown in the drawing. The teeth spaced 9 inches apart work well for general removal work, but 7-inch spacing will probably prove better for pondweeds.

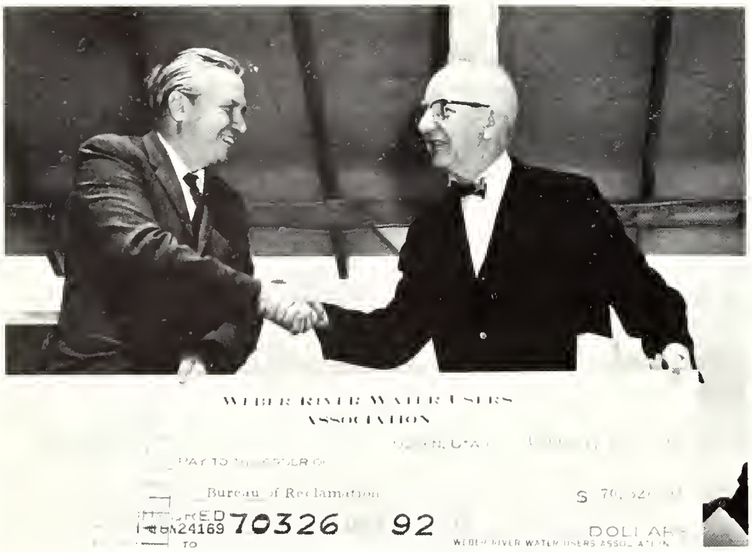
# # #

(The weed rake suggestion is credited to V. Carroll Donner of the Bureau of Sports Fisheries and Wildlife. This article was adapted from information in "irrigation Operation and Maintenance Bulletin" No. 55, 1966, Bureau of Reclamation.)

Arbuckle Center Dedicated

The Arbuckle Job Corps Conservation Center at Sulphur, Okla., was dedicated April 23. Congressman Carl Albert of Oklahoma gave the dedicatory speech, and Reclamation Commissioner Floyd E. Dominy was present.

Edward C. Rodriguez, Jr., is Director of the Center, which is the sixth Bureau center to be dedicated. A plaque noting community appreciation was presented to Rodriguez by Glen Key of the Sulphur Chamber of Commerce, sponsors of the event.



CELEBRATION BY WATER USERS

On June 11 at Echo Dam in Utah, officials of the Weber River Water Users Association presented an outsize check, as seen above, to Commissioner of Reclamation Floyd E. Dominy, on a happy occasion.

The check for $70,326.92 was a symbol of the final installment due the United States for advancing the funds needed to construct Echo Dam, principal feature of the Weber River project. Receiving Commissioner Dominy's congratulations at right is H. J. Barnes, vice president of the WRWUA.

The ceremony marked the discharge of the association's obligation 2 years ahead of its repayment contract schedule.

Commissioner Dominy hailed the association's final payment as another example of how Reclamation developments pay for themselves. "The water users on this project have prospered by this development," Commissioner Dominy said, "and their prosperity is reflected by the prompt repayment of their obligation."

"Since Echo Dam and Reservoir were built, crops having a gross value of almost $289 million have been raised on project farms, and a good portion of this fine total is due to supplemental water deliveries from Echo Dam. I certainly congratulate the farmers and ranchers along the Weber River for their fine financial record, as well as for the excellent care they have given the project's physical facilities," said Mr. Dominy.

Echo Dam, an earthfill embankment 158 feet high, was completed in 1931 as the main feature of the Bureau of Reclamation's Weber River project. The dam and its reservoir provide supplemental irrigation water for about 109,000 acres along the Wasatch Front near Ogden and Kaysville, Utah.

Echo Reservoir, with a surface area of 14,070 acres at total capacity, has become a popular water recreational area. It offers overnight camping, picnicking, swimming, fishing, boating, and water skiing.

Operation and maintenance of the project has been by the Weber River Water Users Association since 1931. The association had entered into a supplemental, 30-year repayment contract in 1938, under which it agreed to repay in 30 annual installments the total Echo Dam construction costs of $2,875,872, less $190,000 for enlargement of a diversion canal to the Provo River, which is repayable by the Provo River Water Users' Association, and less a partial installment on Echo Dam in 1932.

The development of the dam goes back to the early history of Utah. Irrigation from the Weber River started about 1850, 3 years after the original Utah pioneers settled in Salt Lake City. The late summer natural flow was sufficient for a full water supply for about 3,000 acres of land. Before many years had passed a larger area was developed for which there was only a partial supply of water.

The Reclamation Service, now called the Bureau of Reclamation, made a reconnaissance of this area in 1904 and 1905 which resulted in establishing stream gaging stations by the U.S. Geological Survey in 1905. Early in 1922 the Reclamation Service, in cooperation with the Utah State Water Storage Commission, started investigations for a storage reservoir. Upon the selection of a site for the dam and congressional approval an appropriation for construction of Echo Dam was received in 1924. After 2 years of detailed investigation, design, and legal work, construction of the dam began. (*Adapted from an article by D. Earl Harris, secretary-manager of the Weber River Water Users Association, Utah.*)

# # #

Judy Helps the Cause for Natural Beauty

This is Judy Olive, the lovely Camellia Queen for Sacramento, Calif. Judy seems happy to help conserve natural beauty and was willing to be on hand for this year's National Wildlife Federation campaign. Photographer Wes Nell saw one of the posters go up in the Sacramento regional office so he got this shot of Judy on the shore of Folsom Lake.

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Washington, D.C., 20240

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Manmade Lake on Milk Cartons

"You'll love it!" could well be what such a brightly smiling lass just said. And she could be referring to either Lake Powell Vacation Land, or the vitamin D milk in the carton she is holding. Both would be healthful for Colleen Higgenson who just graduated from a high school in Murray, Utah.

In addition to creating the outdoor attractions of Lake Powell in Arizona and Utah, it also has been established that Reclamation's irrigation waters benefit the milk producers and milk drinkers in this normally arid and semiarid area.

The name of the dairy is not shown on the carton, but it is known to distribute milk—and this advertising of the Page, Ariz., Chamber of Commerce—to thousands of people throughout much of five Rocky Mountain States. The photo is by Mel Davis.

Motorized Fruit Collector Tested on Project

A new wrinkle in fruitpicking was tried at Willard Hess' farm on the Columbia Basin project west of Quincy, Wash. As John Marker of the Tree Fruit Experiment Station at Wenatchee handles the controls of the motorized fruit collector, Karen Mickelson, standing, picks the Golden Delicious apples and drops them into a padded stovepipelike receptacle that conveys them into a storage crate at the back of the machine. Primary benefit sought from the innovation, which has been jointly developed by Washington State University and Department of Agriculture personnel at the Tree Fruit Experiment Station, is a substantial reduction in picking time and a more careful handling of the fruit. Normally the apples are picked and carried by the pickers in a bag.

$1.3 Million Contract Awarded for Morrow Point Powerplant Generators

This water resource development agency awarded a $1,352,831 contract June 11 to furnish and install two 60,000-kw.-capacity generators for the Morrow Point Powerplant on the Gunnison River in western Colorado.

The first such underground plant installation in Reclamation history, the Morrow Point structure is being carved out of the left wall of the Gunnison River canyon just below Morrow Point Dam. The dam—a double curvature, thin-arch design with four orifice-type spillway openings—is scheduled for completion during the summer of 1968. The powerplant will be completed in early 1969. They are features of the Curecanti Unit of the Colorado River storage project now being constructed under a $15.4 million contract awarded in May 1963.

The contract for the Morrow Point generators went to Mitsui & Co. (U.S.A.), Inc., San Francisco, Calif., on the lowest of eight bids.

Calmness at Lake Meredith

A striking picture of an elderly couple enjoying the calmness at Lake Meredith behind Sanford Dam, Tex., was shot by C. R. Woodrome. The courtesy boat dock had only recently been installed when the photograph was made last spring.

Eastern U.S. Firm Gets Atmospheric Water Study Contract

A 2-year contract for $66,500 was awarded last spring by the Bureau of Reclamation for developing a scientific method for evaluating the results of cloud-seeding experiments completed in the States of Masachusetts, Maine, New Hampshire, and Vermont. The contract is with W. E. Howell Associates, Inc., of Massachusetts, which is headed by Dr. Wallace E. Howell, one of the world's leading authorities on weather modification. The firm has undertaken weather modification research work for many years in the Eastern United States and in Central and South America.

Most of Reclamation's contracts to date have been in the general area of field experiments to determine the efficacy of "milking" various types of clouds in the Western United States.

Where the Water for Pigs Never Freezes

Water is available at all times and will never freeze with this automatic unit for pigs used by Don DeBoer about 4 miles east of Oral, S. Dak. In his marketing program, DeBoer processes about 550 hogs each year on the Angostura Unit.

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-5935B	Weber Basin, Utah	May 19	Completion of Lost Creek Dam	LeGrand Johnson Construction Co., Inc., Logan, Utah.	$1,052,269
DC-6318	Lyman, Wyo	May 13	Construction of Meeks Cabin Dam and access road	W. W. Clyde & Co. Springville, Utah.	5,873,395
DS-6394	Central Valley, Calif	June 13	Furnishing and installing supervisory control and digital telemetering systems for Forebay pumping plant, Tracy switchyard control and administration buildings, and Delta-Mendota canal check and wasteway structures.	Wismer and Becker Contracting Engineers Sacramento, Calif.	583,323
DC-6400	Central Valley, Calif	June 21	Construction of 55.5 miles of pipelines for Westlands Water District distribution system, laterals 4 and 5, schedule 1.	Beasley Engineering Co. Emeryville, Calif.	6,063,895
DC-6404	Central Utah, Utah	Apr. 15	Construction of streets, sidewalks, and water and sewer lines for Duchesne government community.	Martindale and Blackett Springville, Utah.	106,093
DC-6405	Missouri River Basin, Kans.	May 11	Construction of Downs protective dike, with earthfull in dike embankment and soil-cement slope protection.	Guy H. James Construction Co., Oklahoma City, Okla.	2,758,671
DS-6408	Colorado River Storage, Colo.	June 10	Furnishing and installing two 66,667-kva generators for Morrow Point powerplant.	Mitsui & Co. (U.S.A.), Inc., San Francisco, Calif.	1,352,831
DC-6409	Weber Basin, Utah	Apr. 15	Construction of 3.91 miles of pipelines for West Farmington laterals, schedule 2.	Elden H. Knudson Construction Co., Ogden, Utah.	298,508
DC-6412	Missouri River Basin, S. Dak.	June 15	Construction of stages 05 and 06 additions to Huron substation.	Electrical Builders, Inc., Valley City, N. Dak.	145,905
100C-851	Columbia Basin, Wash	June 17	Construction of 12.8 miles of buried pipe drains and 1.6 miles of open ditch drains for D20-85 and D20-123 drains systems and D20-228 drain, block 20.	A. G. Proctor Co., Inc., Aurora, Colo.	286,771
100C-852	Columbia Basin, Wash	June 14	Construction of 35.1 miles of buried pipe drains for north part of block 46.	George A. Grant, Inc. Richland, Wash.	591,998
100C-854	Columbia Basin, Wash	June 17	Construction of 22.6 miles of buried pipe drains and 2.5 miles of open-ditch drains, blocks 74 and 78.	Equipco, Inc. Ephrata, Wash.	395,051
300C-239	Colorado River Front Work and Levee System, Calif.	Apr. 1	Construction of roads and bank protection structures	Hall Construction Co., Corona, Calif.	177,078
300C-245	Colorado River Front Work and Levee System, Calif.	June 10	Construction of and surfacing 6.65 miles of access roads for Senator Wash reservoir.	Arrow Construction Co., of Arizona, Inc., Yuma, Ariz.	123,758

Reclamation Acquires Radioisotope Laboratory on Wheels

The Bureau of Reclamation has installed radioisotope instruments in a new panel truck to create a special mobile laboratory. The 2,000-pound unit is for handling a wide variety of engineering research studies in field locations, using radioisotopic tracer techniques.

One such study will concern the perfection of techniques for measuring the flow of water by dispersing harmless amounts of isotopes in flowing water and then tracing movement of the isotopes with calibrated detectors. The information received can then be translated into velocities of water.

Investigations to be conducted include research and engineering studies of ground water movement, reservoir currents, sediment studies, water quality determinations, corrosion investigations, and weed control evaluation.

The new mobile unit working out of Reclamation's research laboratory in Denver, Colo., will eliminate the necessity for making field tests under makeshift conditions and will provide the means for obtaining more reliable and complete field data. It will also serve as a "closed off" laboratory for handling concentrated radioisotope supplies. Future field work employing radioisotopic techniques holds promise of greater efficiency, accuracy, and safety and a minimum of interference with regular field office routine.

Radioisotope tracers have been safely used over a number of years in scientific tests and industrial applications. As an additional safety precaution, operators of radioisotopic equipment must go through a training period and be licensed in accordance with Atomic Energy Commission standards.

U.S. GOVERNMENT PRINTING OFFICE: 1966 O—219-177

FRONT COVER PHOTO. The spectacular water scene on the cover is at Grand Coulee Dam—a manmade wonder of the world in Washington State.

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In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. DEPARTMENT OF THE INTERIOR/BUREAU OF RECLAMATION

November 1966

RECLAMATION ERA

Camel Power for Water Work

(See lead story on International Conference)

NOVEMBER 1966 • Vol. 52, No. 4

RECLAMATION ERA

Gordon J. Forsyth, Editor

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United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

Commissioner's Page

Reclamation and Frontier Vigor

The Federal Reclamation program is one of the proven useful tools for stimulating private investment and business activity so as to encourage regional and national economic growth. The program avoids activities which private capital can and does adequately handle.

Full-scale multiple-purpose development of water resources is not attractive in private sectors, to any great extent, because it is difficult to identify the beneficiaries and collect an appropriate charge for such purposes as flood control, water quality control, and fish and wildlife enhancement. Yet these purposes—because of the widespread pattern occurrence of their benefits—are highly worthwhile endeavors. The Bureau of Reclamation includes those purposes together with irrigation, municipal and industrial water supply, hydroelectric generation, and recreational developments.

Economics and social aspects are dominant in this Bureau's developmental programs. Broad objectives such as settlement and commercialization of sparsely populated areas, stabilization of incomes in high risk situations, and providing key investments in economically underdeveloped or slowly emerging regions have historically been achieved by the Reclamation program.

The short returns from these activities seldom interest private investors because of the long time required for payoff, and the form of gain in terms of nonreimbursable social improvements.

Therefore, full multiple-purpose water resource development has fallen into the sphere of Federal Reclamation responsibility. And not insignificantly, this assures continued life for our frontier tradition and helps make all of America the land of opportunity.

Floyd E. Dominy

FLOYD E. DOMINY
Reclamation Commissioner

International Conference on "Water for Peace" Set for Washington, D.C.

by **HARLAN WOOD,**
Conference Director of Information

INITIALLY conceived by President Johnson during the First International Symposium on Water Desalination in 1965, a 9-day *Water for Peace* conference—set for May—will be the largest international meeting to be held in Washington, D.C.

"The earth's water belongs to all mankind. Together, we must find ways to make certain that every nation has its share, and that there is enough for all," said President Johnson at the desalinization symposium. "Today, I want to announce the beginning of a *Water for Peace* program. Under this new program, we will join in a massive, cooperative international effort to find solutions for man's water problems."

President Johnson said that an unlimited supply of pure water would be "an event in human history as significant as the harnessing of the atom."

To pursue that objective, the President of the United States was prepared to convene "another great conference to deal with all of the world's water problems."

Planning Starts

Following the President's mandate, Secretary of State Dean Rusk and Secretary of the Interior Stewart L. Udall joined to begin an expansive assault on the world's water problems. To do this they established an interdepartmental committee composed of all agencies of the Federal Government to develop a cooperative international water program.

At the same time, an interdepartmental staff also was assembled to plan the International Conference on *Water for Peace*—an effort which will lay the groundwork for the longer-range cooperative efforts of the United States and other nations.

President Lyndon B. Johnson.

From the beginning, the Bureau of Reclamation has been given important assignments both in the formulation of the program and in the organization of the conference.

Reclamation Commissioner Floyd E. Dominy said: "The United States is breaking new ground in this endeavor, and it is seeking to explore all of the wells of thought in meeting the President's humanitarian aim of ending drought, flood, and famine forever. The Bureau's resources are fully committed to this effort."

COVER PHOTO. In India and some other parts of the world, camels are most useful animals. Their pulling is still used to draw water from wells.
Photo by Reclamation Commissioner Floyd E. Dominy

This canal in Thailand is used for irrigation as well as for bringing vegetables to market in a boat. The water is polluted.
Photo by Assistant Commissioner G. G. Stamm

The Conference

All nations with which the United States conducts diplomatic relations are being invited to participate in the conference. Attendance is expected to top 5,000 representatives from all over the world.

In describing its purpose, Secretary Udall said, "This conference will bring together representatives and experts from many nations to discuss and explore the world's water problems, the opportunities and means available for attacking these problems, and the cooperation required to stimulate effective programs of water development at national and international levels."

The conference program is being developed on two levels: One designed for Ministers (Cabinet-level) of governments responsible for water policy and development in their nations; the other for experts and observers interested in specific phases of water resource development.

Sessions will concern various aspects of planning, organization, financing, education, training, and technology.

During 6 days of the conference, an exposition will be held to report on the actions and progress of nations to meet man's needs for water and their willingness to help each other, and to demonstrate current scientific and industrial capabilities of the world community in the development, conservation, and utilization of water resources.

The exposition will feature a variety of exhibits by governments, international organizations, scientific and educational organizations, and U.S. and foreign industrial firms.

The Agenda

A provisional agenda for the May 23 to 31 conference has been developed around six broad categories:

- Planning and developing water programs.
- Basic data for water programs.
- Technological gains and research needs in water programs.
- Education and training in water programs.
- Organization of national and international water programs.
- Economics and financing of water programs.

Papers are being solicited throughout the world. About 500 papers will be accepted for publication, and about 125 will be given orally. There will be two general sessions—one on the opening day, the other on the closing day. To cover the massive scope of the agenda, it is expected that five concurrent sessions will be held each day in the remainder of the conference days.

Further information regarding the submission of papers may be obtained by writing: Chairman, Conference Program Committee, International Conference on Water for Peace, Room 1316, Department of State, Washington, D.C. 20520. # # #

Putting Together Reports of Crops Worth $23.2 Billion on Sixtieth Anniversary

BIG IRRIGATION VALUES IN JUMBO PACKAGE

This is Bert Johnson of Montana who receives his water for irrigating beets from the Yellowstone River.

Photo by Lyle C. Axthelm

by GORDON J. FORSYTH

RECLAMATION-TYPE writers have been describing the triumphs and potentials of water control developments for many years and there will be a good many other such explorations. But this year, lo—in a mind's eye view—we hear a thumping on the lid from within the confines of a jumbo surprise package.

We refer, with all due appreciation, to more than 133,000 resourceful farm operators who irrigate through the facilities of water development structures built by the Bureau of Reclamation. We whomp up a big THANK YOU and beam it in the direction of those farmers for their cooperation in providing the Nation with crop statistics which help promote a better understanding of the Federal Reclamation program.

We also refer to the 60th printing of our Crop Report—the publication which contains the new figures of production by those farmers.

These sizable items, which we bring together have hereby—in a manner of speech—thumped open the jumbolike package for a look by our readers.

Actually, the news is that the total harvest records of all previous Crop Report years have been broken. The new Crop Report shows $1.6 billion worth of crops from 8 million irrigated acres of western farmland in 1965. It is up from the 1964 totals of $1.5 billion in crops from 7.5 billion acres of land.

After the crop statistics pass through careful hands in Reclamation field offices, they arrive in Washington, D.C., and are put together for publication and summarization by the employees in the economics and statistics branch.

"The reports from those proficient farmers," said Al Nielsen, branch chief, when we called him about the story, "shows that $23.2 billion have been added to the U.S. economy starting back in about the year of the San Francisco fire and earthquake. That is, 1906. Of course, it wasn't the quake that caused adding all that money to the economy," Al joked. Then he said seriously, "It was the work of a long list of American farmers and Reclamation irrigation water on the kind of land that very few people cared for.

"All of that 23.2 billion dollars—is from irrigation alone," said Al. "It is about five times the total Federal investment in Reclamation facilities including the cost of construction currently in progress."

Al's little speech got the thing going for us. This did sound like it could be what was thumping to get out of the package.

So we let thumper out, so to speak, and launched a kind of "booklet review" to commemorate the anniversary issue of the Crop Report.

A full branch of cherries on The Dalles Project, Oregon, is admired by Joanne Cimmiyotti who is the 1966 Northwest Cherry Sweetheart. The project had a good cherry crop this year.

Photo by J. D. Roderick

The Crop Report is not principally popular reading material. It contains some narrative and summary information on the first pages, so it is not too much a technical work either.

Mostly, it contains charts and tables, where it is intended that one read between the lines. When a person studies the pages in that way it comes close to being a you-are-there closeup, it seems. And it appears to have adventure when looking at the $23.2 billion gain.

Farmers in the Story

Although their names don't appear, all those farmers on Federal Reclamation projects in the 17 arid and semiarid States of the West are the story's principal characters. Those men provided a living for their families with their earnings. The matter of getting water to the land for an assortment of 150 different crops to grow is the story's plot.

A few days after our conversation with Al, he brought over some paragraphs that Frank Ellis had put together. Frank had worked here a few days on a special economic study, then returned to his home office in Region 7's Denver headquarters.

Frank noted that allowing 4 years for the first irrigation structures to be built and for water to be delivered to feed the first crops—after Reclamation's congressional authorization in 1902—the number one Crop Report of 1906 included the farm production on two projects. They are the Klamath project in California and Oregon, and the Carlsbad project in New Mexico. Farmers on those two water developments irrigated 22,000 acres which gave them gross returns of an impressive $244,900.

Sixty years later, growing mostly vegetable, grain and field crops, these first two Federal Reclamation projects produced gross crop values of $27.6 million which was the major economy in those areas. Their acreages had expanded tenfold, but that increase was far outdone by the crop value multiplying 113 times. This may seem amazing, but it's not really unusual for Reclamation projects.

Just like a watered land producer assures a successful crop number two, the figure 113 comes up twice in the 60th Crop Report of 1965. It shows as 113 projects now operating with Reclamation water service.

Though the projects are at various places throughout the West, the irrigated land now totals the record-setting 8 million acres which are a source of income for a farm population of 554 thousand people. Last year these people produced crops valued at $1.6 billion, the highest yet.

Meat and Potatoes

Although the central office for compiling the Crop Report is in Washington, the actual adding up of the "meat and potatoes" takes place in the field. That is the grassroots phase where each farmer who uses Reclamation water for irrigation reports the quantity and value of his irrigated crops. During the last few months of each year, a "farm enumerator" collects the crop census from the farmer. These cooperating water users form the backbone of the Reclamation crop reporting system.

Personal visits to the farmers has been the longstanding practice for taking the crop census. In the early times, the knowledgeable enumerator, who was both amiable and a good listener went in and out of one farm after another doing his job on horseback, or by horse and buggy, each and every fall. It is not seen that the personal contact will be replaced, but with the advent of the computer and automatic data processing, speed and accuracy are expected to soon significantly improve many aspects of the census process.

One afternoon, Al showed me the file of the Crop Reports of former years in the office of Selma Harris. Selma is a statistician who maintains the older reports and does much of the data processing in the Washington office. At her desk she works on large pages of figures on water developments.

Being reminded of the pleasant appearance of last year's booklet, we asked Selma when the Bureau started using attractive project photographs in the Crop Report and printing it with such a presentable green color as the 59th issue.

"The artfulness has been used from time to time, but not with a color until last year," she said. "The new one is blue and white. Our 1952 issue was published with a quality picture on the cover, and others have been since. That was the year it was enlarged to the format that it has at present."

Selma continued: "For the first 48 years it was printed each time as one volume, but two volumes were started in 1954, and there have been some changes in their titles. The more commonly used first volume is now entitled: 'The Crop Report and Related Data,' and its companion volume is 'Statistical Appendix to the Crop Report.'

"Though its distribution is still mainly in Government offices and water user organizations," said Selma, "last year there was considerable increase in the number of requests from college graduate students, professors and other organizations outside of Government. I believe it is a basic source of data for certain water, agricultural or economic studies they may wish to make," she said.

The High Producers

The first mentioned volume of the new report named the high producing projects which have accumulated production totals reaching the "billionaire" category in the last few years. During the 1964 season, for example, the multiple-purpose Colorado-Big Thompson project serving lands in northeastern Colorado became a member of this distinguished group, bringing the total to seven "billionaire" projects. The Rio Grande project in southern Colorado and New Mexico also is in the $1 billion category for farm crop values.

The Salt River project in Arizona jumped into the $2 billion group as shown by the most current

Irrigating grapes on the Salt River Project, Ariz. *Photo by E. E. Hertzog*

figures. It is now up with the Minidoka project in Idaho and Wyoming, the Boulder Canyon project in California and the Yakima project in Washington.

California's giant Central Valley project is the top producer with its $3.6 billion in irrigated crop returns.

The thicker Statistical Appendix containing more than 200 pages presents greater detail about each Bureau of Reclamation project than its companion publication. The pages in both are precisely typed for final printing by Ruth Adair and Thelma Fox in Nielsen's office. A professional economist also does key work, and Glen Johnson has held this position since last spring.

With the efforts of this staff, the Crop Report is attentively put together. Al's boss, Maurice Langley, chief of the division of irrigation and land use, wrote a forwarding letter to Reclamation Commissioner Floyd E. Dominy on page one. He wrote:

"Forty-four multiple-purpose projects provided 546.1 billion gallons of water for municipal, industrial, and other nonirrigation uses, an increase of 29.0 billion gallons over that of 1964. These deliveries supplied about 60 percent of the full requirements of 12.4 million people, an increase of 1.5 million over that of 1964. This is equal to the requirements of 9 cities the size of San Francisco, or 16 the size of Phoenix, Ariz.

"Public use of outdoor recreation facilities on Reclamation projects amounted to 36.5 million visitor-days."

It is not exactly incidental that in a recent 10-year period Reclamation's dams and reservoirs prevented flood damages to private and public property valued in excess of $426 million, not including the saving of priceless human lives.

The contributions of the western part of our Nation—in fact its actual productive existence—has not come just by the flow of history. Its production grew and is still growing because of forward-looking men and the development of the indispensible but scarce water supplies. The Crop Report is, it would seem, an important footnote to that history and development. # # #

Two such self-propelled tomato picking machines are put to use on one farm on the San Luis Unit of the CVP, Calif.
Photo by H. L. Personius

This is it. The land needs only water, gentlemen. The newest successful applicants for CBP farms made this soil examination last August.

The Columbia Basin Colossus

by DAVID F. SCHUY, Chief, Economics Branch, Ephrata, Wash.

IN the early 1930's there was very little inducement for anyone to move into the dry southeastern section of Washington. Occasionally a settler would try to put down roots in that vast wilderness, but he was not able to even settle the dust.

In fact the story is told that passengers aboard an ocean liner 600 miles off the coast of Washington heading for Honolulu in 1931 were suddenly engulfed in a huge cloud of fine dust. The cloud—estimated to extend from about 300 miles inland to 1,000 miles out to sea—was none other than topsoil from the Pacific Northwest.

But if any of that dust was from the Columbia Basin area, the picture has greatly changed in recent years. A lot of people have come to count on the control of some of this rich topsoil by using the conquering influence of irrigation in that part of the Evergreen State.

Since 1948, water from the Columbia River has made huge land sections in the Columbia Basin project attractive to settlers. Now the Columbia Basin—with its dust areas a lot fewer—is a part of the Great Inland Empire. Modern-time fact finders, seeing the settlement and prosperity take place, tell the amazing story of the development from 1948 to 1963, which changed the scene entirely.

This project area of the Bureau of Reclamation leaped from 232 to 380,300 irrigated acres. The population swelled by 47,000; 858 new businesses sprang up, annual pay checks were fatter by $56.5 million, and the assessed value of property increased $75.3 million.

Tax Revenues Greater

As reflected by the major economic indicators, the State, local and Federal tax revenues were 6 to 7 times greater in 1963 than at the start of the irrigation development.

Money from State retail sales taxes was 597 percent higher, the State business and occupation tax revenues were 724 percent higher, the county property tax brought about 600 percent more revenues, and the Federal income tax revenue was 593 percent more.

In other words, after only 15 years of development, the fledgling Columbia Basin project became quite a success.

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Sugar beets from the project.

To insure a complete picture of the project's impact, its economy was measured against a good dryland wheat-summer fallow region adjoining its eastern boundary. The study was conducted cooperatively by the Bureau of Reclamation and the Department of Agricultural Economics at Washington State University. A brief preliminary report of the study under authorship of Dr. Arthur W. Peterson, university extension economist, was entitled: "Economic Development of the Columbia Basin Project Compared with a Neighboring Dryland Area."

Both the irrigated and the dryland areas included in the report resemble each other in ways that are important to an economic study. This provided an excellent opportunity to compare them.

Growth indicators on the dryland area showed only small increases and declines, and that area averages 13 inches of rainfall. The project area with only 8 inches of rain—but with modern irrigation—supported from 17 to 22 times as many people, businesses, retail sales taxes, wages, and workers not counting farm operators.

Irrigation Compared

If attempts at dryland farming had continued in the newly developed area—irrigation being very sparse—its productivity would not have been even 20 percent of the comparison area productivity. However, in 1962 for example, its overall output was 6.9 times greater than the other area resulting in almost a quarter of a billion dollars gross revenues to farmers and businessmen associated with agriculture. Of such a total, $62.7 million was farm revenues, $51.1 million from processing and marketing firms, and $101.8 million for wholesale, retail and service trades.

Previously having scarce vegetation, but used anyway as grazing range for livestock, the farms on the project in 1963 had become worth $212 million including the improved land, machinery, livestock, and operating capital. Farm debt at that time was $67.4 million leaving a net worth to farmers of $144.4 million. This is approximately $3 in assets for each $1 of debt.

Other 1963 figures show an average investment per cropland acre to be $557 as compared to $115 in the comparison area. Put on a single farm basis, the total project farm investment was $84.7 thousand as compared to $163.3 thousand for the comparison area farms, due to the considerably larger size of the dryland farms.

For equal amounts of cropland, the project farmers receive about $4 of net farm income for each dollar of those in the dryland area. The 1963 net income for all the farmers in the project was $30 million.

Healthy Business

Another study made in 1962 gives a good idea of the healthy economy of the off-farm businesses in processing, handling and packing the farm produce. For a total of 1,290 man-years of labor, the 99 such firms paid $6.3 million in wages that year. Since 1962, with expansion continuing, five more potato processing plants have been built.

As reported by the U.S. Census of Population, the increase in average family income in the two primary counties of the project area—Grand and Franklin Counties—was 51 and 62 percent respectively from 1949 to 1959. The increase in the two comparison area counties was 38 and 47 percent.

One can tell by an increase in transportation activities that when business booms in an area other

In 1965, 122,500 cattle were fed for slaughter.
Photo by E. Hertzog

Set a siphon right, and it'll do the job.

parts of the country are going to benefit as well. The project area received 23 times as many carloads of freight and shipped out 8 times as many carloads from an equal number of acres as the comparison area. The wholesale value of inbound freight to the project area was $2.4 million per 10,000 acres of irrigated cropland, and the value of the freight shipped out was $1.8 million.

The higher value of the incoming freight points to the expansion of both farm and business, and the attraction of investment capital. Employment in the transportation industry generated by the project area in 1962 was 25 times as much, and it brought 23 times as much revenue as an equal number of acres in the dryland area's transportation business.

Although growth in the Columbia Basin project has been outstanding when measured in terms of production and income, there is another important measurement, namely opportunity for farm ownership.

People in other areas have their eyes on the flourishing Columbia Basin project area. An average of 57 potential residents have applied for each farming opportunity when the Government-owned lands are offered for sale each few months. But since 1963, the number of these applicants is almost double that average.

A Look Ahead

Although water has been available in the Columbia Basin project for a relatively short time and the resulting growth has been rapid, the full impact of reclamation is yet to be experienced. The productivity of the soil will increase and the agricultural industry has the prospects of improving as it matures. As this happens, farming will shift to more intensive crops such as fruit, vegetables and specialty seeds. There will be even more crops grown than the sixty-some-odd at present. Then, in turn, business, employment and population also will be stimulated extensively.

Although the project is authorized for an ultimate size of 1,029,000 irrigated acres, it is estimated that by 1971, 515,000 irrigated acres will be cropped annually. When the latter acreage is developed to full maturity, its annual crop value at 1963–64 prices is expected to be $138 million. Income from livestock and their related products is expected to reach $63 million, which is approximately triple the 1963–64 production.

Around 1975, with the project still in the development stage, the area populaton is expected to reach 89,000. And at maturity, 154,000. The nonfarm businesses will rise to 2,200 in 1975 and 3,600 at maturity.

Potatoes—the project's largest cash crop.

Electric Power Partner

Although the impact of irrigation on the CBP was a major subject of the report, the electric power produced at Grand Coulee Dam has been an indispensable partner to irrigation. The dam is the principal feature of the project and it produces power for use in a huge sector of the Northwest. Adjacent to the dam are the 6 giant pumps which lift the water about 280 feet up from the river to make irrigation of the entire project possible. However, it produces three other principal benefits:

1. Its generators produced electricity from 1941 to 1964 valued at about $493.8 million. When the third powerplant, recently authorized, is in operation it will nearly triple the present generating capacity to 5.6 million kilowatts.

2. Flood control made possible by Grand Coulee Dam resulted in the prevention of property damage in amounts ranging from $79,000 to $25 million, depending upon the year.

3. The recreational use on the project becoming an increasingly important byproduct of its development each year, was 1,492,000 visitor-days in 1964.

Some of these figures may make it difficult to realize that the CBP is in an early stage of development, and that its impact already could be so significant. However, it is expected that there still will be many industrious Americans taking a good look in that direction—to see if some of that cloud of dust still need settling. # # #

(A comprehensive treatment of this economic study, complete with charts, is expected to be ready this year as Bulletin 669 from the Washington Agriculture Experiment Station.)

Mechanized pea pickers at work. *Photo by Ron York*

URBAN IRRIGATION?

by GEORGE MARTIN, Editor of The "Current" News

MORE than the usual problems of urbanization were experienced when Phoenix, once a sleepy cow town, began an amazing postwar boom.

In 1950, even after the boom had started, the city of Phoenix, Ariz., had a population of just over 100,000. And some suburban communities, like Scottsdale, didn't even exist as incorporated municipalities. Today Phoenix has a population of more than a half million and Scottsdale, with a population of 55,000, is the third largest city in the State.

The rapid influx of people to the Valley of the Sun meant that new homes had to be built on land once cleaved by the plow and the irrigation ditch. Much of this acreage was—and is—within the water rights lands of the Salt River Valley Water Users Association, part of the complex organization known as the Salt River project. And water continues to be a most important business to all the people on that acreage.

J. Frank Chambers, manager of the project's irrigation services department, listed 1951 as the year the project felt the first major population impact—urbanization on land formerly used for farming.

Residential Lots Included

"At that time," Chambers said, "we faced the necessity of revising our water distribution system. We had to include the water needs of residential subdivision lots in addition to our municipal and farm lots."

Of the approximately 238,000 acres in the valley—all served by the project's six storage dams—nearly one-third are in nonagricultural use. That land is either subdivided for residences, or in commercial use.

Where previously we had delivered water to an 80-acre farm account, we now had as many as 320 resident subdivision accounts, said Chambers. And each had individual water right and irrigation facilities.

The project now serves 32,000 residential lots ranging in size from a fifth of an acre to five acres. Most, however, are less than one acre.

To take care of these smaller areas, the project's total acreage was divided into five separate water distribution areas, each having about 50,000 acres. The staff for each distribution area field office, includes a watermaster in charge, plus the clerical help and *zanjero*. (A Spanish word used in the Southwest to denote the one who controls the delivery of water.)

In further dividing, smaller groups used a central schedule board showing the name, address, number account and the time each member is to receive his "order" of water. He then turns his lawn into a pond for a short time—made possible by banking the edges—or he row-waters a garden.

Water Scheduled

Water deliveries are scheduled every 14 days from April through September, and every 28 days

The front lawn of a residence in northeast Phoenix looks like a small lake after being filed with irrigation water. The edges of the property are raised so the water doesn't leak to other yards or into the street.

An irrigated yard not only is good for grass, but it's good for the children to try out their little boats. However, the boat in the background is not little enough. It is taken to one of the project's six large storage lakes.

from October through March. In summer months the water is needed more often and it doubles as a play pool for tiny tots under the watchfulness of parents.

In one trip to the nearby schedule board, each water user may learn when he will receive his water and sign up for the next water run.

Individual water-user sheets on the schedule board also tell the subdivision officer what the credit balance is, posts notice of delay or a cancellation and other information.

Payment of an annual assessment entitles the user to a certain amount of water—normally measured as 50 miners inches to subdivisions. All water above such an amount is covered by additional payments.

Because it is so important to all concerned that water not be wasted, a system of water accounting was established. The system provides for daily reports and attention to water losses by subdivisions or individuals. If wasting, or flooding, is caused by a break in an irrigation line tile, it is repaired promptly.

In fact, such efficient management by the Salt River project and irrigation by ponding are major factors in the creation of the beautiful green and fast growing cities in the desert southwest. # # #

Schedule boards are erected in a convenient location for all residents on the list.

WINTER FISHING ANYONE?

WINTER no longer means the end of fishing in the normally ice-locked waterways of the West. Many reservoirs are open to fishing throughout the year—an off-season recreational dividend of Federal water resources development.

Fishing in the manmade lakes—some 200 of them—and other waterways built under the 64-year-old Reclamation program is administered under laws of the States where the waterways are located. One can obtain information on fishing regulations, and reservoir access, from Bureau of Reclamation offices and State fish and game commissions.

Major winter fishing opportunities in Reclamation waterways are summarized by drainage basin regions and offer more than a dozen kinds of fish:

Winter Favorites

Region 1, Columbia River Basin—Pacific Northwest

Washington. The open areas are Banks Lake, Long Lake, Potholes Reservoir, Winchester Wasteway and Evergreen Reservoirs, Stan Coffin Lake, Lake Linda, Scooteney Reservoir, Camp Lake, Crescent and Long Lakes, and Frenchman Hills Wasteway in the Columbia Basin project. Types of fish—perch, bass, crappie, bluegill, ling, silver salmon, kokanee, eastern brook, rainbow and brown trout, and walleye.

During the winter, the Yakima River is open to fishing for steelhead below Reclamation's Roza Dam.

Oregon. At Emigrant Reservoir on Rogue River, crappie, bass, and catfish are available; at Lake Owyhee and Bully Creek Reservoir, trout and crappie. On January 1, the Malheur River downstream from Warmsprings and Agency Dams were open to year-round fishing.

Idaho. Open areas: Palisades Reservoir, cutthroat trout; American Falls Reservoir, rainbow trout; Little Wood Reservoir, rainbow trout; Boise River Reservoir, trout; entire Snake River, sturgeon, trout, bass, and catfish. Ice fishing at Palisades, American Falls, Little Wood, and Cascade Reservoirs.

Montana. At Hungry Horse Reservoir, trout, kokanee, grayling, and whitefish are available. It also is open to ice fishing. Some roads in the area are kept open for logging operations.

Wyoming. At Jackson Lake, mackinaw lake trout—good catches made. Ice fishing. Rental snow vehicles available at Jackson and Moran.

Choice Angling

Region 2, California's Central Valley and Lahontan Basin, Nevada

California. The open areas are Shasta Lake and Folsom Reservoir for trout, bass, bluegill, and kokanee; Keswick Reservoir, Engle Lake (Trinity), and Lewiston Reservoir, for trout and kokanee; Nimbus Reservoir and Lake Solano, for trout and bass; Friant and Delano Reservoirs, for bass and bluegill; San Luis Wasteway for bass, bluegill, catfish, striped bass, and crappie; Lake Berryessa for trout, bass, bluegill, and catfish; Cachuma Lake for bass, bluegill, and catfish; and Casitas Lake for bass, bluegill, catfish, and crappie.

Sly Park Reservoir, for bass. East Park and Stony Gorge Reservoirs, for bass, bluegill, crappie, and catfish, also are open; however, the trout fish-

Fishing through the ice at Banks Lake, Wash., is popular.

ing in these areas is closed from November 1 through April 30.

Nevada. Open areas: Rye Patch Reservoir for trout, bass, and bluegill; and Lahontan Reservoir for trout, bass, bluegill, catfish, and perch.

Good to Excellent

Region 3, Lower Colorado River Basin and Southern California

Arizona, Nevada, California. All Reclamation reservoirs in the Lower Colorado River Basin are open for fishing year around.

Bass, crappie, catfish, and bluegill are caught in Lakes Mead, Mohave, Havasu, and on other stretches of the Colorado River. Rainbow trout also are caught in Lake Mohave, between Hoover Dam and Willow Beach, and in the river below Davis Dam. Bass, crappie, catfish, and bluegill also found in Roosevelt, Canyon, Apache, and Saguare Lakes on the Salt River. At Bartlett and Horseshoe Reservoirs on Verde River in central Arizona angling for bass and catfish is fair to good.

Walleye were recently planted in Canyon Lake behind Mormon Flat Dam, Arizona. Blankenship Bend, a new area on the Colorado River 7 miles below Topock, Oriz., recently was stocked with rainbow trout, some of catchable size, and will be restocked regularly. Winter fishing is expected to be good to excellent.

Trout That Bite

Region 4, Upper Colorado River Basin and Great Basin

Arizona. Lake Powell is open with trout, bass, and catfish.

Colorado. The open areas are Crawford, Fruitgrowers, Jackson Gulch, Taylor Park, Vallecito, and Vega Reservoirs. Types of fish—trout, yellow perch, and walleye.

New Mexico—Colorado. Trout fishing at the Navajo Reservoir is open for winter fishing.

Utah. Open areas: Willard Reservoir with bass, walleye, and catfish; Flaming Gorge, with trout; Deer Creek, with trout and yellow perch; Lake Powell, Newton, and Midview Reservoirs, with trout and bass; and Lake Powell with catfish.

Wyoming. Fontenelle, Big Sandy and Flaming Gorge Reservoirs are open for winter sportsmen, with ice fishing permitted. Again, trout is the primary catch.

Fish Ponds

Region 5, Rio Grande River Basin and Oklahoma River Basin

New Mexico. Open areas: Alamagordo, Avalon, Caballo, Elephant Butte, and Stubblefield Reservoirs and Lake McMillan, for bass, crappie, and catfish.

Oklahoma. Altus, Fort Cobb, and Foss Reservoirs, for bass, crappie, and catfish.

Colorado. Platoro Reservoir, for trout.

Through the Ice

Region 6, Upper Missouri River Basin

Montana. The open areas are Fresno and Nelson Reservoirs, for trout, kokanee, and walleyed pike; Canyon Ferry Reservoir for trout and perch; Pishkun and Willow Creek Reservoirs, for trout and northern pike; Clark Canyon Reservoir for trout; and Yellowtail Reservoir for trout and walleye.

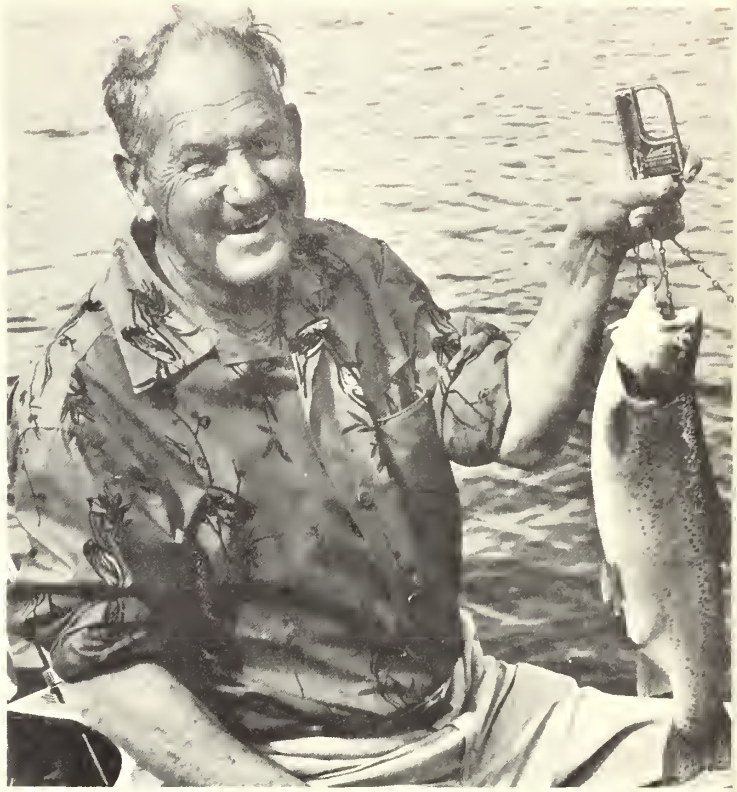
Wyoming. Open areas: Keyhole Reservoir for trout and walleyed pike; Boysen Reservoir for trout, walleye, ling, sauger, bass, and crappie; Buffalo Bill Reservoir, for trout and whitefish; Bull Lake, for trout; Ocean Lake, for ling and crappie;

Cool fishing in Deer Creek Reservoir, Utah.

January fishing in Montana.

Right: A 4-pound rainbow from the Lower Colorado River in February.

Fishing from a special craft on Flaming Gorge Reservoir, Utah-Wyoming, is Gadabout Gaddis, producer of fishing movies for television.



Pilot Butte Reservoir, for trout and ling; Deaver Reservoir, for trout, crappie, and bass; Lake Cameahwait, for trout and bass; and Yellowtail Reservoir for trout and walleye.

North Dakota. Dickinson Reservoir, Heart Butte Reservoir, and Jamestown Reservoirs. All have walleyed pike, bass, and northern pike.

South Dakota. Open areas: Angostura and Belle Fourche Reservoirs, with trout, walleye, bass, crappie, and ling; Deerfield, with trout; James River Division Reservoir, with walleye, crappie, and northern pike; Pactola Reservoir, with trout; and Shadehill Reservoir, with walleye, bass, and crappie.

Yellow perch are also present in most of these South Dakota reservoirs.

A Lot To Offer

Region 7, Lower Missouri River Basin

Kansas. Open: Kirwin, Webster, Cedar Bluff, and Lovewell Reservoirs. Types of fish—walleye, northern pike, white bass, largemouth bass, crappie, and catfish.

Nebraska. Harry Strunk, Hugh Butler, and Swanson Lakes, and Enders Reservoir. Walleye, northern pike, channel catfish, bluegill, largemouth bass, crappies, bullheads, and carp are found in these areas.

Sherman Reservoir has creel and possession limits with northern pike (5–10 pounds), bluegill, largemouth bass, crappies, bullheads, and carp.

Colorado. Open: Bonny Reservoir with northern pike, walleye, white bass, largemouth bass, and crappie available.

Colorado-Big Thompson Project. All reservoirs are open to winter fishing. However, because of fluctuating water surfaces, fishermen are requested to exercise unusual safety precautions.

All reservoirs contain rainbow trout. Lakes Estes, Horsetooth Reservoir, Lake Granby, and Green Mountain Reservoir also have brown trout: Horsetooth also contains kokanee, salmon, bass, and crappie.

Green Mountain, Shadow Mountain Lake, Lake Granby, and Carter Lake also have kokanee. In addition, Carter Lake has bass, and Willow Creek Reservoir has brook trout.

Wyoming. Trout fishermen may use Alcova, Seminoe, Glendo, and Pathfinder Reservoirs.

So! Anglers who are used to sitting around waiting for spring, might try winter fishing.

# # #

Installing a Water Transport at a Saving

by R. H. FULTON, Contractor and R. L. DRAGOO, Project Manager of Lubbock, Tex.

SOMEONE who knew about saving time and money in construction efforts once rightly said: "The old way is usually best—but not always."

When our company contracted for one of the longest water pipe systems in the history of the Bureau of Reclamation, we agreed that for this unusual job, the usual way of laying pipe would not be best.

Presenting the main challenge was the installation of the large pipe—wider than some automobiles—sizes from 5 feet to 8 feet in diameter. The pipe sections averaged 34 tons. Extraordinary trenching and pipe bedding techniques were going to be required for us—Fulton and company—to meet construction schedules for such a water highway spanning the 146-mile section between Sanford Dam and Lubbock, Tex.

The remaining reaches of the 322-mile pipeline would not involve such unusual pipe sizes and machinery. But a savings of a great deal of money resulted from the speedy construction procedure for the larger pipe which was suggested by the Bureau of Reclamation's project construction engineer and his staff.

Using the logic of putting a round peg into a round instead of a square hole, our two organizations began in July 1963 on the large pipe portion of this 11-city water distribution system.

The unusual machine would carve a circular bottom for the circular pipe. It was eased into the trench after a conventional backhoe had completed a rectangular flat-bottom cut. Then this man-power saving machine—looking like a rear-propeller-driven tractor—crawls steadily along the bottom.

In a geyser of flying earth, the propeller-like wheel deepens the center of the trench with a neat, rounded groove just right for the bottom one-third of the pipe.

Actually, the digging wheel of one of these machines consists of dozens of heavy steel spokes with sharp-edged cups around the outside. The length of the spokes was adjustable and could be varied to the four largest pipe sizes. Strongly powered, the excavating wheel speedily conveys the dirt into a winrow on the trench rim for later use in covering the pipe.

Other Trencher Adapted

As our construction progress took us to the more distant points of the system where the pipe was to be smaller, we used a conventional trencher with the water-wheel-like excavator. However, we replaced a portion of the straight edges of this machine's cutter buckets with curved ones so the bottom of all trenching in the entire system would be rounded adjacent to the pipe and provide the many advantages of firm earth support in which the pipe would lay.

As the trencher—either of the kinds used—moved up the line, the pipe crew, following close behind, lowered the pipe into the trench by crane

A 96-inch water pipe for the Amarillo area of the Canadian River Project.

and laid it into the circular bottom upon two narrow sand pads. The sand kept a 2-inch space open between the pipe and the earth for pouring a soil-cement grout.

Soil-cement has been adapted to the Bureau of Reclamation work during the last few years. It has proved to be a tough facing for dams and other water-related structures and now is shown ideal for supporting the pipe of the Canadian River project aqueduct.

Central portable batching equipment for the soil-cement grouting was moved to each 10-mile stretch as we moved along the trench route. Ready-mix concrete trucks then deliver the grouting to a distributor machine which propels itself along the trench astride the pipe. The soil-cement is poured into the distributor tank from which it flows into the 2-inch space along the sides and bottom of the pipe.

Grout Sets Up

The grout sets-up hard forming a firm foundation for the pipe and eliminating the possibility of void spaces or channels around the pipe which could fill with ground water and weaken the foundation. Most of the job is thus complete, but backfilling of the diggings is never far behind.

Though the savings from the new methods of construction has not been accurately calculated, the costs are estimated to be a third less than conventional ways. With the trenching, installing, and backfilling all being done within a short reach and using only one construction supervisor, a savings is obvious. Also the pipe is layed and bedded to the end of the excavation for the close of each day's work. In the summer this virtually eliminates the lost time from pumping rain water out of extra trench after heavy storms. In the winter no frozen subgrade occurs to slow a day's work.

The work of our company alone on the aqueduct portions of the Canadian River project have resulted in construction savings to the Bureau in excess of $1 million. And a savings of similar proportions will be very probable as these proven methods are used in future construction jobs when water must be transported long distances.

We are indeed proud to have worked on this project which has resulted in so many benefits of water storage, distribution, and water-based recreation to the Texas Panhandle. # # #

The wheel deepens the center of the trench with a rounded groove.

The Corpsmen Are Mighty Proud Workers

AN attractive new recreation area has been created along the once remote south shore of Alcova Reservoir, a half-hour's drive from Casper, Wyo.

Started and completed with their own hands, the beautification project has been a significant milestone for the heterogeneous group of young men from the Bureau of Reclamation's Casper Job Corps Conservation Center. Seldom before had they felt the glow of real accomplishment. And this was the first unit completed in their vast conservation and beautification program. The Corpsmen are mightly proud of it, and so are the people of Casper.

The daily Casper Star-Tribune, which has been conservative in praise of the Job Corps, said it this way:

"As clouds of controversy concerning their relative worth swept the State, the 100 enrollees of the Casper Job Corps Conservation Center bent their backs behind pick, shovel, and trowel and in 58,000 man-hours completed work on the development of Cottonwood Recreation Area at Alcova Lake, southwest of Casper.

"Today the 60-acre picnic and camping area and adjacent boating facilities and some 2 miles of road will be turned over to the Natrona County Park Board and the Board of County Commissioners.

"The Park Board estimates that the work done by the Corpsmen would have cost the county government some $250,000."

Encouragement

More difficult to measure is the value of encouragement to young men whose lives had been marred by deprivation, frustration, and failure.

Nor is anyone more pleased than John D. (Dale) Anderson, Director of the Casper Center.

The Casper Job Corps Conservation Center was activated April 15, 1965, in an area that offers exceptional opportunity both for the enhancement of nature and the development of young Americans.

A chain of reservoirs created by the Bureau of Reclamation along the North Platte River has become extremely popular with outdoor enthusiasts from Wyoming and neighboring States. But facilities have proved wholly inadequate in the face of the recreation explosion.

Shorelines offer little shade, comfort, or beauty. Still, almost 435,000 persons visited the Alcova Reservoir area last year—swarming along the developed north shore.

To relieve the crowded situation, the Casper Corpsmen were assigned the development of the south shore and other tasks of conservation and beautification.

The newly completed Cottonwood Recreation Area will accommodate several hundred persons at a time, without crowding.

Cottonwood Area Facilities

In work that started in the fall of 1965 and continued on a limited basis during the winter, the Corpsmen built a 2-mile all-weather road, erected 65 sturdy picnic tables, 5 steel and stone picnic shelters, several latrines, 50 charcoal grills and a similar number of trash racks.

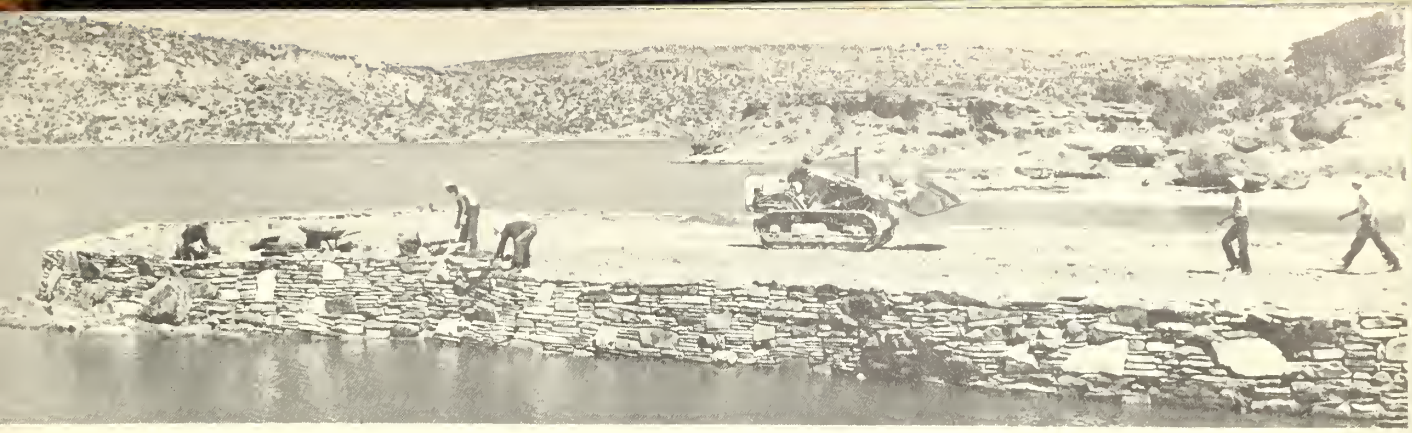
They also developed 30 acres of campgrounds, a half-mile beach and two swimming areas.

Near the center they constructed a 200-foot jetty from native stone and concrete, and flanked it with a boat dock and ramp. They also developed nine auto parking areas embracing a total of 80,000 square feet.

In this inviting expanse they planted 2,000 tiny Ponderosa pines and seeded 20 acres in grass.

An additional 15,000 Ponderosa pines were planted by the Corpsmen on the hillsides and along the North Platte River and on reservoir shores in the Alcova, Seminoe, Kortes, and Glendo areas.

They represent not only future beauty and shade but also wind and water erosion protection.



The Corpsmen have neared completion of the attractive Cottonwood recreation area in Wyoming.

H. P. (Pat) Dugan, Regional Director of the Bureau of Reclamation's Region 7 in Denver, has pronounced the Cottonwood Area a "recreational gem" of Anderson's imaginative planning. Anderson passed the compliment on to his staff and the Corpsmen.

"You can appreciate the project only when you know what the enrollees were like when they came here," Anderson said. "Some were billigerent, some scared, many were homesick.

"But with this large number of active young men as a work force we anticipated accomplishments to start showing quickly, and the initial approach was to send out a work leader with a group of Corpsmen to perform a job. However, followup inspections revealed that not much was being done.

"The work leaders reported only a few would work. This was further examined and we decided only about 10 percent knew *how* to work. The scheduled projects were temporarily shelved and we started all over.

"We had to train the boys in work attitude and even the most basic work skills. The answer, I think, was motivation—the installation of pride in a job well done.

"The training included use of hand tools—axes, shovels, picks and saws—and, later, the use of machinery, from concrete mixer to power shovel."

Promotions To Leaders

As the training period entered the 10th week and all Corpsmen had been given the opportunity to function as group leaders, the staff began selecting Corpsmen for promotion to leaders and assistant leaders.

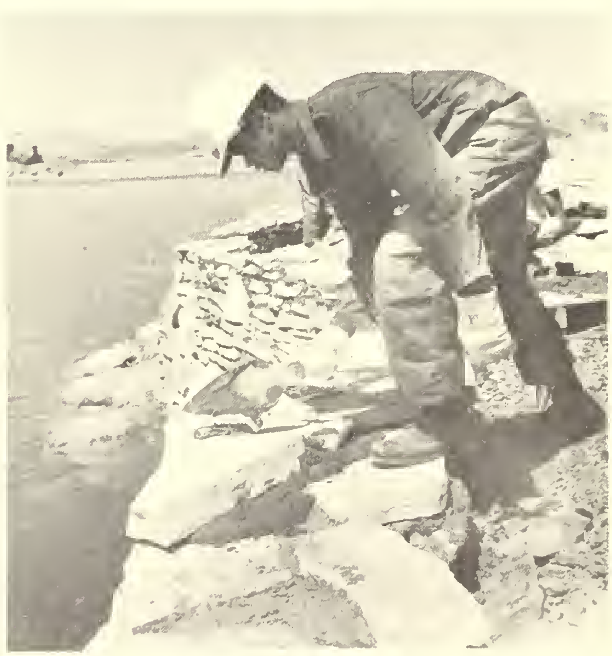
This increase in faith and responsibility was a tremendous challenge to those who had never before felt the obligation of leadership and the trust of adults.

The selection of leaders had a good reaction among those not chosen, as they wanted to be on future promotion lists.

Originally, only four or five Corpsmen could be trained by a staff member, leaving between 20 and 25 men to be supervised by one work foreman. As leaders gained confidence and experience, they began assisting in the training of others. This permitted the staff instructor to maintain only visual control over groups and individuals actually operating heavy equipment.

The early dreams of glamorous adventure have been replaced by pride in accomplishment and

A Casper enrollee demonstrates how this stone work is done.



there's great rivalry among individuals and groups on work projects.

"Corpsmen who once wanted to loiter in the dormitories now clamor to get out into the field," added the Center Director.

Anderson said several enrollees have developed a high degree of skill in the operation of heavy equipment and that many others have taken an intense interest in carpentry and masonry.

It was their work on the jetty in Alcova Reservoir that introduced them to the challenge of masonry, which is patiently taught by Charles E. Galyan, one of the Casper Center's work leaders.

Galyan is a former contractor who served with the Armed Forces in Greenland during World War II.

Borrowing from this experience, he made use of a sturdy prefab shelter during the winter months at Alcova, directing work within the heated building which was moved several times directly over the site on which the Corpsmen labored.

Master Plan

Continuing under a master plan that will keep them usefully engaged for several years, a minimum of 25,000 seedling shrubs and trees will be planted next spring. This number will serve as a goal annually thereafter.

But already underway is the development of a second recreation area north of Cottonwood on Alcova Reservoir along a shore known as Black Beach. As at Cottonwood, the work involves construction of roads and trails, picnic and camp grounds, boat ramps and docks, signs, shelters, overlooks, picnic tables, and latrines.

The facilities are prefabricated in the Casper Center's carpentry and welding shops, with indoor and outdoor crews rotating to give each man full exposure to the wide variety of tasks.

Next on the schedule is a third recreation area at Pathfinder Reservoir, immediately upstream from Alcova. The development started this fall, along with a number of projects for the Bureau of Land Management.

These will include riprapping six livestock dams in the Powder River country north of Casper; the development of springs for livestock water; the fencing of 10 range study plots embracing from 1 to 3 acres each, and the clearing of 3 miles of fire breaks across BLM land on Muddy Mountain south of Casper.

Recent fires in that area have destroyed timber and threatened scenic recreation areas.

Dugan noted that Camp Director Anderson and the Center's Work Director, George E. Davis, are uniquely qualified to serve both as youth leaders and conservation planners.

Anderson was born just across the Wyoming line in Henry, Neb., but received his high school education at nearby Torrington, Wyo. He attended the University of Wyoming and was graduated with a B.S. degree in Engineering in 1942. During World War II he commanded an infantry company in Europe.

On his return to civilian life he spent 4 years with the Soil Conservation Service as construction engineer on flood control projects.

He was recalled to service during the Korean conflict and served as assistant professor of military science and tactics at Central and Centennial High Schools in Pueblo, Colo.

Anderson joined the Bureau of Reclamation in 1961 as hydraulic engineer in the Soil and Moisture Conservation Branch.

George Davis is a Wyoming native who received a B.S. degree in Agriculture and an M.S. in range management from the University of Wyoming. He also was a high school teacher, construction worker, and range management specialist for SCS.

With these and other such men—as well as some Job Corps enrollees with a talent for beautification—the Casper Center will complete considerably more units of work with pride. # # #

This floating dock as well as other improvements were constructed by the young men.

A Man Who Made the Most of an Opportunity

"I CHOSE TO FARM"

by LAWRENCE A. GILLETT

EDITOR'S NOTE: *During his many years in the Mini-Cassia area, Mr. Gillett has served as President of the Cassia County Farm Bureau, President of Idaho Potato Bargaining Association and as a member of the Secretary of Agriculture's National Potato Advisory Board. He was also selected as Minidoka County Farmer of the Year in 1963. In this article, Mr. Gillett describes his personal experiences in growing sugarbeets in a Bureau of Reclamation project area.*

I have been raising sugarbeets every year since I started farming on my father's farm in Declo, Idaho, in 1946. In 1956 I drew a 160-acre homestead 4½ miles from a sugar factory and in 1957 I moved out on this new land.

To me this was the opportunity of a lifetime. That first year I chose a farm, set and leveled the fields, built a new home, machine shed, potato cellar, a large grain storage, a walk-in milk barn, a feed lot, and a pit silo.

With the aid of modern machinery and technology, I was able to put this farm under cultivation and have it under full production the first year. To make an economical operation I rented another farm, and in 1965, I purchased 480 acres of new ground 2½ miles west and 3 miles north of my homestead.

As sugarbeets had been the backbone of my operation in Declo and I had no history on the new farm, the first three or four years I raised only 5 to 15 acres of beets each year. When Castro rebelled, I expanded to around 100 acres of sugarbeets along with potatoes, alfalfa, and grain. I

Soil on the Gillett farm is well prepared.

gradually expanded my beef feeding program from 25 head to my present 600 head operation.

Switched to Tops

After having my corn silage frozen two out of three years, I switched to beet top silage. I wouldn't have a feeding operation without it. It not only frees land that I would raise corn silage on, but the cattle like it better than corn silage. My potato and beef operation has been a rags to riches program. Sugarbeets add stability to my farming operation.

I have always planted my beets the last week of March or the first week of April. I have lost only 7 acres of beets in 20 years to frost and that was 15 years ago on ground I leveled and did not rough up before planting. Early planted beets with good moisture are much hardier than late planted beets with poor moisture.

I usually put manure on in the fall or on the preceding crop of potatoes. Waiting to put manure on in the spring delays planting too much. I put all my fertilizer on prior to planting. If I get caught short on N–2 I add it to my irrigation water.

On my weedy fields the last two years I have had good results with Tillam applied with an incorporator prior to planting. However, by best beets were on ground that came out of alfalfa, then potatoes (weed religiously) and then spring bedded—no herbicide. Nothing replaces rotation and weed control during the year prior to raising sugarbeets. Whenever possible, I fall plow and bed my sugarbeets. I have good results with monogerm seed and speedy thinners and I accomplished the same with pelleted seed and Tillam.

I could write a book on what I think of government's poverty and labor programs. In the meantime, we must mechanize to survive. # # #

(Reprinted by permission from the Spring 1966 issue of *Sugar Beet*.)

Reclamation's Third Year for Top Safety Awards

Secretary of the Interior Stewart L. Udall presented two top safety awards—third year in a row—to Commissioner Floyd E. Dominy, July 20, in the Secretary's office. "I am happy to congratulate the Bureau of Reclamation for again earning these awards and for its outstanding and continuing safety effort," said Secretary Udall.

He presented to the Bureau the 1965 plaques for both the National Safety Council's highest award: the *Award of Honor*, and the Department's highest: the *Interior Safety Award*.

Commissioner Dominy said this recognition was achieved by the unending efforts of the Chief Engineer, the Bureau safety officers, all field staff, administrative supervisors, and employees throughout the Bureau.

The 1965 frequency rate of 2.8 disabling injuries per million man-hours worked is the lowest in Reclamation history and marks the fifth consecutive year the safety record has improved over the preceding year. In 1964 the rate was 3.6; in 1963 it was 4.5; in 1962 it was 5.2; and in 1961 it was 7.6.

Secretary Udall, right, is presenting one of the two awards to Commissioner Dominy at the double award ceremony for the Bureau of Reclamation.

The National Council's award is made each year in recognition of outstanding safety achievement in the construction industry. In selecting the organization to receive it, the safety records of both Federal Government agencies and private industry are considered. The Council has estimated that fewer than five in 1,000 construction firms meet the eligibility requirements to compete for this award.

# # #

Supervision of Dam Regulations for the Safety of the Public

An article entitled: "Supervision of Dams by State Authorities," which should be of assistance in State regulation on design, construction, and maintenance of dams for the safety of the public has been written by T. W. Mermel, Assistant to the Commissioner for Research of the Bureau of Reclamation.

The article appeared in the August issue of *Civil Engineering*, the official monthly periodical of the American Society of Civil Engineers. The piece discusses and summarizes the data in an 80-page report published by the U.S. committee on large dams. It was based on a questionnaire sent to each of the 50 State Governors.

In 9 States there is virtually no control or supervision of dam construction; many States require inspection but do not budget adequate funds; and 15 States felt the need for improvement in their regulations.

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The First Lady Dedicates Glen Canyon Dam

Mrs. Lyndon B. Johnson read the dedicatory plaque after she and Secretary Udall had unveiled it. On the platform from left are Governor Goddard of Arizona, the First Lady, Senator Frank E Moss, Secretary Udall (on right side of plaque), and Governor Rampton of Utah. Acting Commissioner of Reclamation Bennett applauds from his position near the podium. *Photos by Mel Davis*

A WOMAN who has been shown "many a lovely prospect in her time," the First Lady of the United States, said, "I still could not have foreseen the drama and the winning beauty of Lake Powell."

Mrs. Lyndon B. Johnson, the country's foremost exponent on beautification included those comments in her speech dedicating Glen Canyon Dam at Page, Ariz., last September 22. Her message was about beautification as well as a new era of wise water conservation.

"Secretary of the Interior Stewart L. Udall," who was Master of Ceremonies at the dedication, "and his wife Lee, have told me of Glen Canyon. Coming here today, I almost feel I am seeing its wonders for the second time," Mrs. Johnson said.

Secretary Udall reaffirmed a comment he had made about 2 years ago when the waters of Lake Powell behind Glen Canyon Dam first showed blue against spectacular shore formations, "Lake Powell is the most scenic and spectacular man-made lake in the whole world."

Mrs. Johnson, a Texan, voiced an experienced appreciation for the beneficial purposes of the 710-foot high structure she was dedicating in stating, "Glen Canyon is not just a Colorado dam. It belongs to the Nation. Many hopes were born because of Glen Canyon. Many hopes will be ful-

Governor Rampton is presenting to Mrs. Johnson one of the various gifts and mementoes which she received at the event.

filled because of it. Water is a vital commodity in the Southwest today. A dam such as this one is a dramatic element in the whole story of water conservation, and the story of water conservation is of increasing concern to every single American, no matter where he lives.

"The hard core water and power benefits of this dam are well known. Its bonus is the heavenly blue lake that begins here and winds its way through Navajo country towards the labyrinth of the new Canyonlands National Park—created by Congress 2 years ago."

Shortly after her arrival at the top of the dam, where about 3,200 awaited, Mrs. Johnson removed a jacket she was wearing because of the hot desert sun and greeted the crowd amiably. Accompanied by Secretary Udall and Acting Reclamation Commissioner N. B. Bennett, Jr., she walked to both edges of the dam and viewed Lake Powell above and the powerplant and the Colorado River below.

New Mexico Senator Clinton Anderson of New Mexico introduced the First Lady. Also present at the ceremonies were many congressional, State, and local officials from the Colorado River Basin States.

Before making her speech, Mrs. Johnson unveiled a plaque commemorating the event. The plaque was later to be installed in the dam.

In her remaining comments were many thoughts highlighting the role of nature, a national beautification program and the rightful place of man in his surroundings.

"One cannot explore Lake Powell's 1,800 miles of shoreline in a hurry, but the places invite exploration: Places like Rainbow Bridge, Cathedral in the Desert, Hole in the Rock; canyons like Hidden, Driftwood, and Pickaxe, Dungeon, Forbidden, and Catfish.

"In paying tribute to this striking engineering achievement today, and to this landscape, and the new town of Page, I would also like to pay tribute to the strong people who live in this land, and are its stewards. The ruggedness of your task has demanded that you all be conservationists, parceling out resources judiciously, enjoying, and not depleting them.

"To me, the appealing genius of conservation is that it combines energetic feats of technology—like this dam—with the gentle humility that leaves some corners of nature alone—free of technology—to be a spiritual touchstone and recreation asset.

"America is only beginning to discover the natural beauty that is here. Our country is entering a new era of wise water conservation.

"I am proud to dedicate such a significant and beautiful man-made resource. I am proud that 'Man is here'." # # #

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U.S. GOVERNMENT PRINTING OFFICE: 1966 O—230-230

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-6419	Missouri River Basin, Kansas	July 25	Construction of Solomon River bridge, embankment, and channelization for Mitchell County highway C-705 relocation.	Bushman Construction Co., St. Joseph, Mo.	$440,795
DS-6422	Pacific Northwest-Pacific Southwest Intertie, Oreg.	Aug. 4	Detailing, fabricating, and testing Types SMX, SAM, TM, TAM, and TAMD steel towers for Oregon Border-Mead 750-kv direct-current transmission line, Schedules 3, 4, 5, 6, and 7.	Iwai New York, Inc., Los Angeles, Calif.	102,400
DC-6425	Weber Basin, Utah	July 5	Enlargement of Woods Cross equalizing reservoir 18.8, Davis aqueduct.	E. Arthur Higgins, Salt Lake City, Utah.	160,441
DC-6429	Uncompahgre, Colo	July 25	Rehabilitation of Gunnison tunnel	Eagle Construction Corp., Loveland, Colo.	528,340
DC-6433	Seedskadee, Wyo	July 18	Embankment repairs for Fontenelle dam	Brasel and Sims Construction Co., Lander, Wyo.	360,974
DC-6438	Chief Joseph Dam, Wash	Sept. 23	Modifications to River pumping plant, Schedule 1.	Paul E. Hughes Construction Co., Inc., Pasco, Wash.	107,607
DS-6396	Missouri River Basin, N. Dak	July 26	Aerial photography, supplemental control, topographic maps, and cross-section data for Middle Souris area, N. Dak. (Negotiated Contract.)	K. B. MacKichan and Associates and Abrams Aerial Survey Corp., Lansing, Mich.	184,700
DS-6415	Pacific Northwest-Pacific Southwest Intertie, Nev.	July 12	Twelve 8,000-kva shunt reactors for Mead substation, Schedule 2.	Westinghouse Electric Corp., Denver, Colo.	132,250
DS-6416	Pacific Northwest-Pacific Southwest Intertie, Ariz.	July 12	Two 230-kv power circuit breakers for Liberty substation.	I-T-E Circuit Breaker Co., Los Angeles, Calif.	119,760
100C-862	Crooked River, Oreg	July 27	Construction of Combs Flat, Johnson Creek, Tunnel, McKay Creek, Grimes Flat, and Hudspeth pumping plants.	Blickle Co., Portland, Oreg	169,278
200C-633A	Central Valley, Calif	Aug. 31	Constructing Willows field office building	Modern Building Co., Chico, Calif	191,994
200C-644	Central Valley, Calif	Aug. 29	Initial development of recreation facilities, including beach areas and boat ramp, for San Luis forebay reservoir.	Trico Contractors, Merced, Calif	237,960
300C-241	Colorado River Front Work and Levee System, Ariz.	Sept. 16	Stockpiling rock riprap for bank protection	Frank Magini, Phoenix, Ariz	127,600
500C-236	Canadian River, Tex	Sept. 14	Furnishing and installing sewer lines and sewage lift station for Fritch Fortress recreation area at Lake Meredith.	Conklin Brothers, Plainview, Tex	108,891

In its assigned function as the Nation's principal nature resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

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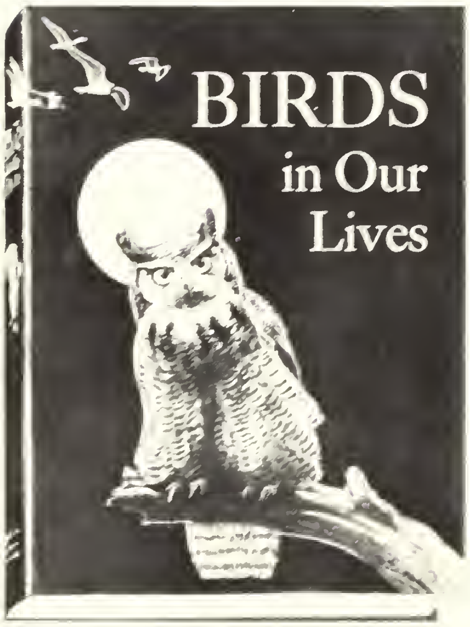

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RECLAMATION
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Building a Dam--
--For a
Better Tomorrow

See story on page 4

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RECLAMATION ERA

Gordon J. Forsyth, Editor

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Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C., 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

Commissioner's Page

"WATER FOR PEACE"

Water resources development is something in which all Americans—indeed all citizens of the world, have a vital concern. This has been reaffirmed by the widespread interest in the forthcoming international "Water for Peace" conference.

Water has been a consideration of civilizations since the first historians began recording the tribulations and triumphs of mankind. It still is a matter of transcendent global importance.

According to the United Nations Food and Agriculture Organization, the world's food output—entirely dependent upon water—failed to increase at all during 1965. But the world's population climbed by 70 million people.

Food production fell two percent in the developing nations of Latin America, Asia and Africa, where 60 percent of the world's people live. In Russia and Eastern Europe the drop in food production was six percent.

The problem is enormous and growing. We are in a race with global disaster on a scale never before known. The time we lose in not reaching solutions will not only prolong the world's many miseries associated with water, or the lack of it, but will permit the problems to worsen.

The purpose of this conference will be to focus universal attention on man's water needs and to stimulate a massive cooperative effort toward the solution of problems in supplying the basic water requirements to live.

Many of the blueprints for possible solutions to water problems of the world can be found in the Bureau of Reclamation's water development know-how, as well as the efforts of other water related agencies. We believe that much can be accomplished through a "Water for Peace" program which emphasizes greater understanding by sharing technical training and education about this basic commodity.

Floyd E. Dominy

FLOYD E. DOMINY
Reclamation Commissioner

Tall date trees form a majestic canopy which is typical of the beauty in Coachella Valley. Basin type irrigation is used here because deep penetration is necessary.

A Valley for Snow "Refugees"

AUTOMATION DOES SOMETHING *for* COACHELLA VALLEY

by **LOWELL O. WEEKS,**
General Manager-Chief Engineer,
and KEITH H. AINSWORTH,
Assistant General Manager, both of the Coachella Valley County Water District

STEPPING up to a panel in the headquarters building of the Coachella Valley County Water District a man presses one of scores of plastic buttons facing him in the big board.

Instantly a gage starts revolving. It shortly stops at a figure on its dial. The operator has just queried and received the panel's answer as to the depth of the water in a district canal 60 miles from the headquarters center.

Until now it has required 3 hours for a man in an automobile to get that information

This is the CVCW District's new telemetering system—one of the first all-automated water agen-

More raw desert was being cleared last year for a new citrus grove.

cies in the West. In its first half year, this fingertip control marvel is credited with saving a major part of 14,211 acre-feet of water in this California district.

At $3 per acre-foot, this represents a dollar saving of $42,633. Not a bad return on a half-million-dollar investment. And vital water was saved.

A low valley ringed by mountains a hundred miles from Los Angeles, Coachella Valley's abundance has attracted national attention. In the "upper" or recreational end are located the famed Palm Springs, Palm Desert, and numerous other communities which are havens to thousands of snow "refugees" from the United States, Canada, and many other countries.

They flock here to laze in the warm winter sun and play golf on some of the 22 courses that spread out along a 23-mile area. Thousands own their own winter homes. Among the winter residents are General and Mrs. Dwight Eisenhower, who lodge at their home between Palm Desert and Indio.

Good Farms

The farms are luxuriant. Orderly squares of towering 50-foot date palms produce virtually all of the United States-grown dates. One also views deep-green groves of grapefruit, tangerines and oranges; thousands of acres of snowy cotton, seemingly endless stretches of grape vineyards from which come the Nation's first grapes each spring; vast plantings of a great variety of vegetables, food grains and hay, not to mention a scattering of many other lesser crops.

This is the home of the irrigation division of the Coachella Valley County Water District.

To nourish more than 70,000 acres of highly productive farmlands in this valley, most of it lying below sea level, the District transports in by canal each year about 330,000 acre-feet of Colorado River water. Traditionally the farms score the highest yield of any larger Bureau of Reclamation-sponsored area. The figure has remained around $730 per acre in recent years.

Should a motorist on Interstate 10 choose to continue his motoring trip beyond the vast farmland checkerboard he will soon find himself on the shores of a great inland body of water—the 34-mile-long Salton Sea. Farms and groves watered by the CVCWD system end here, at a point about 70 miles from where the visitor entered the valley. Here, the motorist will be 232 feet below sea level, second lowest point in the Nation being exceeded only by the 274-foot mark of Death Valley. The elevation at the valley entrance is about 1,000 feet above sea level.

Magic Transformation

At the eastern edge of the Coachella Valley begins the searing and forbidding Colorado Desert, of which the valley itself had been very much a part before water achieved its magic transformation more than a half century ago.

Starting at Imperial Dam on the Colorado River, the water is diverted into the All-American Canal for a gravity flow of 155 miles to the Coachella Valley.

With most of the All-American Canal's water cargo headed for the 450,000-acre Imperial Valley, the Coachella share is turned aside into the

A scene that was once desert now includes the waters of Coachella Canal—electronically controlled—date palms and young citrus trees. ***Photo by E. E. Hertzog***

Coachella Branch of the system 38 miles downstream. It then must travel an additional 123½ miles of almost trackless desert to its terminus.

All of these vital water facilities have been constructed by the Bureau of Reclamation as part of the great Hoover Dam complex whose existence has transformed the Southwest. For its part of the projects, the CVCWD is repaying $27,000,000 for canal and distribution system, and an additional $7,160,000 for a supplementary loan.

Of course, such a strung-out canal lifeline has built-in complexities for the CVCWD watermaster. He must submit his first estimate of water needs 14 days in advance. He can make one final adjustment 5 days prior to arrival. But after that it is the flow in the canal that is his worry.

It was because of this problem and the determination to insure utmost water conservation and service to the water users that telemetering came into use. The District's Board of Directors, headed by Leon Kennedy, prominent farmer in the valley, and the management staff headed by the coauthor (Lowell O. Weeks), decided several years ago that a central control system was a "must" the first moment it could be afforded.

Loan Opportunity

That opportunity came a few years ago when the Bureau of Reclamation arranged a Federal rehabilitation and betterment loan of $7,160,000, to be repaid over 30 years. This would finance several urgently needed installations, including the telemetering system.

The system uses telephone lines, microwave and UHF circuits to link the panel in the headquarters building with the more than 150 responsive stations scattered through the District's service area. An operator is alerted instantly by buzzers when there's trouble anywhere on the system, or, for that matter, in the central panel itself. Trouble can be corrected by radio-directed field crews before the water user is aware there's anything wrong.

Largest of the pieces of equipment operated by the remote control system is a bank of 10 husky automatic debris screens, located just ahead of the first water outlet lateral. These screens sift every cubic foot of water in the canal, removing tons of rubbish.

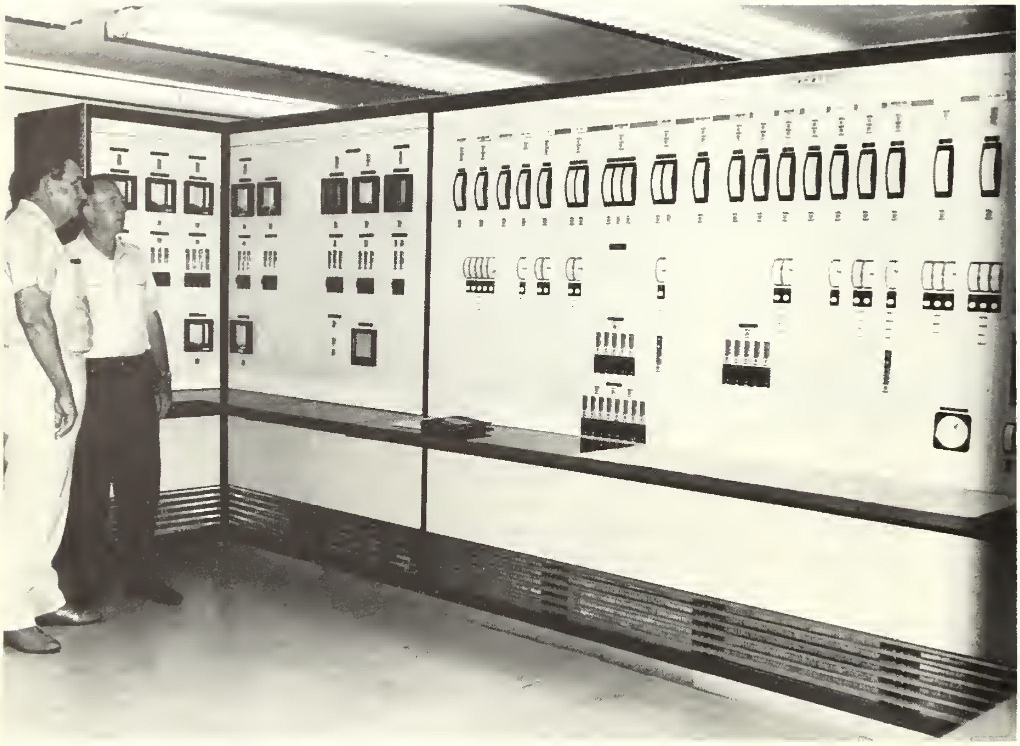
The original five of these screens were installed by the District 9 years ago, and an additional five were financed from the R. & B. program last year. When the first five screens went into operation the District was able to save the expense of paying 60 men who had spent the summer months and part of the winter, around the clock, keeping lateral screens free of debris.

Central Operation

Each of the 10 screens can be operated from the central board as well as the pump on each machine. At the debris screen site is an auxiliary diesel-operated generator that flips into operation the instant there is a break in the electric power.

Importance of water conservation and the desire for the very best service to users have been emphasized as considerations in installing the telemetering system and one other vital factor was flood control.

To maintain grade on the Coachella Canal, when constructed in the 1940's, engineers were compelled to keep it snug against a range of low mud hills for



The water district is proud of its new water-saving telemetering control system. The top row of instruments indicate water levels along the canal; the second row shows the position of the gates; other helpful devices on the panel are pushbutton controls, alarm lights, and audio units. District officials viewing the panel are Leon Kennedy (right), and Lowell O. Weeks.

a distance of about 40 miles. Siphons carry the waterline safely under scores of major washes out of the sparsely foliaged hills. The slopes can send billions of gallons of water tumbling down the washes in times of cloudbursts or heavy winter rains.

Yet smaller washes could not be handled in the same manner and so this drainage had to be turned directly into the canal, forcing it to serve as a flood channel. This dual capacity poses a constant threat of a washout on the canal after a flash flood has hit. It becomes immediately necessary that the gates be manipulated and evacuation channels opened.

Instead of men fighting their way to these installations by car, on foot or even horseback at flood times, the telemetering board now maintains a fingertip, instantaneous control over all of these vital pieces of equipment. Such control can easily mean the difference between canal break and orderly operation of the system.

Increased Services

The multiservices of the CVCWD also have a new bearing on the telemetering installation. The district entered the domestic water field in 1961 and during the past year has directed the building of three major improvement districts—bond-financed domestic water systems within its boundaries. The systems will make water available to homes and businesses in about 20,000 acres.

Now, those widely scattered districts—two of them separated by about 60 miles—will be hooked into the central telemetering room via their own panels. The district is serving domestic water to approximately 4,000 customers. The service within Imperial County is confined to domestic water systems supplying the rapidly growing homelands on the shores of the great Salton Sea, which has become a boat haven for thousands from many parts of the West.

The Coachella Valley County Water District has long been an organization well-known to irrigation district officials around the world, chiefly because of its envied underground water distribution system. The distribution grid extends 485 miles and provides metered service to each 40-acre piece of land in the valley. Today the CVCWD operates in three counties of southern California—Riverside, which includes the bulk of its territory; Imperial and San Diego Counties.

Visitors marvel at the long canal that transports the vital irrigation water across the burning desert to creat an oasis and a highly productive farming area where once only sagebrush, coyotes and horned toads existed. # # #

A Proud Nation Prepares for the Better

This 28-year-old stone cutter works more than he rests.

A Proud Nation Prepares for the Better

THE photograph on the cover and the others on these pages are excellent—perhaps even epical—in their portrayal of how drastic the human need for water can be.

A people determined to make a better tomorrow is unmistakable. Words seem unnecessary. The photographs tell *why* this, or any other growing Nation in an arid zone, absolutely must have important water controls for the survival of its people. This fact overlooked today, may mean *no tomorrow.*

The photos were taken at Nagarjunasagar Dam in a remote southern part of India. They are by the U.S. Agency for International Development.

Chennappa, the 11-year-old boy in the cover shot, is being relieved of a pan of mortar by his father who is a mason worker. In many cases, husbands, wives, and children all work side by side—the shifts going on around the clock.

With the use of machinery being kept to a minimum on Nagarjunasagar Dam, the construction methods and the time for completion contrast highly with those in the United States. However, where modern machinery is essential on the Indian structure, it is properly used.

Named after Acharya Nagarjuna, a revered second century saint, the Indians are proud of Nagarjunasagar. They planned and designed the dam. They are building it well. It will be the world's largest and highest masonry dam—409 feet high.

For many years, India's specialists and those of the U.S. Bureau of Reclamation have exchanged ideas and technical information on water resource developments. Some Reclamation employees have advised on the plans and been at the site of Nagarjunasagar Dam. Like Reclamation's dams, it is constructed for multiple-water resource purposes.

On Turbulent Krishna

Being built to harness the turbulent Krishna River, the dam will store water to initially irrigate 600,000 acres of land, eventually expanding to 3.6 million acres. It is estimated that this irrigation will permit an increase for India of 1.2 million more tons of food grains a year, and 50,000 more tons of sugar.

Its powerplant will generate 400 megawatts of electricity for the benefit of the Nation. The massive dam, including the earth and rockfill sections on both sides, is 3 miles long. The masonry portion, which rises 409 feet high above the deepest foundation, is approximately a mile long.

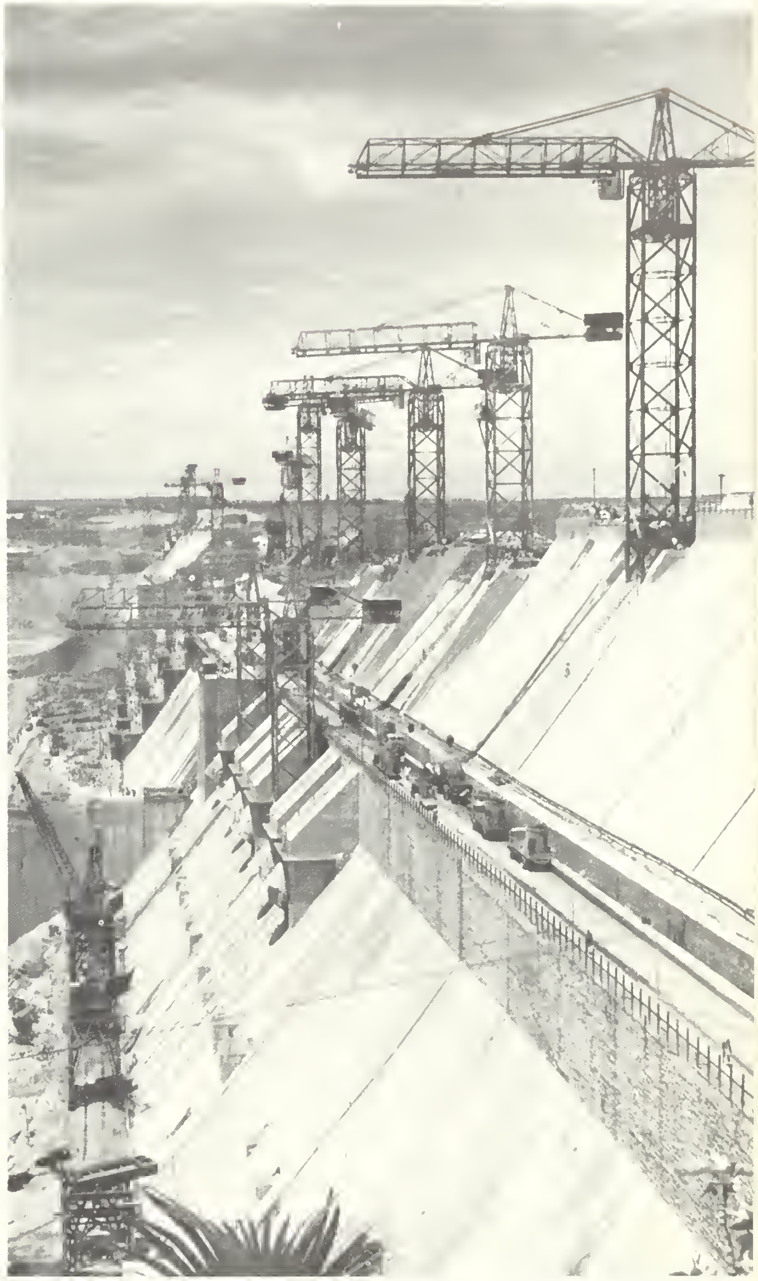
Forty-five thousand people are employed at the dam and about 80,000 more are engaged in constructing the vast network of canals. Because of this large human labor force only a few cranes are used to lift mortar and some granite blocks to the topmost parts.

The photograph showing the man breaking a stone with a heavy hammer is of a stone cutter who has worked there since construction started in 1956. Beginning at 3 a.m., he works 8 hours for 53 cents a day. But he actually earns more because he also works overtime, getting a higher rate.

The 80-year-old lady often comes and sits to watch construction. Her 35-year-old daughter has a job there.

Cement is in short supply in the country. But the Indians are ingeniously using "surki," burnt clay crushed into powder, to supplement cement.

The viewer might readily agree that the spectacle at Nagarjunasager is dramatic. It is attracting 35,000 tourist a month. Many of the tourists visit the museum that has been built to house Buddhist relics uncovered in the area of the dam—preserving the heritage of a proud Nation. Nagarjunasager is expected to be completed within the next 5 years. # # #

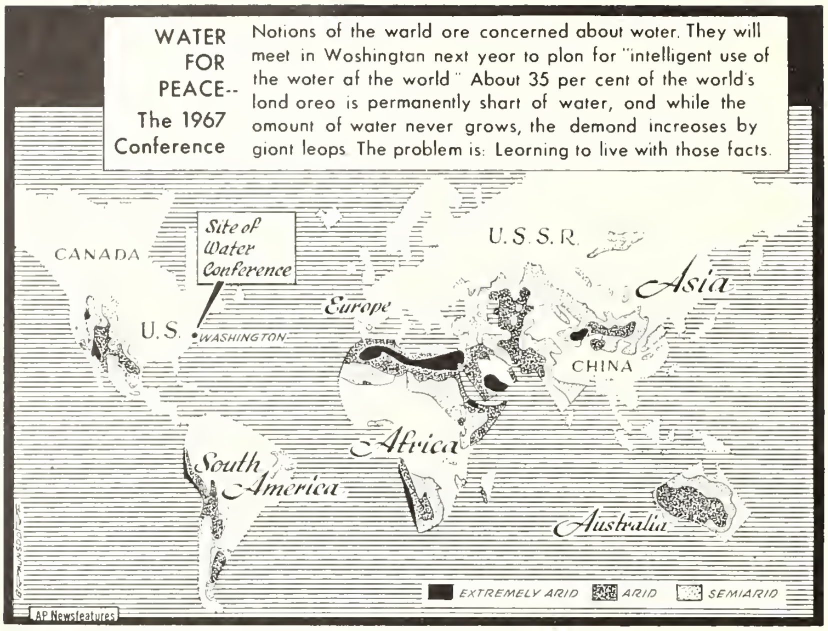


The dam is named after Acharya Nagarjuna, a great Buddhist who started a university in the second or third century A.D.

This 80-year-old lady of the Lambada Tribe admires the construction activities at the dam.

Workers carrying stone, cement, and sand move up bamboo ramps which zigzag to the top of the dam.

Photos by A. I. D.



World Water Map is reproduced through the courtesy of the—*Associated Press.*

World Water Problems for INTERNATIONAL CONFERENCE

by HARLAN WOOD,
Conference Director of Information

THE publications program on world water supply problems for the International Conference on *Water for Peace* is well underway. It is apparent that members of the Bureau of Reclamation will be making important contributions to the success of the historic conference which will be held in Washington, D.C., from May 23 to 31.

Approximately 125 papers will be given orally and 375 additional papers are to be distributed at the conference.

Reclamation Commissioner Floyd E. Dominy has submitted the abstract of a paper which will relate to the world water supply situation. Several other abstracts of papers have been received from veteran Reclamation employees of the Washington, D.C., office including:

Assistant Commissioner N. B. Bennett, Jr.

Assistant Commissioner G. G. Stamm

Maurice N. Langley, Chief, Division of Irrigation and Land Use

Val G. Killin, Chief, Division of Foreign Activities

Daniel V. McCarthy, Chief, Division of Project Development

William H. Keating, Chief, Division of Power

Important abstracts also have been prepared by employees of the regional and field offices of the Bureau including, for example, Chief Engineer B. P. Bellport and Emil V. Lindseth, General Physical Scientists, both of Denver, Colo.

Wide Support

Since announcement of the conference by President Johnson on September 6, 1966, over a score of national associations with water interests have endorsed the conference. Industrial and academic support has been strong. Governors from Massachusetts to California have indicated their support and have named representatives from their States.

Overseas, response to conference planning has been equally as good. Some 33 nations have formed national committees to screen the contributions of their countries to the program content. For example, Great Britain has indicated it may present 45 papers for consideration by conference executives. Even the smaller nations, such as Jamaica, have indicated they would like to have a place on the program.

In the many letters received from throughout the world, one student organization interested in water resource development summed up world response by stating:

"Our initial interest in Water for Peace has been heightened by its organizers' apparent determination to elevate (the conference) from a scholarly meeting of scientists and technical experts to a conceivably more effective gathering of both technical and political executives." # # #

Getting a Bit More Beauty

by **JOYCE HOFF, Sacramento, Calif.**

A BIT more beautification has been woven into the West. From nature's "basket of ideas," the Bureau of Reclamation has been able to weave a pleasing new look around many water resource developments—from enhancing the look of a surge tank above a large underground water pipe, to replanting forests.

The accent on natural beauty efforts at Reclamation structures was stepped up as a result of the White House Conference on Natural Beauty in May 1965.

Projects of beautification got underway then in the Reclamation region of central and northern California and Nevada and parts of southern Oregon. From its headquarters in Sacramento, Calif., the Bureau's region has worked on its own projects and completed others in cooperation with local, State and other Federal groups.

One project was to change the color of the surge tank in the bluffs above Redding, Calif. It had a primer coat of red lead, but it has been painted three shades of blue—blending into the sky and giving a more pleasing view to the residents.

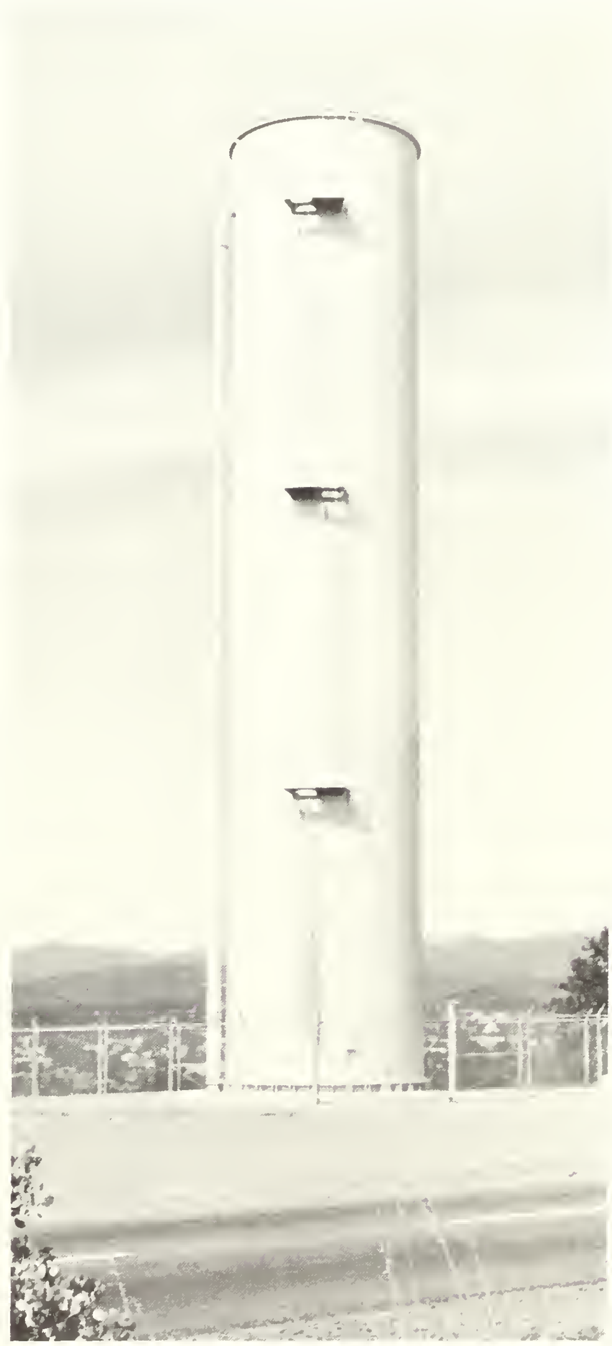
Also in the Redding area, over 96,000 ponderosa and sugar-pine seedlings were planted on some 150 acres of the burnt area by an 80-man crew from the Bureau's Lewiston Job Corps Conservation Center.

Other parts of Region 2 also are benefiting from the new emphasis on appearance.

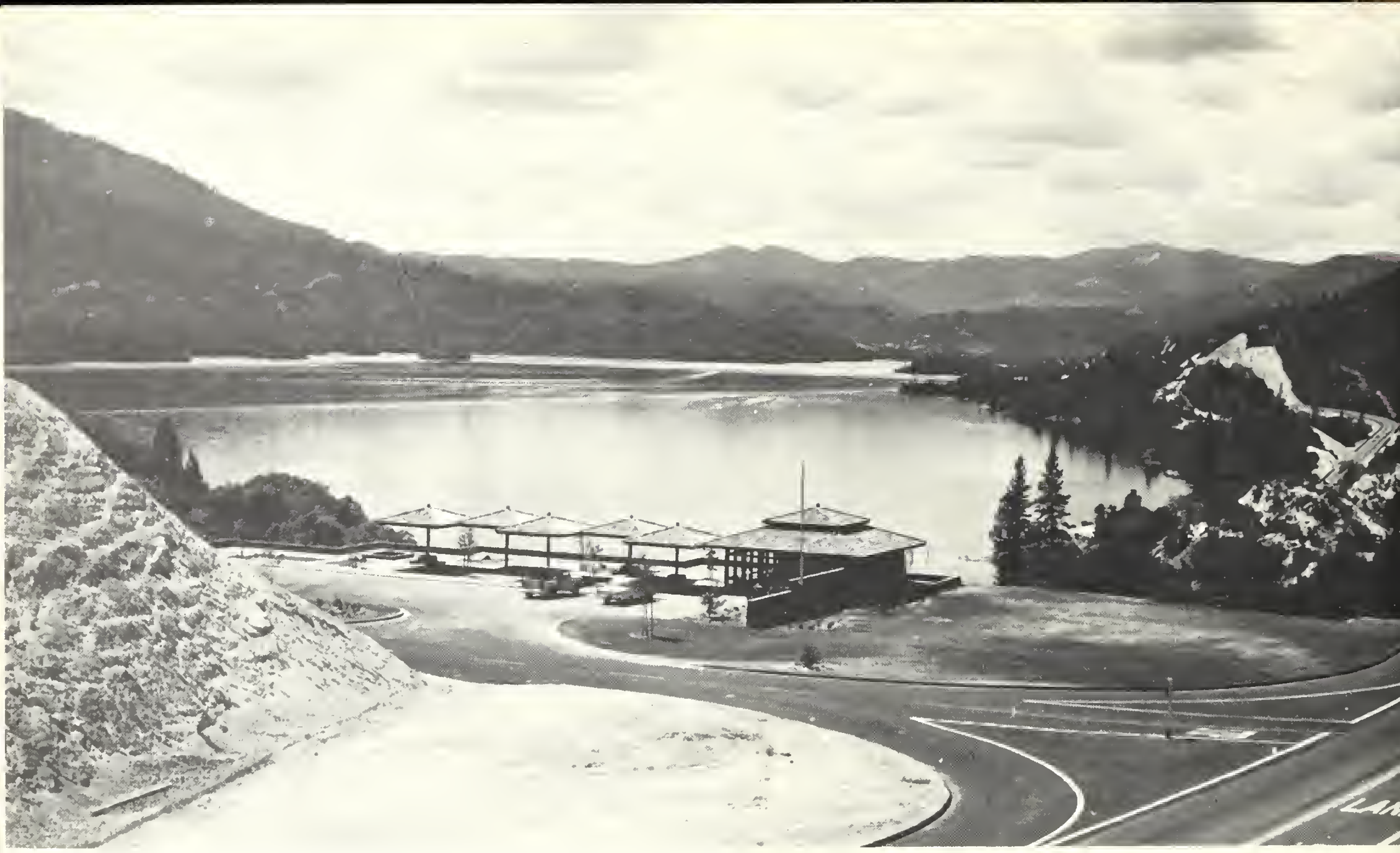
Landscape architect George B. Medlicott has been developing the region's beautification program. Natural beauty coordinators have been appointed in each field division.

Grassed Area

In the Granite Bay area, east of Sacramento, recreationists prefer the newly grassed area. Millions now flock to this area each year. With picnickers now dotting the lawn so much of the time on sunny days, maintenance men have found it difficult to schedule a mowing time, and sprinkling has to be done at night after the recreation area is closed.



This is how a large water tank painted three shades of blue looks against the sky.



A well-designed visitor overlook at Whiskeytown Lake, built with the cooperation of the Bureau of Reclamation and the National Park Service, adds to the beauty of the area.

Not nearly as many people go to the adjacent dirt areas.

Something pleasant also greets visitors at the entrance to the office at Folsom Dam. On the dam's right abutment, a giant replica of the Department of the Interior's buffalo emblem has been artistically inlaid at ground level. Surrounded by a low retaining wall, the 16-foot buffalo is of brown lava stone against a white background. Beside the emblem, white stone letters 12-feet high spell "Folsom Dam" on a background of attractive red stone.

John Paavola, a utility man at the Folsom Field Division, constructed a rock wall near the road leading to the top of the dam. To further improve the setting, junipers and ground cover were planted behind the wall.

Considerable other landscaping is underway at various offices, dams, powerplants, visitor centers, and Job Corps centers.

And for the future, plans are underway to plant shrubs and trees along riding, hiking and bicycling trails which will parallel Folsom South Canal, soon to go under construction.

Eyesore Vanished

In Nevada, local groups who live near Lahontan Dam and Reservoir recently caused an unsightly dump to vanish. The old unpleasant smelling dumping grounds were not only near a reservoir beach area but they also were visible from U.S. Highway 50. After selecting an unobstrusive sight for dumping, the old dump heap was bulldozed into a trench and the sight restored to its natural beauty.

In another drive to clean up trash, Job Corps men from the Toyon Conservation Center in California volunteered two Saturdays last summer to cleanup along 10 miles of State highway.

An agreement between Reclamation and the Forest Service has been worked out for FS to plant grass and low-growing shrubs and bushes on the right-of-way that has been cleared for constructing a section of transmission line of the Pacific Northwest-Pacific Southwest Intertie. This beautification effort also will control erosion of the soil and provide natural food for wildlife.

The Tracy Field Division office has cooperated with many residents adjacent to the huge Contra

Costa Canal by allowing the planting of flowers, shrubs and trees along Bureau right-of-way where the improvements will beautify the area and yet will not interfere with operation and maintenance of the canal.

Trees also have been planted at intersections where highways cross the large canals. Livermore Sea Scouts, assisted by employees of the Tracy Field Division planted trees and shrubs on the right-of-way at the Tracy fish collecting facilities.

A desirable appearance can sometimes be achieved by using properties which also perform a service. This was the case at Prosser Creek Dam, Nevada, when native boulders were hauled in to form an attractive traffic barrier at the dam's vista point.

In the meantime, the visitor rest at Friant Dam has been "spruced up" and others in the region carefully checked. The walls atop Monticello Dam have needed painting—sometimes as often as once a day—when they are defaced by vandals.

The outdoors is not the only place that housekeeping has been underway. The Shasta Visitor Center—which received about 354,000 visitors in 1965—recently was remodeled and its visual and display of the operation of Central Valley project of water resource development was updated.

A Scenic Lake

Some beautification projects require longrange planning and special designing. One such prospect is the scenic Upper Klamath Lake in Oregon. Recreational use could be significantly increased at this lake if there could be removal of the heavy algae growth which has colored the water and created an unpleasant odor. The Bureau's search for a solution to the pollution problem is in cooperation with the Federal Water Pollution Control Administration.

To avoid disturbing the amenities of a recreational area in Nevada, changes are being proposed for the location of two powerlines so they will be separated from the recreation area by natural screening. These transmission powerlines pass in the vicinity of Reclamation's Stampede Dam, now in early stages of construction on the California side of the border.

In a contract witht the Nevada State Park System, plans for enhancement of a recreational area are underway for the Rye Patch and Lahonton Reservoir areas.

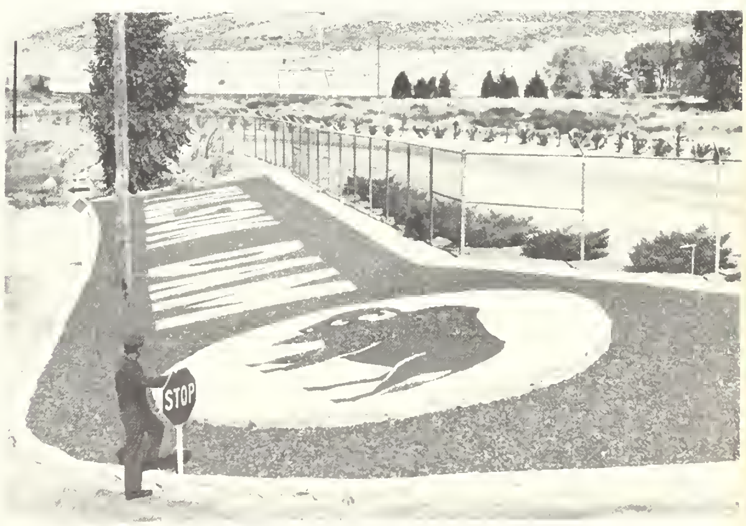
After a forest fire swept the Hayfork area, over 96,000 ponderosa and sugar pine seedlings were planted by Job Corpsmen of the Lewiston Center near Redding, Calif.

The Bureau is negotiating with the Bella Vista Water District in northern California for development of about 5 acres of land into a park around the Wintu pumping plant. The plant is on the bank of the Sacramento River near Redding.

Some progress has been made to transfer approximately 300 acres of land near the Bureau's Red Bluff division dam to the California Division of Beaches and Parks for development with park and recreational facilities.

The Bureau of Reclamation is not only concerned with the conservation and wise use of our water supplies, but also with doing something about preserving our irreplaceable heritage of natural beauty around vital water developments.

\# # #



Secretary Udall Notes "VISION AND PROPHECY" of a Great Conservationist

ALTHOUGH significant forward steps in water resources development are noted from time to time, occasionally one giant step can be viewed, in retrospect, as being eminently noteworthy and almost overlooked in the historical development of a large part of our Nation—the arid and semiarid West.

A recent speech by Secretary Udal recalled one such landmark action which should prove most interesting to those Americans now awakened to the conservation of our water resources.

We include excerpts from the Secretary's speech at the Symposium on Arid and Semiarid Lands, at the Texas Technological College, Lubbock, Tex., October 31, 1966:

Speaking in general terms, approximately 700,000 square miles, or one-fourth of the entire United States of America, could be classified as arid or semiarid. A large part of west Texas falls within these two categories.

In the light of this arid national fraction and our soaring population, it becomes apparent that increasing production of these lands is one of the urgent conservation tasks of our times.

The Department of the Interior today is variously dubbed the Department of Natural Resources or the Department of Conservation. But not so long ago, and with good cause at the time, it was known parenthetically as the Department of the West.

As the Secretary of this Department, I can hardly address a symposium on arid and semiarid lands without referring to John Wesley Powell—a great American scientist whose vision and prophecy left him with only shreads of honor in his own lifetime.

His "Report on the Arid Region of the United States," submitted to then Secretary of the Interior Carl Schurz, April 3, 1878, was described by the late Bernard DeVoto as one of the most remarkable ever written by an American—"A book which of itself opened a new era in national thinking."

For 11 years, Major Powell had studied the ecology of the plains and the high plateaus. He had crossed the plains to the Rocky Mountains and the Great Basin beyond nearly 30 times; he had studied the cycles of rivers and rainfall, the village life of the Mormons and the Indians, and he had learned the essentials of order in the West.

Major Powell had a faculty for grasping the obvious and stating it without embarrassment. Water was the critical resource in the region. What was needed in settling this country was a whole new approach. There was not enough water to go around, but what there was should be shared equitably.

The irrigable lands formed only a small percentage of the area, and the best opportunity for irrigation was in development of the large streams. This would require cooperative labor or capital. His idea was that in the irrigable valleys, nine or

Secretary Stewart L. Udall

more settlers could join to form irrigation districts and apply to the Federal Government for a survey.

He believed also that the survey should proceed not only by the traditional rectangular system but according to watersheds and drainage basins. Water access was absolutely essential, so the plots should be shaped by the terrain.

The land itself, without water had little value, so new water rights and new forms of cooperation would be needed. Reservoir sites should be selected early and reserved so there would be no problem later in increasing irrigation by the storage of water.

He foresaw that the whole region would come to grief unless land policies and political and social institutions were shaped in accordance with its peculiarities, and the Homestead Act would have to be revised. For in the high country of the West, 160 acres was either too much or too little—too much for the irrigation farmer who at that time could not cope with more than 80 acres, but far too little for a cattle ranch.

The pasture lands, which formed the largest part of the arid regions, were a special problem. Overgrazing had already damaged millions of acres of public rangeland, and even here in Texas, where nearly all lands were privately owned, grassland displacement and erosion were severe.

Proposed They Organize

Powell proposed that the settlers organize themselves into pasturage districts, and that Government surveys carve out livestock ranges covering four whole sections and a water right. Ranch residences, he said, should be grouped to secure the benefits of local social organizations, and the range should be a jointly managed common pasture.

In dealing with the timberlands which constituted 20 to 25 percent of the arid region, he observed that the area of standing timber was much less than the extent of the timber region because the forests had been partially destroyed by fire.

The timber regions were not suitable for either farming or pasturage, but in order to preserve them, they had to be protected from fire. Because it was believed that the Indians had set the fires in order to drive out game, the way to preserve the forests was to find more suitable places for the Indians.

The report in that day was political dynamite—it spoke of deficiencies when everyone believed in inexhaustable natural resources—and it was coldly received by his contemporaries.

It was dusted off a decade or so later when the droughts of the eighties had their disastrous effect. In 1888 Congress passed legislation and Powell was put in charge of an irrigation survey.

He thought it might take 6 or 7 years and $6 or $7 million to get the necessary facts as a basis to lay out reservoir sites and canal lines for a sound program. Time and impatient politicians conspired against him, and the irrigation survey was discontinued 2 years later.

But ultimately his ideas were to be vindicated. And a few months before he died in 1902, legislation was passed establishing the Reclamation Service.

In the decades that followed we have seen the harnessing of all the major streams of the west with multipurpose dams and the extension of irrigation to vast areas of desert and semidesert country.

Reclamation has not only altered the economy of the West, it has had a pronounced effect on the food supply of the rest of the country. # # #

Era Reader Gets 90 Percent Seal Of Water Leaks

Dear Editor:

In your February 1966 publication of *Reclamation Era*, we were particularly interested in the article, "The Miracle Leak Sealer," describing the experience of Mr. H. V. Eastman of the Chowchilla Water District in California with NH_3.

After reading of Mr. Eastman's success with the "miracle sealer," I had our construction and maintenance department run a test on a pipeline that was leaking considerably. Three days after the completion of the test, the leaks and seepage spots were observed and they appeared to be 90% sealed, and much more economically than by the process of sealing by hand.

We bring our experiment to your attention to let you know that we enjoy your publication and have benefited by the research of those contributing to your publication.

Very truly yours,
H. Shipley
Assistant General Manager
Salt River Project
Phoenix, Ariz.

Regulation

A PLUS AT SENATOR WASH DAM

by T. H. MOSER, Project Manager at Yuma, Arizona

HERE'S a dam which never will dam the source of its water. Yet when it starts continuous operation, it will save enough Colorado River water in a year to supply a city the size of Washington, D.C.—170,000 acre-feet.

This is Senator Wash Dam, recently completed. With its unique, regulating-type reservoir having a usable capacity of 12,250 acre-feet, the amount of water it saves in 12 months will be more than 14 times that figure. That's what Regulation can do in the field of water reclamation.

Although it regulates the water in the main stem of the Colorado River, Senator Wash Dam is actually located on a side wash or channel about 20 miles upriver from Yuma, Ariz. To accomplish its unique purpose—multiservice *regulation*—water is pumped into Senator Wash Reservoir when the river contains an excess flow. Later, it is released back to the river when it can be fully utilized for irrigation.

This regulation will conserve irregular flows of the river which result from unscheduled changes in irrigation diversions upstream, from storm inflows, or from vagaries of the river channel.

Another need for regulation is because of irrigation variations in the areas served by Imperial Dam which is immediately downstream. Weather, or other changes that affect the river can originate any place in the 145,000-acre irrigated area in Arizona, or the irrigated 550,000-acre area in southern California including the Imperial and Coachella Valleys.

Flows Were Excess

In the past—since Imperial diversion dam has almost no storage capacity—most of the unused flows from that dam have passed down the river to Mexico in excess of scheduled deliveries as agreed in a 1944 treaty. Previously this overage was lost for any use in the United States, but much of it can now be salvaged by storing it in Senator Wash Reservoir until needed.

The dual-purpose pumping units which push Colorado River water into the reservoir are reversible and serve another operation, that of turning hydroelectric generators during the release of water back to the river. In this way, water returning to the river generates salable power and recovers some of the pumping costs.

Power for the pumping operation is obtained from the upstream Parker-Davis power generation and the power generated from the new dam's return flows—having a 7,200-kilowatt capacity—goes back into the power system where it is available for a growing power market.

Aerial view of Senator Wash Dam and Reservoir (center). Squaw Lake Dike and the dual-purpose Pump-Generating Plant are at left.

How It Operates

The power equipment at Senator Wash ties into the Parker-Davis system by an 18-mile, 69 kilovolt transmission line. But when pumping, the six new 48-inch turbines will be able to pump more than 900 cubic feet per second against a full reservoir head and will release more than 1,000 cubic feet per second. Normally, however, not over five units are operated at one time, with the sixth serving as a spare. This extra unit allows for maintenance to be performed without having to curtail service.

This two-purpose plant is operated by remote control from Imperial Dam where the Bureau already has an operator on duty around the clock. With irrigation in this Arizona-California area carried on for 12 months a year and with year-round deliveries to Mexico, operations at Imperial and Senator Wash Dams will be continuous.

Investigations for a pump-storage and water salvage project in the lower Colorado River area were initiated in 1962 and its feasibility soon became apparent.

Named After Mine

The name "Senator Wash" is derived from the abandoned "Senator Gold Mine," located near the wash. Built as a feature of the Bureau's Colorado

Enjoyable activities on Labor Day 1966 at Senator Wash Reservoir.

River Front Work and Levee System, the Senator Wash facilities include a 2,340-foot-long earthfill dam across the main wash and a concrete overflow spillway. The prime contractor was M. M. Sundt Construction Co. of Tucson, Ariz.

To impound water in the reservoir, low swales are blocked by two dikes, the largest of which is Squaw Lake Dike. Constructed into this structure is a 10-foot-diameter outlet pipe which carries water to and from the river by way of the pump-generator plant.

During construction considerable local interest was displayed because the dam would transform a desolate, normally dry wash into a sizable clear blue body of water.

Even though the adjacent Colorado River always has flowing water, boating is treacherous because of sandbars, snags, and meanders. However, the 300 to 470 acres covered by the fetching Senator Wash Reservoir would cause large areas of open water.

Before construction was completed in 1966, the reservoir began its role of salvaging water. Heavy rains in the watershed during November and December 1965, produced enough runoff to start impoundment.

During January 1966, the contractor started pumping water into the reservoir to test the installation of the pumping-generating equipment. In August the reservoir was completely filled for the first time. However, normal operation of the plant has been temporarily interrupted, because it became necessary to correct a manufacturing defect that showed up in the turbines after their initial successful testing.

Proved Itself

Even though it has operated only a short time, the structure began proving itself. As a means of conserving water, for example—during the first 5 months of operation from April through August 1966—the excess deliveries to Mexico were only 4,000 acre-feet as compared with the typical 92,000 acre-feet for the same months of 1961 and 76,000 acre-feet for 1962. A large part of the recent reduction of the over deliveries is because of the new facility.

In addition the reservoir has already become popular for all types of water-oriented sports, as well as camping, picnicking, and sightseeing. The paved access road built as a part of the project, has opened up a section of the river that was previously only accessible by boat, thus increasing the recreation potential too.

To provide for boating safety and accessibility to the reservoir, a concrete boat ramp to allow future launchings at any water level was constructed before the water got too high. Besides speedboating and water skiing, sailboating is becoming more and more popular on the reservoir, largely because of the water's depth and stillness.

Swimming, both in Senator Wash Reservoir and the adjacent Squaw Lake arm of Imperial Reservoir, has become most popular on the basis of total amount of participation. To provide greater swimming safety, the best adapted areas in each of the reservoirs have been designated exclusively for swimming and have been enclosed by buoy lines. Funds have not been allocated for the construction of beaches, however, the natural beaches at each location have proved adequate for present use.

Has Fish Anyway

Fishing was not considered to be very practicable in the planning of the project because large fluctuating water levels are necessary in the operation. In spite of the fact that the waters have not been stocked, fishing for bass and other game fish has become quite popular.

Surprisingly, fish from the river have passed through the turbine pumps with no apparent harm and are becoming established in the reservoir.

Each form of recreation has potential for increasing. During some weekends last summer, the daily use exceeded 3,000 persons and this was before construction of the recreational facilities. Such accommodations are designated for near future development by a local agency.

Reclamation has only limited authority and funds to construct recreational facilities. The Federal agency will, however, supply drinking water, as well as other basic facilities for the health and safety of the public.

Beautification has not been overlooked. Landscaping, indigenous to the Southwest, has been supplied where needed to enhance the natural beauty of the area. Care has been exercised in color-blending painted surfaces.

In addition to indirect benefits, Senator Wash Dam and Regulating Reservoir prove to be performing their function. They are excellent examples of water conservation by *regulation*, with important bonus benefits on the side. # # #

This printer, being checked by Francis Swain of Reclamation's Denver office, produces the computer's calculations at 1,000 lines a minute.

Photos by F. B. Slote

Fast Working Partner Hastens "*NEW ERA*" for Reclamation

DRILLS, dredges and dynamite may be standard tools of reclamation progress, but there's a more modern instrument—an electronic voice—which must be heard long before the tools do their work.

It's the computer—an imposing symbol of modern technology which is helping to spawn a "new generation" in water resources development.

With help from this versatile and tireless new ally, Bureau of Reclamation is seeking to make each gallon of water do the work of two or three in serving municipal and irrigation needs and in generating power.

Reclamation began its computer program a decade ago. Today, it is one of the leaders in computer applications to engineering, economic, and administrative problems. In that brief span, too, Reclamation specialists have come to regard the computer as an essential tool in water resources development, rather than merely sophisticated collection of wires, condensors and tubes whose function is to compute at dizzying speeds.

This instrument is hastening by years the completion of Reclamation projects which will make water available that much sooner. It is producing savings in terms of man-years and dollars that now can be invested in planning still other vital water projects. And it is permitting the instant recall of highly technical knowledge required in planning.

In one recent example, the computer accomplished in 50 minutes that which would have required 50 man-years of manual effort to reduce and analyze. It involved 5 million calculations from 15,000 meter readings taken from within a concrete dam.

On another occasion, the task of performing analyses of concrete arch dams was automated to the extent that about 3 man-years of manual labor may now be accomplished in 10 minutes of computer processing time.

And from information on daily releases of water from Parker Dam, the computer predicts the hourly flows of the Colorado River at Imperial Dam, 148 miles downstream. These predictions are critical to the use of the Colorado River in

Shown at work in the computer center are, from left, John R. Heinz, Mrs. Margaret Veatch, and Ralph Johnson.

meeting the U.S. treaty obligation of riverflows to Mexico.

Command Post in Denver

The command post for these and other computer operations is the Division of Data Processing at the Office of Chief Engineer in Denver, Colo.

Here, Division Chief Francis E. Swain and his staff devise programs and direct the operation of a digital computer system which operates virtually on a round-the-clock, 7-day-a-week basis, so great are the demands for its services.

The system installed in 1965, is rated at a capacity of about 40,000 additions per second. Newer, more complex models are capable of performing operations in terms of nanoseconds—billionths of a second.

The system actually employs two computers, one behind the other and one with a greater capability than the other. Like a football teammate running interference for the ballcarrier, the less sophisticated to the two computers performs much of the preliminary work. Information on punchcards is first submitted to one computer. It records the data on reels of magnetic tape. With all essential elements of the problem thus recorded, the tape then is played to the bigger computer in its own "language." This instrument digests the information, then prints the solution on a high-speed printer at the rate of about 1,000 items per minute.

One of the more impressive accomplishments of the computer system was the design of much of a 123-mile long canal that is part of the $610 million San Luis unit in California.

The canal alone requires 57 million cubic yards of excavation. That's enough to form a trench 16.5 feet wide and 10 feet deep from Denver to Boston—biggest earth-moving job in the Bureau of Reclamation's history.

Throughout canal building times, the surveying and plotting of a waterway has been one of the most time-consuming chores. Survey crews must take readings to determine a variety of figures to make construction accurate. These survey figures must be converted to, for instance, about a million plots for part of the San Luis Canal.

Search for Short-Cut

With this monumental chore at hand, the Division of Data Processing set out to find a computer shortcut. Mr. Swain's crew and the construction staff on the San Luis Canal devised a computer program which furnished the required data.

Figures accumulated by the survey teams were sent to, Denver as they became available and the computer was put into action. For the construction effort, the computer provided a step-by-step guide. It also proved valuable in determining the pay earned by the contractor.

Program specialists feel assured that the San Luis computer success has made obsolete the old practice of graphing canal cross sections by hand—calculations for a mile of canal in a workday, done by the computer in less than a minute.

It is esimated that the computer program for the San Luis Canal alone saved 26.6 man-years of labor.

The instrument is in standard use for other Reclamation jobs. It controls water at key points to meet local irrigation needs, it prints monthly billings for power users, and it figures payrolls for some 20,000 Federal employees.

The principal goal of the pushbutton era in Reclamation, however, is to assure optimum deliveries of water to all Bureau water users. To accomplish this, the giant dams are still there in the West, and others will be built as needed. But a fast moving partner called instrumentation is hastening a "New Era" as well as more effective water conservation. # # #

A Dedication can be a "Hair Raising" Affair

There's little doubt that this is part of the "—Wind Section" of the Borger High School Band.

Photo by H. L. Personius

IT is doubtful that many dedications are considered "hair raising" affairs. But one could be, as seen by the raised coiffures of the band members in the photo on this page as they tunefully performed at the dedication of Sanford Dam and Lake Meredith in Texas.

The ceremonies for these water control structures is a milestone of considerable significance for Reclamation and the residents of the Texas Panhandle. About 1,200 people—in addition to the school band and others on the program—turned out on the windy but sunny day. Hopefully the wind won't be absent at a future time for some pleasant sailboating on Lake Meredith.

Secretary of the Interior Stewart L. Udall was featured speaker at the event held last November 1 at the Vista Point overlooking the scenic developments. Reclamation Commissioner Floyd E. Dominy was master of ceremonies.

"We all know," said Secretary Udall, "that many obstacles were overcome through the desire of you west Texans to invest in your future and the future of your children—a future that can encompass great prosperity as a result of this unity of purpose."

Pointing out a large savings in the cost of constructing these features of the Canadian River project, the Secretary continued:

"At the groundbreaking ceremonies (held about 4 years previously) I told you that the cost of this project would run somewhere in excess of $90 million. I am happy to state here at the dedication of these facilities that this figure has been cut by some $10 million."

Others For 1966

And now to continue with some dedications of other water development structures in 1966:

We don't recall that those attending faced a wind problem, but the Arizona sun was rather warm the day Mrs. Lyndon B. Johnson dedicated Glen Caynon Dam, as noted in the November 1966 issue of the *Reclamation Era*.

That impressive ceremony on September 22 marked the second such dedication of a Reclamation dam by the First Lady of the United States. She dedicated Flaming Gorge Dam on the Green River in northern Utah on August 17, 1963.

We only have the two weather related events, but residents of three other localities might recall dedications of Reclamation structures:

On April 9, the Judge Francis Carr Powerplant near Whiskeytown Dam in California was dedicated. Commissioner Dominy gave a speech at the ceremonies honoring the late Judge Carr. The powerhouse formerly known as Clear Creek Powerplant and an adjacent memorial park and fountain overlooking Whiskeytown Lake also were named after the prominent water lawyer.

Also in California, Commissioner Dominy was a speaker at the dedication and naming of Lake Woolomes, which was formerly Delano Regulating Reservoir near the city of Delano. This was July 9.

Agate Dam on the Rogue River Basin project near Medford, Oreg., was completed approximately 9 months ahead of schedule and dedicated on May 6. Assistant Reclamation Commissioner G. G. Stamm gave the dedicatory speech.

Near the town of Sulphur, Okla., a dedication was held for the Arbuckle Job Corps Conservation Center as noted in an article about that Center elsewhere in this issue of the *Reclamation Era*.

—GJF

Job Corps at Friendly Sulphur, Okla.

WORLD OF WORK AND TRAINING AT ARBUCKLE

by L. R. ANDERSON, Administrative Officer of Arbuckle Center

WE understood that the Job Corps program was being questioned in some quarters. It has not been questioned here.

Extensive progress was expected at the Arbuckle Job Corps Conservation Center. And that's the kind of progress we have had.

Since its activation November 17, 1965, this center near the town of Sulphur, Okla., has seen amazing beneficial developments. Arbuckle's Job Corps enrollees have advanced their education, learned useful skills, adapted themselves to social discipline, and gained friends and respect in the community.

Young men come to the Job Corps wanting a live program. Apathy and procrastination—so much a part of the background of culturally deprived individuals—are objectives of replacement at the Arbuckle Center. The starting point is that corpsmen are different from other young dropouts in that these are asking for help with their education.

As the young men needed help, so did the site that would become the Arbuckle Center. It had to be started "from scratch." Actually the physical location of the center has been built up like the character of its future inhabitants would be built up, starting as a wide-open pasture with a good deal of potential, then blossoming into an effective force.

Development of the physical facilities came first. The full staff of leaders and trainers arrived on board in time to receive training of their own then to double as carpenters, truck drivers, and labor-

Roger Steinback of Iowa and William R. Norman of Indiana, removed, completely overhauled, then reinstalled back in the car, this engine donated by Center Director E. C. Rodriquez.

In the woods—clearing out underbrush where picnic facilities will later be installed.

ers to locate and block up our trailers; haul furniture, set up dormitories, classrooms, and offices; get the kitchen in operation; and to perform the seemingly endless tasks that had to be done in the few days between completion of our buildings and the arrival of corpsmen.

Getting Ready

There was a great deal of apprehension, in spite of a general feeling of being "ready," but this quieted after getting to know the corpsmen.

The friendly town of Sulphur, with about 6,000 population, is surrounded by fine ranching country and scenic recreational areas. It is a stable, progressive community and the citizens have earned due credit for the success of this center.

They wanted Job Corps and have responded by receiving the youths into the community, into the churches, and into their homes. Several of the present businessmen and other outstanding citizens remained in Sulphur following their training at a nearby Civilian Conservation Corps camp of some years ago. Therefore, the opportunities and problems of our program are regarded with hope and with tolerance. A group of community leaders have joined with members of the Job Corps staff in forming a Community Relations Council. They expected no serious incidents or bad behavior from the corpsmen, and to date there has been none.

The townspeople's friendship has fostered a reciprocal desire to contribute to the town in the form of community projects performed by the corpsmen. Such projects include regularly picking up trash along 2 miles of city streets, removing one-half mile of old fence around the municipal airport, cleaning the fence row, mowing the 50-acre area around the airport on three occasions, and helping the city clean up and repair the municipal golf course.

Although enrollees have as many different personalities and problems as there are corpsmen, most of them have common traits that stand out:

- He is asking for a "first chance" or a "last chance", as the case may be.
- He is aware that he needs training.
- Having always known insecurity, he is seeking security. This is evident by the strong attachments formed to the staff members.

Mud Everywhere

The first corpsmen moved into a building just assembled. The ground was torn up from the construction stage, and with winter rains beginning, there was the problem of mud—everywhere. All hands were busy in the ensuing months, with the corpsmen determined to make the center a "show place" by spring, and we are proud of the results. It was dedicated April 23, 1966.

All of the buildings have been underpinned, requiring carpentry work with 6,300 square feet of lumber; 9 breezeways have been constructed at building entrances for protection against weather and screened to keep out insects; an attractive rock flower garden was built around the flagpole; 125 crepe myrtle shrubs were planted along the entrance driveway.

Also twenty-five 8- to 14-foot sycamore trees were moved from their creek bottom home and now line our streets; 100 flowering bushes and 1,000 feet of hedge were planted to beautify the sidewalks and line the buildings; and 600 feet of solid board fence were put up to separate staff living quarters from the center proper.

Our carpentry shop turns out benches, shelves, bulletin boards, and many other needed items.

The most advanced on-the-job training areas to date are in carpentry, welding, custodial maintenance, landscaping, heavy equipment operation, and truck driving. However, we plan to begin an automotive mechanics course soon and set up shop facilities for training and at the same time accomplishing all maintenance on all our vehicles.

Work Program

Much of the work program so far has been in Platt National Park, 2 miles south of the center and in the center itself. The park was largely developed 30 years ago by the Civilian Conservation Corps and this fine work, which remains in good condition today, is a source of inspiration to the corpsmen to also build well.

Accomplishment in the park was considerable. About 600 picnic tables and benches were assembled, 10,000 trees were planted in open areas throughout the park, 6,600 feet of vitreous clay sewerline and necessary structures were installed, 5 miles of road were cleared and gravel paved to open up new public places, and 373 steel fireplace boxes were built.

For an area adjoining Arbuckle Reservoir, the corpsmen have completed work on 200 steel racks for trash cans and other recreational projects.

Meanwhile, there is no small amount of excitement about the use of three additions to the center itself. They include a new gymnasium, a vocational-education building, and a welding shop.

Our student cook's program merits special mention. Twelve students are enrolled for this vocational training, working six to a team, on alternate weeks. Probably more than is true in any other area, we can graduate a trained cook capable of going right into a well-paying job in only 6 to 10 months in Job Corps. We have a student cook at present who would be a very welcome member to our own staff.

Main Emphasis

Of course, the main emphasis in Job Corps is toward education and accomplishment. Conservation is our training ground where knowledge gained is put to work. Many corpsmen come to us highly motivated to do something they have never done before—that is to read and write, and the Job Corps curriculum is divided into levels, or grades, for each individual's needs.

One corpsman recently stated, "I have learned to read at Arbuckle, mostly at the Thursday evening classes, and because the ladies from town are such good teachers.". Actually, his conviction probably derives in part from the friendliness and patience of the ladies concerned; but this lad came to the center, a nonreader, and he *is* learning rapidly.

Reading enrichment activities consist also of evening library hours and afternoon trips to the Sulphur Library. According to "Scholastic Scope," a high school student magazine, a million students quit school each year because of problems with reading. This is one of our major problems today.

We have had good success in our math program, which includes 13 steps. A corpsman advances to the next step when he completes the one he is on, and it is felt that the absence of the need to compete, or to stay up with a class, sets the stage for receptive thinking.

In the first few months, 24 corpsmen have completed the curriculum in math, and only 2 corpsmen have failed to advance. Five different corpsmen assistants have certainly helped with other corpsmen, attaining their respect as proficient tutors. Overall, it has been discovered that these boys wanting help do not question the source.

Education Profitable

Although the classrooms are not the most popular part of Job Corps life, the corpsmen know that education is one of the most profitable parts and attendance in school has not required any special effort by the staff.

An equally important part of the educational program is entitled "World of Work." This is where the corpsmen learn about various occupations, salaries, educational requirements, areas of highest demand, potentials of automation, and other vocational factors. He is assisted in making his own assessments and plans. This is also programed classwork with typing and driver's education among the subjects taught.

Some corpsmen have assisted staff members in typing chores, and 21 corpsmen have passed the State of Oklahoma driver's examination. The latter have been issued Government-driver licenses, and are used as drivers in the operation of this center.

Such important topics as job interviews and filling out job application forms are, of course, covered regularly. The corpsman wants understanding of measures of success, and, consequently, wishes to discuss "meat and potatoes" facts. Is he employable? How employable?

Entertainment from Sulphur

The small town of Sulphur has been successful in helping to fill entertainment needs. The program fills most of the off-duty time. Between activities at the center and trips to adjacent points of interest, most corpsmen find little time to be bored. This area of Oklahoma is excellent for outdoor recreation such as fishing, and water sports and organized athletics such as baseball, football, basketball. A golf driving range is operated at the center, and other hobbies help fill a corpsman's leisure time. The young men have been amazed by their own acomplishments in leathercraft, painting, copper tooling, and other art work. They prize the articles they complete, some of which are intended as gifts that can be sent home.

Even though we see progress, there is probably no staff member who feels that he "has all the answers." Job Corps is a living-and-learning situation. Corpsmen must accept a new standard of living. And although we might feel that better food, clothing, health care and sanitation are bound to make him a contented youth, the fact remains that this new way of life is not a selling point.

Many youths are just plain homesick. With others, there was a certain amount of comfort in their poverty—namely nothing much was expected of them. Comfort? Perhaps. The old way of life could appear very comfortable when, upon first arriving at the center, they fear the challenge of meeting the requirements of being a corpsman. Rules to follow, authority, order and regimentation might be quite terrifying at first view.

Other boys quickly show appreciation for this same order.

The staff then has a guideline that will meet acceptance of all the corpsmen. He must, by his conduct and fairness, sense of responsibility, and show of understanding—set a good example.

The change in most of the boys is not so gradual as to go unnoticed.

When one sees some of these youths become "regular guys," holding their own in the give and take of dormitory living, taking pride in their appearance, or the difference in the way they look you in the eye and talk to you, then you realize that they are gaining in self-esteem—the vitally important part of becoming a man.

If there can be smiles where there were tears; understanding where there was hate; confidence where there was fear; hope where there was despair; and knowledge where there was doubt—then a staff member's work is beyond measuring in dollars and cents or "projects completed."

For how much is a boy worth? Then, how much more a man? # # #

Demonstrating the skill of carving a roast is Dennis K. Grasmick of Colorado. The others, hardly able to wait for their serving, are Edward Woolever of Ohio, John G. Feltrop and Charles A. Kemp both of Missouri, and Malcolm Thompson of Texas.

Photo by Denman's Photography, Sulphur, Okla.

Recognition for Water Related Efforts

Reclamation Commissioner Floyd E. Dominy was presented *The Star of the Order of The Crown of Thailand* by Prime Minister Thanom Kittikachorn of the American Embassy in Bangkok while on his trip to review Reclamation activities in foreign countries last fall.

He was accompanied by Floyd C. Bonge, Perris, Calif., vice president of Eastern Municipal Water District.

The Thailand medal is the second official foreign recognition the Commissioner has received recently. It was made on September 30. Last June, he received *The Great Cross of the Order of Isabel the Catholic* from the Government of Spain, noted in the August 1966 issue of the *Reclamation Era.*

U.S. Ambassador to Thailand Graham A. Martin and other officials of the American Embassy and of Thailand's Royal Irrigation Department attended the award ceremony. Martin Tank, the Thailand Director of the Agency for International Development and Lyle W. Mabbott, Reclamation Project Engineer and team leader of the 35-man U.S. Reclamation team on the Pa Mong River Project in that country also were present.

The citation of the Thailand award commended Commissioner Dominy on the Reclamation service under his leadership as "most helpful in rendering technical assistance to various departments and organizations of the Government of Thailand in the fields of water resources and hydroelectric power development, particularly in irrigation and drainage."

As Chairman of the U.S. Delegation to the Economic Commission for Asia and the Far East, Commissioner Dominy represented the United States in the 7th Regional Water Resources Development Conference, in Canberra, Australia, September 19 to 26. He also presented a paper entitled: "The Development of Cost Allocation Methods." While in that country he conferred with the Snowy Mountains Hydro Electric Authority.

When he arrived in the Philippines, Mr. Dominy presented a completed report on the multiple-purpose Uper Pampanga River Project of that country to AID officials. The Bureau of Reclamation's investigation of the proposed project was launched in 1962.

Commissioner Dominy receiving the medal from Prime Minister Kittikachorn.

The report found the Upper Pampanga River Project in the central Luzon area both engineeringly feasible and economically justified.

The Commissioner also went to India and reviewed potential water developments in Punjab State.

Distinguished Service Awards

Still another award was presented to Commissioner Dominy in 1966. On November 10, he and 13 other employees or former employees of Reclamation were presented the Department of the Interior's highest award, the Distinguished Service Award for service in water resource development efforts.

The others are as follows:

Daniel V. McCarthy, Max H. Kight (retired), Carl J. Hoffman (retired), G. Vernon Becker (retired), Harvey C. Olander (retired), Wade H. Taylor, Archie M. Rankin, Wesley G. Holtz, Edwin H. Hopper (retired), Everett A. Pesonen (retired), William J. McCrystle, Byron L. Miller, and John T. Hicks (retired). # # #

Distinguished Service Awardees in photo on next page, from left are: Mr. Kight, Mr. Miller, Mr. Hoffman, Mr. McCrystle, Mr. Becker, Mr. Pesonen, Mr. Olander, Mr. Taylor, Mr. Hicks, Mr. McCarthy, Commissioner Dominy, Mr. Hooper, Mr. Rankin and Mr. Holtz.

U.S. GOVERNMENT PRINTING OFFICE: 1967 O—239-500

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6414	Missouri River Basin, N. Dak	Oct. 24	Three 20,000/26,667/33,333-kva autotransformers for Jamestown substation, stage 07.	Westinghouse Electric Corp., Denver, Colo.	$197, 150
DS-6440	Office of Saline Water, Calif	Oct. 26	Six pumping units for San Diego Saline Water test facility.	Mitsui & Co. (U.S.A.), Inc., San Francisco, Calif.	356, 770
DS-6443	Colorado River Storage, Colo	Oct. 6	Three 52,000-kva power transformers for Morrow Point powerplant.	Societa Nazionale delle Officine di Savigliano, Turin, Italy.	287, 432
DC-6447	Bostwick Park, Colo	Oct. 4	Construction of Silver Jack Dam	Johnson Brothers Highway and Heavy Constructors, Inc., and D. H. Blattner and Sons, Inc., Litchfield, Minn.	3, 539, 101
DC-6450	Missouri River Basin, N. Dak	Dec. 20	Construction of stage 07 additions to Jamestown substation.	Kinetic Engineering & Construction, Inc., and B & A Electric Co., Inc., Sacramento, Calif.	219, 220
DS-6452	Missouri River Basin, N. Dak	Nov. 4	Three 230-kv and two 115-kv power circuit breakers for Jamestown substation, stage 07.	Westinghouse Electric Corp., Denver, Colo.	232, 846
DC-6455	Washoe, Calif	Nov. 4	Construction of Stampede Dam and roads	Ray Kizer Construction Co. and R. A. Heintz Construction Co., Redding, Calif.	9, 220, 895
DC-6456	Baker, Oreg	Nov. 10	Construction of Lilley and Lilley relift pumping plants and appurtenant pipelines.	Galey Construction Co., Inc., Boise, Idaho.	483, 163
DS-6458	Pacific Northwest-Pacific Southwest Intertie, Ariz.	Oct. 26	Two control desk console and six enclosed switchboard assemblies for Liberty substation and one enclosed switchboard assembly for Liberty line at Mead substation.	Westinghouse Electric Corp., Denver, Colo.	103, 354
DC-6460	Navajo Indian Irrigation, N. Mex	Dec. 23	Construction of 2.2 miles of concrete pipe siphons and 2.7 miles of concrete-lined canal for Main canal, Schedule 1.	Universal Constructors, Inc., Albuquerque, N. Mex.	6, 730, 000
DS-6462	Colorado River Storage, Colo	Nov. 2	Three 230-kv power circuit breakers for Rifle substation.	Westinghouse Electric Corp., Denver, Colo.	178, 582
DS-6464	Fryingpan-Arkansas, Colo	Oct. 31	Two 3.5-foot by 4-foot tandem outlet gates and liners for outlet works at Ruedi Dam.	Steward Machine Co., Inc., Birmingham, Ala.	178, 412
DS-6473	Colorado River Storage, Ariz	Dec. 20	One 100,000-kva autotransformer for Glen Canyon switchyard.	Westinghouse Electric Corp., Denver, Colo.	148, 634
100C-892	Columbia Basin, Wash	Dec. 2	Construction of concrete lining and culvert repair for East Low canal.	Equipco, Inc. Ephrata, Wash	154, 537
200C-650	Central Valley, Calif	Oct. 18	Rehabilitation of nine timber bridges along Friant-Kern canal between mile 102.16 and mile 136.67.	Kaweah Construction Co., Visalia, Calif.	128, 997
300C-250	Colorado River Front Work and Levee System, Ariz.	Oct. 21	Construction of roads and bank protection structures A-4-P, A-5-P, A-6-P, A-7-P, A-8-P, A-9-P, C-4-P, C-5-P, and C-6-P, pilot channel, and 2.6 miles of access road to Agnes Wilson road bridge.	W. R. Whitlow, dba Whitlow Construction Co., Riverside, Calif.	289, 981
300C-253	Colorado River Front Work and Levee System, Ariz.	Dec. 1	Construction of inlet and outlet works and boat launching ramp for development of Oxbow area.	Philip H. Lewis, dba Airco Engineering Co., Yuma, Ariz.	139, 987
500C-238	Canadian River, Tex	Oct. 20	Construction of headquarters building for Canadian River Municipal Water Authority.	High Plains Building Co., Amarillo, Tex.	145, 994
604C-64	Missouri River Basin, Mont	Oct. 7	Furnishing and applying buried asphaltic membrane lining for reaches of East Bench canal, Schedule 1.	Lewis Construction Co., Great Falls, Mont.	129, 736
701C-646	Missouri River Basin, Kans	Oct. 19	Clearing 700 acres and buildings from 75 farmsteads for Waconda Lake area.	Melvin McGowan, dba McGowan Clearing and Sodding, Ottertail, Minn.	115, 914

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U.S. GOVERNMENT PRINTING OFFICE

In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. DEPARTMENT OF THE INTERIOR/BUREAU OF RECLAMATION

RECLAMATION
ERA
May 1967

1st INTERNATIONAL CONFERENCE on WATER FOR PEACE May 23-31

"we must come to grips with our water problems." See article by Vice Pres. Hubert Humphrey

May 1967 • Vol. 53, No. 2

RECLAMATION
ERA

Gordon J. Forsyth, Editor

Contents

COVER PHOTO. The giant white curtain of water which appropriately outlines the inset photograph of Vice President Humphrey on the cover is the rapid descent of water on the spillway of the 602-foot high Shasta Dam, Calif.

Commissioner's Page

A WORLD WATER CONFRONTATION

Of the 1.1 billion people living in the rural areas of the free world's developing Nations, nearly 800 million had no water service *at all in 1964, according to the Federal Committee on* Water for Peace. *Of the urban population, 140 million—an imposing 40 percent—also had* no water service.

In fact of the 1.5 billion people in those developing countries, only 170 million, or one person out of nine, had water piped to his habitation.

I am sure that such drastic water situations need the bold confrontation of everyone who is able, especially the world's top experts in water related fields, and all willing leaders.

This month's Water for Peace *conference—the first such international confrontation in history—brings such people together for a courageous first step. The key of a free world bringing about the solutions is well expressed by President Johnson: "Massive cooperation—International effort." We recommend a furtherance of this program for the consideration of active citizens everywhere.*

Those who attend the conference will be given a survey of the existing world problems, and they will be asked to go forward cooperatively with water developments large and small—developments which will feed the hungry and create economic betterments which will be powerful factors for peace.

It is with confidence in the Bureau of Reclamation's experience, both in the western parts of this country and abroad, that our experts will participate in this great conference and contribute in such water efforts as planning, economics, construction, conservation, research and training.

Floyd E. Dominy

FLOYD E. DOMINY
Reclamation Commissioner

"providing it clean and uncontaminated where and when men need it." This high view shows part of the water operation of Glen Canyon Dam, Arizona, on the Colorado River.
(Photo by Mel Davis)

Coming to Grips With Water for the 21st Century

by Honorable HUBERT H. HUMPHREY
Vice President of the United States

THE struggle to capture water and turn it to human use is as ancient as man himself. In our modern world, the effort is not only still necessary—it is even more urgent.

For growing food—for producing the elementary goods of life—for life itself—water is essential. Men have fought wars over this vital commodity. Civilizations have perished for lack of it.

A precedent-shattering move toward solving the water supply problems of many nations, and our own—probably the first in international history—is the "Water for Peace Conference" in Washington this month.

This great assembly is for the mutual benefit of all nations. Preconference response has been gratifying. We are encouraged that this event does have outstanding prospects for increased international cooperation and exchange of knowledge in the wise conversation and use of priceless water supplies.

Conservation and wise use are, of course, the crux of mankind's problem. As a renewable resource, the *quantity* of water in the world is not decreasing. The problem is providing it clean and uncontaminated *where* and *when* men need it. Existing needs will double by the end of the century. A population explosion has caused upward revision of many previous estimates as to water needs. This means that within the coming decades, we have a tremendous job of planning and ground work if we are to be ready for the new century.

Honorable Hubert H. Humphrey. The Vice President of the United States ". . . shared in the privations of drought and Depression of the late 1920's and early 1930's," said one biographer about the author of this article.

That Vice President Humphey is an ardent conservationist is understandable. From a typical American boyhood and sturdy family roots nourished in the arid Great Plains, he gained the practical experience and deep understanding which led after service as a mayor and for 16 years, a U.S. Senator, to election to the Nation's second highest office. He knows well the crisis of water which he so effectively describes on these pages.

Although ours has been a nation of wealth and dynamic progress, we have tended to be indifferent to this natural resource as the wellspring of human progress. We have moved ahead economically to a large degree at the *expense* of our easily available supplies of water. A day of reckoning approaches unless we remember that no other natural resources can be developed without this one. It is an irreplaceable commodity—better living calls for more and more of it. Thousands of gallons of water are required to produce most of the items we buy on the market.

Operations Curtailed

This became very meaningful in the Northeast where both industry and dense population are heavy users. Drouth in recent years in that part of the country has dramatically demonstrated critical shortages. Many industrial plants curtailed operations or shut down during the worst months. Water disappeared from restaurant tables. Lawn sprinklers went dry and automobiles went unwashed. Many individuals stored containers of water in their homes as a safeguard against a total drying up of the taps.

Ironically, while the reservoirs for the world's largest city were nearly dry, the Hudson River flowed sluggishly alongside Manhattan, laden with sewage and industrial waste and totally unfit for slaking the mounting metropolitan thirst.

Although the Hudson is formed from fresh streams in astonishingly beautiful country, population gradually crowded in around it; much of its beauty was ruined and its abundant fish and wildlife were shamefully replaced with flowing refuse and effluvia. This was the distressing result of widespread civic inertia.

Fortunately, there is hope for the future in a long-range Federal study looking toward a co-

United States Department of the Interior, Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy, Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

Water for recreation and sports. A youngster from a school for the mentally retarded, and who loves to swim, chats with Vice Pres. and Mrs. Humphrey at their homeside pool.

operative clean-up of the Hudson and restoration and development of the great potential in the entire Hudson River Basin. Similar steps are being planned in the Potomac where President Johnson has directed an all-out effort to demonstrate that our streams can be cleaned up and made whole and useful.

Other areas of the United States have taken major steps to correct local pollution problems.

No time should be lost. I firmly believe the solution to our water supply problems is one of the keys to the future welfare of most parts of our country. It is a vast undertaking. It will require united and cooperative effort at all levels of government as well as strong participation by every segment of the community.

Stepped-up Undertakings

The effort to purify salt water for domestic use has been stepped-up tenfold following Federal efforts to stimulate development.

Fascinating also is the practical research the Federal Bureau of Reclamation is undertaking to tap the "rivers in the sky." If established principles of weather modification can be applied to induce additional precipitation from moisture-laden clouds, it will open up a whole new horizon of water availability to fill reservoirs and keep our rivers and streams flowing.

Fortunately, nature renews the purity of water when it falls as rain or snow. But renewing second-hand water artificially is also possible. I learned of an example of used water being remarkably transformed in the town of Santee, Calif.

As Santee grew in the dry hills above San Diego, its resourceful officials turned to the purification of sewage water as a possible source to augment short water supplies. A $700,000 bond issue was the financial start for a treatment process that now supplies the city with a new lake clean enough to be used as a swimming pool. Santee also disposes of sewage for 10 percent less cost than transporting it to San Diego's sewage system—and Santee has some fine recreational lakes in the bargain. There is good reason to believe that in the future, this process will be further refined, so that renewed water can flow through our taps for domestic use.

This is another reason why the water outlook for the 21st century does not have to be bleak. But immense initiative is necessary.

"Who Will Make"—Emerson

Emerson once said: "What we need most is someone who will make us do what we can do."

It has been my experience that when citizens encourage—"make"—an elected official do what he "can do" as a leader, the wheels of progress really begin to accelerate. This is our situation today in regards to water. Every man and woman must look to the future. We cannot afford just to talk about *what* and *where* the water should be. The League of Women Voters and other public-spirited organizations have done a commendable job of helping to sound the alarm. Once we have fully alerted America to the danger, our task is to move our country ahead in a bold program.

Water leaders in the arid and semiarid West have already set a valuable pattern. That part of our country has adapted so well to perpetual drouth situations for many decades that its example is a lesson in resourcefulness to the nation and the world. What an invaluable part Western water leadership has played in strengthening our national economy! Achieved amidst harshness and austerity, the impressive records prove that the West's pioneer settlers knew that water was everybody's business and that proper water control was essential for their progress.

Maricopa County in Arizona and the Snake River Valley of Idaho are samples of early day economies built on the principle of proper use of available water supplies for irrigation, resulting in notable growth and prosperity.

Modern-Day Example

The Columbia Basin project in central Washington State is a modern-day example. For cen-

Irrigation helps assure the country's food supply. Water for this alfalfa field is from Canyon Ferry Reservoir in Montana.

turies, the Columbia River encircled this heartland of the Northwest without being put to any really worthwhile purpose. But since 1948, water has been diverted and has made huge land sections in the Columbia Basin project attractive to settlers, meanwhile increasing land value many fold.

Today, this project area is an agricultural showplace. The irrigated area jumped from 230 to over 410,000 acres. The population swelled by 47,000; 850 new businesses sprang up, annual paychecks were fatter by over $56 million, and the assessed value of property increased $75 billion. This trend will continue until the project matures. Its full economic impact means broader security and food for the hungry.

Electric power produced at the project's principal structure—Grand Coulee Dam—has been an indispensable partner to the irrigation in the area. It is the availability of power to pump water out of the gorge as well as sale of the great amount of power produced at the dam which made the project possible within the framework of reimbursability—the cornerstone of reclamation.

The Bureau of Reclamation's program is just as successful in many other areas of the West. Its multiple-purpose water control projects not only attract Americans looking for opportunity, but have been favorably studied every year by thousands of technicians from foreign countries who are trying to solve their water problems.

"water that we and the coming generation will need." This is a scene of a Reclamation reservoir in Teton National Park, Wyo.
(Photo by D. J. Weir)

"a future rich with water." A drink from the garden hose being enjoyed by these California lads is not possible in many parts of the world.

Private and State organizations and the U.S. Department of Agriculture have also helped conserve water in a number of areas. And the Army Corps of Engineers has built great waterworks, principally for flood control purposes.

Be "Water Missionaries"

One of the best examples of "water missionary" activity has occurred near where I was born in South Dakota. The millions of acres of rich soil in that region have attracted enterprising dry farm operators ever since the earliest settlers.

But the residents of Campbell County are highly interested in broadening and diversifying their economic base. A potential means has been found through a survey which declared about 15,000 acres of that land, not far from the Missouri River, as suitable for irrigation, for water-based recreation and for sport-game benefits in a potential project area.

With a supercharged community spirit, the residents do everything possible to become informed and to qualify for the financial aid needed to build the permanent water structures. Though the population is small, large delegations of their citizens arrange to participate and get support for their cause at State and National water conferences. They know the earliest they can possibly have their first water will be in about 8 years, but their enthusiasm is at a high pitch; that is half the battle for fulfilling the dream.

It is the future that these enterprising people are looking to—water, wealth productivity, and brighter prospects for their children and grandchildren. It is an historic effort; it is "making" our leaders do what they can do. Other communities throughout the Nation might well follow suit.

Meantime, right there in the Missouri River basin is another problem—stream sharing. This has long deterred water progress elsewhere as well. It has not been a universal custom to share and protect downstream counties or States in the use of rivers. Everyone does realize that our streams do not confine themselves to arbitrary political boundaries. In view of inevitable growth, basin- and region-wide plans must be expanded. To take care of upstream and downstream users alike in the challenging future, we simply cannot afford to confine our thinking to an immediate city or county area, or in many instances, just one State.

Tackle At Once

To summarize, we should tackle at once the jobs of saving water in every part of the country. Forward-looking citizens—at all levels—should help chart a course for a future rich *with* water.

Many competitive needs do confront our Nation; financial resources to fulfill our needs must be carefully allocated. Wise decisions must be made now—and next year—and the year after that—at all levels of government and by our private economy. Time should not be needlessly or arbitrarily lost before we proceed to construct known feasible projects which will overcome present supply shortages. In recent years, Federal help has become available for this purpose.

Hopefully, the level and speed of planning could be raised for well-justified potential projects which have been talked about for many years, but have not progressed beyond that stage. This could include plans for new supplies for all purposes, not forgetting antipollution, water-based recreation, and beautification.

Federal interagency river basin surveys are now underway for some regions through the auspices of the Water Resources Council. Cooperation with such surveys and other kinds of inventories of future water needs will be very important to a national survey to be done either by established factfinding agencies of the Government or by the National Water Commission, as the Congress may decide.

In effect, we must come to grips with our water problems; we must take timely action before the next decade or so when it may be either *too late* or *too expensive*. This is a great challenge; in fulfilling it, we will better ourselves and improve the future for those who will follow after us. We will be sure of supplying, or having on hand, the water that we and the coming generation will so vitally need.

Let us not "fight wars over it" and not permit "our civilizations to perish for lack of it." But let's stand ready as neighbors to help solve one of the most critical problems of this or any time.

Adequate water for all Americans, for the good life, for an ever better life—this is our goal. We can fulfill this goal. We must. We shall.

# # #

Secretary Udall will be Presiding Officer
(*Photo by Jim Aycock*)

Photo at right. Delegates to the conference may view Washington and the Potomac River in night scenes like this.

A BROAD-SCALE PROGRAM

Water for Peace Conference
May 23, 1967

by **HARLAN WOOD**
Conference Director of Information

AN estimated 5,000 people from all over the world will gather in Washington, D.C., on May 23 to attend the International Conference on *Water for Peace*. Secretary of the Interior Stewart L. Udall will be presiding officer.

The 9-day event covering all aspects of water, will feature, in addition to Conference sessions, the largest exposition of industrial water equipment ever assembled in the United States.

Some 18 months in planning, the Conference was called by President Johnson "to deal with all of the world's water problems." As a result of the President's directive, the Department of the Interior and the Department of State, organizers of the meeting, have a broad-scale program on all aspects of water resource conservation, development, and use.

Nearly 700 papers will be presented, either orally or published, at five concurrent daily sessions. The bulk of these come from 46 nations and 12 international organizations.

Regarding its purposes, Secretary Udall said, "President Johnson, in calling the Conference, stressed that a massive, cooperative assault should be launched within the range of existing technology to meet world water needs. Thus, this Conference will be a major planning session to encourage concrete action by individual nations and by international organizations and nations working together."

Because the meeting is more than an exchange of technical information, many nations are sending cabinet-level officials with water resource responsibility in their countries. Special sessions are planned for these ministers.

The Governors of the 50 States have also been invited to attend or send representatives.

Among the representatives of the Bureau of Reclamation who will deliver papers are: Commissioner Floyd E. Dominy and Assistant Commissioner Gilbert G. Stamm.

In addition to members of official delegations and accredited international observers, Conference sessions (to be held at the Sheraton-Park Hotel) will be open to those who register in advance prior to May 19. Anyone desiring to attend should write: Secretary-General, International Conference on *Water for Peace*, Room 1318, Department of State, Washington, D.C., 20520. # # #

Water for Industry Problem is Economic

High pressure hoses are used to wash sludge into settling ponds where the copper is about 80 percent pure at this Bingham Canyon Copper plant in Utah. The water is then drained off and pumped back to start the cycle again.

by **WILLIAM T. PECORA**
Director of Geological Survey

YOU turn on the tap scores of times a day without ever thinking about it. Yet most people can easily imagine the confusion, suffering, and sheer hard work that would result if public water supplies were cut off, and there were no water for washing, drinking, cooking, and other domestic uses.

But did you ever stop to think what would happen if water supplies for industrial plants dried up or were destroyed by some catastrophe? The results might be less irritating to the individual person, but they would be devastating for civilization. Industry depends on water just as life itself does.

Without water for industry, our culture would return to a primitive level; we would eventually have to go hunting with bows and arrows and return to cultivating the soil with a sharpened stick. We would not have farm machinery to use in growing food. We would not have trucks, trains, or boats to transport food to the consumer.

All such machines require steel, and to manufacture a ton of steel requires 270 tons of water. Ten gallons of water are needed to produce 1 gallon of gasoline with which to operate the machines; 920 tons of water are needed to make a ton of rayon fiber. A ton of sulfite pulp to make paper requires 200 tons of water.

Today, industry needs water in fantastic quantities and the demand is skyrocketing. It has increased tenfold since 1900, although the population has little more than doubled. Industries in the United States use 700 gallons per person per day; an individual person in his home for drinking, washing, and other household purposes uses an average of only 50 or 60 gallons a day. Ninety-four percent of industrial water is used for cooling, and most of this can be used again.

There is a widespread notion that U.S. industry will soon be faced with a serious permanent water shortage. This is not true, for the overall supply exceeds the demand and will continue to do so in the foreseeable future. However, there may not be enough water at a given place in a given season, at a price that industry is willing to pay. Every plant will not have available all the cheap water it can use.

Where does industry find the water it needs? Some smaller companies get it from public supply systems. This water is generally used by industries that require small quantities of high-quality water and are in locations where suitable water cannot easily be obtained from wells.

Very large industries usually find it more economical to set up their own supply systems—if they are near adequate sources of water from lakes,

streams, or ponds. If water for self-supplied systems is not available nearby, industry then has to rely on public supplies.

Cities and States can transport water long distances, as a public service, while industries cannot afford so much extra expense. The cost of transporting the water added to the costs of materials and productions would price them out of the market.

Some Use More

Some industries use much more water than others. For example, the electric power industry uses almost 10 times as much as the chemical industry, which is the second largest user. The amount of water used depends on the size of the industry and on how the water is used. Industry uses water for cooling, processing, and for sanitation and services.

The electric power industry cools the steam from turbines with water. The cooled steam condenses, thus reducing the back pressure on the turbines, and increasing the efficiency of the plant. The chemical, petroleum-refining, and steel industries also use large quantities of cooling water. Water for cooling does not have to be of especially high quality.

Water for processing is either incorporated in the product, as in soft drinks or canned fruit, or it comes in contact with the product during manufacture. For certain industries, process water would obviously have to be of very high quality. The pulp-and-paper industry uses water for washing the pulpwood, cooking the woodchips, and transporting the pulp to the paper machines. Such water would not have to be quite as pure and free from dissolved solids or bacteria as water used in food packing plants, or in the making of synthetic textiles.

Water is also used in factories for sanitation and services—to clean and maintain the plant. Drinking water, showers for workers, lawn watering and firefighting are some examples of this kind of use. Some industries need water only for sanitation and services. Such plants usually use water from public supply systems—their water needs are so moderate it would not pay them to develop their own systems.

Even within an industry the amount of water needed to make a given product varies widely. The reasons for this wide range are complex. Take carbon-black, for instance. This is the soot produced by partial combustion of natural gas, and it is one of the important ingredients in rubber tires, shoe polish, carbon paper, and typewriter ribbons.

The contact process of carbon-black manufacture requires only 0.14 gallons per pound—in contrast, the furnace process requires 3.26 gallons per pound. Hot carbon-black-laden gases from the furnace process are cooled with a water spray, but cooling water is not required in the contact process.

Some other industries, such as the aluminum industry, require large quantities of electricity. Water requirements of a plant are greater if the electricity is generated at the plant than if it is purchased.

The water intake of a plant may be reduced by using the water several times over. This reuse is what makes it so hard to estimate the relationship between supply and demand in water planning. Some petroleum refineries use the same water to cool the hot gas as many as 50 times. Such reuse reduces the cooling water intake to one fiftieth, and the total water intake to one-twelfth of that needed without recirculation.

Water used for cooling many times over is greatly reduced in quantity. In the cooling process, some water is constantly being lost due to evaporation. Some petroleum refineries consume almost all the cooling water through evaporation.

Reduces Quantity

Reuse not only reduces the quantity of water, it has a bad effect on its quality. All natural water contains dissolved minerals, and some water contains more than others. As the circulated water evaporates, the dissolved minerals become concentrated in the water that is left. When the concentration of dissolved minerals reaches a certain level, this water must be discarded.

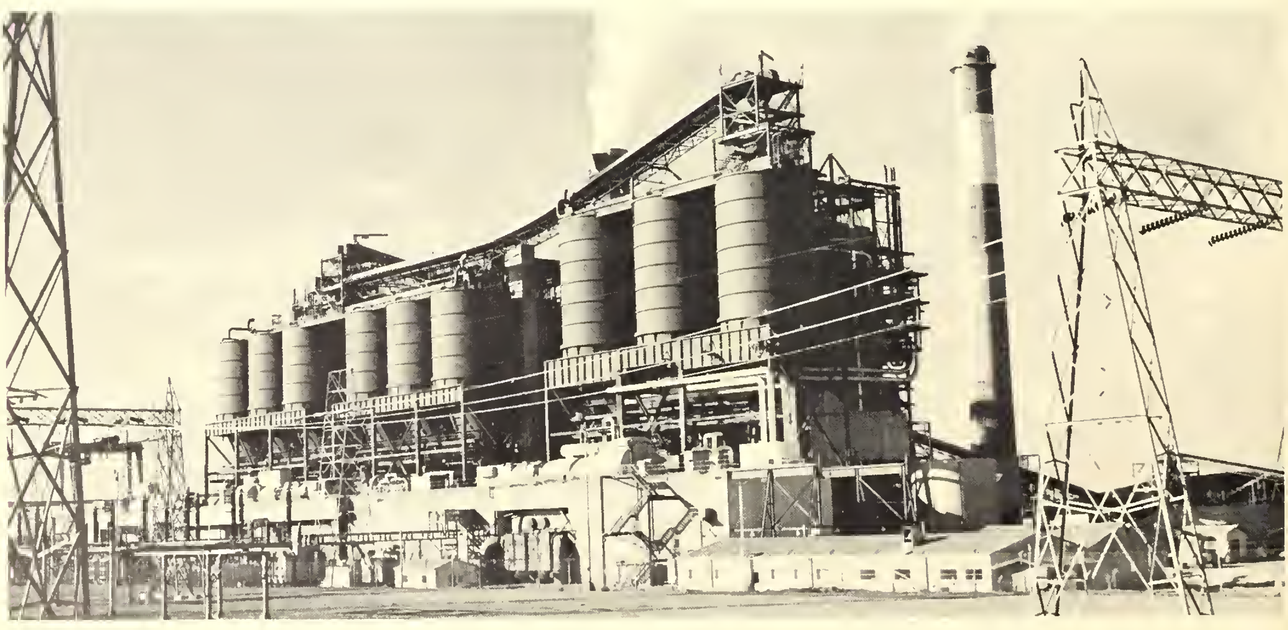
Some industries can use more highly mineralized water than others. However, incoming water having a high mineral content can be reused fewer times than water having a low mineral content. If the local water supply has a high mineral content and cannot be reused, more water will be needed.

Sometimes saline (salty) water may be used for cooling, if the water is to be used only once. However, the machinery for using saline water must be designed to resist rusting. Saline water is used only when fresh water is not available at a reasonable cost, because rust-resistant machinery is more expensive than ordinary machinery.

Many plants all using the same stream for cooling purposes can seriously damage its water quality. The Mahoning River in eastern Ohio is an outstanding example. Several steel mills use this stream as a source of water for cooling and return the warmed water to the stream. A water temperature of 117° F. was observed in July 1941.

These mills heated the water sufficiently in December 1949, to increase the average water temperature from 35° F. at Leavittsburg, above the mills,

Such steam generating plants as this one near Farmington, New Mex. use coal to generate electricity and much water as coolant.



to 84° F. at Lowelville, below the mills.

You may wonder why we describe this artificially warmed water as of poor quality. One reason is that the warmed water may upset or harm fish and other aquatic life in the river. Another reason is that warm water is unsuitable for some domestic or industrial uses.

Some industries require a high standard of quality of water, but others can use water of poor to medium quality. In general, calcium and magnesium compounds are undesirable in process water, especially if the water is used hot, because a scale will be deposited in the machinery, just as scale forms in teakettles. Certain minerals are likely to stain the product and are therefore undesirable. If the product is a synthetic fiber such as rayon or acetate, iron and manganese interfere with bleaching and dyeing. Synthetic fibers require a very high quality water—soft, and low in mineral content.

One very important use of water by industry, is for disposal of the waste products of processing. At one time streamflows were adequate to dilute, dissolve, or carry away these wastes. But now, many of the larger rivers in the United States are depleted by use and overloaded with wastes. This pollution not only upsets the delicate balance of nature between plants, insects, and fish, it also poses problems of water quality for the people and industries downstream.

There are various kinds of industrial waste pollution. Organic wastes mostly come from food packing plants and also from pulpmills. Inorganic waste consists of chemicals—acids, cyanides, etc.—and comes from many different industries. Then there are insoluble particles (such as mineral tailings) which may make the water turbid or settle at the bottom, smothering purifying organisms. Finally, there is heat, which we have already mentioned as a form of pollution.

Industries generally are aware of the problems created by waste disposal in rivers and are trying to help in pollution abatement. For instance, the pulp and paper industry, which used to be one of the worst offenders, has cut the pollution load per ton of product in half by spending millions of dollars on treatment facilities.

Predisposal Treatment

Other industries and groups of industries are doing research on predisposal treatment of their waste products before disposing of them. Such research and treatment are expensive, however, and add to the cost of the product. It is not surprising that some medium-sized industries as yet do little or nothing about the problem.

Food processing plants must have clean water supplies. Checking the quality of the potatoes in his plant at Billings, Mont., is Phil Werle, manager.

Now you begin to see how complex the industrial water picture is. National averages of industrial water use don't mean very much. Comparisons of supply and demand, even in a local area, are not very meaningful unless the quality of the supply and the quality requirements of the industry are considered. Requirements vary from plant to plant, depending on the product, the process used, the kind of water available, and the amount of recirculation practiced. An accurate water balance of use versus demand would require a detailed study of local conditions and the industries concerned.

Forecasting industrial water use very far into the future is even more difficult. Products and processes become obsolete. Recirculation and other water-use practices change with the changing times. For example, the present trend in textiles is to replace natural fibers with synthetic materials whose manufacture requires larger quantities of water.

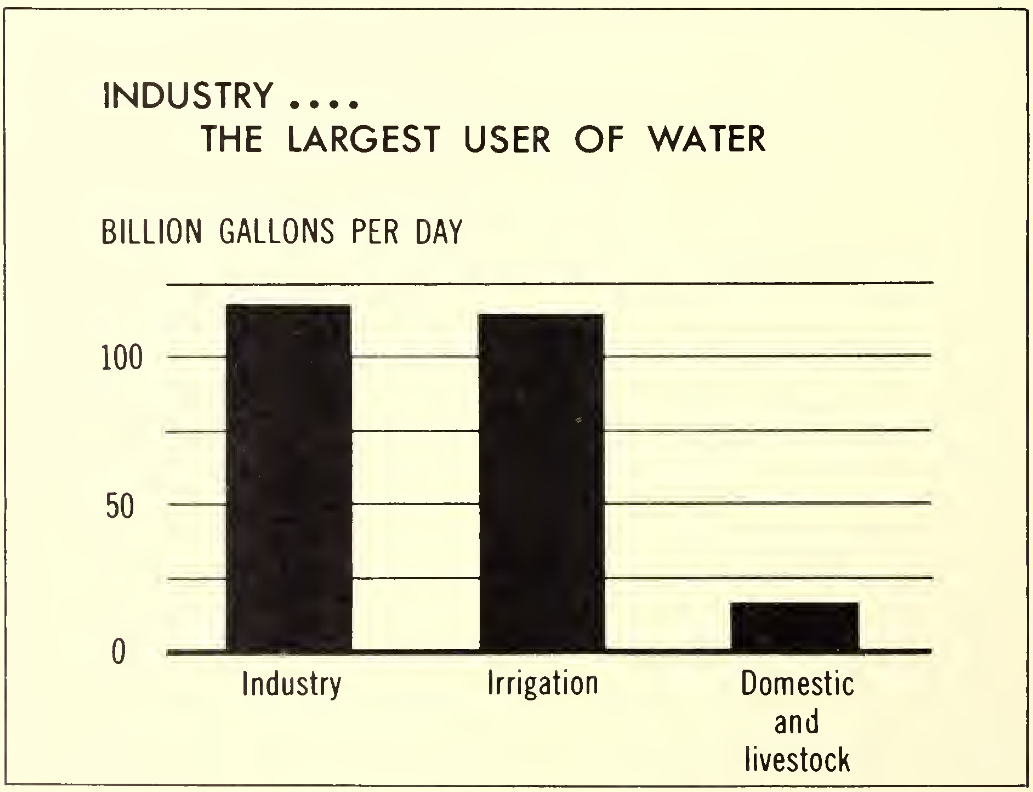
On the other hand, some forces will tend to cut back the amount of water used for industry. The cheapest and easiest sources of water have already been developed by man. As the cost of water increases, conservation practices will necessarily become more attractive. The largest industrial use—fresh water for cooling—can be reduced greatly by using the water several times, and by using saline water where available. The added cost of corrosion-resistant machinery is offset by the lower cost of developing the saline water.

As the cost of fresh water goes up, the use of saline water will be more and more favored. In the same way, air cooling is being adopted in some industries, instead of water-cooling systems. Several petroleum refineries have found that under some conditions their cooling facilities can be expanded more cheaply by using an air system instead of a water system.

Without a doubt the demands on our fresh water supply are becoming critical in some areas, and this trend will continue. Industries using large quantities of water per employee will be discouraged from locating in water-poor areas. For example, an electronic tube industry that required 310 gallons per employee per day is more likely to locate in a water-poor area than a steel rolling mill that requires 11,400 gallons per employee per day.

Total cost to industry of obtaining water and of treating industrial wastes will probably rise in the future, as there is more competition for fresh water, and as more States insist on treatment of wastes. U.S. industries will have to plan more carefully for adequate water supplies and treatment. Enough water is available, overall; the water problems of industry are largely economic problems. # # #

WILLIAM T. PECORA *was appointed Director of Geological Survey of the Department of the Interior in 1965. His selection to head the agency culminated a 27-year career with Survey. Water problems and their impact on the national economy are fundamental to his interests.*



Fifteen canoe teams assemble on water that is perfect for another leg of the derby event. Tension mounts in each boy. Teams start at 1-minute intervals in the 97-mile race. (*Photos by Ray H. DeKramer*)

Dam Enhances Boy Scout Canoe Races

by RAY H. DEKRAMER, Branch Chief in Region 6

IN record time, 18 Boy Scout canoe teams paddled their crafts over 97 miles of the winding James River last summer. The winding team covered the course in less than 9 hours of actual paddling time over a 3-day period.

This annual canoe derby highlights a special scouting activity and outdoor adventure for boys in a 31-county area in South Dakota and 1 county in Minnesota. Tryouts are held in the several local Scout troops and Explorer posts of Pheasant Council. The outstanding canoe teams are then qualified for entry in the "Derby" event.

James Diversion Dam, recently constructed by the Bureau of Reclamation across the James River north of Huron, S. Dak., provides a near 50-mile-long river impoundment above the dam. Controlled releases through the dam help stabilize downstream flows and retain a within-channel reservoir above. These conditions have created an ideal watercourse for the 36 canoeists.

This reach of the river between Redfield and Huron, has now had 14 Boy Scout canoe derbies over the past years. But before the dam was built low water levels and low river flows were a frequent concern. Oftentimes, unscheduled portages were required, much to the dismay of the glory-seeking canoeists. James Diversion Dam has eliminated such discouragements.

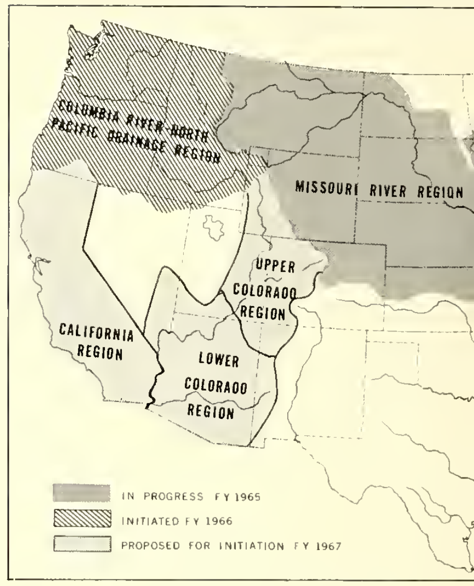
Completed in 1965, the dam will ultimately become an integral facility in the project works for irrigating part of the potential 495,000-acre Oahe unit in north-central South Dakota. A large pumping plant to be installed at this dam will permit the diversion of floodflows to a nearby regulating and storage reservoir. The water will irrigate when farmers welcome such moisture during hot and dry summer months.

During the interim of feasibility planning by the Bureau and congressional authorization for the Oahe unit, the city of Huron had requested construction of the diversion dam to alleviate the city's otherwise inadequate water supply.

After the Oahe unit is developed for irrigation, the water facilities will further assist in providing Huron with an adequate water source.

Even if there were no further justification and planned use of the James Diversion Dam, the Boy Scouts are quick to praise the development. It is an excellent watercourse for their annual canoe derby, as well as many other outdoor scouting activities.

Reclamation has built larger dams and reservoirs, but those connected with the James are "big" in what they already provide. And the utility will increase considerably when it begins to function for irrigation purposes. # # #



River Basin Surveys Underway

by **JACK C. JORGENSEN**
Coordinator of Surveys

AN increased interest in water has drawn considerable attention to planning for river basin developments across the country. To farmers, industrialists, nature lovers and many others, the term, "Comprehensive River Basin Planning," has new significance.

The Bureau of Reclamation participates in the comprehensive *framework* planning for the regions of Missouri, Columbia-North Pacific, Upper Colorado, Lower Colorado and California (type I); and the comprehensive *detailed* planning for the individual river basins of Willamette Basin in Oregon and the Puget Sound in Washington (type II), shown in the accompanying maps.

Plans for all the areas shaded on types I and II maps are underway and are scheduled for completion in 1972.

The fiscal year 1967 combined program or these studies will total $1.48 million, and the President's fiscal year 1968 budget requests an additional $2.5 billion.

In order to accommodate better liaison with the Federal and State agencies as well as Department of Interior leadership, the Bureau of Reclamation has named three of its top planning engineers as River Basin Planning Officers. They are Paul Harley, with offices in Omaha, Nebr., covering the Missouri Basin study; Elwyn White, with offices in Portland, Oreg., covering the Columbia-North Pacific area; and Wallace Christensen, with offices in San Bernardino, Calif., assigned to the Colorado River and California studies.

The present national effort is an outgrowth of recommendations made by the Senate Select Committee on National Water Resources established by the 86th Congress. As a result, a water resources council within the President's Cabinet was formed assuming the activities of a temporary council which began operations in 1961.

In 1965, Congress passed the Water Resources Planning Act (Public Law 89–80) creating the permanent Water Resources Council. It consists of the Secretaries of the Departments of the Interior, Agriculture, Army, Health, Education, and Welfare, and the Chairman of the Federal Power Commission. Secretary of the Interior Stewart L. Udall was named chairman of the group.

Cooperative Groups

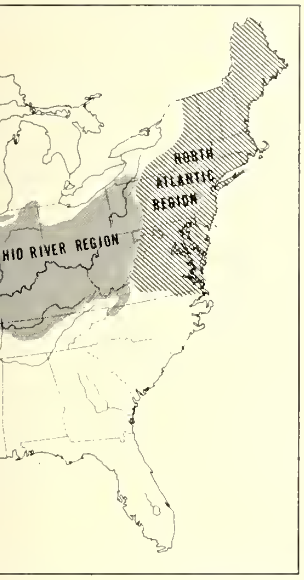
One section, title II, of the 1965 act authorized the formation of cooperative river basin commissions to conduct water resources planning. At present four such commissions are being formed—New England, Great Lakes, Souris-Red-Rainy, and Columbia-North Pacific.

The shaded area of the title II map shows the four commission areas. It is anticipated that about 15 river basin commissions will cover the United States.

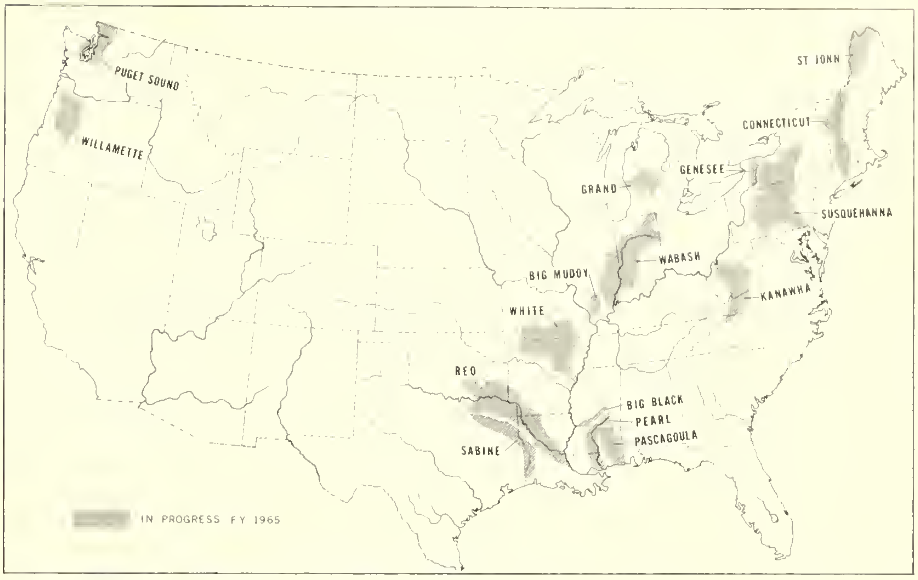
Title III provides a financial assistance program to States to promote greater interest and participation in water resources planning efforts.

The Council, through its field organization of

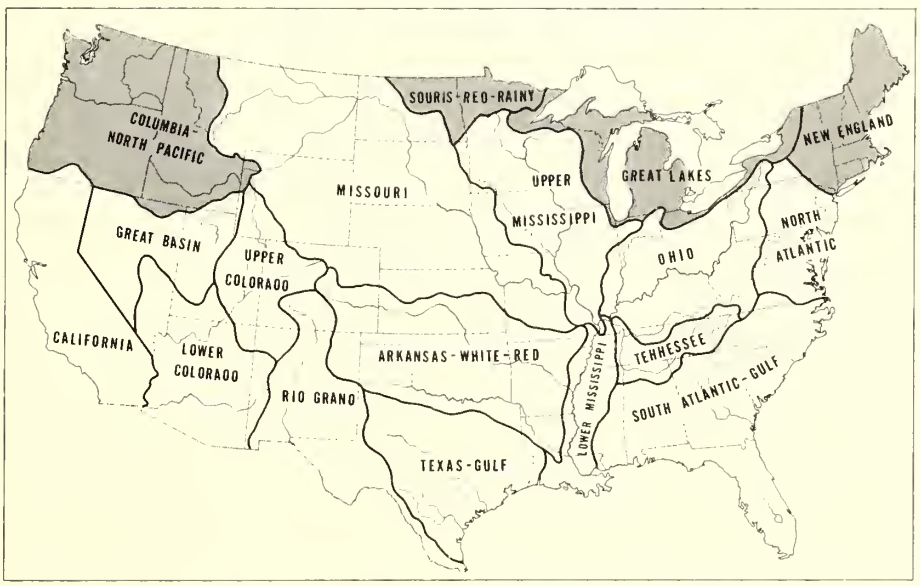
ERWAY IN 1967



RIVER BASIN DETAILED SURVEYS (TYPE II) UNDERWAY IN 1967



TITLE II RIVER BASIN PLANNING COMMISSIONS



interagency committees, coordinating committees, and river basin commissions, will carry on the coordinating activity. The planing programs will continue to be performed by existing planning organizations of the participating agencies concerned with water resources.

Financial assistance to the States involved in these and other water studies during the current fiscal year (1967) amounted to $1.75 million. This was distributed to 46 applicants including States, the District of Columbia, Puerto Rico, and the Virgin Islands.

Population, land area, financial need, and the extent of known water problems were factors in apportioning the money available. The President's fiscal year 1968 budget includes $2.25 million for this purpose.

Experience to date has shown that techniques change and comprehensive study programs are more sophisticated than past efforts. Also closer ties between water planning groups at all levels of government are producing beneficial results.

Reclamation looks forward to accommodating many diverse interests in the efforts underway and to minimizing the mistakes and lack of planning of the past. # # #

Topock Marsh is not only sought by Canadian geese as shown in this January 1967 photo, but the improved water quality and stabilized level makes it popular with other wildlife and fishermen.

Wildlife Abounds i

FACILITIES to stabilize the water level in the Topock Marsh on the Colorado River 100 miles downstream from Hoover Dam to preserve and enhance fish and wildlife in the area have been completed and in operation for several months.

A 3½-mile-long dike, inlet and outlet structures, and a dredged access channel have been constructed in the marsh under a joint agreement between the Bureau of Reclamation and the Bureau of Sport Fisheries and Wildlife, both Department of the Interior agencies.

The Topock Marsh is one of the West's most important warm water fisheries and wildlife habitats. It is a part of the Havasu National Wildlife Refuge, administered and managed by BSFW.

Reclamation dams like Hoover along with related river control and conservation works have created recreation, fish and wildlife benefits along the Lower Colorado River and its tributaries enjoyed by an estimated 7 million people annually.

The Topock Marsh facilities will extend the life and usefulness of the important fish and wildlife habitat indefinitely. Formerly threatened by a falling water level, the slough can now be regulated for the fullest benefit to fish and wildlife, including:

1. Insuring controlled water levels that will not vary with fluctuations in the Colorado River;
2. Providing dependable resting areas for migratory waterflowl and access through the marsh by boat for hunting and fishing; and,
3. Assuring a flow of fresh water into the marsh and permitting use of Colorado River water within limits established by the U.S. Supreme Court decree.

The Topock Marsh is a productive warm water fishery in which large-mouth bass and catfish abound. Refuge management personnel estimate that the slough provides approximately 125,000 man-days of fishing a year. This usage is expected to quadruple under planned management, and as a result of the new facilities.

Ducks and Canada Geese

The marsh is expected to provide wintering for approximately 50,000 Canada geese and about 100,000 ducks of various species. Approximately 4,000 acres of water in the marsh will attract waterfowl while farmed feeding areas will be expanded as required to meet the needs of the expected increase in the size of flocks wintering in the area.

Once blocked by sandbars and low water, the marsh's mouth was dredged to restore good boating access from the river.

The dike, the major item of Reclamation construction, isolates the Topock Marsh from the water level fluctuations in the river. Dredging of a million cubic yards of sediment from the bottom of the marsh was required to build the 3½-mile-long, low dam. An inlet channel at the upper end of the marsh required the excavation of 293,000 cubic yards of earth. The inlet and outlet control structures contain 320 cubic yards of concrete and 300 lineal feet of 42-inch pipe.

The dike and the boating access channel were constructed by the Bureau of Reclamation's 12-

tabilized Marshes

inch cutterhead dredge stationed in the Needles vicinity of the Colorado River. The inlet channel and the inlet and outlet water control structures were built by Lloyd R. Johnson under a $259,000 contract.

Suisun Marsh

Suisun Marsh in Solano County, Calif., at times hosts as many as 750,000 ducks—20 percent of the winter duck population of California—on its 40,000 acres. Improved quality of the water in the marsh would contribute to an increase in food available for the birds.

Although there has been a substantial reduction in outflow from the Sacramento-San Joaquin delta during the past 20 years, the quality of water available in the Suisun Marsh has been improved due to flow releases provided by the Bureau's Central Valley Project during the critical dry months of summer and fall.

Future State, Federal, and local diversions from the Sacramento and San Joaquin Rivers for use and exportation will, however, greatly reduce the delta outflow and will change the quality of water available in the marsh area.

Using surplus water from Putah South Canal, the Bureau initiated a research and testing program some months ago to determine how well the quality of water in the marsh could be controlled through fresh water releases. Initiation of this program required concurrence of Reclamation, the Suisun Soil Conservation District, the Solano Irrigation District, and the Solano County Flood Control and Irrigation District. The agreement among these four agencies must be renewed each year after an evaluation of the previous year's testing results and current water storage in Lake Berryessa.

Quality Monitored

From August 24 through October 30, 1965, 28,230 acre-feet of water was released into the marsh. During this period the quality of water was monitored at 50 testing sites in the marsh. The results of this monitoring indicate that the quality of water was much higher than that normally found in the marsh waterways during the months of September and October. This is of particular significance in the fall when marshlands are flooded for waterfowl and also in the spring when the floodwaters are drained from the islands carrying away salts that would otherwise be deposited in the soil.

The marsh research and testing program for 1966 was coordinated with Putah South Canal capacity tests, in order to fully utilize the flows needed for the capacity test.

A reconnaissance study is programed for fiscal years 1967 and 1968 to evaluate a plan for irrigating land between Cache and Montezuma Sloughs. The distribution facilities serving this area could also deliver water to the eastern portion of the marsh. These facilities in conjunction with flow releases from Putah South Canal into McCoy, Suisun, and Green Valley Creeks would provide a high degree of control of water quality in the marsh area. # # #

King size brown trout are again being taken on the 'Miracle Mile" section of the North Platte River in central Wyoming

COMEBACK ON THE "MIRACLE MILE"

by LARRY PETERSON

DOES the term "Mircle Mile" mean anything to you? It does to many Wyoming and Colorado anglers. The term was first used by a group of fishermen 15 or more years ago to describe the stretch of the North Platte River upstream from the backwaters of Pathfinder Reservoir. The anglers found it hard to believe the fantastic ability of that section of the North Platte to produce, year after year, the many catches of 3- to 8-pound brown trout in the face of ever-increasing fishing pressure, at times as high as 20 cars a mile.

Bear in mind that the "Miracle Mile" is still fairly remote to any town. It is located about 65 miles south of Casper and 300 miles north of Denver. Reference is made to Denver because about three out of every four anglers who fish this section of the North Platte River are from the Denver area.

Brown trout fishermen enjoyed outstanding success on the "Miracle Mile" until the summer of 1961. On a very warm Independence Day weekend that year, disaster struck many of the brown trout in that section of the North Platte. They died by the hundreds in some portions of the stream. Several additional kills occurred that year and again in the summers of 1962 and 1963. The fish population in the "Miracle Mile" had been all but eliminated.

What caused the fish kills? Man's disregard for nature, in an effort to provide more electrical power from new hydroelectric plants downstream, had changed the water flow pattern on the North Platte River. Complete shutoffs of water during hot summer days caused the water chemistry of the river to change in such a manner that it became lethal to trout.

Efforts Coordinated

The following two summers, Wyoming fisheries men worked with the Bureau of Reclamation, U.S. Bureau of Sport Fisheries and Wildlife to arrive at a minimum flow that would sustain fishlife and fishfood. In the summer of 1964, the Bureau of Reclamation adjusted its flow releases from Kortes Reservoir to allow for the passage of the recommended minimum waterflow. A request to Congress to permit the minimum flow in the future is currently being prepared.

What does all this mean to the fisherman? It means that the famed "Miracle Mile" of the North Platte River is making a great recovery. Since minimum water releases have been maintained during the past two summers, no more fish kills have occurred. Fishfood, such as the highly desirable fresh water shrimp, are again found in abundance. But the real payoff is the fish in the angler's creel. During the fall of 1965, brown trout in the 2- to 5-pound class were again common in the creel and 6- to 8-pound browns from Pathfinder Reservoir were again beginning to use the "Miracle Mile" area. Many fish over 7 pounds

Good fish from the North Platte River is shown here by Frank McKlosky and his son John.

(Photo by L. C. Axthelm)

were checked at the Alcova store last summer.

Since brown trout tend to be caught most readily in the fall, rainbows are now stocked in the section of river to add to the angler's creel and sport during the other months of the year. With the food supply again abundant, the rainbows grow fast, averaging a half to three-quarters of a pound for a 10-inch fish.

So the "Miracle Mile" is again beginning to show signs of its former self. This is one instance where a section of excellent fishing stream, rated by many anglers as one of the top trout streams in the country, has, by cooperative effort, been returned to production approaching its original condition after being virtually destroyed. It is an example of the fishermen's voice being heard, and heeded, all the way to Washington because he had a justifiable request. # # #

(Appreciation for reprint permission is extended to the author and George Sura, editor of Wyoming Wildlife.)

LAWRENCE W. (LARRY) PETERSON *of Marshfield, Wis., author of this article, received his B.S. degree in fisheries management from Utah State Agricultural College in June 1950.*

Larry was first employed by the Wyoming Game and Fish Department in 1950 as a fisheries biologist and also has had positions at Lander and Laramie. In 1955 he was made foreman of the Reservoir Fishery Management Crew at Casper, and has since taken a fisheries management position on the North Platte River from Seminoe Reservoir to the Wyoming-Nebraska State line.

A Job Corps Conservation Story

One Job Corps experience is integrating education and conservation around a table.
(Photo by Paul Fitzhugh)

They're "*Climbing the Ladder*" at Collbran

by **BILL J. McCLENEGHAN, Engineer at Grand Junction Office, Colo.**

THERE is a harmonious blend in the high-pitched scream of a powered chainsaw and the deep rumble of a bulldozer.

In the forests of west central Colorado, those sounds mean both the *education* of their operators and the *conservation* of vital natural resources—a kind of invasion by the eager work crews from the Collbran Job Corps Conservation Center.

Success to young underprivileged individuals also results.

Construction of the Collbran Job Corps Center was initiated early in 1965. It was to be on the site of the old and dissassembled Collbran Project Construction Camp about one-half mile west of the small farming community of Collbran, Colo. With hurried preparations on the installation of utilities, erection of six-man "transa-house" living quarters, as mess hall and other necessary facilities, the center was ready for the corpsmen.

The first contingent of young men, their faces displaying wonderment and concern over their first airplane ride, were met at the Grand Junction airport during late May of 1965. Immediately the enrollees, from many walks of life, were given medical examinations and indoctrination lectures and were assigned to living quarters. Sore arms and bewilderment seemed the "order of the day."

However, all survived and "the ladder upward" became the symbol of the Job Corps.

Meanwhile the work program was being planned. Employees of the Reclamation office in Grand Junction, Colo., were reviewing and cataloging work which could be done on federally owned lands in western Colorado.

Meetings were held with other Federal agencies which administered the lands—the Forest Service and Bureau of Land Management. The reception was enthusiastic and a comprehensive program was established with conservation and beautification of public lands as the primary objective. Construction also would be done on badly needed recreation facilities.

Eager To Work

The corpsmen highly anticipated going "out in the field." And finally that day arrived. It was the middle of June—a beautiful sunny morning with crisp mountain air. Eagerly they collected the necessary tools, equipment, safety helmets, and

TIMBER—R—R—R—R . . . . and another dead tree falls during the clean up effort by the Collbran Job Corps youth.

were ready to go. Corpsmen assigned to the messhall had prepared lunches for the work party and were wishing that they, too, could get away from the center for the day.

The first work assignment was to remove dead or diseased aspen trees from around Vega Reservoir. This reservoir was constructed by the Bureau of Reclamation on part of the Collbran project. With a surface area of 940 acres, Vega had become one of the favorite spots for thousands of fishermen. Boating, water skiing, picnicking, and camping near the reservoir also have been enjoyed by many people.

Unfortunately, however, a disease had attacked the aspen trees near the reservoir and in the picnic areas. Many of the trees were dead and hundreds were dying. These skeletal remnants of formerly majestic trees made an unsightly blight to an otherwise beautiful recreation area. To stop the spread of disease, the corpsmen were directed to remove all dead and dying trees and destroy them by burning. With swinging axes and chattering chainsaws, the young men launched their attack.

One learns to use a power saw as dead trees are removed from the area of Vega reservoir.

Safety and Progress

Safe practices were uppermost in the mind of the work leaders, and the corpsmen were watched closely. Instructions on safe operation and practice were given many times that day. The boys had never worked with chainsaws or axes before, but in a very short time they had learned the basic "know how" and progress was beginning to show.

Day after day trees were felled, cut up, and burned. Each evening a tired but happy crew returned to a well-earned hearty meal at the center messhall.

The corpsmen are assigned to 1 week of work and 1 week of education. During this time, he gains basic knowledge of work habits, equipment operation, and related skills. Whenever possible, the individual is assigned to a work party that is performing the type of work in which he shows most interest and ability. Thus, if a corpsman is interested in, and displays ability to operate heavy equipment, he will be assigned to the work party that is doing this.

In the education half of his program, the corpsman is individually tutored in basic reading, math, or in whatever subject he may need help. Again, efforts are made to integrate problems and instructions closely related to the vocation he might have chosen.

Vega Reservoir is different now. Because of the young men of the Job Corps, the beautiful lake is surrounded by trees which have shimmering green leaves, in summertime, and not stark bare branches.

After completion of the work at Vega, the work crews moved to Cottonwood Reservoir No. 1 on Grand Mesa. This scenic little lake is about 10,000 feet in elevation. It is operated by the Bureau of Reclamation as part of the power facilities of the Collbran project. While building the Collbran project, an access road was constructed to the formerly inaccessible lake—now a fisherman's mecca.

However, no recreational or camping facilities were available for several miles. Since the lake lies within the boundaries of the Uncompahgre-Grand Mesa National Forest, it was necessary that Forest Service cooperation include designing a campground with related facilities, and furnish some such facilities as tables and fireplaces. The Job Corps, under the jurisdiction of the Bureau of Reclamation, would provide all labor to construct the recreational area.

Some Handicap

This project was approached with the same enthusiasm as the previous work near Vega Reservoir. Although handicapped by hordes of mosquitoes, many rain squalls and snowstorms in October and November, the Job Corps was able to complete nearly 60 percent of the required work.

When winter weather set in at the higher elevations, work activity was concentrated near the city of Grand Junction, Colo. This area—at approximately 5,000 feet above sea level—usually has mild winters and outdoor work can be carried on nearly every day.

One Job Corps effort was beautification along the 50-year-old Highline Canal of Reclamation's Grand Valley project. This project area traverses the north side of the large valley known as Grand Valley. The city of Grand Junction and towns of Palisade, Clifton, Fruita, and Loma lie within this valley.

By way of the several bridges which cross Highline Canal, the Government lands on one side became strewn with household trash, rubbish, tree cuttings, an odd assortment of discarded auto bodies, refrigerators, and other unattractive junk.

The Corps was assigned the job of cleaning up the dumps. The materials were moved into large excavated pits and covered. Soon the once unsightly area was smoothed over and planted with a hardy grass. It was a dirty job but a beneficial contribution to the restoration of natural beauty.

The education effort at Collbran also has paid off in helping the young men get starts in the next phase of their lives. Of the 70 graduates, 34 have taken jobs averaging about $1.50 per hour with some as high as $3 per hour; 3 were hired as resident youth workers at other centers; 1 passed an examination for a diploma equivalent to that of a high school graduation; 14 returned to school, and 7 were accepted in the Armed Forces.

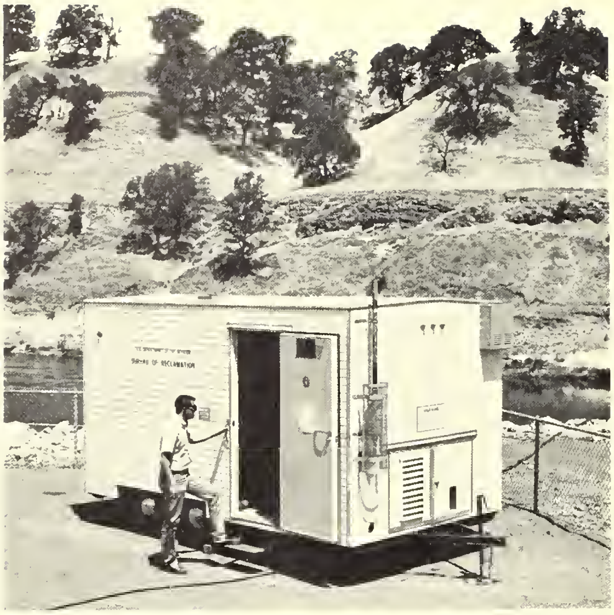
Future plans for the Collbran Job Corps Conservation Center will include more schooling and thousands more man-hours of conservation and beautification work—preventing erosion, revegetating semiarid lands, disposing of cluttered refuse areas, and continuing construction of new recreation facilities throughout western Colorado.

By combining needed conservation work with education, the young men of the Collbran Job Corps are "climbing the ladder to success."

# # #

While he takes a refreshing drink, this thirsty young man lets a few extra rivulets cool his mid-section.

(Photo by Bill J. McClenaghan)



With this mobile unit, Reclamation hydrologists make more complete examination of pollution spots.

Water Quality Tested by New Mobile Unit

A new mobile water quality monitoring station has been placed in operation in Region 2, headquartered in Sacramento, Calif.

The unit measures and records selected water quality characteristics. It is trailer-mounted for mobility—the only one of its kind.

Specifications for the unit were drawn up by the regional office, and Honeywell, Inc., was awarded the contract to supply the system. Delivery was made about 2 years ago.

Water to be sampled is drawn by a submersible pump positioned at the desired water depth. The water is fed past the sensing instruments, where the values are "read" and recorded permanently on a moving chart with color-coded dots.

The six water quality parameters the unit records are:

1. Dissolved oxygen.
2. Specific conductance (an indirect measure of totally dissolved solids).
3. Turbidity.
4. Temperature of water.
5. pH—(index of acid or base concentration of water).
6. Sunlight intensity.

This unit is an expansion of Region 2's water quality monitoring capability. Its first use was in the Sacramento-San Joaquin Delta. Although the Bureau has been monitoring delta water quality since 1950, only recorders measuring salinity were permanently installed. Tests for other parameters required analysis of spot samples, which does not reveal important quality changes occurring between samplings.

The monitoring system is also being used on water quality studies of the Lower American River, the proposed Peripheral Canal, and the San Joaquin River-Stockton area pollution block.

The equipment will allow the Bureau to examine much more completely trouble spots indicated by its regular program of direct sample testing. It also will help delineate water environment changes brought about by construction and operation activities.

# # #

Contribution to Water Quality for Fish

Reclamation has leased 32 acres of land below the Nimbus Salmon Hatchery to the California State Department of Fish and Game without charge for the construction of its first fish and wildlife pollution control laboratory plant.

The plant, which is being built and operated by the Department of Fish and Game, will conduct experiments designed to determine the effects, if any, of suspected toxic materials, the calibration of pesticides safety limits in variable water solutions, or relatively unknown pollution conditions including the physical factors of temperatures or silt.

Construction is scheduled to be completed early in 1967. Physical facilities in the 4,400-square-foot building will include four laboratories, a reference work room, a storage and mechanical equipment room, a continuous flow trough room for testing, and office facilities.

The Fish and Game Department plans to use the remainder of the land leased from the Bureau for construction of a new fresh water trout hatchery in 1968.

# # #

Cloud Seeding to Increase Snowpack

THE Bureau of Reclamation and the Bonneville Power Administration, sister agencies within the Department of the Interior, contracted last December for a Montana research program to determine the feasibility of increasing the winter snowpack in the Hungry Horse Basin by cloud seeding.

The contract is with North American Weather Consultants, Inc., of Santa Barbara, Calif. The project will span a full year, but the cloud seeding program extended only through last March.

North American is a private research firm which has performed weather modification work for more than 15 years for private utilities, water user groups, and government agencies in wide areas of the West.

The project is considered a step in this Nation's quest to tap the "rivers of the sky" for a more abundant national water supply.

Cloud-seeding programs have been conducted in this country for nearly two decades. Based on an analysis of recent programs, the National Academy of Sciences reports that the evidence indicates some increases of about 10 percent in natural precipitation may be possible.

This field technician at work on the program of atmospheric water resources is operating an instrument to learn a potential pattern of snowfall. *(Photo by W. L. Rusho)*

In the Hungry Horse Basin, this would represent an increase of perhaps 1 to 2 inches of moisture annually. In terms of runoff into the giant Hungry Horse Reservoir, however, this inflow would give assurance of adequate storage for multiple benefits, including steady power production to help serve the industrial and domestic needs of the Northwest.

Will Try to Save Wildflowers at San Luis

PROJECT Construction Engineer Max R. Johnson announced that landscaping of the San Luis Dam area includes California poppies and other wildflowers from the San Luis Reservoir area.

The Bureau has removed several truckloads of topsoil from an area of the San Luis Reservoir site which has shown abundant wildflower growth. The removed topsoil has been placed in an area above the high water line near the Romero Overlook site which is near the dam. Here, these wildflowers will add beauty to the landscape viewed by visitors from this high point.

Care of the flowers growing around the overlook site will be provided by the State division of beaches and parks.

Miss A. Marion Stockton originally suggested the removal of the poppies from the reservoir and their replanting. She sought and obtained support for her idea from local civic groups, as well as Clyde Robin, a member and committeeman of the California Society for Preservation of Native Vegetation. He is a Castro Valley nurseryman and is a recognized authority on wildflower seeds and shrubs.

After inspecting the area recently, Mr. Robin reported that "there is no question in my mind that the valley contains a rich flora which may include a subspecies of *Eschscholzia* California (the California poppy) not known to be located elsewhere."

# # #

Here and There—

Plan Doubling Third Powerplant at Grand Coulee Dam

Plans were announced early this year for doubling the capacity of the proposed new third powerplant at Grand Coulee Dam, Wash., ultimately bringing that facility to 9.2 million kilowatts.

That much hydropower—more than the combined present total capacity at Grand Coulee, Hoover, Shasta, Oahe, Robert Moses-Niagara, St. Lawrence, and Chief Joseph Dams—doubles the third powerplant capacity from 3.6 million to 7.2 million kilowatts.

Although the accompanying artist's conception shows what changes the third powerplant would have made in the dam's right abutment, the newly announced enlargement will mean even more extensive alterations of a similar design.

Congress last year authorized adding the third powerplant to Grand Coulee's present 2 million kilowatts installed in the 1940's after the dam was built as the principal structure of the Columbia Basin Reclamation Project. The new plan is to install the authorized 3.6 million kilowatts in the form of six 600,000-kilowatt units and to design and construct the forebay to accommodate ultimate installation of 12 such units.

In addition to being a great power producer, pumps at the other end of the dam raise water to irrigate a highly fertile, but previously arid, 1-million-acre area of central Washington called the Columbia Basin project. Fish and wildlife enhancement and recreation benefits also have increased in the area.

East-West Electric Closure Successful

A significant East-West test closure of an interconnection of power systems was successfully completed last February 7, at four intertie points in Western United States, under the direction of a task force representing both public and private power entities.

At 9:49 a.m., m.s.t., the closure of an interconnection at the Bureau of Reclamation's recently completed Yellowtail Powerplant on the Bighorn River in south-central Montana intertied power systems representing about 94 percent of the generating capacity of the United States.

Some 265,000 miles of major transmission lines and 209 major public and private power systems with a generating capacity of 245 million kilowatts were involved. Major systems in eastern and western Canada were also tied into this single operating unit. The intertied systems represent about 40 percent of the world's electric power capacity.

Operations were directed and controlled from the Bureau of Reclamation's Watertown, S. Dak., Power Systems Operations Office. This is the control center for the Federal Missouri River Basin power system.

Engineering Campus for the World

The Bureau of Reclamation's Engineering and Research Center at Denver is an engineering campus for the entire world.

The staff of the Denver center has provided basic and special water and power resources training to more than 1,500 engineers and scientists from some 60 nations. Among the "graduates" of the Reclamation foreign training program is the Premier of Turkey, Suleyman Demirel.

Funds for the training are provided by the Agency for International Development, the United Nations, appropriate embassies, various funds and foundations.

Young Illinois Subscriber Likes Grand Coulee Dam

Dear Editor: Ever since we visited Grand Coulee Dam last summer, I have been interested in water projects. I subscribe to your magazine and enjoy reading it.

For my fifth grade assignment, I am making a booklet about the State of Washington. I want to put in as much information as I can about Grand Coulee Dam—its history, how it was built, and what it means to farmers, its electric power output—and all the other important dams in Washington.

I am sending you a check for $1 to pay for any material and photographs you can send me that would help. When I grow up, I would like to work with dams.

Thank you for your help.

Christopher Bone,
Palatine, Ill.

EDITOR'S NOTE: *Letters from our readers and requests for information are welcome. However, we prefer that no money be sent to this office.*

WITH THE WATER USERS

Mr. Boustead for Colo. | Mr. Jones for Nebr. | Mr. Goodrich for Wyo. | Mr. Ayers for Kans.

Four distinguished service awards of the Upper Missouri Water Users Association were presented at the 19th annual meeting of the Upper Missouri Water Users Association in Billings, Mont., last December.

These awardees shown in the group photograph are from left, Carl Kuehn of Washburn, N. Dak., Ralph Bricker of Great Falls, Mont. (Vernon S. Cooper, president of the Association, center, presented the awards), Earl Lloyd of Cheyenne, Wyo., and J. W. Grimes of Pierre, S. Dak.

Grimes, an employee of the Bureau of Reclamation from 1936 to 1955, at another ceremony, also received the distinguished service award of the South Dakota Reclamation and Water Development Association, and a cash award by a dairy from Sioux Falls, S. Dak.

Headgate Awards of the Four State Irrigation Council were presented last January at an annual council banquet in Denver, Colo. The first man to win the award posthumously was the late Charles H. Boustead of Colorado. The other awardees are Dan S. Jones, Jr., Nebraska; G. W. Goodrich, Wyoming; and John E. Ayers, Kansas.

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OREGON (Except Southern wedge)
(Region 1)
Fairgrounds, Fairview Ave. & Orchard St.
Boise, Idaho, 83707

CALIFORNIA (Northern & Central)
NEVADA (Northern & Central)
OREGON (Southern wedge)
(Region 2)
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Sacramento, Calif., 95813

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CALIFORNIA (Southern)
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UTAH (SW. tip)
(Region 3)
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Boulder City, Nev., 89005

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COLORADO (Western)
NEW MEXICO (NW. tip)
WYOMING (SW. tip)
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(Region 4)
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125 S. State St.
Salt Lake City, Utah, 84111

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OKLAHOMA
KANSAS (Southern half)
NEW MEXICO (Except W. third)
COLORADO (Southern wedge)
(Region 5)
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Amarillo, Tex., 79105

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NORTH DAKOTA
SOUTH DAKOTA
WYOMING (Northern)
(Region 6)
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NEBRASKA
KANSAS (Northern)
WYOMING (SE.)
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Ideal Salmon Facility for California Canal

TO KEEP their delivery rooms scrupulously clean, today's hospitals utilize many modern methods. Now comes the Bureau of Reclamation with a new device for cleansing the 3¼-mile-long "delivery room" it is preparing for salmon on a canal in California's Central Valley.

Reclamation designed and is building a cleaning rig to flush out fine silt that collects in the 30 inches of gravel on the bottom of spawning areas, suffocating eggs and fingerlings. The rig consists of a steel baffle extending across the waterway spawning ground; a wall-like structure, it is suspended from a carriage that straddles the canal and rides on rails along the banks.

The rig will be used in an artificial spawning area created on a new section of the 140-foot-wide Tehama-Colusa Canal, 115 miles north of Sacramento. As the baffle is lowered into the water to the level of the gravel, the normal flow of the canal will be restricted and forced at greatly increased velocity beneath the baffle, scooping the gravel off the bottom, washing it and dropping it downstream.

The mobile washing machine will clean the beds between spawning periods whenever silt deposits accumulate.

Digs Resting Pools

The rig can also be used to dig trenches in the gravel, thus creating resting places in which the salmon headed up the canal can recuperate at intervals from the exertion of their continual battle with the current.

The Tehama-Colusa spawning beds were planned by the Bureau of Reclamation and the Department of the Interior's Fish and Wildlife Service after considerable research conducted at the Bureau's laboratories in Denver and at the University of California.

From that research emerged the concept of the novel washing apparatus, which will be built in sections and assembled at the site.

That section of the canal in which the spawning grounds will be developed will be a dual-purpose waterway. The 3.2-mile-long reach directly below Red Bluff Diversion Dam on the Sacramento River in Tehama County will not only create an artificial spawning area; it also will constitute the initial stretch of a 122-mile canal which will carry millions of gallons of water to irrigate thirsty acres along the west side of the Sacramento Valley.

Such dual-purpose use of a canal on a major scale is a first in the history of conservation in the United States.

The salmon will find near-ideal conditions for spawning in the manmade nurseries: gravel carefully selected to conform with that found in the best natural beds, and water from nearby Shasta and Trinity Reservoirs in the suitable 50° to 55° temperature range, flowing above the bed at a controlled velocity of from 1.2 to 3.5 feet per second, and with its naturally high oxygen content unimpaired. The canal stretch will have a normal depth of 6 to 8 feet.

The Spawning Beds

Branching off from the end of the dual-use channel, two other canals will be built side by side, each a mile long. These twin canals will also be lined with gravel to create artificial spawning beds. And a single concrete-lined access canal will be built from the twin canals to Coyote Creek, which flows into the Sacramento River, thus furnishing a highway for the salmon back to the river and on out to the sea.

After completion of the artificial nursery, some of the adult fish headed up the Sacramento River intent upon laying their eggs north of Red Bluff Dam will be trapped and planted in the new beds.

Management of the fish transfers and overall biological control of the operations will be conducted by the Bureau of Sport Fisheries and Wildlife. These operations will be coordinated with the Bureau of Reclamation's needs for furnishing water for irrigation, municipal, and industrial use through the entire length of the Tehama-Colusa Canal.

After the eggs hatch, the fingerlings will start down the Tehama-Colusa on their journey to the Pacific Ocean. Drum fish screens will guide them out of the main canal into the canals which flow into Coyote Creek.

Three or four years later these fish will instinctively return up the Sacramento and into the Tehama-Colusa Canal to their birthplace to lay their eggs. Eventually a Tehama-Colusa strain of salmon is expected to develop, and trapping at the Red Bluff Dam will no longer be necessary. The beds will be able to accommodate annually about 40,000 salmon, producing 140 million eggs.

In addition to creating new artificial spawning beds below Red Bluff Dam, the Bureau's construction of the Tehama-Colusa Canal will be used to help improve natural spawning conditions in both Thomes and Stony Creek, which flow into the Sacramento. They contain good natural gravel beds, but their erratic flow reduces their effectiveness as spawning areas. The Bureau plans to make continual releases from the canal into these streams to maintain the fishery and, during spawning season, will make further releases to attract the salmon.

To Avoid Fish Losses

Development all along the Tehama-Colusa Canal is being accomplished with a view to mitigating any fish losses inherent in the construction as well as providing new spawning facilities and enhancing existing spawning areas.

In line with this policy, fish ladders have been built at Red Bluff Dam to avoid blocking fish on their way upstream to their natural spawning beds. Just downstream from the dam a series of louvers will be installed to discourage fingerlings hatched above the dam from wandering out of the river and into the canal.

A "velocity barrier" has been designed to keep those fingerlings hatched in the canal from venturing into the desilting basin above the spawning areas and being drawn into the Corning Canal pumps. This will be achieved by narrowing the canal to increase the velocity of the water so as to impede the progress of the young fish. In addition, electronic devices will be installed to count the number of downstream migrating fingerlings.

Development of the spawning grounds in the canal and improvement of the nearby natural beds resulting from other facilities built in conjunction with the canal are expected to increase the value of the Sacramento River salmon fishery by an estimated $1 million annually.

The Tehama-Colusa Canal is part of the Sacramento Canals unit of the Central Valley project. Construction on the canal began in July 1965. The initial contract for building the desilting basin and velocity barrier was awarded to Durtzer and Dutton of Reno, Nev., in January 1966.

The contract for the main spawning facilities will be awarded in July 1967. # # #

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-6459	Pacific Northwest-Pacific Southwest, Intertie, Ariz.	Jan. 6	Construction of Liberty substation and 10.8 miles of Liberty-Estrella 230-kv transmission line, Schedules 1 and 2.	Wismer & Becker, Sacramento, Calif.	$2,096,53
DC-6472	Central Valley, Calif.	Jan. 20	Construction of San Luis operation and maintenance center	Cortelyou & Cole, Inc., Mountain View, Calif.	1,699,93
DC-6475	Missouri River Basin, Iowa.	Mar. 2	Construction of stage 03 additions to Spencer substation	Capitol Electric & Engineering Co., Denver, Colo.	175,06
DS-6476	Colorado River Storage, Colo.	Jan. 23	Three 20,000/26,667/33,333-kva autotransformers for Midway substation, stage 01.	Legnano Electric Corp., New York, N.Y.	217,92
DS-6478	do	Feb. 6	Two 230-kv power circuit breakers for Curecanti substation	Westinghouse Electric Corp., Denver, Colo.	126,27
DS-6483	Pacific Northwest-Pacific Southwest, Intertie, Nev.	Feb. 14	Two 230-kv power circuit breakers for Mead substation	do	134,71
DC-6488	Central Utah, Utah	Mar. 7	Construction of Starvation Dam and roads utilizing soil cement on upstream slope, Parts A and C.	Goodfellow Brothers, Inc., Wenatchee, Wash.	8,182,75
DC-6489	do	Mar. 17	Construction of Starvation feeder conduit, Sta. 15+50 to 116+75, 1 mile concrete-lined Starvation tunnel, 3,500 feet of 84-inch-diameter precast concrete pipeline, outlet channel, and structures, Schedules 1 and 2.	W. W. Clyde & Co., Springville, Utah.	1,250,03
DC-6490	Pacific Northwest-Pacific Southwest, Intertie, Nev.	Feb. 27	Site grading of alternating-current and direct-current switchyard, and construction of 3.4 miles of access and service roads and 3.8 miles of water supply line for Mead substation, Schedule 1.	Charles T. Parker Construction Co., Inc., Las Vegas, Nev.	555,40
DC-6492	Central Utah, Utah	Mar. 10	Construction of Knight Diversion Dam and access road	United Structures, Inc., Dolores, Colo.	537,33
DS-6498	Missouri River Basin, Iowa.	Mar. 27	Two 161-kv power circuit breakers for Creston substation	Allis-Chalmers, Denver, Colo.	109,49
DS-6506	Columbia Basin, Wash.	do	Eight 230-kv power circuit breakers for Grand Coulee powerplants and consolidated switchyard, Schedule 1.	I-T-E Circuit Breaker Co., Los Angeles, Calif.	804,85
Do	do	do	Two 230-kv power circuit breakers for Grand Coulee powerplants and consolidated switchyard, Schedule 2.	Cogenel, Inc., New York, N.Y.	163,37
100C-889	do	Feb. 8	Construction of 11 miles of buried pipe drains and deepening open ditch wasteway and drain for Blocks 45 and 47, Schedules 1 and 2.	John M. Keltch, Inc., Pasco, Wash.	188,83
100C-902	Crooked River, Oreg.	Feb. 15	Construction of 14 miles of unlined and 1.7 miles of concrete lined canals, 2.1 miles of pipelines and laterals for Crooked River extension.	Equipco, Inc., Ephrata, Wash.	306,90
100C-905	Columbia Basin, Wash.	Mar. 10	Construction of 9.3 miles of buried pipe drains and .5 mile open ditch drain for DW54F drain and D78-101 and D78-96K drain systems, Block 78, Schedule 2.	do	195,98
300C-257	Colorado River Front Work and Levee System, Ariz.	Jan. 17	Construction of earthwork, bank protection structures, Sta. 1872+50 to 2000+00 and 7.9 miles of haul roads.	Arrow Construction Co. of Ariz., Inc., Yuma, Ariz.	153,64
500C-245	Pecos River Basin Water, Salvage, N. N. Mex.	Mar. 15	Clearing of phreatophytes from flood plain of Pecos river and tributaries for Unit No. 1.	Joe P. Starr, Albuquerque, N. Mex.	155,92

Major Construction and Materials for Which Bids Will Be Requested Through May 1967*

Project	Description of work or material
Baker, Oreg.	Raising existing road for a distance of about 4,500 lin ft and constructing a 2-lane, 58-ft-long concrete bridge. About 17 miles southwest of Baker.
Central Utah, Utah	Four 4- by 5-ft high-pressure gate valves, hoists, and conduit lining for Starvation Dam.
Central Valley, Calif.	Constructing about 10 miles of 2,300-cfs-capacity concrete-lined canal with underdrains, including concrete siphons, concrete bridges, and an earth-lined reservoir. Tehama-Colusa Canal, Reach 1, Sta. 197± to Thomes Creek. South of Red Bluff.
Do	Constructing 3.1 miles of reinforced concrete-lined, dual purpose canal, with 100-ft bottom width and 2,530-cfs capacity, with 30-in. spawning gravel; 1 mile of unreinforced concrete-lined, twin spawning channels with 30.5-ft bottom width and 115-cfs capacity, with 30-in. spawning gravel; and 1 mile of unreinforced concrete-lined channel with 12-ft bottom width and 230-cfs capacity. Work will also include extensive fish handling and counting facilities and administration and storage buildings. Tehama-Colusa Canal, Reach 1, Sta 29± to 197±. Near Red Bluff.
Do	Constructing 72 miles of 10- through 54-in.-diameter pipeline with heads varying from 25 ft through 175 ft, and five water screen and recirculating structures. Westlands Pipe Distribution System, Laterals 8-12. Near Mendota.
Do	Earthwork and structures for installing 2,600 ft of 15-in. reinforced plastic mortar pressure pipe. Westlands Lateral 7-9.5S. Southwest of Fresno.
Do	Excavating about 130,000 cu yd of unclassified earth and rock material from Area No. 2 and hauling to disposal area about 0.75 mile downstream. Trinity Dam, near Lewiston.
Central Valley, Calif.	Three vertical-shaft, single-suction, double volut casing centrifugal pumps with a capacity of 22 cfs at a total head of 197 ft at a speed not exceedin 360 rpm, complete with 7,000-hp electric motors three vertical-shaft, single-suction, double volute casing centrifugal pumps with a capacit of 125 cfs at a total head of 197 ft at a speed no exceeding 450 rpm, complete with 4,000-hp elec tric motors; three vertical-shaft, single-suction single or double volute casing centrifugal pump with a capacity of 45 cfs at a total head of 197 ft at speed not exceeding 720 rpm, complete with 1,25 hp electric motors. Butterfly valves for each uni with hydraulic valve operating system will als be required. Pleasant Valley Pumping Plant.
Chief Joseph Dam, Wash.	Constructing 3 pumping plants of precast concret piles upon which concrete decks are to be place for mounting 6 pumping units (2 per plant) wit capacities varying from 5.75 to 2.75 cfs, and con trols. The structures will extend into the rive and will have from 40- to 48-ft long and 15-ft-wid decks for access to the pumping units and suppor for discharge pipes. Constructing about 2,90 ft of discharge lines. Auxiliary Pumping Plant 1, 2, and 3, on the Okanogan River, south o Oroville.
Do	Constructing Toats Coulee Diversion Dam with a 40-ft-long concrete weir and a reinforced concret sluiceway and headworks; and constructing th 6-mile Sinlahekin Siphon, a precast concret pipeline of 18-, 36-, 39-, and 45-in. diameters, an an outlet structure. Ten miles northwest o Tonasket.

U.S. GOVERNMENT PRINTING OFFICE: 1967 O—247-970

Major Construction and Materials for Which Bids Will Be Requested Through May 1967*—Continued

Project	Description of work or material
Colo. R. Front Work & Levee System, Ariz.	Earthwork and structures for 8.5 miles of reinforced concrete pressure pipe, including 6.2 miles of 66-in. pipe and 2.3 miles of 48- to 60-in. pipe. At Yuma.
Do	Constructing roads and bank protection structures about 10 miles below Parker.
Do	Constructing a timber bridge at Needles, Calif.
Colo. R. Storage, Ariz.	Furnishing material and placing 0.5-in. bonded terrazzo finish on floors and stairs in Glen Canyon Powerplant; furnishing and applying polyurethane resin coating to walls in elevator tower and some powerplant walls; and furnishing and installing suspended acoustical ceiling in right abutment adit to the powerplant. Near Page.
Colo. R. Storage, Colo.	Constructing Rifle Substation, Stage 01. Four miles south of Silt.
Do	Constructing Midway Substation, Stage 01. Near Midway.
Do	Constructing a prefabricated metal pumphouse, a sprinkler irrigation system, and landscaping about 3.7 acres. Power Operations Center at Montrose.
Do	Constructing about 87 miles of single-lane unsurfaced access roads with culverts, fence gates, and one bridge, between Cortez and Montrose.
Columbia Basin, Wash.	Earthwork and structures for about 15 miles of earth-lined canal with bottom widths of 32 and 30 ft; 4 miles of concrete-lined canal with a 10-ft bottom width; and 8.4 miles of unlined wasteway channel with a bottom width of 8 ft. Wahluke Branch Canal and Saddle Mountain Wasteway, near Othello.
Do	Enlarging Potholes Canal, Sta. 2477+00 to 3104+00. West Eltopia.
Do	Constructing 28 miles buried pipe drains and 1 mile open drain, west of Connell.
Do	Constructing 2.8 miles of buried pipe drains and 0.1 mile open drain, south of Moses Lake.
Do	Constructing 0.4 mile of buried pipe drain and about 2 miles of open drain, southwest of Eltopia and west of Mesa.
Do	Solid state relaying equipment for Grand Coulee Consolidated 230-kv Switchyard.
Do	The work will include, but is not limited to, rebusing and reconnecting the units in the existing Right and Left Grand Coulee Dam Powerplants, combining the existing right and left 230-kv switchyards into a single consolidated 230-kv switchyard located on the left side of the river, and replacing the existing overhead 115- and 230-kv circuits from the powerplants to switchyards with new 115- and 230-kv cable circuits running from the existing powerplants through the dam to the combined switchyard. Most of the existing electrical equipment in the switchyard will be replaced with new equipment which will be Government furnished. Most of the electrical equipment in the powerplants will be retained, and will remain in service throughout the construction, brief outages for reconnection excluded. However, additional Government-furnished switchgear assemblies are to be installed for each unit in the powerplant. The existing right and left 230-kv switchyards will remain energized throughout the construction period. Power deliveries will be made from completed portions of the newly constructed switchyard as they become available. During the work in the powerplants, the inplace electrical equipment must be protected from construction dust and falling particles. About 28 miles northeast of Coulee City.
Do	Two 345-kv and seventy-three 230-kv disconnecting switches; and one 115-kv and seventeen 230-kv interrupter switches for Grand Coulee 230-kv Consolidated Switchyard.
Do	230-kv and 115-kv high-pressure oil pipe-type cables for Gand Coulee Left and Right Powerplants.
Fryingpan-Arkansas, Colo.	Constructing roadbed and structures for about 16 miles of relocated Denver and Rio Grande Western Railroad. Adjacent to and west of Pueblo.
MRBP, Iowa	Constructing Creston Substation Additions, Stage 03.
MRBP, Kans.	Constructing Cawker City Dike, an earthfill structure about 50 ft high and 15,000 ft long, and a small concrete outlet works. Slope protection on the reservoir side of the embankment will be one of three alternates: (1) riprap on bedding (2) soil-cement, or (3) asphaltic concrete. The outlet works will consist of an intake structure, a 3-ft-diameter steel-lined concrete conduit, pump and control house, stilling basin, and service bridge. Constructing two new water supply wells, two pumping and chlorination plants complete with equipment and water supply piping, constructing a sewage chlorination building and chamber and a sanitary sewer drain from existing sanitary facilities to exit through the outlet works structure. Heating and ventilating systems and electrical controls will be required. Work will also include earthwork, structures, and bituminous surfacing for about 1.1 miles of county road, bituminous surfacing of about 0.8 mile of county road, and earthwork and structures for 0.1 mile of city street. Near Cawker City.
MRBP, Kans.	Constructing about 3 miles of unlined canals and laterals with bottom widths of 8, 4, and 3 ft and with capacity varying from 15 to 4 cfs; and constructing two pumping plants, one with three units of 3.34-cfs capacity and one unit of 6.68-cfs capacity, and the other plant with three units of 3.34-cfs capacity at a maximum head of 36 ft. Near Superior, Nebraska.
MRBP, Mont.	Constructing an auxiliary outlet works attached to the existing canal headworks structure in the left abutment of Tiber Dam. Work will include constructing a tunnel, a tunnel drop, a gate chamber, shaft, control house, chute, and stilling basin About 23 miles southwest of Chester.
Do	Work will consist of restoring and resurfacing 4.2 miles of access road and widening and resurfacing service roads to top of Yellowtail Dam, powerplant, switchyard, spillway inlet, and parking areas. At Fort Smith.
Do	Additions to the Yellowtail Switchyard will consist of constructing concrete foundations; furnishing and erecting steel structures; installing one 230-kv circuit breaker, and associated electrical equipment, major items of which will be Government furnished. At Fort Smith.
MRBP, Nebr.	Furnishing and placing about 2,800 steel jacks along the banks in Frenchman Creek, between Enders Dam and Wauneta.
Do	Relocating about 0.95 mile and reconstructing about 0.64 mile of the existing Sidney-Ogallala 115-kv, wood-pole, H-frame Transmission Line and salvaging materials from about 1.32 miles of existing line. Near Brule.
MRBP, N. Dak.	Three vertical-column, single-stage, dry pit pumps with two interchangeable bowls and impellers for different head ranges, 685-cfs minimum capacity each, total head range 2 to 76 ft; and three 9,000-hp, 200-rpm, vertical-shaft electric motors. Model tests will be required. Snake Creek Pumping Plant No. 1.
MRBP, S. Dak.	Constructing Stage 02 additions to Pierre Substation.
MRBP, S. Dak. and Nebr.	Complete testing of steel towers for Fort Thompson-Grand Island 345-kv Transmission Line.
Pacific Northwest-Pacific Southwest Intertie, Ariz.-Nev.	Constructing the Mead Substation will consist of clearing right-of-way, constructing concrete footings, and furnishing and erecting steel structures for the taplines to the substation; constructing a service building; constructing substation concrete foundations; furnishing and erecting steel towers; installing one 3-phase, 450/600-mva, 345/230/25-kv transformer, one 3-phase, 3,000-kva, 230/13.8-kv transformer, one 3-phase, 345/230/25-kv transformer, seven 345-kv, twenty-six 230-kv, and four 25-kv circuit breakers, twelve 1-phase, 8,000-kva shunt reactors, and associated electrical equipment, major items of which will be Government furnished; and fencing the substation area. Near Boulder City.
Do	Enclosed switchboard assemblies for Mead Substation and carrier current relaying equipment for Mead, Basic, and Amargosa Substations, and Davis and Hoover Powerplants.
Parker-Davis, Ariz.	Constructing a new 7,500 gpd extended aeration process sewage treatment plant with facilities for chlorinating effluent. Contractor will furnish and install all materials and equipment. Davis Powerplant, near Kingman.
San Juan-Chama, N. Mex.	Constructing Heron Dam and Dike, both earthfill structures. The dam will be about 265 ft high, 1,250 ft long, and will contain about 2,700,000 cu yd of material. The dike will be about 78 ft high, 2,370 ft long, and will contain about 450,000 cu yd of material. Appurtenant features will consist of a 40-ft concrete, ungated, ogee spillway crest and a concrete chute in the left abutment of the dike. The outlet works will consist of a 10-ft-diameter pressure tunnel, an inlet structure, a gate chamber and shaft and a 14-ft 6-in. diameter tunnel downstream containing an 111-in. steel pipe, a control structure, and a stilling basin in the left abutment of the dam. Work will also include relocating about 8.4 miles of State Highway No. 95. On Willow Creek, about 25 miles southwest of Chama.
Do	One 7.25- by 9.25-ft outlet gate and two 5- by 6-ft outlet gates and liners for Heron Dam.
Seedskadee, Wyo.	Constructing a cofferdam, unwatering and cleaning the outlet works stilling basin, excavating slide material from the channel, replacing backfill, and repairing eroded concrete surfaces. Work will also include erecting safety fencing and removing an existing cofferdam in the spillway outlet channel. Fontenelle Dam, about 24 miles southeast of LaBarge.
Washoe, Calif.-Nev.	Four 4- by 5-ft outlet gates and liners for Stampede Dam.

*Subject to change.

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

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RECLAMATION ERA

August 1967

PRESIDENT VISITS CONFERENCE *(See picture caption and Pres. Johnson's speech inside)*

August 1967 • Vol. 53, No. 3

RECLAMATION
ERA

Gordon J. Forsyth, Editor

CONTENTS

COVER PHOTO. President Lyndon B. Johnson, second from right, was keenly interested in the numerous exhibits and in comments by the people present at the Water for Peace conference last May. The man talking with the President is unidentified, as is the smiling lady observer standing below the French sign reading: "water for food." (President Johnson's speech starts on the opposite page).

In the photograph on the opposite page, President Johnson, left, and Interior Secretary Udall pause for a comment in the exhibition hall of the water conference.

Commissioner's Page

Skywater

Mark Twain used to have an old saw: "Everybody complains about the weather, but nobody does anything about it." But today that just isn't so.

It is now evident that we can*—when conditions are right—do something about the weather. We can milk from clouds more precipitation in the form of rain or snow than would naturally fall. Actually, this effort to improve upon nature has come a long way, particularly in the last 15 years.*

From region to region the need for water differs, but finding additional supplies of it is a must. *Some States have shortages right now and are developing their last available surface and underground sources. By the year 2000 many major areas will have a critical need for greater supplies that are not presently in sight.*

The Bureau of Reclamation's weather modification effort—called Project Skywater*—is aimed initially at learning the circumstances under which it is feasible to increase flow into its reservoirs.*

This augmentation of rain or snowfall by the work of Project Skywater *is not the complete solution to the water problem. The situation is too complex for that. But the efforts of the Bureau of Reclamation in this area give promise of adding a fourth dimension to water supply efforts.*

Like obtaining water from the ocean by desalinization, controlling our surface streams and lakes, and managing underground water, Project Skywater *holds an exciting challenge in our future.*

Floyd E. Dominy
Reclamation Commissioner

WATER —*The Key to Sustaining Growth*

President Johnson Addresses The Water for Peace Conference

TODAY, man is losing his race with the growing need for water," said President Lyndon B. Johnson to the delegates attending the opening of the first International Conference on *Water for Peace* in Washington, D.C. last May 23.

"How well—and how long—" the President earnestly asked the large assembly from 91 nations, "can the earth sustain its evergrowing population?" Then he emphasized: "As much as anything, water holds the key to that question: Water to drink; water to grow the food we must eat; water to sustain industrial growth."

Secretary of the Interior Stewart L. Udall, who was President of the historic conference, introduced President Johnson to the enrollees and guests attending at the Sheraton Park Hotel, then accompanied him on an inspection of the numerous exhibits.

President Johnson and Secretary Udall found several exhibits to be of special interest.

President Johnson recalled his own first-hand experience with the realities of water problems, in his speech. He also challenged his listeners to take vigorous action and leadership, and he proposed the creation of a global network of regional water resource centers with vital jobs to do.

His speech follows:

"Distinguished delegates, Members of Congress, honored guests, ladies and gentlemen: This conference has a vital mandate. The questions you will consider deal directly with the future of life on earth. No President has ever welcomed a gathering with greater expectations.

"I come from land where water is treasure. For a good many years, I have done my share of agitating to increase the water resources of my native state. I have known the frustrations of this task. A member of the Texas legislature once recited some lines on this subject:

"Oh the glamor and the clamor
That attend affairs of state
Seem to fascinate the people
And impress some folks as great.

"But the truth about the matter,
In the scale of loss and gain:
Not one inauguration's worth
A good, slow two-inch rain!"

"As man faces the next century, one question stands above all others: How well—and how long—can the earth sustain its evergrowing population?

"As much as anything, water holds the key to that question: Water to drink; water to grow the food we must eat; water to sustain industrial growth.

"Today, man is losing his race with the growing need for water. We face, on a global scale, the plight of the Ancient Mariner:

"Water, water, everywhere—
Nor any drop to drink."

"For a planet two-thirds covered with water this is a strange shortage. There is so much plenty all around us. Yet 97 percent of our waters are in the oceans—thus far, but I hope not for long, of little use for drinking or irrigation.

United States Department of the Interior, Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy, Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

"Another 2 percent lies frozen in glaciers and icecaps. The 1 percent remaining could meet most of man's needs—if only it were distributed when, and where, we need it. But today, while millions suffer the ravages of storms and floods, other millions are thirsty.

"While men barely tap the abundance of lakes and rivers and streams, other men watch their crops shrivel with drought.

"More and more, people dwell in cities, where clean water means the difference between sickness and health. Yet today, 40 percent of the world's city dwellers—four out of 10—have no water service.

About The Future?

"If this is the problem now, what will the future bring? By the year 2000, the world's population will have doubled to 6 billion. Our need for water will have more than doubled.

"I call upon this conference to take, as its point of perspective, the year 2000. Imagine, as you meet here, that you are facing the needs of your children and your children's children. Examine what we must do to move the world from now until then.

"Ask yourself the big questions:

- How can we engineer our continents and direct our great river systems to make use of the water resources we now waste?
- How can we tap the vast underground waters now undeveloped?
- How can we modify the weather and better distribute the life-giving rain?
- How can we desalt the waters of the ocean and freshen brackish waters?
- How can we use our water supplies again and again before yielding them to the sea?
- How can we curb the filth that pollutes our streams?

"During the past 3 years I have proposed and the Congress has supported programs in each and all of these areas—Water Managment, River Valley Development, Desalting, Pollution Control, and Research on Weather Modification. But we have barely begun.

"And you must consider the most important question of all: How can we awaken the world's people and the world's leaders to this urgent task?

"Even at the risk of being called dreamers, you must ask these questions, and seek the answers. Unless you do, you will not measure the true dimension of mankind's great need. You must chart the specific steps toward a more abundant future.

To Quicken The Pace

"One step must be this: To quicken the pace of science and technology. Last week, I signed an Act of Congress to make possible a new plant which will more than double the world's present capacity for desalting water.

"A decade ago, the best plant design could produce only 50,000 gallons per day at a cost of $5 per thousand gallons. This new plant, powered by nuclear energy, will eventually produce 150 million gallons of fresh water per day—at a cost approaching 20 cents per thousand gallons. That is 3,000 times as much, at one-twenty-fifth the cost!

"But the world needs fresh water at even lower costs. This is my country's pledge: To continue work in every area which holds promise for the world's water needs. And we pledge to share the fruits of this technology with all who wish to share.

"American scientists will begin discussions next month with India on experimental rainmaking projects which may hold promise for drought-ridden countries all over the world.

"A second need is to train more manpower. We must attract the best technicians and planners to this life-giving science. And we must devise programs to educate all our people in the wiser use of water.

Conference enrollees were able to exchange ideas one with another in lectures, by casual chatting, and through the publications available. Here, enjoying one of the latter, the May issue of the *Reclamation Era* are, at left, Mahammed Takkiddine, Lieutenant Commander of the Syrian Navy; and Farouk Adhami, 3d Secretary, Embassy of the Syrian Arab Republic.

"Third: We need to build better institutions for managing water resources. This point cannot be overstressed. We need improved management as much as we need new technology.

"We must support the United Nations and the international agencies which provide world leadership in this field. We must develop more effective forms of local, national, and regional cooperation. For this truth is self-evident: Neither water nor weather is a respecter of boundary lines.

"But we also need to create strong regional offices throughout the world to provide leadership and stimulate cooperation among nations. The United States is prepared to join others in establishing a network of regional Water Resource Centers. We will provide our fair share of the expert assistance, the supplies and the equipment, and the financing.

"We are confident that the United Nations and other international organizations represented here

This sunset view showing recreational advantages of Shasta Reservoir in California is one of over a hundred Reclamation photographs chosen for illustrative purposes by exhibitors at the conference. *(Photo by A. G. D'Alessandro)*

today can and will play a key role in this enterprise. We should seek to put the first two centers in operation within 24 months—to serve as the spur and the goad in promoting Water for Peace.

"Finally, we need to support new programs in water resource development. Projects of international cooperation must be multiplied many times—like those now underway in the Mekong and the Indus River basins.

Not Using Imagination

"Frankly, I am not statisfied with the progress now being made. We are not using all the imagination and enterprise that this task demands. We need agents who will push and prod and shove ahead our international efforts.

"We need planners to help develop concrete projects, financial experts who know how to interest the world's lending institutions, educators to recruit and train skilled manpower.

"To set top priority for these endeavors in our own Government, I have directed the Secretary of State to establish a Water for Peace Office. Its major role will be to lead and coordinate this country's efforts in the world's water programs.

"We have called this conference to learn—and to share. No group could have a more exciting mission. You study the life-cycle of our planet. You deal with nature's elements as men have always known them: The river, the sea, the sun, and the sky.

"Man once looked to these elements and found his poetry. Now he must find his preservation.

"You will grapple with the political as well as the physical problems of mankind, For ages past, men have fought over water without adding one single drop to the world's supply.

"Now we share the challenge to use water—more abundant water—as the enduring servant of peace. Let this be your vision during the next week—and in the years to come.

"Thank you." # # #

NO POWER CABLES IN SIGHT

Yellowtail Dam and the water below it in the Bighorn River are well complimented by Montana's moonlight and electric lighting. The powerplant is the rectangular structure in the lower left area close to the water.

Streamlined Look At Yellowtail Dam in Montana

THE things different about the appearance of Yellowtail Dam are: that it is located in the spectacular Bighorn Canyon; and the skyline over the gracefully curved structure has no sign of the conventional steel towers and conductor wires normally seen with high voltage transmission.

Emerging from an underground tunnel about one-third of a mile from the dam are its modern transmission cables which are the means of preserving the scenic "no transmission lines" view back at the dam.

This underground method of power transport which the Bureau of Reclamation built, will carry high voltage electricity through two power lines encased in pipes filled with more than 5,000 gallons of oil serving as an insulation and cooling medium. The two oil-filled conduits, one a little larger than the other, run side-by-side through the tunnel starting at the 250,000 kilowatt-capacity powerplant down at the toe of the dam.

With a diameter of 8 inches, the larger of the two conduits contains three, single conductor cables which comprise one 230-kilovolt transmission line. The smaller pipe contains three cables comprising a 115-kilovolt line.

Sloping Tunnel

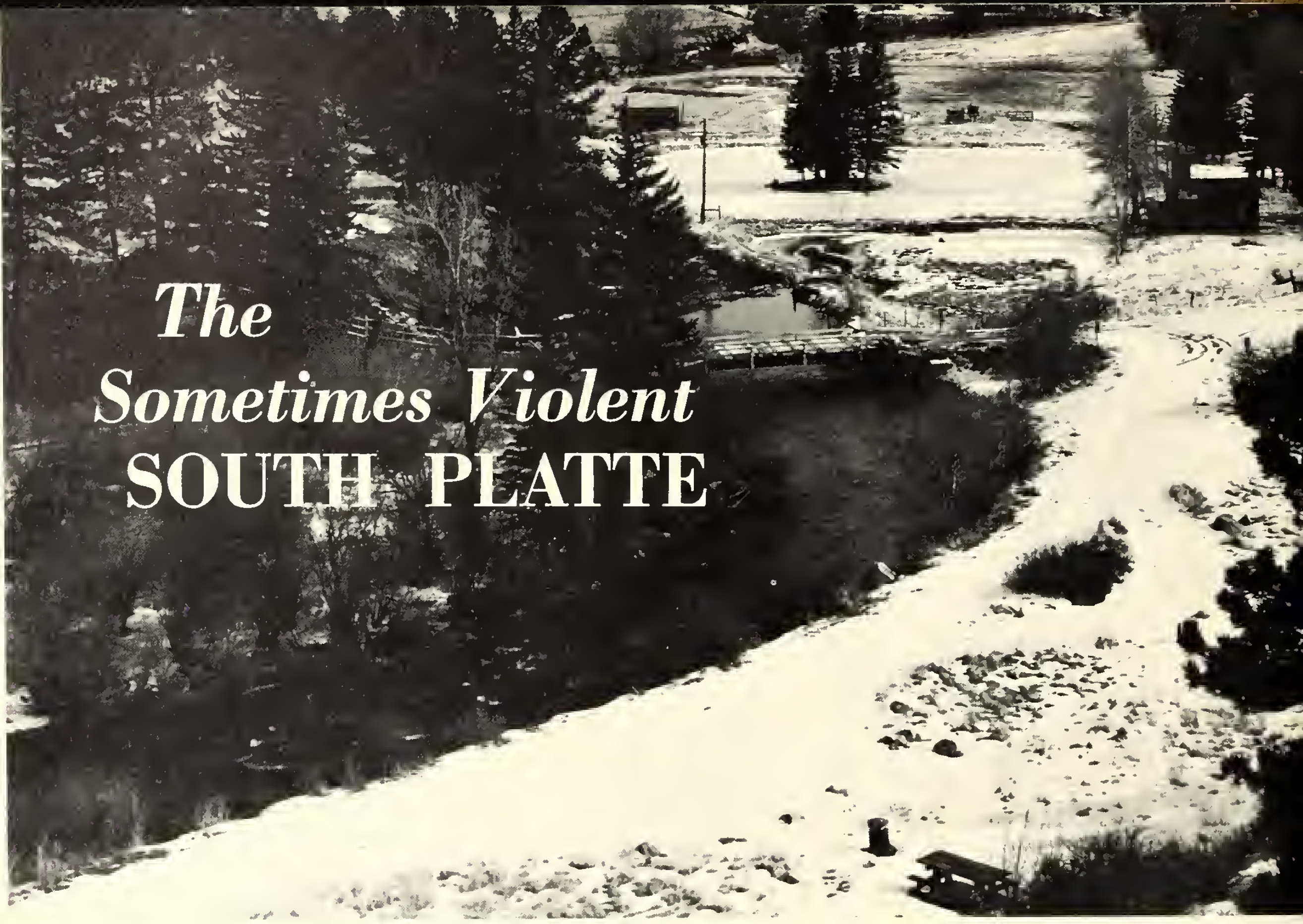
Inclined steeply upward, the man-sized tunnel extends from the powerplant through the right abutment of the dam and the canyon wall, ending its 630-foot ascent a third of a mile away at the switchyard on the ground surface.

Yellowtail's entire power facility was finished, and the power operation begun, in the fall of 1966. The power being produced is fully integrated with the more than 2.4 million kilowatts of hydro capacity of other Federal developments in the expansive Missouri River Basin, and it is distributed by local utilities to millions of homes in cities and on farms.

The dam itself is only 2 years old. At 525-feet, it is the highest dam in the tributary system of the Missouri River. In addition to its modern power facilities and streamlined look, Yellowtail's established fundamental benefits are irrigation, flood and sediment control, and fish, wildlife and recreation enhancement. And in the opportunities that relate to these fields, there will be new growth for the area.

# # #

Shown here is a cross-sectional model depicting how the three single conductor cables rest on the bottom of the 8-inch, oil-filled pipe. The three copper cables appear to be large dots inside dark wrappings of insulation paper.



The Sometimes Violent SOUTH PLATTE

by **NELLO CASSAI**
Region 7 Information Officer

PERHAPS no river in America is less impressive than the South Platte, yet so spectacular in its achievements.

It beckoned the trapper to the fabulous Rocky Mountain fur trade and marked the route of the Pikes Peak gold rush.

It was often an illusion to early travelers seeking water and yet today it supports the greatest population center between Kansas City and the West Coast.

It flows right through the heart of Denver and yet it goes largely unnoticed, even unseen. In flood, however, it's a savage.

Intersecting what was once known as the Great American Desert, the South Platte has created agricultural riches but has never been navigable.

Sometimes, when the season has been long and dry, and municipal and irrigation demands heavy, the Platte all but disappears as a living stream.

Fremont tried boating it on one of his expeditions and gave it up. Some of the fur traders used the river, in proper seasons, to float bales of skins down to Missouri River trading posts.

But "the river that flows upside down" has never been a reliable waterway.

It performs its hurculean tasks today only because man has been ingenious and watchful, annually bolstering its strength with massive transfusions of water from the other side of the Continental Divide—a physical transfer, chiefly from the drainage of the Pacific Ocean to that of the Atlantic.

The South Platte rises in central Colorado and flows generally northeastward.

Its Mountain Energy

Sapped of its mountain energy by the numerous demands made on it, the stream leaves the State near Julesburg and joins the North Platte to become the Lower Platte River near the city of North Platte, Nebr.

Downstream is where the fur trappers, coming up the Missouri River, first saw it. And they were the ones who named it—"platte" being the French term for broad or flat.

Rivers of the West

Former President Eisenhower fished in this area when he visited his "Summer White House" in Colorado. *(Photo by A. E. Turner)*

During the rampage shown below at least two lives were lost.

Had the French explored the river from its source they would have given it another name.

For the stream at birth plunges down the towering slopes of the Rockies icy and clear, and sometimes violent. Here there were deer, bear, bighorn sheep and mountain lion.

Huge colonies of beavers dammed and diverted the stream to provide homes and regulate the flow of water.

Out of the mountains the river meanders through a vast and beautiful meadow known as South Park.

High but sheltered, this was a popular wintering ground of Indians and many famous mountain men—including Kit Carson and Jim Bridger. Buffalo and antelope sought food and shelter here by the thousands. The smell of wood smoke and roasting meat were the rewards of the hardships.

Here too under the banks and in deep pools created by sand and gravel bars lay the cutthroat trout, hungering for grubs or insects—or imported English flies.

The upper reaches of the Platte still provide good trout fishing today, despite the encroachment of civilization.

Colorado Spinner

Story has it that the Colorado spinner was devised on the banks of the South Platte in the river's canyon just south of Denver.

Fishermen in the early days caught the narrow gage train out of Denver and got off along the Platte when they saw some lively looking water. On this day, two fishermen were waiting for the train to return them to Denver when one idly flipped into the water a small metallic trademark he had picked off a plug of chewing tobacco.

A big trout is said to have lashed at the fluttering object and thus was born the idea of a popular fishing lure.

The South Platte Basin embraces more than 24,000 square miles of land, most of it in Colorado. Dimensions of the basin are 240 miles in an east-west direction, 175 miles north and south, and 270 miles diagonally.

Elevations range from more than 14,000 feet to 2,800 feet at the mouth of the South Platte.

The drop near its source is more than 1,000 feet per mile. At its lower reaches it averages 8 feet per mile.

Remarkable is the fact that although a small boy can throw a rock across the South Platte above Denver, this unique stream and its tributaries provide municipal and industrial water for a basin population of 1.4 million.

More than 1.1 million of these people (over half the population of Colorado) are concentrated in the six-county Denver metropolitan area, site of the first gold discoveries in the late 1850's.

Producing Land

Irrigated land comprises about 980,000 of the 15 million acres of land in the basin.

The value of crops and livestock produced on this land runs into the millions of dollars.

Additional millions are added by that great quick-buck cash crop known as the American recreationist.

This production, remember, is achieved on land written off by explorers in the early 1800's as uninhabitable—"600 miles of plains, treeless, waterless, barren . . . fit only for Nomadic tribes of Indians, Tartars, or Buffaloes."

The discovery of gold near the confluence of Cherry Creek and the Platte at the present site of Denver focused attention on the area 110 years

A trading post built by Louis Vasquez near Denver was captured and looted by Arapaho raiders in 1842. Now it is restored as a historical monument.

ago. Actually, the Rockies had been rather thoroughly explored and considerably traveled before Cherry Creek got into the news of the day.

The Overland Trail up the North Platte and over South Pass in Wyoming was a well-established roadway for three earlier historic migrations—the Oregon pioneers, the Forty-Niners to California and the Mormons to Utah. But even before these mass movements, the Colorado Rockies were crossed by conquistadores, official explorers, trappers, cavalrymen and dragoons.

Spanish soldiers as far back as Coronado in 1541 had been in the area. French traders coming up the rivers from the east reached the foothills of the Rockies in 1706. The glamorous fur trade reached its height in the 1820's and 1830's.

Lt. Zebulon Pike

But it was Lt. Zebulon Montgomery Pike who set the stage of mountain history. The first official explorer of the Colorado plains and Rockies, he was sent out in 1806 to study the remote reaches of newly purchased Louisiana.

He came up the Arkansas River along the Santa Fe Trail in southern Colorado, discovered a lofty mountain but failed in his efforts to climb it. Pikes Peak nonetheless became a major landmark, a catchword, a pot of gold, a promising pinnacle to those seeking a new life and a fortune anywhere along the Front Range of the Rockies in Colorado.

And the South Platte Valley became the gateway to the Pikes Peak region. (The famous peak is about 70 miles south of Denver and is visible from Denver on clear days. Complemented now by the nearby U.S. Air Force Academy, it is still Colorado's number one tourist attraction.)

(However, there are 54 peaks in Colorado having an elevation of 14,000 feet or higher. Pikes Peak, at 14,110, ranks 32d.)

Back to the Platte, Louis Vasquez in 1832 established an adobe and log trading post on the river a few miles northeast of present-day Denver. He bought beaver pelts from Indians and trappers and hunters, and he frequently purchased gold.

Great Pathfinder

Then came the Great Pathfinder, John C. Fremont. Starting in 1842, he led five expeditions to find an easy way through the Colorado Rockies. He learned a lot about geography—and transcontinental railroads subsequently took over routes to California.

Meantime, passersby and prospecting parties were washing small amounts of gold dust out of the sands of Cherry Creek and some embellished accounts appeared in the press of the East.

In the summer of 1858 there appeared among the crude settlements and Indian lodges of future Denver an experienced prospector named William Green Russell. He had paused here to pan gravel several years earlier on his way to the California gold fields.

By October the Russell party had found gold in paying quantities and had accumulated $500 worth—cause for new excitement.

Early in 1859, George A. Jackson made a spectacular gold strike west of Denver near Idaho Springs on a tributary of the South Platte. Jackson too was an experienced California Forty-Niner.

On May 6, 1859, John Gregory made another great strike on what would become the booming camp of Central City—"the richest square mile on earth."

To thousands now it became "Pikes Peak Or Bust."

Greeley in 1859

Horace Greeley, editor of the New York Tribune, arrived in 1859 on one of the first stagecoaches from Leavenworth, Kans., and quickly dashed up to Gregory Gulch.

A month later he described the scene to his readers:

"As yet, the entire population of the valley—which cannot number less than 4,000, including five white women and seven squaws living with white men—sleep in tents or under booths of pine boughs, cooking and eating in the open air. I doubt that there is yet a table or chair in these diggings.

". . . The food, like that of the plains, is restricted to a few staples . . . but a meat shop has just been established, on whose altar are offered up the ill-fed and well-whipped oxen who are just in from a 50-day journey across the plains."

Unknowingly, Greeley in this last sentence also described the start of the cattle industry in this part of the West. For it was quickly discovered that these enfeebled oxen, given rest, could thrive on the native grasses of the South Platte Valley, even in wintertime.

Farming began to flourish and in the early 1870's the Greeley Colony settled and developed irrigated agriculture in Caché la Poudre River Valley near Greeley and Fort Collins, north of Denver.

Major Tributary

The Poudre is a major tributary of the South Platte River.

In the early 1900's, the basin outgrew its native surface irrigation water supply and the first of the transmountain importation systems were constructed.

Growth and prosperity in the South Platte Basin have consequently been attributed to:

- Early recognition of the limitations of the river's native flow and subsequent development of a vast system of storage reservoirs.
- Efficient use and repeated reuse of the water.
- The importation of water from the western side of the Continental Divide, mainly from the Colorado River, via elaborate collection systems, long-haul canals, pump lifts and lengthy tunnels.

Native surface runoff in the basin averages about 1.2 million acre-feet annually. Another estimated 600,000 acre-feet of ground water are pumped annually in the basin for irrigation alone.

Importations through 15 diversion systems last year totaled 360,000 acre-feet.

Now, this appears to add up to a lot of water. But depletions and losses are severe in this semiarid country—Denver receives an average of only 14 inches of precipitation a year—and the outflow from the basin averages but 303,000 acre-feet annually.

The Place and Time

Another problem, of course, is getting water to the right place at the right time.

The answer is importations—and they are increasing.

The native flow of the river above Denver, for instance, averages 272,000 acre-feet a year. But demands on the Denver water system last year totaled 208,000 acre-feet.

Had the city been forced to rely solely on its direct-flow water rights, there may have been trouble.

Denver, however, has good carryover storage. And it also has two major transmountain diver-

Gold prospectors with pick and burro were replaced in later years by this dredge which chewed up the gravel beds of the river.

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sion sources employing the Roberts Tunnel, 23 miles long, and the pilot bore of the Moffat Railroad Tunnel, 6.4 miles long.

Imported water from these two sources last year alone totaled 108,000 acre-feet.

Although badly tarnished by humans and industry, most of Denver's supply is returned to the river for reuse downstream.

Here the river begins to flatten out among the sandbars, willows and cottonwoods, and its water becomes further polluted.

But out of the mountains to the north and west comes new vigor in the form of important tributaries. The biggest of these is the Poudre, flowing off the Continental Divide and joining the South Platte near Greeley. Eight small transmountain diversion systems import water directly into the Poudre drainage.

Engineering Marvel

But in addition to this, the lands of the Poudre Valley receive half the irrigation water imported by the engineering marvel known as the Colorado-Big Thompson Project. It was constructed by the Bureau of Reclamation.

One of the foremost transmountain diversion developments in the United States, this project diverts water from the headwaters of the Colorado River on the western slope through the Alva B. Adams Tunnel. This 13.1-mile underground waterway crosses under the Divide to the Big Thompson River.

A portion of the diverted water is used for municipal and industrial uses. But most is used as a supplemental irrigation supply on some 720,000 acres of land in the South Platte Basin.

The gross value of crops produced on the 720,000 acres of the Northern Colorado Water Conservancy District in 1965 totaled $95.7 million, with sugar beets accounting for $21 million.

Another $46.4 million represented the value of feed and forage crops used to feed livestock.

District officials said the value of livestock sold to packers in 1965 added another $220 million to the economy of the community, the State and Nation.

Reclamation's Big Thompson Project also is a large producer of electric power. And it provides tremendous recreation benefits at 10 major reservoirs.

Tranquil, No!

Out on the plains now, the South Platte has lost its speed and sparkle. Broad and flat, yes, but tranquil, no!

Sustained floods and flash floods have ravaged the basin at dismaying intervals since the white man came.

The first city of Denver was laid to waste, with the loss of 12 lives by a Cherry Creek flood on May 19, 1864.

Plum Creek, another upstream tributary, exploded in June of 1965. The ensuing flood on the Platte also took several lives and caused property damage estimated at $500 million.

Among the unsolved mysteries in Colorado history is the disappearance on the night of May 21, 1878, of a standard gage locomotive in Kiowa Creek, another tributary of the Platte.

A flash flood had destroyed a wooden bridge and the freight train (Kansas Pacific) plunged into the torrent. The engineer, fireman, and brakeman went down with the engine, which sank out of sight in the sand.

A search was made by probing the creek bed with long metallic rods. All explorations indicated that the bedrock formation was probably 50 feet below the channel of the Kiowa. And the locomotive was never found.

The Corps of Engineers completed a huge flood protection reservoir on Cherry Creek in 1950 and now is planning another flood project known as Chatfield on the main stem of the South Platte, upstream from Cherry Creek and Denver.

The Bureau of Reclamation too is planning to further tame the river with a high dam and reservoir (Two Forks) near the North and South Forks of the South Platte.

Two Forks will be primarily for the storage of municipal and industrial water but also will provide flood control and possibly hydroelectric power. The Narrows Unit also will include flood control and supply supplemental irrigation water to the service area of the Lower South Platte Water Conservancy District.

Both reservoirs should be extremely valuable for recreation and fish and wildlife propagation.

Though the South Platte has had ups and downs and its service to man may yet be increased, great stretches of its beauty have not been smothered—nor all its ferocity tamed.

# # #

YUMA THEN; YUMA NOW

by H. FAYE MINNICH
(One who was there then)

I CLIMBED down from the Southern Pacific train on one of September's hottest days 51 years ago. I'll admit I didn't know what to think as I looked around, but I needed a job so I began to call the situation an adventure.

I had come to Yuma to teach. I learned as much as I taught.

Yuma is in Arizona, bordering the east side of the Colorado River, about 20 miles north of Mexico. My teaching job was on the west side of the river in California, post office Bard.

Yuma was, and still is, the hub of the locality. There were Main Street with a cafe or two, a couple of general stores, a drugstore and a few saloons—the old time kind with swinging doors. There were three or four churches, two doctors, one elementary school and a small high school which had originally opened up for business in the notorious old territorial prison.

Occasionally a cowboy would drop into town, throw his horse's rein over a hitching post and go somewhere to eat or drink, his chaps flapping around his legs. People who lived on the California side did most of their shopping in Yuma. They rode horses or came in spring wagons to the river, hitched their horses to the mesquite trees on the bank, then either walked the footbridge alongside the railroad track across the river or ferried across.

The old ferry encouraged Yuma's growth. Many a California-bound immigrant crossed the river at that point, riding the Butterfield Stage Coach. Ruins of one stopping place west of the river, where travelers could get food and a change of horses, can still be seen. It is now U.S. Route 80.

For centuries, the land in and around Yuma belonged to the Indians, mostly the Quechans and the Yaquis and some smaller tribes.

Attracted by Gold

The first white settlers were attracted by gold. There was a lot of it in the hills and shipping the

The Yuma area bloomed considerably after this.

ore by the Southern Pacific became an industry. Jesuit missionaries taught the Indians and were instrumental in getting the Government to establish a school, a church and a hospital on a hill on the California side in the late 1700's. That became Fort Yuma.

Gradually a city began to grow. The people were folksy and sociable. Teachers were invited to parties. Yuma is still like that. Two outstanding pioneer names were the Brownstetters and Sanguinettis, both merchant families. They are no more, but they deserve credit for getting Yuma off to a good start.

However, a few of Yuma's pioneers were unfriendly on occasion. An early settler told me of an incident that happened to him one dark night. He was going through Yuma from the valley settlement of Somerton with a wagonload of hogs. It had been raining and the street was rutty and difficult for driving. Making the situation more weird, a saloon door opened and in the brief light he saw somebody pitch something out onto the street.

When he reached that point, his horses balked. Leaving the pigs squealing behind him, he got down from his seat to investigate. The body of a dead man stretched across the road. The settler pulled the body to one side; then his horses consented to proceed and the party moved on.

The sun is Yuma's most dependable feature. One of the first hotels offered free meals to customers any day the sun did not shine sometime during the day. Things really began to buzz in and around Yuma in 1912. Thanks to Theodore Roosevelt and other forward-looking fathers, the Laguna Diversion Dam was built under the Reclamation Act of 1902. Completed in 1912 (one record says 1909), it was the first project of its kind on the Colorado River. Until then, irrigation was privately owned.

Land Drawings

Under Reclamation, each side of the river was levelled and divided into 40-acre farming units. These plots, with irrigation structures installed were acquired by drawing. The applicant whose name was drawn was required to build a dwelling and pay the construction charges over a period of years until it was clear.

With expert advice from the U.S. Agricultural Experiment Stations, the occupants began farming, at first raising cotton, alfalfa and citrus fruits. Most of them were inexperienced, having been tradesmen, professionals or in fields otherwise unrelated to ranching. Life was no bed of roses, indoors or out. Sometimes the San Jero (the water man, pronounced Zan Kero) would ride his horse up to the house and call or whistle, "Yoo-hoo. Take the water now."

Whether the rancher was snug in his bed or eating lunch, he immediately went to open his gates and irrigate his crops. Mosquitoes, rattlers, and scorpions often disputed his rights. The San Jero now telephones or uses a car to notify water users.

The refrigerator of those early days was ingenious. It consisted of a box with shelves, covered with burlap or canvas, and kept dripping with water from an overhead tank. This simple method of evaporation was surprisingly effective in keeping butter and milk. Electric refrigerators might have been in the back of somebody's head then, but there was no electricity, except in Yuma.

Some of the women and children were sent off to the coast for the hottest weeks of summer. Those not so fortunate had to match wits with the weather by jumping into irrigation ditches. The muddy water was no complexion treatment, but in lieu of swimming pools it was cooling.

Things went along pretty well until 1906, when the mightly Colorado went on a rampage and a good part of Yuma and farmland on both sides of the river were flooded. Tremendous losses were suffered in crops, homes, and business establishments.

Following this catastrophe, the Parker, Hoover, and Imperial Dams and the All-American Canal were built, which solved the flood menace. All diversion in the Yuma area now is from Imperial Dam to the All-American Canal, which supplies a good part of Imperial County in California and Yuma County in Arizona. The service is known as the Bureau of Reclamation.

Program of the 1930's

Most of the water conservation and control program occurred during the 1930's when the country was badly in need of prosperity. People came from all parts of the country to work on the dams. Some liked Yuma, summer heat and all, and remained, sending for relatives and friends.

Yuma is still growing up, but it has come far in the last 50 years. All the comforts of life available

Left. Irrigated agricultural development followed Reclamation's completion of Laguna Dam over 55 years ago, shown being celebrated here.

Below. More than 23,000 irrigated acres of citrus are under production in Yuma County.

elsewhere are available there. One can stay in modern hotels or motor lodges, or live in air-conditioned houses. For several years Yuma has had airport service. The airport is now international.

A permanent U.S. Marines base lies nearby and a large military proving ground is about 20 miles to the north where ideas are born and tested. A modern hospital serves the community. The original high school, which had its beginning in the old territorial prison, now houses an interesting museum. An annual rodeo draws large crowds and greyhound dog racing vies with Santa Anita in betting excitement. The huge million dollar Greyhound Clubhouse with its 40 acres of parking space is a showplace. There are shopping centers, of course, and a new $6 million center is in the planning stage.

Outstanding in all the Yuma story are the surrounding farms on both sides of the Colorado. Agriculture still stands first, but it is a big business and not many operators fool around with 40 acres. Land which cost the original settlers $77 an acre, plus the dwelling, now sells for upwards of $1,000 per acre.

Yuma's Production

From this once challenging, useless looking land comes much of the Nation's cotton, alfalfa, citrus fruits, lettuce, carrots, peanuts, melons, sweet corn, sugar beets, dairy products, and meats. Some crops are grown for seed. Ninety-five percent of the world's production of Bermuda Grass seed is harvested in Yuma County.

Brangus cattle, a cross breed of the Aberdeen Angus and Brahma, got their start in Yuma County. They are beefy and adapt well to the hot climate because they have sweat glands.

This arid expanse needed only man's interest and skill to transform it into an Eden. The population is estimated at 33,950, with a probability of 57,000 by 1970. Those who stay in the summer heat move from air-conditioned cars to air-conditioned dwellings. They might whistle,"Whew! It's hot today," but they aren't suffering any more.

Lest some wonder how Yuma got its name, it must be admitted that nobody knows for sure. There is still a Yuma Indian Reservation and some think the name originated from humo, Indian for smoke. The earliest settlers saw brush fires on the river bank and were told the Indians made medicine and seeded clouds for rain with the smoke. The Indians themselves like to be called Quechan, but their agency on Fort Yuma is listed as the Fort Yuma Sub-Agency. It is confusing.

The rugged souls who created Yuma paid the price. Those who enjoy it now are collecting dividends. # # #

(Appreciation for reprint permission of this article is extended to the author and Desert magazine.)

THE best egg factory is the egg factory that works. Here is one—tunneled out of a rock cliff—that's complete with water and 2,500 happy laying hens.

The idea of a cave as a chicken house with ready-made rock insulation for both summer and winter comfort almost has to be new. At least it is different. And it is the result of some resourceful thinking by R. J. Miller of Moab, Utah. Miller's cave

by **MEL DAVIS, Head Photographer Region 4**

UNDERGROUND EGG FACTORY

is on his 147-acre ranch reaching along the Colorado River.

The red sandstone cliffs jutting up on this part of his land has the river flowing conveniently through its "front yard." Mr. Miller had studied the unusual site with the thought of excavating to form a large cavern. Such an enclosure would be more economical than constructing foundations, framing and roofing of conventional buildings.

Once Miller thought of using the cave for some type of public use, such as ice skating or dancing, or perhaps a motel. But in spite of many opinions that it wouldn't work, he decided to excavate the 24 x 160-foot room for an egg factory.

Now, after 4 years of operation, he has a successful business. His feathered factory hands produce an average of 2,100 eggs a day.

The blasting and excavating job was awarded to a rock miner who had equipment he wanted to keep busy. For two reasons, the work was started part way up the face of the cliff: To shorten the distance of drilling a vertical ventilating shaft; also the rock taken out could be dropped outside as fill to form an entrance.

In addition to taking care of what she is shown doing here, Marlene Bailey, also operates a modern appartus for inspecting the eggs.

A factory with all the comforts.

Hens from Colorado

Miller then went about doing his best to make the project commercially worthwhile. His white leghorn hens are purchased from a Colorado firm and put into production when 5 months old. They stay in rows of wire cages several feet off the floor. These individual compartments are just large enough to allow each hen to concentrate on the work she does best—eating, drinking, and laying eggs. After the eggs drop onto a slanting wire net under the cages they roll to the front where they are easily gathered.

A watering trough extending along one side of the cages is kept at constant level automatically. Feed is placed twice each day in a trough on the other side of the pens.

Lights tell the hens when to "go to work." Automatically the lights go on at 5:30 each morning and off at 6:30 in the evening. Little, if any egg laying is done in the dark. Plans are to increase the "daylight" by 15 minutes each week until the lights are on 20 hours a day for maximum egg production.

After about 14 months, the entire lot is retired and either sold cheaply to individual buyers or to a commerical plant where they are processed for public consumption.

Mr. Miller points out that one of the big advantages of his "cave coup" is the ease of maintaining constant temperature. This varies only from a low of about 50 degrees in winter to 80 degrees in summer. The heat sources are from the lights overhead and from the hens themselves. Ventilating fans are temperature-controlled and draw fresh air through the shaft extending from the top of the rock roof.

Fertilizer System

Another benefit from the egg factory is fertilizer. Water flushes the droppings along troughs between the walkways taking it into a central pipe. This pipe empties into a large tank outside where chemicals are added to keep the solution as a liquid and to prevent the settling of solids. Because the tank is higher than the surrounding area, the solution is turned onto the fields by gravity through the regular irrigation ditches. This system assists in growing alfalfa and pasture grasses for raising cattle and sheep.

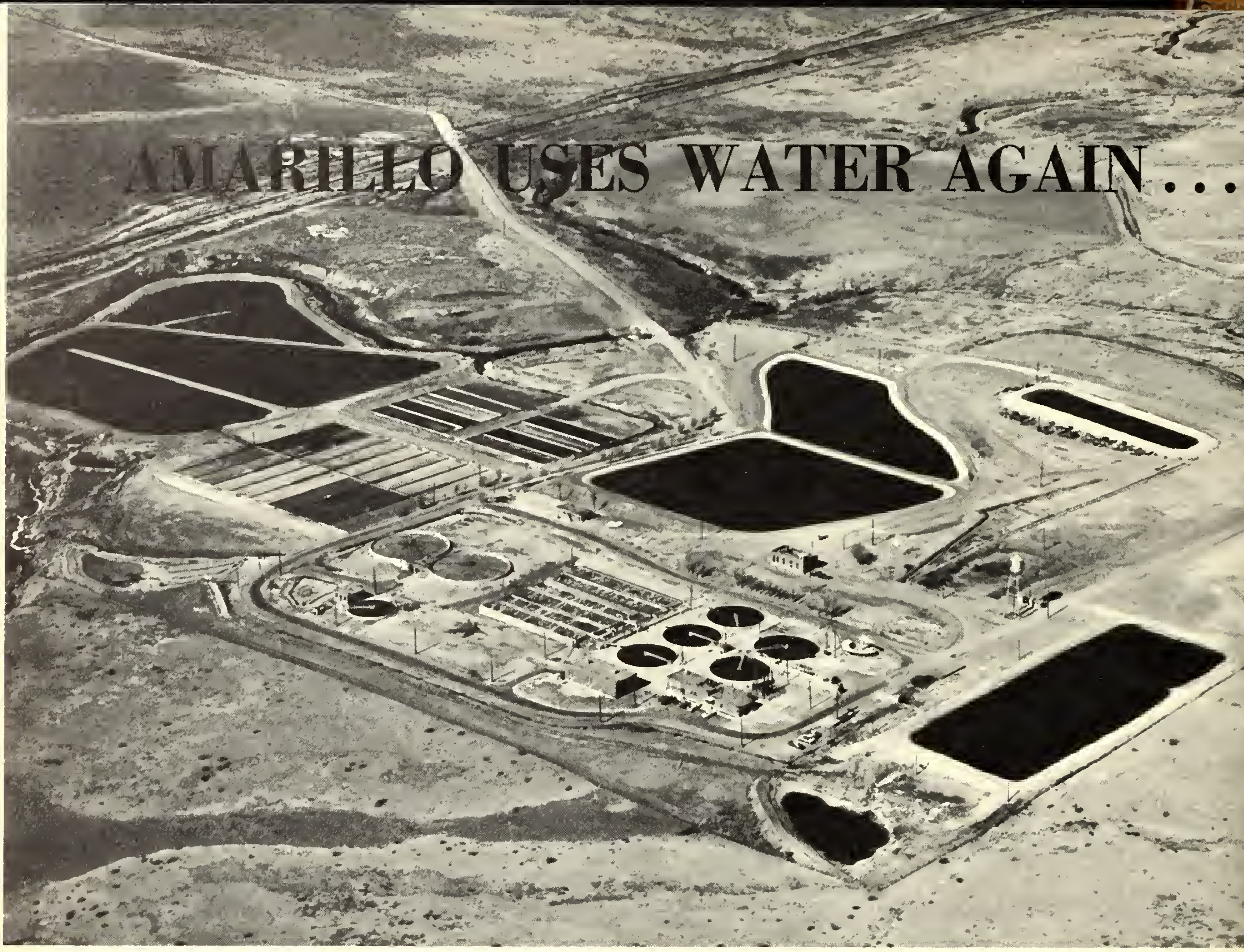
Most of the egg-producing operation is handled by a member of the family, Mrs. Ivan Bailey. She washes and candles the eggs, puts them into cartons, then delivers them to another of Mr. Miller's businesses, a supermarket in downtown Moab. When Miller is not attending to matters of the Grand County Commission, of which he is chairman, or working the ranch, or tending to matters at his supermarket, he helps with the work at his egg factory. Another man helps part time with the feeding, egg gathering, and cleaning out the laying room.

There are other advantages for the resident of this area of Utah. In his spare time, Miller can jeep into the surrounding hills and canyons in search of old Indian ruins. He can take a boat trip on the scenic Colorado River or Lake Powell behind Glen Canyon Dam, Ariz. Or he can visit the newest of the national parks, the colorful Canyonlands nearby.

As for the hens, they seem content to lay eggs and cluck noisily to each other. Possibly they feel a little superior to hens which do not work in an air-conditioned, underground egg factory.

# # #

AMARILLO USES WATER AGAIN . . .



and again . . . and again

by J. D. TERRELL, Regional Information Officer

COOL, clear water . . . put to music is part of a western ballad continuing popular for decades in hill and prairie country. While the song is familiar, the idea of making cool, clear water available from sewage effluent is relatively new, and—in modern times—not necessarily disagreeable.

In the Texas Panhandle where the new Canadian River Project's Lake Meredith has begun to relieve the water deficiency somewhat, the city of Amarillo has gone a step further by assuring its citizens they will get the most mileage possible out of this precious liquid.

The farsighted city fathers initiated the idea of building and operating two modern sewage treatment plants to reclaim the waste water and make it usable for industry and agriculture. Spawned in 1955, this idea resulted in two plants for Amarillo which today treat more than 10 million gallons of water a day.

Left. This sewage treatment plant near Amarillo reclaims raw sewage water by chemical treatments prior to its sale to two industrial plants.

An important consideration for any city contemplating this kind of operation is the initial financial outlay which, in this case, amounted to approximately $3 million for the two plants. With a staff of 26, these plants have an annual operation and maintenance cost of $270,000. The figures might seem quite prohibitive to many communities, for 95 percent of all the towns and cities in the United States receive no revenue from their sewage treatment facilities and therefore their annual operating budgets are complete financial liabilities to the taxpayers.

Amarillo, however, receives approximately $160,000 annually from the sale of its three products. Sale of industrial water is estimated at $134,000 annually, while irrigation water sales amount to about $4,000. Fertilizer is sold retail for $3 per cubic yard at the plant loaded on the customer's truck or trailer and realizes approximately $2,000 per year. The city gets about $20,000 in power savings from the use of sludge gas in the two 175-horsepower engines furnishing process air and for heating.

Better Looking Plants

The new sewage treatment plants and the old style ones are as dissimilar in looks as they are in processes. The Amarillo plants boast of beautiful lawns, flower beds, and attractive buildings, which belie the nature of their work.

But the new look also is carried through to the actual work performed. Men in clean overalls, well versed in laboratory work, handle the unique treatment process.

As raw sewage enters the treatment plant, large objects, sand, and grit are screened out. Items such as grapefruit rinds, old shoes, and rags also are removed. The screening equipment once even produced a shovel. Following the removal of larger objects, the sewage is transported into a large tank where other solid matter is settled out and pumped to a closed tank.

At this stage the "bugs"—or minute animal life—are pressed into service. These "bugs" consist of two types of bacteria: One called anaerobic, which thrives on lack of air in a temperature of 92 degrees; and the other, aerobic, requires a certain amount of air. These microscopic organisms demand living conditions that are constant or they will die. If a "rocking of the boat" should occur, throwing the conditions out of balance and resulting in the death of the aerobic and anaerobic bacteria, other organisms would take over and the process would be halted.

The anaerobic "bugs" are fed the solid pollutional material in tanks, covered to exclude air, to collect the gases produced, and heated within a range to 1° to 2° to control bacterial activity. Here, temperature is kept at 92° with heat from a burning gas which is produced in the process. Under these conditions the raw sewage solids start the anaerobic cells growing. This continues as long as they have food or until they become 2 to 4 hours old and die. Dead cells are then transformed into a dark liquid and pumped into drying beds which become dried digested sludge or fertilizer.

Liquid Is Mixed

From the tank where the smaller solids were settled out, the remaining liquid is pumped out, mixed with aerobic cells and moved into a large tank where the proper amount of air is added to the mixture. In these large open tanks the bacteria digest the remaining organic matter in the solution leaving almost pure water, except for the bacteria. By this time the bugs have grown enormously and more cells have been produced for the continuing process with enough left over for the bacteria down in the other tank to feed on. The well-fed bacteria are separated from the cleaned up water, and some are disposed of while others are reinjected into more sewage for feeding.

A lack of food, too much air, a toxic metal, or certain chemicals in the sewage can cause the death of the cultures, or working bacteria, which in turn, would stop the whole process. Such a stoppage is guarded against because it could result in a shutdown in water production of 24 hours or longer.

As a preventive measure, the Amarillo Water Reclamation and Sewage Treatment Plant purchased and equipped a mobile laboratory in a clean white panel truck. An industrial wastes technician patrols the sewer system in this mobile laboratory testing and checking. At the first sign of a waste that might be harmful to the bugs at the plant, he radios the plant operator to be on the lookout, then traces the poison back to the offending industry where he arranges to have the damaging flow stopped.

In supporting action at the plant, samples are taken all through the process then tested in the plant laboratory. Ten thousand of these chemical analyses are made each year in the lab in addition to the 60 chemical tests conducted daily by the operators.

In order to kill any remaining bacteria, chlorine is added before the water is piped back to the city for industrial use. Water from the south plant is sold to some farmers in that area for irrigation.

10.5 Million Gallons

The average daily flow of treated water amounts to 10.5 million gallons. Of this amount, direct industrial reuse accounts for 4.5 million gallons per day while direct agricultural reuse consumes 1.25 million gallons daily. The daily release to the Canadian River amounts to 4.25 million gallons a day.

One testimonial to the quality of this water is from the fact that some anglers have caught several fish from the stream that flows into the Canadian.

Fertilizer is produced from sludge cakes removed from the drying beds and ground into relatively fine particles, a process which improves its value and reduces odor. Response from homeowners has been overwhelmingly favorable. This material is a good soil conditioner for lawns, shrubs, flowers, and vegetable gardens. It has been credited with noticeably reducing watering requirements on lawns.

At present, a refinery and power generation plant are the two industrial users of the treated water. In both cases the water is used in cooling towers. At the refinery, the water is then made available for cleaning purposes and for possible firefighting.

After the power generation plant uses the water, it is piped across the road where a farmer reuses it for irrigation.

The water purification and reuse program by the water conscious city of 138,000 is a significant step in the direction of full utilization of available water. And as one of the 11 cities of the Canadian River Municipal Authority, it soon will be receiving other needed water supplies from the Canadian River Project built by the Bureau of Reclamation. Although this project already is producing benefits, it will not be completed, nor bring the greater benefits for several months.

Meanwhile, as Amarillo continues its effective efforts for economical water, it also will have more potential growth and prosperity. # # #

Even Texas' traditionally rural industry—cattle raising—will benefit from supplementary water supplies. The checkered surge tank, built on Reclamation's new 322-mile-long pipeline, and a time-honored windmill bespeak the new and the old sources of water.

WHERE DOES THE WATER GO?

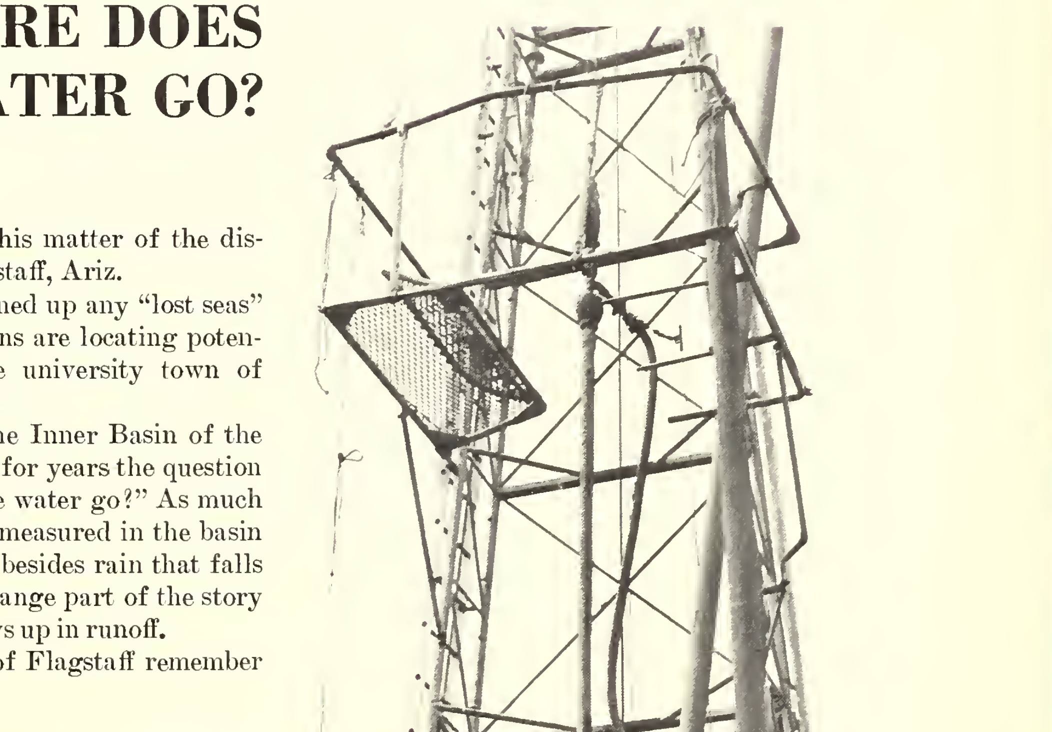
IT is a mysterious case—this matter of the disappearing water at Flagstaff, Ariz.

Studies so far haven't turned up any "lost seas" yet, but at least investigations are locating potential water supplies for the university town of 25,000 in northern Arizona.

The area of mystery is the Inner Basin of the San Francisco Peaks where for years the question has been, "Where did all the water go?" As much as 50 feet of snow has been measured in the basin (altitude about 10,000 feet) besides rain that falls at various times. But the strange part of the story is that very little of this shows up in runoff.

Water-conscious citizens of Flagstaff remember

by JOHN J. SWINGLE, formerly a newspaper reporter at Flagstaff, Ariz., now from Peoria, Ill.



The members of the drilling crew (with one not shown) are Ike Hopkin, Vic Pinneo, Ray Becker, and Gordon Lofshult.

(Photos by John Swingle)

Watching the initial flow of water from the well is Don Woltersdorf, of Reclamation's office at Flagstaff.

well the severe water shortage it suffered through the 1950's and cooperative efforts by several agencies are being made to prevent a recurrence of the situation.

Latest projects in the area include the drilling of two test wells on the Inner Basin of the volcanic peaks which tower nearly 13,000 feet above sea level, and a dam site in the southeastern corner of Coconino County.

In commenting on the test wells on the Inner Basin, Don B. Woltersdorf, chief of the northern Arizona field office of the U.S. Bureau of Reclamation said, "There appears to be excellent potential for the development of an additional water source for the Flagstaff area."

Pumping tests have been conducted on the second well and Woltersdorf added, "The test shows very good permeability for the well, but total volume will have to be determined through additional tests."

Supply Has Quality

A 24-hour pumping test produced nearly 500,000 gallons of high quality water recently, which seemed to hardly dent the supply. At the start of the test, water level was 133.5 feet, and after the 24 hours of pumping, the drawdown totaled only 4.1 feet, of which 1.7 feet was attributed to entrance loss in the first few minutes of the test. A few hours after completion of the test, the water level had recovered to within 1.8 feet of the original level.

This second well, 12 inches in diameter, was drilled to a depth of 248 feet and is located less than 200 yards down the basin from the first. The initial well, a 6-inch hole, was drilled to a depth of 348 feet and the water level was 162 feet from the surface. No pumping tests have been conducted on the first well.

Stage recorders have been placed on both wells and will keep constant records of the water levels in each. The recorders will remain in operation at least one full hydrologic cycle, a period of 1 year, and will be read regularly.

While potential appears excellent, says Woltersdorf, studies and tests will continue through the full cycle before a complete evaluation is made. He is optimistic because the level for the first pumping test in November was at a low point in the cycle.

The Inner Basin is surrounded by the jutting ridges of the San Francisco Peaks which once formed the rim of a volcano. Glaciers later pushed out one side of the rim, making a gateway to the Inner Basin and causing a natural watershed.

There is much glaciated material in the area and Woltersdorf feels there may be a number of alluvial deposits acting as natural water reservoirs. If such deposits can be located and tapped, it could result in salvaging large amounts of water which is presently unavailable.

Also it is felt that such deposits, or perhaps underground caverns, may be the answer to the disappearing water mystery.

Unique Method

Flagstaff's water supply may be unique in the method it is collected. The community obtains up to 25 percent of its water from a system of collection points and pipelines to catch runoff from mountain peaks. The runoff is caught at key points on the mountain and channeled through pipes to a reservoir at the northern edge of the city.

As much as possible, the city's water is obtained from Lake Mary, several miles south of the community.

The city of Flagstaff just recently put into operation a new water plant capable of processing some 8 million gallons of water a day from Lake Mary. Capacity of the old plant, some 2 million gallons a day, had been exceeded.

The drilling is part of the continuing bureau study and exploration for water to serve the Flagstaff area, which is part of northern Arizona studies and the Lower Colorado River Basins investigations.

Another segment of these programs is a feasibility study of the Wilkins Dam Site on Clear Creek in southeastern Coconino County at the mouth of Willow Creek. Reconnaissance studies already have been completed.

Tentative plans would include a dam 210 feet above the streambed with a water capacity of 45,000 acre-feet covering some 566 acres. While preliminary reports show the location as favorable, further studies are continuing on the water-holding capabilities of the reservoir area.

The Clear Creek dam could provide additional water supplies for Flagstaff, Ashfork, Williams, Winslow, and Holbrook in northern Arizona. However, the search continues, because a lot of water is still doing a disappearing act.

# # #

Kudos for Reclamation Job Corps Center

Dear Sir:

I want to say several complimentary things about the Job Corps Conservation Center of Sulphur. I live near the entrance, and I am pleased with what I see. It is amazing how well behaved these teenage boys are. They are nice mannered, and neatly dressed. I quite often give them a lift to and from town in my car.

This is our part of the Great Society which is really worthwhile, and since Sulphur is the home of Platt National Park it is nice the boys can take part of their training in the park. It is a good way to give these underprivileged youth a chance to become good U.S. citizens.

The directors are really doing a grand job of bringing out the good points in these "drop outs."

Most sincerely,

Mrs. J. F. Daugherty,
Sulphur, Okla.

Bureau of Reclamation
Water Headquarters Offices

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Washington, D.C. 20240

CHIEF ENGINEER'S OFFICE:
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Denver, Colo. 80225

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(Except Southern wedge)
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Denver, Colo. 80225

Secretary Udall Dedicates New Reclamation Building

RECLAMATION's Office of Chief Engineer has a new home. Interior Secretary Stewart L. Udall gave the principal address at the dedication of the new building on May 11. It is located at the Denver Federal Center, about 9 miles west of Colorado's capital city of Denver.

"I share the pride of Commissioner Dominy and Chief Engineer Bellport in this new building. They have worked hard and long toward the fulfillment of this eventful day," said Secretary Udall to the 4,500 who attended the dedication ceremonies.

The move into the new 14-story office structure was during the last 2 weeks of April.

The high-rise building provides quarters for Chief Engineer B. P. Bellport and all but 200 of the 1,350 employees at Denver.

With them, when they made the move from a converted wartime ammunition plant at the Federal Center, went 650 telephones, 640 drafting tables, 3,260 chairs and draftsman stools, 1,954 desks and tables, 2,400 filing cabinets, 15,000 technical reports and 20,000 volumes from the library, six safes and other paraphernalia of considerable variety.

The move to the new facilities climaxes an effort led by Commissioner Floyd E. Dominy, who began the quest for a modern headquarters building for the Reclamation engineering staff as early as 1960. The Commissioner conducted an intensive campaign to acquaint key members of Congress with the makeshift conditions under which the Chief Engineer's staff worked in drafty old Building 53 at the Denver Federal Center. Working quietly and forcefully, his efforts were rewarded when, in 1963, Congress authorized construction of the new building.

Ninth Home

The new headquarters is the ninth home for the Office of Chief Engineer in Denver since it was established on April 1, 1920. The first Bureau of Reclamation office facility in Denver consisted of 11 rooms in the old Chamber of Commerce building, rented for $150 a month back in 1903, before the Office of Chief Engineer was established.

Contrasted with the offices in Building 53, the new all-concrete structure provides vastly improved departmental layouts, greater accessibility, more efficient working areas and more attractive surroundings for engineers, stenographers, messengers and clerical workers alike. Air conditioning is another major improvement in the working conditions.

For the first time, too, it provides a functional and impressive setting for the hundreds of top-level engineers and other specialists who visit the Office of Chief Engineer each year—representatives of governments from around the globe, officials from other U.S. Government agencies, educators, and technical authorities who look to the Bureau of Reclamation as the most illustrious organization of its kind in the world.

The building stands directly opposite the Reclamation Engineering Research Center (laboratories) in Building 56. A concrete-framed shelterway connects the two buildings. The 20 members of the research center, part of the Reclamation facility, will remain at their present location.

Cost $7 Million

Built at a cost of $7 million, directly appropriated by Congress, the new structure was designed by the architectural firm of Hellmuth, Obata & Kassabaum, Inc., of St. Louis. MSI Corp. of Rockville Center, N.Y., was the general contractor, and Ketchum, Konkel, Ryan & Hastings of Denver was the structural engineer firm. Associate architect on the project was Scott Associates of Denver.

To the west of the new building rises the front range of the Rocky Mountains; to the east, visible from the upper stories, one can see the changing Denver skyline.

Because of a rainstorm at the time of dedication, the speaker's rostrum was moved inside the new building. Interior Secretary Udall is at the lectern giving his address.

The 220-foot-high building looks tall against the Colorado sky. Because of Denver's mile-high elevation, it is little more than a mile higher than New York's Empire State Building. Even without the altitude help, the structure is the tallest in Colorado's populous Jefferson County.

A landscaped plaza area 270 feet deep and 285 feet wide affords an attractive approach.

The framing and exterior are of lightweight aggregate concrete, with post-tensioned floor slabs to provide greater strength with less bulk and a corresponding reduction in construction cost. The exterior surface was sand-blasted to provide an exposed aggregate finish for aesthetic effect and to reduce maintenance. The recessed windows all are of heat-absorbing gray glass. With a gross area of 375,000 square feet, the new office building has service from six passenger elevators and one freight elevator.

Ground Broken By Dominy

The construction contract was awarded October 23, 1964, and a groundbreaking ceremony—with Commissioner Dominy officiating—was held November 18 of that year. (See article in May 1965 *Reclamation Era.*)

Mr. Bellport, the seventh of Reclamation's Chief Engineers, was appointed in 1963.

When the Office of Chief Engineer was established in 1920, its first head became Frank E. Weymouth, who held the position until 1924. Following Weymouth were Raymond F. Walter (1924–40), Sinclair O. Harper (1940–44), Walker R. Young (1944–48), Leslie N. McClellan (1948–58), and Grant Bloodgood (1958–63).

Historically, the Denver Reclamation office was established in 1903 to direct field work at Reclamation projects in Colorado and the immediately adjacent area. Formal executive offices were organized at Denver in 1915 when then Interior Secretary Franklin Knight Lane determined that "the executive offices (in Washington) were too far removed from the projects themselves to have the work carried on with the greatest efficiency, the least friction, and the least expense."

Moving Job

The assignment to move the employees and equipment quickly and with a minimum of disruption from the old building was the job of the Services Branch of the Office of Business Management.

"Never in all our years of moving has such a mass move been so well-planned and organized in advance," said a spokesman for the contractor. "Without that planning, the move would have taken at least half again as long. And it would cost a lot more money, too."

In spite of rain, sleet, and snow on the first day of the move, the contractor's 42-man crew and seven vans, shuttling between the two buildings in 25-minute cycles, gained a 4-hour advantage on their schedule.

"It went off without a hitch," said the contractor, whose crews worked in two shifts from 5:30 one morning until 2:30 the next 7 days a week.

So well did it go off, in fact, that few Reclamation employees were away from the job for longer than 2 hours. Although many others were at work again in less than 1 hour—same desk, same chair, or same drafting table, they were cheered with their offices in streamlined surroundings.

# # #

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6461	Nam Yang, Nam Mun, and Nam Chi, Thailand.	June 7	Conducting engineering geologic studies. (Negotiated contract.)	Woodward-Clyde-Sherard and Associates, Denver, Colo.	$288,600
DS-6500	Colorado River Storage, Colo.	Apr. 10	Three 115- and two 14.4-kv power circuit breakers for Midway substatiou, Schedules 2 and 3.	General Electric Co., Denver, Colo.	106,594
DS-6504	Parker-Davis, Ariz	Apr. 12	Four 230-kv power circuit breakers for Basic substation, stage 02.	Westinghouse Electric Corp., Denver, Colo.	246,934
DS-6505	Fryingpan-Arkansas, Colo.	Apr. 3	One 5-foot by 6-foot and four 3-foot 6-inch by 3-foot 6-inch high-pressure gate valves, two transitions, five hydraulic hoists, one gate hanger, and two chute linings for outlet works at Sugar Loaf dam.	Steward Machine Co., Inc., Birmingham, Ala.	157.957
DS-6509	Columbia Basin, Wash	Apr. 27	Eighteen 14,000-volt switchgear assemblies for generator units L-1, through L-9 and R-1 through R-9 at Grand Coulee left and right powerplants, Schedules 1 and 3.	Westinghouse Electric Corp., Denver, Colo.	1,427,140
DS-6509	do	do	Eighteen generator-voltage isolated-phase bus structures for generator units L-1 through L-9 and R-1 through R-9 at Grand Coulee left and right powerplants, Schedules 2 and 4.	I-T-E Circuit Breaker Co., Philadelphia, Pa.	327,768
DS-6513	Palisades, Idaho	May 12	One armature winding for generator Unit 4 at Palisades powerplant.	Allis-Chalmers, York, Pa	168,052
DC-6516	Colorado River Storage, Colo.	May 9	Construction of Rifle substation, stage 01	A. G. Proctor Co., Inc., Aurora, Colo.	278,666
DC-6517	Chief Joseph Dam, Wash.	June 12	Construction of auxiliary pumping plants No. 1, 2, and 3	E. W. Eldridge, Inc., Sandy, Oreg.	233,043
DS-6518	Columbia Basin, Wash.	May 18	Six 230- and two 115-kv high-pressure oil, pipe-type cable systems for Grand Coulee left and right powerplants and left switchyards.	Mitsui & Co. (U.S.A.), Inc., San Francisco, Calif.	1,200,076
DS-6519	do	May 15	Eighteen 230-kv disconnecting switches for Grand Coulee left and right powerplants and consolidated switchyard, Grand Coluee third powerplant, Schedule 4.	Allis-Chalmers, Denver, Colo.	153,452
DS-6519	do	May 19	Fifty-eight 230-kv disconnecting switches for Grand Coulee left and right powerplants and consolidated switchyard, Grand Coulee third powerplant, Schedule 5.	Westinghouse Electric Corp., Denver, Colo.	290,982
DC-6520	do	May 26	Construction of 15 miles of earth-lined and 4 miles of concrete-lined Wahluke Branch canal, Sta. 1355+30 to 2348+91.1 including Wahatis wasteway and Saddle Mountain wasteway culverts, Schedule 1.	Sime Construction Co., Kennewick, Wash.	2,962,636
DC-6520	do	do	Construction of 8.4 miles of Saddle Mountain wasteway, Sta. 69+42 to 580+00 (end), Schedule 2.	Pontius and Russell, Othello, Wash.	743,668
DC-6522	Missouri River Basin, Kans.	do	Construction of two pumping plants and 3 miles of Courtland pump canals 3A and 3B and laterals.	Bushman Construction Co., St. Joseph, Mo.	226,003
DS-6526	Pacific Northwest-Pacific Southwest Intertie, Nev.	June 28	Enclosed witchboard assemblies for Mead substation and carrier-current relaying equipment for Mead, Basic, and Amargosa substations and Davis and Hoover powerplants.	Westinghouse Electric Corp., Deuver, Colo.	389,702
DC-6530	Pacific Northwest-Pacific Southwest Intertie, Calif.	May 29	Construction of 33 miles of 230-kv Round Mountain-Cottonwood transmission line.	Dominion Construction Co., and Hatfield Electric Co., Inc., Scottsbluff, Nebr.	1,578,294
DC-6536	Seedskadee, Wyo	June 23	Repair and additional repairs of river outlet works stilling basin at Fontenelle Dam.	Saguaro Contracting Co., Phoenix, Ariz.	193,090
100C-910	Columbia Basin, Wash.	Apr. 11	Construction of 9.7 miles of buried pipe drains for D72-268, D77-112, and D77-98 drain systems, Blocks 72 and 77.	M and J, Inc., Moses Lake, Wash.	155,346
100C-919	do	May 16	Construction of 27.6 miles of buried pipe drains and 1.2 miles of open ditch drains for D18-24, -26, -41, -97, -157, and -201 drain systems, Block 18.	Equipco Contractors, Inc., Ephrata, Wash.	450,577
200C-670	Central Valley, Calif	June 19	Surfacing of O&M roads along Reach 2 of San Luis canal, Sta. 895+81 to 2053+15, Schedule 2.	Fresno Paving Co., Fresno, Calif.	252,140
300C-262	Colorado River Front Work and Levee System, Ariz.	June 14	Drilling and casing twelve drainage wells near Yuma, Ariz. for Ground Water Recovery Regulation.	Beylik Drilling Co., Whittier, Calif.	193,296
300C-263	Colorado River Front Work and Levee System, Ariz., Calif.	May 12	Construction of 10.3 miles of haul roads and bank protection structures A-10-P through A-18-P and C-7-P through C-12-P near Parker, Ariz.	Lloyd R. Johnson and C.A.N., Inc., Rialto, Calif.	452,790
500C-243	Canadian River, Tex	Apr. 7	Furnish and erect two 100,000-gallon elevated steel water storage tanks for Fritch Fortress and Cedar Canyon recreation areas.	Bering Tank Division, Inc., Dallas, Tex.	112,848

U. S. GOVERNMENT PRINTING OFFICE : 1967 O - 264-947

Major Construction and Materials for Which Bids Will Be Requested Through August 1967*

Project	Description of work or material
Bostwick Park, Colo	One 2-ft 9-in. by 2-ft 9-in. bigh-pressure gate valve, hoist, and transition; and four 2-ft 3-in. by 2-ft 3-in. high-pressure gate valves and hoists for Silver Jack Dam. Estimated weight: 49,500 lb.
Central Utah, Utah	Constructing the 4.1-mile-long, free-flow, concrete-lined Water Hollow Tunnel; the 1-mile-long, unlined Outlet Channel No. 2 with a series of reinforced-concrete drop structures. Near Duchesne.
Do	Work will consist of rehabilating about 4.1 miles of Currant Creek Road from U.S. 40 to Water Hollow; rehabilitating about 5.6 miles of Currant Creek Road from Water Hollow to Layout Creek; and constructing about 4.8 miles of access road from junction with Currant Creek Road to Water Hollow Tunnel portals. From U.S. 40 to a point about 70 miles west of Vernal.
Central Valley, Calif	Constructing about 10 miles of 2,300-cfs-capacity concrete-lined canal with underdrains, siphons, 11 bridges, and a 25-acre-ft. reservoir. Tehama-Colusa Canal, Reach 1—Station 197± to Thomes Creek. South of Red Bluff.
Do	Constructing 3.1 miles of reinforced concrete-lined, dual-purpose canal, with 2,530-cfs capacity, 1 mile of unreinforced concrete-lined, twin spawning channels with spawning gravel; and 1 mile of unreinforced concrete-lined channel with 12-ft bottom width. Tehama-Colusa Canal, Station 29± to Station 197±. At Red Bluff.
Do	Constructing 45 miles of 12- through 78-in.-diameter pipeline, and three concrete water screen and recirculating structures. Westlands Pipe Distribution System, near Mendota.
Do	Constructing 63.7 miles of 10- through 60-in.-diameter pipeline and seven recirculating structures. Near Mendota.
Do	Constructing a fisbtrap and a fish ladder on the left abutment of the Red Bluff Diversion Dam.
Do	Work will consist of furnishing and installing an electric-motor-driven, vertical pumping unit in each of four existing pumping plants and associated electric equipment. Contra Costa Pumping Plants Nos. 1, 2, 3, and 4.
Do	Nine vertical-shaft, single-suction, centrifugal pumps complete with electric motors. Pleasant Valley Pumping Plant.
Colo. Rvr. Front Work and Levee System, Ariz.	Earthwork and structures for 8.5 miles of reinforced concrete pressure pipe, including 6.2 miles of 66-in. pipe and 2.3 miles of 48- to 60-in. pipe. At Yuma.
CRSP, Colo	Work will consist of placing concrete for turbine and generator support; installing two turbines and a transformer bank; constructing a switchyard and additions to Curecanti Substation; installing 230-kv pipe-type insulated buried cable; constructing a reinforced-concrete visitors building, 75 by 75 ft, and a sewage treatment plant. Morrow Point Powerplant and Switchyard completion, 22 miles east of Montrose.
Do	Constructing about 230 miles of single-lane, unsurfaced access roads, with culverts and fence gates. Along Curecanti-Hayden 230-kv Transmission Line, between Montrose and Hayden.
Do	Constructing Midway Substation, Stage 01. Near Midway.
CRSP, N. Mex	Work will consist of removal and repair work; constructing a cofferdam, Navajo Dam, about 39 miles east of Farmington.
Columbia Basin, Wash	Constructing the outdoor-type W53.1D WW Pumping Plant witb a reinforced concrete substructure 20 ft wide by 25 ft long with three motor-driven pumping units having a total capacity of 45 cfs at 20 ft total dynamic head. Work will also include constructing a water surface control inlet to an existing 36-in.-diameter culvert and an inlet transition to tbe pumping plant. About 13 miles south of Quincy.
Columbia Basin, Wash	Enlarging turnouts to the PE55 and PE59.4 later ls at Potholes Canal, and carthwork and structures for enlarging about 15 miles of laterals with bottom widths varying from 12 to 3 ft. Block 16, southwest of Eltopia.
Do	Constructing about 23 miles of buried pipe drains and about 0.8 mile of open drain and wasteway. Blocks 42 (south of Moses Lake), 86 (north of Royal City), and 87 (east of Royal City).
Do	One double-ended unit substation with two 1,500-kva, 6,900-480/277-volt transformers for Grand Coulee 230-kv Consolidated Switchyard.
Minidoka, Idaho	Constructing Minidoka Interconnection Substation additions. About 6 miles south of Minidoka.
Duck Valley (Bureau of Indian Affairs), Nevada.	Constructing Wild Horse Dam, a concrete thin arch structure about 105 ft high at the maximum section, and 430 ft long at tbe crest. Excavating a 6-ft-minimum-diameter hole through the existing Wild Horse Dam will also be required. On the Owyhee River, about 70 miles north of Elko.
MRBP, Kans	Earthwork, structures, and surfacing 3.4 miles of relocated Mitchell County Road C-705. South of Cawker City.
Do	Eartbwork, structures, and surfacing 1.4 miles of relocated Township Road T-277 and about 2 miles of other township roads. South and west of Cawker City.
Do	Constructing Cawker City Dike, an earthfill structure about 50 ft high and 15,000 ft long, and a small concrete outlet works; slope protection to be of (1) riprap on bedding, (2) soil-cement, or (3) asphaltic concrete; and outlet works. Constructing two new water-supply wells, two pumping plants, and other facilities. Work will also include earthwork, structures, surfacing for about 1.1 miles of county road, bituminous surfacing of about 0.8 mile of county road, and earthwork and structures for 0.1 mile of city street. Near Cawker City.
MRBP, Mont	Constructing an auxiliary outlet works in the left abutment of Tiber Dam. The auxiliary outlet works consists of a tunnel, tunnel drop, gate chamber, shaft, control house, chute and stilling basin. Work will also include a 50-ft-higb cofferdam across the existing spillway channel. About 23 miles southwest of Chester.
MRBP, N. Dak	One 115/41.6-kv, 12-mva transformer for Killdeer Substation.
MRBP, S. Dak.-Nebr	Detailing, fabricating, and testing two steel towers totaling 40,000 lb, for the Fort Tbompson-Grand Island 345-kv Transmission Line.
MRBP, Wyo	Constructing tbe outdoor-type Hanover No. 5 Pumping Plant, with a reinforced concrete substructure, to accommodate two pumps with capacities of 19 and 6 cfs. Near Worland.
San Juan-Chama, N. Mex.	Constructing Heron Dam and dike, both earthfill structures and appurtenant structures. The dam will be about 265 ft high, 1,250 ft long, and will contain about 2,700,000 cu yd of material. The dike will be about 78 ft high, 2,370 ft long, and will contain about 450,000 cu yd of material. Tbe outlet works will consist of an inlet structure, a 10-ft-diameter pressure tunnel, a gate chamber and shaft and an 11-ft-wide modified horseshoe free-flow tunnel downstream with a stilling basin in tbe left abutment of the dam. Work will also include relocating about 8.4 miles of State Higbway No. 95. On Willow Creek, about 25 miles southwest of Chama. Stabilizing Willow Creek channel, near Chama.
Weber Basin, Utah	Constructing the 80-acre-ft, compacted carth-lined Farmington Equalizing Reservoir, near Station 520+00, Davis Aqueduct; three inlet or outlet regulating structures; and a pipeline connecting to Davis Aqueduct and West Farmington trunkline. Near Farmington.

* Subject to change.

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

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In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. DEPARTMENT OF THE INTERIOR/BUREAU OF RECLAMATION

November 1967

RECLAMATION ERA

Mt. Timpanogas—Supplier of Water

November 1967 Vol. 53, No. 4

RECLAMATION ERA

Gordon J. Forsyth, Editor

CONTENTS

COVER PHOTO. An early spring scene showing snow-melt below Mt. Timpanogas—a large supplier of water for the Provo River project, Utah, mentioned in article: "Green, Clean and Fully Grown."

(Photo by Mel Davis)

Commissioner's Page

WORLD AWAKENING

Until recent times water resources were rarely recognized as a critical factor in world politics. Nevertheless serious water problems have existed for centuries.

Water is as important as the air we breathe. Without adequate supplies, all human activities would be hindered and ultimately grind to a halt. Civilizations have faltered because of failure to protect and wisely use their water supplies and other natural resources. Even in this enlightened age, of the one and a half billion people who live in the developing portions of the free world, nearly a billion are dependent upon crude and unsanitary sources for water. Thousands die from water borne diseases.

I have found, however, on my review of water resource developments and their potential around the world in recent years, that quite suddenly a large number of countries have begun seriously thinking and talking "Water." A great awakening and some hope has been triggered. This was evident again in my travels this fall. People in Nations large and small alike are realizing they lack adequate storage and distribution systems to utilize their water supplies effectively. The International Water for Peace Conference last May, in which 99 Nations participated, contributed to the awareness. Sixty-one Nations met at this year's conference of the International Commission on Large Dams at Istanbul, as compared to only 44 countries six years ago.

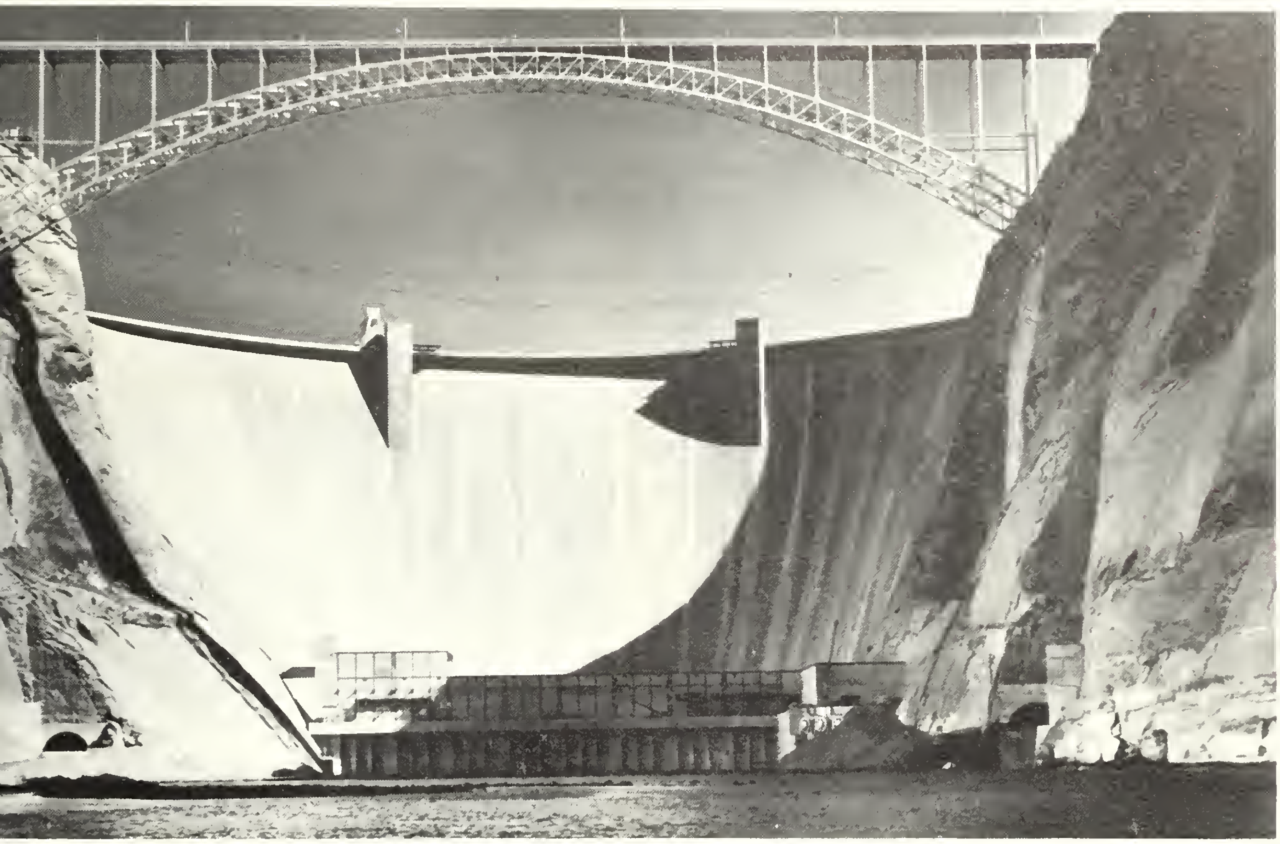
In actual results, 757 dams have been built by 60 countries in only a recent 3-year period. Though this country built more than a third of the total, Japan was second with 91 dams. The Republic of South Africa built 32 dams in the 1963–65 period as did India, where the resources problems today are a matter of life or death. Mexico built 23 and Canada 17.

The Bureau of Reclamation is proud to have an expanded role in this vital movement which offers hope for the future. And since such efforts are really only beginning, we invite the greatest possible interest of people everywhere in continuing research, planning and building to help put water where it can best be used and is so positively needed.

I was somewhat overwhelmed by a tribute to the Bureau of Reclamation while at the Istanbul meeting. A preface to a report on large dams constructed in Turkey had this to say:

> *"In the list of foreign engineering organizations which played a great part in the technical development in this country, U.S. Bureau of Reclamation will undoubtedly take the foremost place. The present activity in dam design and construction in Turkey will not have been possible had DSI, as well as other governmental agencies, lacked the cordial and the first quality training and assistance afforded by this engineering institution."*

Floyd E. Dominy
Reclamation Commissioner



Brought industrial benefits all over the United States.

Big Impact at Glen Canyon Dam

WHEN construction men moved in their equipment to build Glen Canyon Dam—one of the highest concrete dams in the world—a many-phased project was begun which would bring long-needed water resource developments to the Colorado River Basin and a large part of the West.

To do the work, the builders purchased and shipped to the northern Arizona damsite more than 1.1 million tons of materials and equipment from throughout the Nation—a weight equivalent to about half a million automobiles. This does not include the preponderant weight of the dam, which was sand, aggregates, and water, available at or near the site.

Then it required 25,000 man-years of direct on-site and indirect off-site employment, or the equivalent of 5,000 men working 5 years each, to complete the job.

Started in 1957 and completed in 1966, the construction cost of the 710-foot-high Glen Canyon Dam added up to $243 million, as of Dec. 31, 1966. Its water storage capacity is greater than all other storage features of the Colorado River Storage Project combined.

Huge jet valves for water.

The dam is viewed with other major distinctions: It's powerhouse contains 900,000 kilowatts of commercial power capacity, which will pay for the costs of building the dam with interest over the years. It caused the impoundment of Lake Powell which already is world famous for its varied sport pleasantries. The dam also is responsible for irrigation, flood control and silt retention.

The construction information herein has been newly collected by the Bureau of Reclamation as an important guide in establishing, on selected projects, scheduling and purchasing efficiencies for its varied program, and to reflect how much and where industrial impact occurs.

It cost $110 million for the permanent materials and equipment noted above.

Cost of shipping the materials and equipment by train, truck, and airplane from all off-site locations was an additional $10 million.

Regional Suppliers

Since the dam is located in the Southwest, that large region supplied 41 percent of the shipping. The States include Texas, Oklahoma, Arizona, and New Mexico, and the purchases came to $49.5 million.

Next highest supplier was the Mideast and New England regions, where 17 percent, totaling $21.1 million, was purchased. More than 60 percent of all electrical equipment came from the industrialized Mideast region alone—largely from Pennsylvania, New York, and New Jersey.

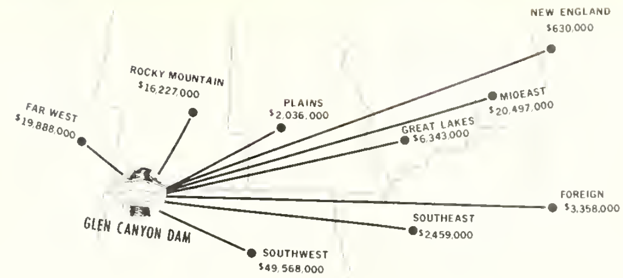
5 million man-hours by workmen. (*Photo by A. E. Turner*)

United States Department of the Interior, Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy, Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).



GLEN CANYON DAM AND POWERPLANT, DIRECT CONSTRUCTION MATERIAL, EQUIPMENT, AND FREIGHT REQUIREMENTS SUPPLIED BY ALL REGIONS OF THE NATION

Almost the same percentage and dollar value of shipments came from the Far West region of California, Oregon, Washington, and Nevada.

Industry in the Rocky Mountain region supplied 13 percent, amounting to $16.2 million.

Shipments of materials and equipment from the Great Lakes area achieved a total value of $6.3 million. Two-percent regions were the Southeast, with $2.5 million, and the Plains, with $2.04 million in shipments.

Hence, nearly 60 percent of the supplies for this great construction project originated beyond the borders of the geographic region in which the dam was built. This bears out a claim long made by Bureau of Reclamation officials that Reclamation construction benefits all parts of the Nation.

Materials shipped in for the vast construction job were 60 times greater than the equipment tonnage. The largest item, by far, was concrete products, totaling 807,200 tons. Rubber, petroleum, and repair products were next, with 125,100 tons. Metal products came to 60,700 tons. Other major shipment tonnages: chemicals and explosives, 24,200; building materials, 20,300; and miscellaneous materials, 60,500 tons.

Shipments of equipment used in construction of the dam totaled 17,800 tons. Most of this was made up of electrical equipment, 6,300 tons, and motorized equipment, 5,900 tons. Next in descending order were concrete equipment, construction tools, housing equipment, office and engineering equipment, asphalt, and miscellaneous equipment.

Employment Requirements

A majority of the construction men and their families, whose livelihood came from their work at the dam resided in the modern town of Page, which was built at the site.

The total direct employment requirements for designing and constructing the entire Glen Canyon feature was over 25 million man-hours. Except for Government planning, design, and administrative activities at the Bureau of Reclamation's Regional Office in Salt Lake City, Utah, and the Chief Engineer's office in Denver, Colo., the labor requirements were all at the construction site. On-site construction contract forces were both skilled and unskilled. About one-third of the workers with special skills or experience came from States other than Arizona where the work was going on.

Nineteen percent, or 5 million man-hours, were performed by nonskilled laborers. The amount of work by machine operators and carpenters was about equal, at between 2.8 million and 2.6 million man-hours. The remaining work was by truck-drivers, iron workers, electricians, plumbers and cement masons, and others.

It also is significant that 24 million man-hours—an equivalent of 12,000 man-years—of employment benefits resulted at locations other than the dam. These were in mining, manufacturing, transportation, wholesale and retail trade, agriculture, and such fields. This included 13 million man-hours of primary employment in the final stages of the direct material and equipment requirements, and 11 million man-hours of secondary interindustry employment in processing materials and delivering them to the manufacturer.

It so happened that on-site and off-site efforts were quite near being equal. There were 56 man-years of direct on-site labor and 48 man-years of indirect off-site labor for each $1 million of total construction cost.

Estimates have not been made of the multiplier benefits wherein employees and businesses respend their wages and profits for other goods and services. However, it may be concluded with certainty that Federal construction of such projects as Glen Canyon Dam have been economically worthwhile to the region and the Nation. # # #

Dippy Duck is popular in Imperial Valley as spokesman for canal safety. He says . . .

STAY OUT—STAY ALIVE!

CHILDREN in elementary schools and many adults in the Imperial Irrigation District area are becoming well acquainted with a cartoon character named Dippy Duck—and what he stands for.

Dippy Duck's motto warns: "Don't go near the water in canals. Stay out—Stay Alive!" With such helpful advice, this "juvenile sheriff-type" duck, drawn with badge and uniform, is the popular spokesman for canal safety efforts of the irrigation district in southern California.

Some youngsters even foretell a visit. A district-owned car with the shield of the IID painted on the side, one time parked at a school in view of the children and was quickly announced with the exclamation: "Oh boy, here comes Dippy Duck!"

During last May, 108 Dippy Duck programs were presented to children in all public and private elementary schools in Imperial County. This was accomplished with full-time services of two men in an effort to prevent drownings in the district's 3,100 miles of open canals and drains. The water system is highly beneficial to this arid valley. And the IID is one of the largest and most productive irrigation districts in the Western Hemisphere.

However, like most canal systems, they have had a problem of canal drownings which goes back to the early years of development. Although the water flowed slowly enough for the pioneers to learn to swim in it, lives were lost then, too. When the All-American Canal was completed, bringing additional supplies from the Colorado River, the swimming hazard increased because of faster flows and sudden changes in depth.

Some thought that fences installed along the canals might provide the protection needed. But since this would involve a prohibitive investment of many millions (also be long enough to extend from San Diego to New York City and back) a plan was developed to build a "psychological fence." This would consist of an intense public education program with probably even more effectiveness and other desirable aspects.

7 to 10 Fatalities

Research showed that an average of 7 to 10 persons a year lost their lives in the canals. Causes of death were analyzed and defensive measures developed.

The resulting safety program had two purposes: (1) to prevent canal accidents, and (2) to teach proper defensive measures should a person get in a canal.

In the first year, a brochure on canal safety was distributed to schools. The next year, the program was expanded to include presentations and a film on mouth-to-mouth resuscitation. "Rescue Annies" were acquired for actual rescue practice. The program was further enlarged to include first aid instruction by such groups as the police and fire departments.

The mouth-to-mouth resuscitation training of both young people and adults had results in 1 year of saving the lives of at least 10 persons who had stopped breathing.

The idea for Dippy Duck to be a spokesman for canal safety was introduced in 1966 at the Annual Canal Safety Program. Inspiration for the idea came from an occasion when a real duck, which was taking a swim on the All-American Canal, had gone through the turbine of a powerplant and emerged a little later a somewhat "plucked duck"—without feathers—and considerably worse for wear.

It is now hoped by the Imperial Irrigation District that Dippy Duck will do for water safety what Smokey Bear of Forest Service fame has done for fire prevention.

A 12-minute sound filmstrip presenting Dippy Duck is narrated by TV star Les Tremaine. Dippy Duck is the star actor, introducing four basic points of safety:

1. Never go near a canal.
2. When you go to and from school, don't walk on canal banks.
3. If you see children or adults near a canal, warn them and then call another adult.
4. Watch out for younger children.

Everyone Joins

When the film is over the most important points are carefully reviewed in person for the children by the attending district representative. Then all of the children are made club members, pledging to abide by the code: "I promise not to play near canals, to look after younger children, not to walk on canal or ditch banks, and never to try to swim in a canal." The schoolteacher handles the club badges and the official Dippy Duck coloring book.

Many teachers use the coloring books as part of an art project and Dippy Duck posters as the central theme for bulletin boards. Some schools have developed a complete safety unit, including water safety, for part of the school program just prior to summer vacation.

The safety club badges are an immediate hit with the youngesters. Pupils who have younger brothers and sisters come into the various district offices to pick up extras. In 1966 an illustrated official club newspaper was distributed, entitled, "Don't Go Near the Water in Canals."

The program also has received the assistance of professional educators. Consultants from the county superintendent of schools' office have assisted in coaching IID staff members on their classroom presentations. And school administrators have cooperated to assure a smooth schedule of presentations.

Ordinance on Sports

Although the State Health and Safety Code prohibits swimming in rivers, streams, and reservoirs containing domestic water, the county district attorney felt a more specific ordinance was needed to cover canals. A county ordinance prohibiting swimming or other forms of water sports in canals has been adopted.

The IID has been gratified at the enthusiasm generated by the general public for the Dippy Duck program. Many ideas and suggestions for expanding the program are excellent. One suggestion, which may be tried, is having Dippy appear during the summer at kiddie shows in local theaters. Other ideas are bumper stickers, costumes, and dolls.

For the past six summers, radio spot announcements have been made in both English and Spanish, urging parents to look out for their small children. Other news media cooperated by providing good publicity, and, of equal importance, by withholding information or photographs which would encourage children to play in or near canals.

The canal safety program not only has been awarded the Norman E. Borgerson Award by the National Safety Council for 1966, but it also receives intermittent personal assurance, such as one letter from a fourth grader to Dippy Duck, which reads: "Dear Friend: Thanks for coming to our school. We will stay out and stay alive." # # #

School children enjoy the safety program being discussed by the Dippy Duck creator himself, William Stadler, right, Public Information Officer of IID.

Reviving Production . . .

Alvin E. Stewart, Superintendent of the new station locating a tract for early development.

IN SAN JUAN COUNTY

UNTIL the 1930's agriculture was the major industry and economic base for San Juan County in New Mexico. At that time farming lost its footing because of the historic falling farm prices, the loss of traditional markets, and severe drouth.

Now, this predominantly Navajo Indian country—with favorable climate, soil, transportation, and potential manpower—is getting its footing restored.

And just as important, San Juan County has the only large supply of undeveloped water supplies for agricultural purposes in the State of New Mexico. This precious resource is the San Juan River, a tributary of the Colorado River in the northwest corner of the State.

Many years of determination by project backers to stabilize production resulted in the Bureau of Reclamation's completion, in 1962, of a principal water control structure, the 402-foot-high Navajo Dam on the San Juan River. When diversion and irrigation works from the reservoir behind the dam are completely developed, the total irrigated lands in the county will jump from the present 42,800 acres to more than 216,000 acres.

This full irrigation development by Reclamation for the station includes more than half of the acreage in the Navajo Indian Irrigation Project, as well as some irrigation and some municipal water for the proposed Animas-LaPlata Project in Colorado and New Mexico. The Bureau of Indian Affairs also is developing 2 projects—scheduled for completion by 1970—comprising 4,150 acres for irrigation.

by BERT LEVINE, Project Construction Engineer, and JAMES MADISON, Land Officer, Farmington, New Mexico Office

Frank Dickpeter, 12-year-old Navajo, watches the erection of the first building for the Experiment Station. Frank looks after a flock of sheep. (*Photo by T. R. Broderick*)

Experiment Station

Another large and more recent step toward achieving a sound future for farming in San Juan County was the decision of the State in February 1966 to appropriate funds for an agricultural experiment station.

The station in this area will be highly useful to farmers in demonstrating the best in farm practices before they risk large investments in private developments.

Too much risk has been the farmers' problem in the past. There was practically no production in the 1930's. The 1940's and the postwar period saw a resurgence, but the area was hit in the 1950's with a gas and oil boom which relegated agriculture to a minor industry. Many farms and orchards were turned into drilling sites, housing projects, or small tracts, and farmers were forced to seek jobs elsewhere. The end of the gas and oil boom in the early 1960's and the resulting unstable conditions to the county, caused agricultural and business leaders to take a long hard look at the future.

The gas wells have a reserve for 36 years and the oil for 13 years. After that, what? The answer again, will be agriculture, the industry of renewable resources.

Reclamation has helped establish agricultural experiment stations in conjunction with water development projects at various places in the West. With cooperative energies, such stations have proven highly useful in demonstrating the best in farming practices.

San Juan County agricultural leaders, local businessmen, representatives of the Navajo Tribe, and Federal and State agencies united for the New Mexico effort.

Good Support

Because of good local support, a new agricultural experiment station was made part of the program of the New Mexico State University.

The Navajo Tribe leased, without charge, 253 acres of land in the Navajo Indian Irrigation Project for the chosen station site. Other lands were sold or given to the university project.

Technical assistance is provided by the Bureau of Reclamation, the Soil Conservation Service, the Bureau of Indian Affairs, and local organizations and individuals.

The station has been under construction for several months. Farmington City Engineer with assistance by Reclamation prepared plans for a 6-inch pipeline from the Fruitland Canal a few miles away. The pipeline was put under construction by the Power Construction Co. of Albuquerque in January 1967.

Work began last spring on two buildings designed by a Farmington architect. Two other farm buildings made of metal also were recently started, and a cover crop for stabilizing soil was planted on a 50-acre field last summer.

The branch station will conduct several studies to help develop and maintain the agricultural potential in the San Juan Basin. This will include methods to overcome problems of salinity, drainage, permeability, and water logging in presently irrigated areas. Research in marketing, development of high-income cash crops, irrigation methods to provide maximum efficiency of water use, conservation, and insect and disease control also are needed. The station will provide other research and an education program to aid people in the techniques of irrigated farming.

Research Procedures

The university has outlined procedures which they feel will be most effective in assisting the community.

- The first research projects will be designed specifically to answer practicable production problems which commercial growers will be confronted with as the new land is brought into cultivation. As the program develops, some emphasis will be shifted to basic problems concerning soil, water, and crop production.
- Basic design of experimental plots will include the demonstration approach to each research problem. These plots will be strategically located to evaluate different land conditions represented on the station, allowing for visiting groups and individuals to inspect first hand the results as they occur.
- Each research project will include the use of the demonstrational medium for the dissemination of information.
- Periodic visiting days will include annual and semiannual days planned when organized educational programs will be presented by the research staff. These special visiting days will be closely coordinated with all agricultural personnel and programs associated with the Navajo Tribe, SCS, Bureau of Reclamation, BIA, and the Cooperative Extension Service.
- Special programs also will be planned to discuss in depth research results with those tribe and project agricultural personnel who are directly concerned with the Navajo Irrigation Project. In turn, these professional people will be encouraged to disseminate research results to their respective agricultural clientele in San Juan County.
- Emphasis will be given to releasing research results through all news media available in the San Juan area.
- The immediate publishing of research results will be given top priority. Publications will be distributed free of charge to all technical personnel and agricultural producers.
- Special farm visits will be made by the branch station staff to commercial growers in the area to assist with specific soil, water, and crop production problems.
- A special advisory committee of agricultural workers and commercial growers in San Juan County will be appointed to assist and guide the research staff in selecting research projects which will hasten to solve the production problems which are inherent to any new irrigated agricultural project. This committee will also assist in bringing individuals and groups to the station to observe demonstration research plots and in the dissemination of timely research results.

The present staff includes two agricultural scientists, a foreman, and two technicians. Alvin E. Stewart, an agricultural engineer, is the superintendent of the branch station. He is assisted by Joe Gregory, a research agronomist. The station foreman is Myrle P. Cross.

As the station is developed, the university plans to add more scientists to the staff. These positions will include a pathologist-entomologist, economist, and a horticulturist, thereby assuring that adequate services in all phases of agriculture anticipated for the area will be provided. # # #

Tunnel Holed Through

Tunneling crews holed through the 5-mile-long Tunnel No. 2 of the Navajo Indian Irrigation Project last July 18.

The project will include five tunnels with a combined length of about 11 miles, about 550 miles of canals and laterals, numerous siphons to cross rough terrain, an offstream dam and reservoir, a small hydroelectric powerplant, and six pumping plants.

Now undeveloped due to lack of moisture, the only agricultural use being made of the project land is livestock grazing.

Green Clean and Fully Grown

by MELVIN M. PETERSON,
Agricultural Economist

MANY specialty crops are now successfully produced in the Western United States because of irrigation, but one irrigation crop—lawn sod—has had to wait for a construction boom.

Actually commercial turf farms have been a big-city development for many years in Eastern parts of the country. The industry is growing and the results of tests are continuing to improve both the type of grass and the harvesting machinery.

The *bare today, lawn tomorrow* change came to Salt Lake Valley, Utah, in the fall of 1965. Stan Pennington, once a grass seed producer in Salt Lake City, now produces instant grass instead of seed on the 100-acre farm he named Blue Grass Turf Farms, Inc.

A lawn is started about 18 months before it is ready to lay in the yard of a new owner. The soil is plowed in the spring and left in the rough for a few months. It is then harrowed, leveled, and planted with grass in early fall. Irrigation starts immediately and it is done three times a week when growth has started. The next year the grass is fertilized about every 6 weeks. When growth is established, it is mowed at a height of 2 inches twice a week.

Ready-made lawn is laid as soon as possible

Watered . . . grown . . . rolled and ready.

274-629 O - 67 - 2

after cutting. Normally, it is cut one evening and laid the following day. The farm has a special garden-type tractor cutter which slices the turf into 1-inch thick strips 18 inches wide and 6 feet long. These strips are rolled up and loaded on trucks for delivery.

At the new site the turf is unrolled right in place on well-packed level soil. It is then firmly pressed with a heavy roller and watered for about 10 days to reestablish the root system.

Irrigation on Mr. Pennington's farm is accomplished by an automatic sprinkler system. Part of the irrigation water comes out of Utah Lake through the Bureau of Reclamation's Provo River project. A deep-pump well supplements the Utah Lake water.

At a premiere showing, Pennington demonstrated his "instant" lawn in the 1966 Parade of Homes in Salt Lake City. Not only are his green, clean, fully grown lawns counted as another one of the benefits of irrigation, but they also are a contribution to the rapid beautification of a fast growing city.

# # #

The bare today, lawn tomorrow look is being "unrolled" here by foreman Grant Richardson. (*Photos by Mel Davis*)

"Rivers in the Sky" Film Available

Practical research to produce more water from the atmosphere is portrayed in a new Bureau of Reclamation motion picture, "Rivers in the Sky," now available for public use. A congressional showing of the picture was held last February.

The 16-mm color picture relates the efforts Reclamation's Office of Atmospheric Water Resources is making to put to practical use, the known processes of weather modification which have been developed by scientific research in the decades since Drs. Irving Langmuir and Vincent J. Schaefer first produced ice crystals and precipitated an artificial snowstorm in a deep freeze in 1946.

Dr. Schaefer is a consultant to the Office of Atmospheric Water Resources and also was a technical adviser in production of the picture, "Rivers in the Sky." Historic motion picture footage of his first weather modification experiments is a part of the new picture.

Separate projects, which are adapted to varying geographical and climatological circumstances, are portrayed in exciting photographs including time lapse sequences to show the changes in cloud formations as artificial seeding is undertaken to trigger rain and snowstorms or to induce added precipitation.

The motion picture, "Rivers in the Sky," may be obtained on free loan for group viewing from the Bureau of Reclamation Film Distribution Center, Building 53, Denver Federal Center, Denver, Colo. 80225.

Honored for Conservation

John W. Simmons, as President of the Texas Water Conservation Association, Executive Vice President and General Manager of the Sabine River Authority of Texas, Vice President for Texas of the National Rivers and Harbors Congress, has been influential in the development of national and State water programs. He was selected this year to receive a Department of the Interior Conservation Service Award. The award was made at the convention of the Rivers and Harbors Congress in Washington, D.C., on June 1.

The citation recognizes Mr. Simmons' years of work in developing the State's water resources (especially involving the Sabine River Basin and Texas Basin Project), and in furthering "constructive water legislation in Texas."

While Water Use Grew in Basin

MANY ways have been found for measuring milestones of progress. But the most pleasant way, it will be agreed, is when the growing up of a pretty girl is a real part of the story.

Because lovely Lea Jean Bair reached the age of 18 this year, now has to be the best time to talk of that progress as far as one girl and her family are concerned.

It is easy to compare this daughter of Mr. and Mrs. Harry Bair with the Reclamation development she was born on—the Columbia Basin Project in central Washington. Lea's birth was the first on the million-acre project. Her parents were among the first settlers to come to this unfurrowed land back in 1948.

A graduate of Pasco High School last June, Lea has somewhat outpaced the project development which has only about half matured to its potential million acres. Also growing was the Bair family farm from the 65-acre original unit, purchased from a railroad company, to its present 200 acres. Potatoes, wheat, clover seed, and field corn are the crops.

No weeds in this potato field.

Meanwhile, about like several other starting farmowners, the Bairs have seen their home progress from a tent where the first cold fall and winter was spent, to a comfortable three-bedroom ranch house.

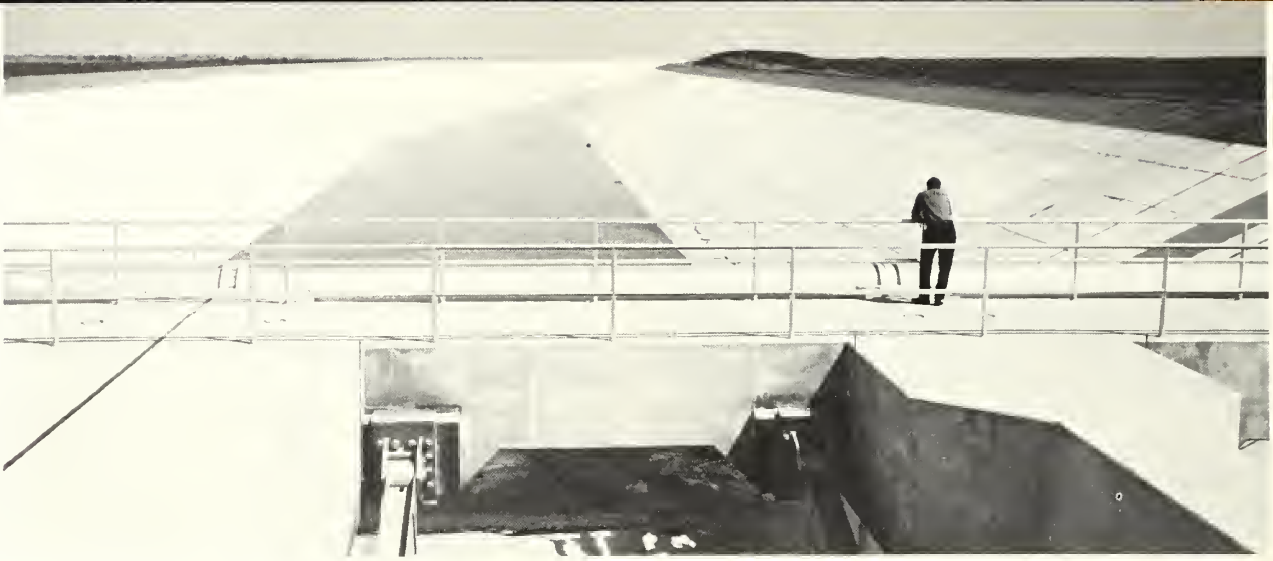
Lea became well acquainted with the duty of pulling weeds which infested the crops, but she also took tap dancing lessons and became a charter member of the Columbia Valley Junior Grange at age 5.

The warm months were not all work and practice because there was fun to look forward to at the Camp Wooten summer camp where Lea is now an assistanct on the staff. This year she placed high as a tap dancer on two talent contests and is a finalist for "Miss Tri-Cities" (the tri-cities are Pasco, Kennewick, and Richland). Plans have been that she study at Washington State University to become a physical education teacher.

The family also includes daughter Carol, who is an airline employee in Seattle, and a 14-year-old son, Kirk who still lives at home. The sixth member of the family is a poodle named Frosty.

Although pioneering was supposed to have gone out with the 19th century, it took a pioneering spirit for the Bairs to trade the comforts of modern living for a life on sand and sagebrush and an untried irrigation project. Mr. Bair had farmed with his father on an irrigated farm near Yakima, but there's quite a difference between an established farm and one that has never known the plow. However, hard work and good management paid off.

Mr. Bair and his wife Betty have been active in community affairs. They have held positions in the valley Grange and in the higher Grange orders. Harry is a member of the Washington State Potato Commission and president of the Board of Big Bend Electric, an electric co-op Franklin County area. # # #



The San Luis Unit in California Under Construction Since 1963

MAJOR FEATURES COMPLETED

THE Bureau of Reclamation has accepted from the contractor three major features of the San Luis Unit of the Central Valley Project, including the third largest dam in the United States and the structure housing California's largest hydroelectric plant.

All of the facilities completed—San Luis Dam, O'Neill Dam, and San Luis Pumping-Generating Plant—will be used jointly by Reclamation and the State of California to store surplus wintertime runoff from northern California streams for beneficial use in the southern two-thirds of the State.

These joint Federal-State facilities were constructed under a prime contract for the San Luis Unit by a joint venture made up of Morrison-Knudsen Co., Inc., Brown & Root, Inc., and Utah Construction and Mining Co. Work on the contract began February 4, 1963, and has been completed 2 months ahead of schedule at a cost of $87.7 million.

San Luis Dam is the most massive earthfill dam ever constructed by the Bureau of Reclamation. It is 3½ miles long, 384 feet high, and contains 77.6 million cubic yards of impervious clay, heavy rock, and huge boulders. Its huge mass is exceeded now only by Fort Peck and Oahe Dams in the Missouri River Basin. Oroville Dam, being built on the Feather River by the State of California, also will be larger.

The San Luis Pumping-Generating Plant will house eight pump-turbines, capable of lifting over three-quarters of a million pounds of water per second 310 feet into San Luis Reservoir. When the flow of water is reversed, the plant's dual-purpose pump-generators will be able to generate up to 424,000 kilowatts of power—45,000 kilowatts greater than the capacity of Shasta Powerplant, at present the largest hydroelectric plant in the State.

Three Pumps Tested

The pumping-generating units themselves are being installed in the Pumping-Generating Plant under another contract. Three of the eight units have been tested so far. All of them are scheduled to be ready for operation by June 1968.

O'Neill Dam is 70 feet high, with a crest length of 13,500 feet. Surplus runoffs will flow into the 58,000 acre-foot O'Neill Forebay from two major sources. The State-constructed California Aqueduct, when completed, will carry water by gravity into the O'Neill Forebay. Reclamation's Delta-

A scene only moments before water first flowed in this new CVP canal last April. (*Photo by J. C. Dahilig*)

3½-mile long San Luis Dam as of last July. *(Photo by L. W. Nielsen)*

Mendota Canal delivers water to O'Neill Pumping Plant from the Delta 70 miles to the north. The pumping plant then lifts it into O'Neill Forebay.

From the Forebay, water is pumped into the 2.1 million acre-foot San Luis Reservoir. When needed, water is released through the generating units back into the forebay, then into the 103-mile-long San Luis Canal, now nearing completion. These facilities will be one of the major waterways of the West and one of the few man-made structures that will be visible to our astronauts when they land on the moon.

Portion of Aqueduct

The canal will carry water to Kettleman City, where the southern portion of the State's California Aqueduct will take the water and deliver it as far south as San Diego. All along the way, water will be drawn off as needed.

Just before reaching Kettleman City, some of the canal water will be channeled into another facility, the Pleasant Valley Pumping Plant, which will raise water 125 feet into the Pleasant Valley Canal. Flowing 20 miles south, the water will irrigate farms in the southwestern part of the San Luis service area and provide municipal and industrial water for the Coalinga area.

Two detention dams along the canal, completed in 1966, provide flood protection from cross drainage, Los Banos and Little Panoche Detention Dams are both located southwest of Los Banos on Los Banos Creek and Little Panoche Creek.

The San Luis Canal is being constructed in five reaches, three of which are finished. The other two reaches are 73 and 65 percent complete, respectively. The first reach of the canal, 15.8 miles in length between O'Neill Forebay and Dos Amigos Pumping Plant, is now filled with water. Water will be pumped into Reach 2 as soon as the Dos Amigos pumps are ready to lift it, probably early this fall. The entire San Luis Canal should be completed by December 1967. All joint-use features of the San Luis Unit will be turned over to the State Department of Water Resources for operation and maintenance July 1, 1968.

$121 Million Saving

All the joint-use features of the San Luis Unit are being completed at a saving of $121 million below the originally estimated cost of $432,948,000, due to a number of factors including the substitution of a siphon for a detention reservoir, keen competition among bidders for construction work and the supply of equipment, good weather, and efficient planning.

Continued on page 110

An old homemade windmill now in Pioneers Park, Lincoln, Nebr.

Nebraska is credited with 2,000 private windmills for irrigation in 1898. Kansas and eastern Colorado also were leaders in an early Great Plains windmill trend.

WALTER Prescott Webb speaking at Lincoln, Nebr., in 1953 said: "The windmill was like a flag marking the spot where a small victory had been won in the fight for water in an arid land."

When the dry years of the 1880's and 1890's struck the Great Plains, this mechanical device was put to work to irrigate the arid land. One of the earliest *modern* irrigation projects in Kansas was built in 1870 by soldiers at Fort Wallace on the Smoky Hill River to irrigate the fort's lawns and 4 acres of vegetables. A similar project was developed later by the soldiers at Fort Sidney, Nebr.

Examples of windmill and pump irrigation plants can be found in the 1870's and the 1880's. By 1881, in Kansas, a slogan was developed for farms that could not be reached by a stream or brook calling for "a windmill and a pond on every farm."

Mother Nature might neglect to send the rains, but she had left vast reservoirs of underground water that might be utilized for irrigation if tapped by man. In a few areas farmers had drilled artesian wells which flowed freely, but in most cases the well had to be pumped by wind or other power.

Interest in irrigation in dry years rose like the barometer on a clear day. By 1892, after crop failures spread over the Great Plains, interest was revived and it took on the characteristics of a crusade which continued until late 1896 with the return of the rains.

In plain fact, the farmer could not succeed in some areas of the Great Plains without resorting to irrigation.

There were numerous forces at work which stimulated this new interest. Drought, population exodus, low prices, tax rates as well as railroad rates, unemployment and many others kept up the

WINDMILLS SPURRED IRRIGATION

by DR. A. BOWER SAGESER

Productive farm-garden made possible by a windmill. (*Credit to Nebraska State Historical Society*) desire for better irrigation practices. By this time, Francis H. Newell's surveys of water resources in the United States had been made and Secretary of Agriculture Jeremiah M. Rusk showed great interest in the survey of possible underflow and artesian waters.

Irrigation associations at local, State and National levels were formed and frequent meetings held. The general press and numerous periodicals gave ample space to the problems and new methods of irrigation. Especially valuable were periodicals devoted entirely to the cause of irrigation, as Joseph L. Bristow's *Irrigation Farmer* and William Smythe's *Irrigation Age*.

Life and Salvation

To areas receiving less than 20 inches of rainfall per year, and not properly distributed during the late growing season, irrigation became the life and salvation. Dry years pushed the areas needing irrigation eastward. The growing interest in this new type of farming can be seen in the private applications for the use of water from Nebraska's streams and rivers. Nebraskans adopted their first general irrigation law in 1889.

Prior to 1895, some 1,000 claims were recorded. Under a second law of 1895, 694 applications were made in a single year. The rains returned in 1896 and 1897, and the number of applications was greatly reduced.

By 1904, the State Board of Irrigation was cancelling undeveloped claims at the rate of 150 per year. Judge J. S. Emery, a national lecturer on irrigation, described the Kansas interest in 1894 writing that "Kansas has her head and tail up, and irrigation is a go."

The years of 1890–96 might be called the experimental years for the use of the windmill in irrigation. It was during these years that the factory and homemade mills were put to work. Some farmers made more from a single mill than their neighbors were able to make on 160 acres. Others produced more foodstuffs on 1 acre than on the remaining quarter section.

In the Platte River and Arkansas River valleys the settlers were fortunate to find that the underground water (usually called underflow) could be reached with shallow wells only 8 to 30 feet in depth. Here a mill, even of low efficiency, could easily be applied to irrigate a few acres of land and produce a variety of crops.

Some commercial mills were developed, but there was a genuine industrial lag in this area unti around 1898, and they were expensive for the times. The editor of the *Irrigation Age* admonishe the farmer, "if you can't buy one, make one." Th farmer, accustomed to developing farm machine to fit his particular need, turned to the homemad mill.

Erwin H. Barbour, a distinguished Nebrask geologist, found seven main classes of these mill and 20 varieties in his study in 1898. With scra material from the farm, lumber, castings, and bearings from discarded farm machines, iron rods canvas, and even tin cans, the farmer designed hi own source of power. The costs ranged from $1.5 upwards.

Other Sources

Farmers not only used this type of mill fo pumping water, but also for other sources of powe as grinding and operating farm tools, even tools i the blacksmith shop. In some cases the homemad mill was a necessity, but it frequently became a convenience and a luxury, built by well-to-d farmers. It was not unusual to find three or four o these mills pumping water in a single pasture.

Today, the Federal Government subsidizes th farmer for the costs of such wells to keep the cattl from wearing off the fat in a long trek to a wate source. The editor of the *Kansas Farmer* wrote o May 28, 1908: "Like the sod house the Jumb windmill was useful for its day, but for the averag farmer that day has long since passed." This mil had become a "has been" of pioneer times.

The names of the homemade mill, soon sprea across the frontier, included Jumbos (mediun giant and screw), Merry-go-round (includin mounted and unmounted forms), Battle-Ax mill with two to eight battle axes, Holland or Dutc mills, Mock turbines closely resembling shop-mad mills with 4, 6, 8–20, 50 fans, and Giant Turbines some vaneless, reconstructed turbines with or without rudders.

For upland farms with deeper wells the factory made mill was more efficient. These were widel used in the eastern Great Plains area.

When the Kansas Irrigation Board develope 20 experimental wells in western Kansas in 1895–96, only one was powered by a 10 horsepowe gasoline engine furnished by the Fairbanks Mors Co. Nineteen were pumped initially by windmills Some wells could not be pumped continuously wit the large mills used by the State.

Finney County in 1894 had over 100 pumping plants, mostly wind-powered. By 1910, many types of factory-made mills were for sale. Irrigation boards and State agricultural colleges were still urging their use.

The leaders were the Dempster, the Gause, the Aeromotor; others were the Ideal, Crane, Fairbanks-Morse, Double-Header-Challenger, Cyclone, Eclipse, Woodmansee, Carlyle, Halladay, Corcoran, Althouse, Gem, Perkins, Stover, and Buchanan. Most of these could be found among the county fair exhibits.

The farmer could make his homemade mill, but he was never freed completely from factory or shop-made equipment for his irrigation plant. Several firms manufactured sandpoints, but on occasion the farmer made his own or improved upon the machine-made point. This consisted of a sickle knife welded on the end of a perforated pipe with the pipe wrapped with screen.

Almost always the farmer purchased a cylinder and valves that were factory made. He was likewise dependent on the itinerant well driller to put down his well at a cost of 50 cents to $1.50 a foot.

Reservoir Usefulness

No matter how good a mill the farmer built or bought, it was not in itself a satisfactory system unless a reservoir was built. Water piped directly to the cropland sank in too rapidly. The reservoir enabled the farmer to deliver water to a much larger area.

Here the science of reservoir building developed quickly. With the reservoirs, the mill could run day and night and when the water was turned on to the soil it moved more rapidly. Many reservoirs, 60 feet wide and 100 feet long, were located on higher ground.

Retaining walls ranged from 3 to 5 feet in height. In order to check water seepage some walls were 8 to 12 feet wide at the bottom and the inside lined with clay or brush to check wave erosion. Some reservoirs ranged from 1 to 3 acres.

The bottom of the reservoir was compacted to make the soil less porous. Often the earthen floor was covered with water and horses or cattle were driven around on the floor through a regular loblolly until the area was firmly packed. Usually a clay tile or wooden pipe was used as an outlet.

Some farmers practiced winter irrigation. Others stored ice from the pond for summer use. A few stocked the reservoirs with fish.

Reconstructed windmill and irrigation pond near Ashland, Nebr.
(E. H. Barbour, U.S. Geological Survey)

In most cases, areas irrigated by the windmill ranged from 2 to 5 acres. I. L. Diesem at Garden City irrigated 15 acres during the summer of 1894 from two reservoirs. An 8-inch pump was powered by a 14-foot mill which produced 4,400 barrels of water per day. One reservoir was 80 feet wide and 150 feet long; the other was 60 by 100 feet.

Diesem had 8 acres in orchard and produced garden vegetables and berries on the remainder of the 15-acre tract. Not far from Diesem's farm, D. M. Frost had 20 acres of vegetables irrigated by two windmills. One mill was a standard make, the other an "over-shot" or "Great Mogul." He claimed the latter with a reservoir was the cheapest.

Estimates on pumping capacity and acres irrigated were often over-optimistic.

The extent of the use of the windmill is difficult to determine. Estimates vary and were no doubt too high. But Nebraska, Kansas, and eastern Colorado were leaders in the use of the underground resources. One estimate in 1898 credits Nebraska with 2,000 private systems using the windmill. Records kept in 1904 on the performance of 72 windmills at Garden City, Kans., ranged from one fourth an acre to 7 acres.

Prime Mover

There had been no single crop failure in the previous 10 years where a windmill provided moisture. Writers frequently spoke of the mill as a prime mover, which enabled the farmer to succeed. Much had been gained in this experimental era. Dry lands which could not be reached by streams and canals were irrigated. Crop yields had been doubled and at times quadrupled. Crops were diversified. It was great news when a farmer at Ord, Nebr., produced 105 bushels of barley to an acre.

The diet of farm families was greatly improved. At least one enthusiast predicted that irrigation would do away with patent medicine and M.D.'s.

For some farmers the mill had been a means of survival. Moreover, its use had generated dreams of a new Utopia, stimulated State experiment stations, the adoption of State-paid irrigation engineers, and the passage of better State irrigation codes.

More was learned of the supply of underground water. Old superstitions on the harmful effect of ground water on crops were destroyed.

Experiments with the windmill were to continue. In Kansas, $125,000 a year was appropriated as late as 1915 for windmill experiments and six western counties bought 160-acre tracts and donated them for the State experiments.

But the windmill did not bring large-scale irrigation. It was not until bigger pumps, deeper wells, and new sources of power were put into use that well irrigation really flourished. Then, and only then, could the farmer irrigate 40- to 80-acre tracts from a well. The years 1897 to 1910 might well be called the years of adolescence for pump irrigation.

By 1910, irrigation by larger capacity pumps was a flourishing business, both for the farmer and the manufacturer. Deeper and more productive wells could be developed. Many irrigators used 6- to 36-inch well casings and it was not unusual to find wells 200 feet in depth.

Pumps were powered by engines ranging from 2 to 400 horsepower. The engines were fueled by gasoline, distillate, and steam. A few pumps were driven by compressed air, and by 1910 electric motors were in use on many irrigation systems.

Four Types Made

Four types of pumps were manufactured: the plunger or piston, the vacuum, the rotary, and the centrifugal. In a few wells, lakes and reservoirs a chain-bucket elevator was used. On occasion, the hydraulic ram was put to use.

The centrifugal pump, freed from the use of valves that might stick, was the most efficient. A good propeller or centrifugal pump delivered from 400 to 6,000 gallons per minute. An abundant supply of underground water enabled the new pumps to flow continuously, eliminating the need for a reservoir.

Many of the leading manufacturers of windmills turned to the production of engines and pumps. One of these produced 20,000 gallons per hour, using a 12-inch bored well 200 feet deep. These power driven pumps were not always used with large casing wells. In some areas the farmer drove several sand points, usually 1½ to 2 inches in diameter, several yards apart and connected these smaller wells above the ground with a large pipe attached to a pump. Several of these systems are in use in the Arkansas River valley today.

Many examples of new plants can be found. At Garden City, in Finney County, Kans., the U.S. Sugar and Land Co. irrigated 3,500 acres, using a 400 horsepower engine to run a 350-kilowatt generator. Through 20 miles of electric line, 14 pumping plants were operated each with a capacity of 1,800 to 2,000 gallons per minute.

In 1911, Finney County, Kans., had 6,500 acres of land irrigated by centrifugal pumps which were powered by gasoline or distillate. With the pumps, as with the windmill, the river valley farms were the first to be irrigated.

While the U.S. census reports for 1910 on the use of wells for irrigation are not complete, some trends can be seen. By 1909, 13,738,485 acres of land were under some form of irrigation. In the 17 arid and semiarid States there were 14,558 wells being pumped, irrigating 477,625 acres. This total does not include the use of pumps for streams, lakes, or reservoirs. In Kansas today, 72 percent of the land irrigated is watered by the use of pumps.

The pumping capacity of the 14,558 wells was about 10 million gallons per minute in 1909. The five leading States in the number of pumped wells, in order, were California, Kansas, Arizona, New Mexico, and Texas. This report did not include the wells in Texas that were used to irrigate rice. The greatest use of wells was east of the Continental Divide and in southern California. Wyoming reported three pumped wells, Utah 27, Montana 10, Colorado 121, Idaho 24, Nebraska 66, and Oklahoma 69.

Deep Well Pumps

Deep wells and big pumps were costly. The irrigator had to be a man of fair means or of good credit to pay from $12 to $25 per acre for his plant. It was easy to invest $1,000 to $3,000 in a project, and land values soared where deep well irrigation was possible.

The impact of the big pump and deep well was much the same as the windmill. More productive wells freed the farmer from the interstate rivalry over the use of the streams. There was more diversification of crops and more experiments at State and National levels. For example, the National Government provided one experiment for the production of tea. Technology had responded to meet almost every need of the irrigation farmer.

Some farmers looked upon irrigation as a lazy man's way. The irrigator could just provide the water and let it run. Experience showed that this was not true. Irrigation became "a way of life," and it was hard work.

Francis H. Newell had stressed that the "ideal" was 40 acres in the irrigated country. But he also added that the irrigated country was no place for the poor farmer. According to Newell, the man who goes to the irrigated country "must use his brains in all his farming."

There was an extensive amount of published information for the irrigation farmer by 1910. Of course, there was always the academic argument in the arid lands between those who favored farming by water and those who supported "dry farming" or "horse-leg irrigation" because water was conserved by tillage.

By 1910, a farmer knew the real value of well irrigation. The system would be extended throughout the land wherever a supply of underground water could be found. With adequate finance the farmer could always escape the effects of the droughts through well irrigation. Authors of the U.S.D.A. Experiment Station bulletins for the period of 1908–10 still referred to pump irrigation being in or just past its infancy. But all predicted that pumping plants would reclaim much arid land in the future.

Certainly, the irrigator of the past two decades owes much to the experiments which took place from 1890 to 1910. So influential was this new way of life that the natives in their moments of relaxation often ordered "Ditch and Bourbon" from their favorite barkeeper. # # #

Dr. A. Bower Sageser is professor of History at Kansas State University. We extend our appreciation to him for his permision to reprint this article, which appeared originally in the Nebraska Historical, *summer 1967 isue, under the title, "Windmill and Pump Irrigation on the Great Plains 1890–1910," well documented with footnotes. Born and educated in Nebraska, author Sageser's books and numerous articles present accounts of early irrigation developments.*

Large battle ax mill in Nebraska in 1898.

Self-Help on Afghan Canals

by **DICK ADAMS, Reclamation Engineer**

A 1,200-year-old canal, the Jui Engel, transports water 15.5 miles for the people in the town of Herat. But old Jui Engel, being typical of the other canals in Afghanistan, has a long record of breaks and lack of use.

Back in the 12th or early 13th century, both the canal and Herat were destroyed and it was about 50 years before rebuilding was done. History lays that long interruption to a warring and destructive group, the Moguls, who ruled the country at the time.

Little if any precise engineering has been done when canals like Jui Engel were constructed or reconstructed. Local people, working with hand shovels, simply dug diversion outlets in the river banks. If water flowed in a ditch at a reasonable rate of speed, they had an irrigation canal.

These canals crossed large washes with no provision for controlling increased flows due to annual rains and melting snows. As a result, in recent years, whenever a canal washes out, as many as 3,000 people come with shovels and work 6 or 7 days to repair the banks.

7 Breaks a Year

Both the Jui Engel and Jui Nau, in this northwest part of the country, averaged seven breaks per year. The water-users coped patiently with the problem for centuries, but, finally, in 1966, a request for assistance was made by the Governor of Herat Province to the Minister of Agriculture and Irrigation in Kabul.

A three-man team consisting of a design engineer from Bulgaria, and an Afghan engineering trainee, and the writer, flew to Herat in July 1966 and examined two of the major washes. A recommendation was made to construct an overflow wasteway of stone masonry on a major wash in the Jui Engel. But then the question arose: How would it be paid for?

A quick reply came from the Governor. The irrigation agency would collect money from the farmers, each one to pay according to the amount of area he farmed.

Design work started immediately and an estimate of 1 million afghanis (U.S. $14,300) was submitted to the Governor. With warm enthusiasm, construction started in mid-October and was completed in early December. Several two-shift operations had been necessary due to foundation problems and water in the cutoff wall area. From 100 to 250 laborers per shift were used, resulting in that problem being solved.

People Request

In answer to requests from the people themselves in all sections of Afghanistan, this team of specialists inspects one trouble spot after another. They continue on projects through each phase of work, concluding with the role of supervisors of construction. In addition to four Bulgarian engineers, Tom Dewhurst, formerly from the northwest USA Reclamation area, and I have been members of the team for some time. Others recently added are Albin H. Wadin, team leader, from Yuma, Ariz., Lawrence M. Ehrhardt of Sacramento, Calif., and George E. Nichols of Salt Lake City, Utah.

Other engineering efforts also have started on a reinforced concrete flume across a large wash on the Jui Nau Canal. This feature will cost about $9,000, which likewise will be collected from farmers. Excavation also will soon have begun, by the time this is printed, on the relocation of a quarter-mile portion of this canal by the 300 families who use its water. Each family will excavate 2 linear meters of the canal as their share of the cost.

This is the type of operation which demonstrates what the people of Afghanistan can do when given some of the assistance in design and supervision they so eagerly seek. # # #

Construction on a canal flume underway in Afghanistan.

Transporting concrete aggregates across an old canal for flume building.

New Wasteway structure provides an escape for high storm waters, completed with help of Reclamation specialists.

Director-Management teamwork helps irrigation business

Keeping Directors Interested!

by THEODORE NELSON, Chief, Irrigation Operations Branch, Boise, Idaho

IT will not be news to the man of experience, but the irrigation business is like many other businesses—the key to its success is teamwork between the directors and the manager. Essential to achieving this teamwork is a well informed board of directors.

The manager knows that for the board to be informed it must actually see many of the problems in the field, not just discuss them around a table. A picture is worth a thousand words, it is said, and seeing is far more impressive than just hearing.

The board establishes policies and provides guidance to the manager in the performance of his responsibilties. But if the directors did not also participate in field reviews and have adequate knowledge of major field problems, substandard operation and maintenance practices could readily result. A strong manager may overcome the handicap of a poorly informed board, and a well informed board usually is an indication of an efficient and progressive operating entity attuned to the needs of the water users and their future.

An outstanding illustration of a highly successful director-management team is the Boise Project Board of Control, the operating organization for the Arrowrock Division of the Boise Project. This Idaho project serves irrigation water to approximately 165,000 acres of highly productive farmland in the Boise Valley. It was constructed by the Bureau from 1906 to 1911.

The board of control was created in 1926 with five irrigation districts varying in size from 56,282 to 1,696 acres. Seven men are on the board of the largest district and three on each of the other four boards. The board of control is composed of nine of these directors representing the five districts.

Well-Spoken Of

With this organization in the Arrowrock Division there has been no problem of larger districts gaining more influence than the smaller ones, and water users speak highly of the benefits of a board of control-type organization.

Vital to the efficient management of the Arrowrock Division in recent years is the annual 3-day examination of facilities carried out by the board of control manager, Royse Van Curen. Directors of the five districts attend. Key operation and maintenance personnel and Bureau of Reclamation representatives also participate.

Even with adverse weather conditions on the last 2 days of the 3-day tour in 1966, the attendance of the examining team was excellent. On the first day 28 participated and the smallest attendance for any single day of the tour was 24. The directors were appreciative of the opportunity to participate in the field tour and were interested in witnessing the work that was being accomplished during the fall and winter maintenance program.

The outstanding interest in the procedures used by this manager should be an example to other districts where relatively poor field examination and support to the manager has been the case. Mr. Van

Directors take to the field to see how things are doing.

Curen has developed several ways to generate and hold interest:

4 Important Ways

First, the examination schedule is set up well in advance considering the time when most directors can leave their own farmwork.

Second, the high points of the season's operation and maintenance program is brought to their attention during monthly meetings, and special effort is put forth to keep them informed and interested. These work items are pointed out during the annual examination.

Third, before going to the field some time is given to showing slides highlighting the current maintenance program and pointing out other important work items that time would not permit covering on the field tour. This is another way the manager illustrates his work program to the directors at their convenience.

Fourth, the field trip is planned with excellent travel accommodations for all participants. Two-way radio-equipped vehicles make it possible for the tour leader to keep everyone informed as the tour progresses. The noon hour of each of the 3 days on the 1966 tour provided a banquet table dinner for hungry appetites, an opportunity for reviewing current work problems, and exchanging ideas on future improvements.

Throughout the inspection, the manager pointed out what was being done to modernize the 60-year-old distribution system.

Modernizing

Here are some examples: Small open laterals are being replaced with buried pipe. The last of the numerous flumes that were a part of the original construction is planned for pipe replacement and improved measuring devices have been installed at canal and lateral headings.

Extensive reaches of concrete lining have been recently added. Considerable emphasis was given to what is being done to preserve the life of the many miles of asphaltic concrete lining in the main canal. Concrete structures are being repaired or replaced.

Ditch rider housing is being modernized and greater consideration is given to employee fringe benefits in an effort to attract and hold competent operating personnel. The manager's well-prepared agenda also provided historical data concerning the many facilities visited and detailed comments concerning their functions, needed improvements, and plans for future work.

There is no doubt that the strength of an irrigation operation requires firsthand knowledge of field conditions. And the results are worth a special effort. This is well demonstrated on the Boise Project where this highly efficient director-manager team is making outstanding progress in bringing an old irrigation system up to modern standards.

# # #

TOYON

Offers Second Chance

by **ANNE VOETSCH**
of Mount Holyoke College

"BEFORE they were dependent upon other people, now they have useful skills and can take opportunities which benefit themselves and the community."

Basil B. Sharp, Head Cook of the Bureau of Reclamation's Toyon Job Corps Conservation Center near Redding, Calif., was speaking of the 22 corpsmen who have graduated from the cook-trainee program at Toyon during the past 2 years.

As he watched two of the youths carry the remaining dishes from the cafeteria, Mr. Sharp described his part in the Toyon Center's program to give unemployed young men, aged 16 through 21, a chance to resume their education while learning the technical skills required in securing a job.

Twice daily, the former Army cook holds classes in the essentials of cooking. Enrollees begin their training in the kitchen's clean-up detail and, as their skill and knowledge increase, assume the responsibility of preparing portions of the three meals.

By dividing the 11 corpsmen currently interested in cooking into two groups, Mr. Sharp can give individual attention to each boy's progress. Practicing the skill of deep-fat frying or learning the various cuts of beef provides the corpsmen with on-the-job experience and the specialized knowledge that prospective employers demand.

Cooking is just one of 14 vocational areas in which Toyon's 163 corpsmen can receive on-the-job training.

Two of the most popular trades, according to Vocational Guidance Counselor Robert Hegge, are auto mechanics and heavy equipment. Although waiting lists of corpsmen anxious to learn these skills are often necessary, corpsmen are also eager to train for masonry, building repair, grounds-keeping, laundry work, carpentry, conservation, janitorial work, maintenance mechanics, warehousing, the medical corps, and as service station attendants.

The corpsman is free to switch vocational choices. After he discusses his decision with his counselor, the change is made as quickly as possible.

As he develops his job skills, he improves his employment potential with additional education. Toyon's program alternates one week of work with one of schooling.

The classroom, once a source of fear and hostility, becomes an important link to "being someone." Six dedicated teachers dispel the corpsman's former defeatist attitude.

For the first time the corpsman can see an outcome other than failure and he tries hard to take advantage of his "second chance." Even the boys who don't enjoy the classroom recognize their opportunity and voice a genuine desire to improve. As George, 17, remarked, "Well, all school is about the same, but I'd rather be here because you're learning a trade, too."

Corpsmen build nature trail at Whiskeytown Lake. Toyon Center.

Unlike public school students, the corpsmen progress at their own learning rate by use of self-teaching materials. Nevertheless, the teacher is of utmost importance in maintaining the boys' morale.

Mrs. Marylynn G. Leiter, teacher of Language Arts and Beginning Reading, who has a reputation for strictness among the corpsmen, reports that she has never had any trouble in the classroom since she has taught at Toyon. She has never heard any cursing and has rarely seen a corpsman get discouraged and just quit. Like all the teachers, Mrs. Leiter offers "close supervision and much intuition."

The Sullivan series, used by all corpsmen, plays an important part in providing incentive to improve. After the corpsmen finishes two books of the series, he receives a $5 raise in his monthly allowance, which ranges between $30 and $50.

One of the most popular self-teaching devices is the Language Master Card Set, prepared especially for the Job Corps. To use the set, the beginning reader feeds a vocabulary card into the machine and then sees the word on a screen while he hears it pronounced through his earphones.

Health and physical education are also included in the program, as well as Drivers' Education, available to academically qualified corpsmen.

In contrast to their independent learning of the three R's, the corpsmen meet in groups to discuss procedures for finding a job and objectives and behavior necessary to keep a job. In this "World of Work" program, the corpsman is outside the classroom, with its maps of the United States and colorful reproductions of paintings by Wyeth, Manet, and Picasso, and in a more conference-table atmosphere, learning to cope with the impersonal working world.

Mr. M. H. Haban, who conducts the "World of Work" classes, feels that the corpsmen's main problem is that they "don't sell themselves." Often a boy feels guilty about presenting a totally positive self-image and wants to bring up the failures of his past.

Typical of this conflict is the response Mike, 17, made to the question "Why did you join the Job Corps?" Instead of stating that he couldn't find a job, Mike sat silently for several minutes, shifted, and then replied uncertainly, "Well, I could tell a few lies."

Toyon Job Corps Conservation Center operates on a budget of about three-fourths of a million dollars a year. The Center's work projects make a large contribution toward repaying the taxpayers' investment in the corpsmen.

Toyon corpsmen recently completed a half-mile nature trail near Whiskeytown Lake, for which they built eight rest benches and a foot bridge. They also sunk flagstone strips about every 15 feet along the trail to prevent erosion.

A 5-mile trail near Brandy Creek is one of their projects, and plans are to make Whiskeytown Lake, behind the Bureau's Whiskeytown Dam, the largest camping area in northern California by building from 350 to 500 campsites in the surrounding hills.

One ambitious project is the Judge Francis Carr Memorial at Whiskeytown Lake. They have recently completed a concrete walkway near the lakeside and have laid water and sewer lines and underground electric lines. Future construction includes a parking area, restroom building, light-

On-the-job training with an auto parts company. Toyon Center.

ing around the circular driveway, and a lighted fountain. Skilled craftsmen, hired from the Redding area, are helping the corpsmen learn the various skills involved.

Toyon corpsmen have also proved their value to the Redding area. On Memorial Day 30 corpsmen and three staff members volunteered to clean up the community cemetery in Red Valley.

In close cooperation with the U.S. Forest Service, they have spent 3,500 hours in firefighting. Sporting its own 1937 Ford fire engine and an ever-ready supply of canteens and well-sharpened axes, Toyon offers a 16-hour training course in firefighting to interested corpsmen. When called for assistance, the center's firefighters can mobilize within 30 minutes.

In the Toyon community itself, consisting of 52 buildings and 40 vehicles, corpsmen are largely responsible for keeping the Center running smoothly. Corpsmen service the Center's cars in the garage, aid Medic G. L. Ralston in the dispensary, and supervise the storage and distribution of supplies in the warehouse.

Last 4th of July, the corpsmen built a new barbecue pit and picnic tables for the holiday celebration. They are also developing a lily pond, complete with waterfall, mosquito fish, and a Polynesian bridge.

Toyon Center has an excellent record of good relations with the community of Redding as well as an absence of major incidents within the center. The challenge to succeed in the community is strong and maintained through the staff's ability to encourage self-improvement and the willingness of the residents to accept the corpsmen.

From the time the Toyon Conservation Center opened in April 1965, the Redding community has helped to make the project a success.

A local car dealer has donated two old cars for mechanic's training and the Redding Health Service frequently assists in the Dispensary. Regularly, an employee of the Redding Employment Agency visits the "World of Work" classes to conduct professional job interviews.

The cooperation of local businesses in giving opportunity to use their training on the job is especially valuable. Pacific Gas and Electric Co., Rother Auto Parts of Redding, and the Bureau of Reclamation have all set up on-the-job training programs.

Assemblies to recognize worthy corpsmen are held in the gym each Monday morning. At this time, promotions are announced, graduation certificates are awarded, and the naming of the "Corpsman of the Month" is accompanied by the presentation of a watch by the Shasta Dam Area Chamber of Commerce.

The points also help to determine which men will be promoted to the positions of Specialist and Senior Specialist, an indication that the corpsman has mastered particular trade skills, and to the responsible position of Corpsman Leader. Each promotion carries with it an increase in pay, up to $50 a month for the leaders.

Besides orienting newcomers, the corpsman leaders help smooth out possible trouble areas. Said Hector, 19, "The corpsmen who want to leave, you can spot right away. They're the ones who don't want to do anything, and just mess around."

Corpsman leaders may also earn the added privilege of living in houses with other responsible corpsmen. Since the houses offer more privacy, this prospect is very desirable.

Upon graduation, a corpsman can enter one of three different environments. If he has been in the Job Corps less than 2 years, the maximum period allowed for training, he can continue the program at one of the urban centers. Or he can make use of his newly acquired skills and seek employment. A Job Corps Occupational Specialist located in the State Employment Office makes a maximum effort to put graduates to work.

Frequently, the corpsman follows the third possibility and enters military service.

The Toyon graduate looks forward to a productive future of "being someone." But he looks backward, too. As he moves out into the working world he joins the ranks of the gainfully employed. Under the new pride in his performance, sense of responsibility, and competence in his trade, lies an unflagging desire to show that his "second chance" was a public investment that he can repay fourfold. # # #

Miss Anne Voetsch, author of this article, spent her 1967 summer vacation working at the Bureau of Reclamation Information Office at Sacramento, Calif., at no expense to the Government. Her travel and expenses were provided through her winning a $500 scholarship award from Mount Holyoke College, South Hadley, Mass., where she returned this fall as a junior.

Miss Stockton was on the case alone to start, then she got encouragement from Washington, D.C. and considerable local support.

THE CASE OF THE FLOWER FIELD

Getting together on the case of the flowers are, from left, Mrs. Ann Iocapi, president of the Westside Pioneers and Descendants; Miss Marion Stockton, wildflower enthusiast; and D. J. Reimann, San Luis Project Administrative Officer.

WHENEVER a well traveled highway gives motorists a good view of a Reclamation reservoir, an equally fitting overlook is constructed on a convenient curve or hill.

But because of the determined efforts of a 74-year-old lady and the cooperation of the Bureau of Reclamation, the vista-point at San Luis Reservoir in California has a command view not only of the 2.1 million acre-foot body of blue water, but also of the surrounding hills afire in spring with California poppies.

Only a few months before, at a lower elevation, the annual floral display faced the perilous prospect of extinction—a burial of water.

A lone crusader to start, but soon to be joined by many others, Miss Marian Stockton began a campaign. She is not only a wildflowers lover, but also a member of a pioneer Los Banos family.

The case became clear to Miss Stockton one day when she was viewing the San Luis Valley from Romero overlook. She saw San Luis Dam under construction and behind the structure, where nature had caused a carpet of flowers to grow in spring, would be the reservoir. Something must be done, she thought, to save those flowers from a watery grave. And she decided pretty well what should be done.

This is how flowers improved the view.

She explained the situation in a letter to the wife of President Lyndon B. Johnson. Nowhere else in the State do California poppies attain the size and depth of color of those in the San Luis Valley.

A reply through a White House social secretary said: "Mrs. Johnson shares your interest in the wildflowers of our Nation . . . she was interested to learn of your efforts to preserve the seed-laden topsoil of San Luis Valley, and she hopes that you will be able to find some means to do so."

In 1966, local groups, flower authorities, and several newspapers joined Miss Stockton's "Save the Poppies Campaign," but problems remained. If a way could be found to transplant the seeds and bulbs on higher ground, would they grow again? There was not enough time or money to experiment, because the reservoir would soon be starting to fill.

Then in December 1966, about 2 months before filling would begin, Max R. Johnson, the Bureau's project construction engineer, offered a solution. While there was no Federal money earmarked for large-scale removal of topsoil from the reservoir site, it did have plans and money to landscape two barren knolls overlooking the reservoir.

To attempt to save the flowers by removing better areas of the topsoil was agreed by Miss Stockton and the San Luis Recreation Coordinating Committee. Also Clyde Strickler, recreation area supervisor for the State Department of Parks and Recreation, agreed to care for the flowers if the transplanting was successful.

Scraper and carryall machines promptly did the job. Hopefully, two knolls visible from Romero overlook, where permanent visitor facilities will eventually be built, were spread with the valley soil.

By February 1967, it was plain something was growing on the two knolls. Two months later, other hillsides near Los Banos bloomed as they usually did, but not the two knolls. Then as if in answer to a prayer, April was unusually rainy.

During the first week in May, the two knolls below Romero overlook were suddenly covered with a multicolored carpet of native California poppies, up and blooming in their new home. Their varieties were numerous and distinctive and only 5 months had passed from their replanting. Miss Stockton discovered an added bonus—a patch of Mariposa tulips.

Future motorists and floral fanciers who pull off the road in spring and see what is going on in San Luis Valley will owe a debt of gratitude to Miss Stockton who, with the help of Reclamation, solved the case of the flower field. # # #

Golden Spike Day

A "Golden Spike" celebration for completion of a railroad to the town of Royal City, Wash., was held last June. It was a milestone for the farm community of 550, which was incorporated in 1956. The event also was a mark of progress for the Columbia Basin Project, supplier of Royal Slope's irrigation water for the 12 years.

In the late 1880's pioneers first settled on the slope—mostly cattle ranchers near Crab Creek. But stretches of sagebrush began to change to productive fields when Columbia Basin Project canals and laterals brought water from the Columbia River. By 1966 the irrigated acreage had extended from the original 4,000 to serve 83,184. The 64,000 acres actually irrigated produced 50 different crops with a gross value of nearly $11 million.

Their longest new rail line since 1910, the 6½-mile spur of the Chicago, Milwaukee, St. Paul, and Pacific Railroad signifies not only a growth for that company, but also the coming of age for Royal City.

More Gains

Predictions for the area foretell even more spectacular gains. Within a few years, it is planned that the irrigable acreage rise to 90,000 acres, with at least 85,000 acres actually irrigated each year. The annual gross crop value is expected to be around $23 million. Livestock and livestock products will probably add another $10 million annually to the gross product of the area. The total farm and nonfarm population is expected to reach 23,000. In addition to the agricultural activities there should be about 500 nonfarm businesses providing employment for some 3,200 persons.

The large crops grown plus the transportation now available by rail, highway, and the Columbia River waterway only a short distance away, will encourage more agriculturally-oriented industries to locate at Royal City. For example, potato and vegetable plants, freezing, canning, and dehydrating plants; alfalfa processors, fruit packing plants; and additional dealers in equipment, fertilizer, fuel, chemical, and other products.

There seems good reason for the residents of this project area to enthusiastically mark this year's highlight in their economic betterment. # # #

"MAJOR FEATURES COMPLETED."

Continued from page 93

The San Luis Unit will make available each year over a million acre-feet of new water to irrigate 600,000 acres of dry but fertile land 65 miles long and averaging 13 miles wide, on the west side of the San Joaquin Valley. Farmers are now forced to irrigate from wells in this area, and as a result, ground water is being used up much faster than it can be replenished, while pumping costs also are rising steadily.

The San Luis Unit will allow underground water to return to normal levels, as well as conserving and improving production on land already being irrigated. Besides encouraging more diversified farming, the water supply will enable some undeveloped land to come under the plow.

The San Luis Unit also will provide about 45,000 acre-feet of water for urban and industrial use.

The reservoirs of the San Luis Unit have formed the only recreational lakes on the west side of the San Joaquin Valley. Campsites, picnic areas, marinas, beaches, and other facilities are planned at reservoirs behind San Luis, O'Neill, and Los Banos Detention Dams. The State Division of Beaches and Parks will administer the recreation areas.

The joint agreement to have the State of California operate the major San Luis facilities and the Bureau construct them has resulted in savings of many millions of dollars on both sides. Costs are divided on a 55–45 basis, with the State paying the larger share. # # #

Booklet on the Electricity "Free Loader"

For the last few years, the Bureau of Reclamation has had a unique way of using electricity not connected in any visible way to a source of power. Because of its simplicity and economy, the device—nicknamed "free loader"—offers an efficient way of drawing small, noncommercial amounts of electricity from the electrostatic field surrounding high-voltage transmission lines without physically tapping the lines themselves.

Some uses of, and technical information and drawings about the invention have been included in a 55-page booklet entitled "Theory and Application of the Electrostatic Induction Power Supply" available from the Office of Chief Engineer, Bureau of Reclamation, Denver, Colo. 80225. A nontechnical news feature dated October 18, 1966, about the system is available at the Washington Office.

The device has been patented, but the patent is available for public use and adapation without charge.

The *Reclamation Era* included a notice about the "free loader"—which was invented by John E. Skuderna of the Bureau's Denver Office—in the November 1963 issue.

Bureau of Reclamation

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As Corpsman Charley Horton recites a lesson, his instructress, Helen Branson, follows the text in Braille. Marsing Center.

Achievements at Marsing Center

A Job Corpsmen's newspaper entitled: "Snake River News" won awards and considerable recognition earlier this year, an achievement of the young men of the Marsing Job Corps Conservation Center in Idaho.

Although this was the first year for the publication, the "Snake River News" was entered in the newspaper competition of the Idaho State High School Press Association convention which was held at Idaho State University, Pocatello. The "News" won a 3d in the category of Illustrative Material-Mimeographed, in which about 100 publications from all over the State were entered. It also won three honorable mentions, including one for general excellence, one for best interview, and the other for front page. Ten corpsmen and a staff member attended the convention.

Largely responsible for the participation of and achievement by the corpsmen was Mrs. Helen K. Branson, a teacher at the center and editorial coordinator of the "Snake River News." Mrs. Branson is nearly blind and uses braille text in much of her work, but she enthusiastically instructs and exemplifies educational values in the Marsing program. # # #

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6521	Missouri River Basin, N. Dak.	July 13	Three pumps and three motors for Snake Creek pumping plant No. 1.	Hitachi New York, Ltd., New York, N.Y.	$999,560
DC-6525	Pacific Northwest-Pacific Southwest Intertie, Nev.	July 21	Construction of Mead substation and Mead 230-kv tie lines	C. R. Frederick, Inc., and M. M. Sundt Construction Co., Novato, Calif.	3,733,500
DC-6528	Colorado River Front Work and Levee System, Ariz.	Aug. 17	Construction of 8 miles of pipelines for Yuma Mesa conduit	Hood Corp., Whittier, Calif.	2,192,000
DS-6532	Pacific Northwest-Pacific Southwest Intertie, Ariz.	July 14	Supervisory control and digital telemetering with automatic data logging equipment for Phoenix Dispatcher's office and Liberty substation.	Gulton Industries, Inc. Metuchen, N.J.	122,204
DC-6535	Columbia Basin, Wash.	July 12	Modifications to Grand Coulee left and right powerplants and left switchyards.	Jelco, Inc., and Gibbons and Reed Co. Salt Lake City, Utah.	10,165,271
DC-6540	Fryingpan-Arkansas, Colo.	Aug. 4	Relocation of 16 miles of Denver and Rio Grande Western railroad, Pueblo dam and reservoir.	H-E Lowdermilk Co., Englewood, Colo.	2,956,100
DC-6545	Central Valley, Calif.	Aug. 2	Construction of 9 miles of concrete-lined Theama-Colusa canal, Reach 1, Sta. 196+24.85 to 685+00 and eleven county and farm bridges.	Rivers Construction Co., Westo Construction, Inc., and Purtzer and Dutton, Inc., Tracy, Calif.	5,569,691
DC-6548	Missouri River Basin, Kansas.	Aug. 17	Construction of Cawker City protective dike and water supply facilities, with soil cement slope protection.	Bushman Construction Co., Inc., St. Joseph, Mo.	2,442,621
DC-6550	Central Valley, Calif.	Sept. 7	Construction of 63.7 miles of pipelines for Westlands Water District distribution system, laterals 6, 7, 8, 9, 10, 11, and 12.	Lentz Construction Co., Sacramento, Calif.	3,994,701
DS-6551	Central Valley, Calif.	Sept. 25	Nine motor-driven pumping units, nine butterfly valves, and one valve operating system for Pleasant Valley pumping plant.	Mitsui & Co. (U.S.A.), Inc., San Francisco, Calif.	1,161,742
DC-6553	Colorado River Storage, N. Mex.	Aug. 18	Modifications to Navajo dam outlet works and stilling basin	Industrial Builders, Inc. Far Fargo, N. Dak.	608,523
DC-6554	Missouri River Basin, Kansas.	Sept. 7	Relocation of 3.4 miles of Mitchell County Highway No. C-705 and construction of township roads 356 and 500.	Heide-Christolear, Inc., and Van-Pak Construction, Inc. Smith Center, Kans.	1,395,186
DC-6555	Duck Valley (Indian), Nev.	Aug. 17	Construction of Wild Horse dam	Myers Construction Co., and D. Gerald Bing Minden, Nev.	1,145,210
DC-6556	Washoe, Nev.-Calif.	Sept. 22	Four 4-foot by 5-foot outlet gates and liners for outlet works at Stampede dam.	Toyomenka, Inc. San Francisco, Calif.	121,596
DC-6558	San Juan-Chama, N. Mex.	Sept. 8	Construction of Heron dam and relocation of 8.5 miles of New Mexico State Highway No. 95.	Universal Constructors, Inc. Albuquerque, N. Mex.	8,597,550
DC-6560	Missouri River Basin, Kansas.	Sept. 1	Reconstruction of 3 miles of Mitchell and Osborne County township roads and construction of two concrete bridges.	Reece Construction Co., Inc. Scandia Kans.	557,295
100S-930	Columbia Basin, Wash.	Sept. 8	Furnish and erect fifty 3-bedroom portable family dwellings and ten 2-bedroom mobile homes on a lease basis for Grand Coulee dam third powerplant.	Motors Investment Corp., Boise, Idaho.	975,750
100C-933	Duck Valley (Indian) Nev.	Aug. 8	Clearing campsite, erecting 20 mobile residences, and construction of office and laboratory buildings and two garages for Wild Horse dam government camp.	Bliss Construction Co. Fallon, Nev.	115,940
100C-937	Columbia Basin, Wash.	Sept. 15	Construction of 12.4 miles of buried pipe drains for D85-50, D86-11, -65 drains and D86-60, -62, -64, -66 drain systems and .3 mile of open ditch wasteway for W69.7, Blocks 85 and 86.	George A. Grant, Inc. Richland, Wash.	165,695
100C-938	do	Sept. 20	Construction of 8.67 miles of buried pipe and .35 mile of open ditch drains for D87-154, D87-155, D87-157, and D87-238 drain systems and D87-264 and D87-23A1 drains, Block 87.	Wells Construction Caldwell, Idaho	144,336
100S-941	do	Sept. 8	Furnishing space and facilities for 10 house trailers and 50 portable family dwellings on a lease basis for Grand Coulee dam third powerplant.	Convention Cities Seattle, Wash.	292,800
100C-942	Columbia Basin, Wash.	Sept. 15	Enlarging 11.7 miles of Potholes canal, replacing three county road bridges, construction of buried pipe and open ditch drains DPE254, DPE54A, DPE54B, and miscellaneous work.	Peters and Wood Co. Pasco, Wash.	364,599
100C-943	do	Sept. 15	Construction of concrete-lined East Low canal, Sta. 2123+58 to 2153+65.	Equipco Contractors, Inc. Ephrata, Wash.	286,829
100C-945	do	Sept. 20	Enlarging 11.4 miles of PE55 and PE59.4 laterals, Block 16	Peters and Wood Co. Pasco, Wash.	391,344
200C-682	Central Valley, Calif.	Sept. 26	Drilling horizontal drain holes and construction of drainage system for excavation area No. 2, downstream from left abutment of Trinity dam.	Andersen Drilling Co., Inc. Petaluma, Calif.	143,837
400C-349	Colorado River Storage, Colo.	July 26	Rehabilitation of 86 miles and construction of 24 miles of single lane unsurfaced access roads for Curecanti-Hayden transmission line.	Nick H. Gray, Montrose, Colo	153,753
400C-355	Weber Basin, Utah	Sept. 22	Repairing Gateway canal, Sta. 203+00.3 to 442+59	R. C. Jones and Co., and C. U. Shafer, d.b.a. Shafer Brothers Construction Co., Salt Lake City, Utah.	129,105
500C-251	Pecos River Basin Water Salvage, N. Mex.	July 21	Clearing phreatophytes from Pecos River flood plain, Dexter area.	Joe P. Starr, Albuquerque, N. Mex.	218,000
500C-252	San Juan-Chama, N. Mex.	Aug. 14	Construction of 3.8 miles of channel and maintenance road for Azotea Creek.	Herren-Strong, Inc., Platteville, Colo.	378,156
604C-66	Missouri River Basin, Mont.	Sept. 22	Construction of buried asphaltic membrane lining for East Bench canal, Sta. 974+50± to 1058+19.9±.	R. J. Studer and Sons, Billings, Mont.	102,045
706C-657	Fryingpan-Arkansas, Colo.	July 12	Clearing 986 acres for Turquoise Lake area	Herman H. West and Co., Murphy, N.C.	144,000

U. S. GOVERNMENT PRINTING OFFICE : 1967 O - 274-629

Major construction and materials for which bids will be requested through November 1967*

Project	Description of work or material
Central Valley, Calif.	Constructing the Pleasant Valley Pumping Plant, an intake transition, and a discharge line, with appurtenant mechanical and electrical equipment. The pumping plant structure is to be a reinforced concrete substructure and brick masonry superstructure on a structural-steel frame. There will be nine vertical-shaft, centrifugal-type pumping units, three each at 225 cfs, 125 cfs, and 45 cfs, all pumping against 197-ft total pumping head. The discharge line will be about 6,600 ft long with a 13-ft diameter. Alternate bids will be for steel cylindrical prestressed concrete, precast concrete, or monolithic concrete pipe. The discharge pipe will terminate in a discharge structure with a steel radial gate, about 20 miles northeast of Coalinga.
Do.	Constructing a fish trap and a fish ladder at the left abutment of Red Bluff Diversion Dam. At Red Bluff.
Do.	Modifying Contra Costa Pumping Plants No. 1, 2, 3, and 4 and constructing a 2,500- and a 1,500-kva switchyard. At Antioch.
Do.	Constructing two 12-ft paved lanes with 4-ft paved shoulders, including a passing lane, about 7,000 ft in length. Road extends east from Interstate No. 80 to Auburn-Folsom road. Near Auburn.
Do.	Excavating five 6- by 8.5-ft tunnels from 550 to 750 ft long, excavating a vertical 10.5-ft-diameter shaft about 185 ft deep with a 5- by 7-ft tunnel about 350 ft long taking off at bottom of shaft, and a number of 5- by 7-ft drifts with an average length of about 75 ft which are to take off from tunnels. Work will also include preparation of jacking test sites in the 5- by 7-ft tunnel and drifts. Southeast of Auburn.
Do.	Drilling about 56 horizontal holes for drainage on the downstream left abutment of Trinity Dam, installing drainpipe in holes, and constructing an erosion control and drainage system. Near Lewiston.
Do.	Furnishing material and constructing an exhibit building about 24 by 60 ft, a comfort station about 20 by 28 ft with storage room, a sewerage system, an under ground electrical system, a metered water system with sprinklers, a paved parking area to accommodate 200 vehicles, and relocating a road and landscaping. At Auburn Damsite.
Chief Joseph Dam, Wash.	Constructing Toats Coulee Diversion Dam and the Sinlahekin siphon, a 6-mile-long pipeline of 18-, 36-, 39-, and 45-in. diameters with alternate designs of either concrete pressure pipe, pretensioned pipe, noncylinder prestressed pipe, steel pipe, or asbestos-cement pipe. Ten miles northwest of Tonasket.
Colo. Rvr. Front Work & Levee System, Calif.	Quarrying and placing rock riprap in windrows on the Arizona side of the Colorado River; constructing haul roads and gravel surfacing same and gravel surfacing Topock Marsh Dike. At Needles.
CRSP, Colo.	Constructing about 120 miles of single-lane, unsurfaced access roads, with culverts and fence gates. Along Curecanti-Hayden 230-kv Transmission Line (Schedule No. 2), Between Montrose and Hayden.
CRSP, Colo	Completion work for Morrow Point Powerplant and Switchyard will consist of placing concrete for turbine embedment and generator support; installing two 83,000-hp, 180-rpm, vertical-shaft, hydraulic turbines; installing a transformer bank; constructing switchyard; additions to Curecanti Substation; installing equipment; constructing an entrance and visitor facilities building; landscaping; and constructing a sewage treatment plant. Twenty-two miles east of Montrose.
CRSP, Utah	Drilling and anchoring rock bolts and constructing concrete wall or barrier fence along left abutment of Flaming Gorge Dam. Near Dutch John.
Columbia Basin, Wash.	Work will consist primarily of excavating for Forebay Dam within specified limits, excavating common material east of the north end of the existing right switchyard, and excavating for the cable spreader yard. Work will also include constructing the Forebay Dam cofferdam, removing a portion of the existing Grand Coulee Dam as needed for the Forebay Dam construction, and constructing access roads over the cofferdam to the Marina Way and to the cable spreader yard. Right abutment of Grand Coulee Dam.
Do.	Constructing 51 miles of buried pipe drains and 1.3 miles of open drain in Blocks 82, 14, 42, 43, 19, 77, and 79.
Do.	Three vertical-shaft, Francis-type turbines, rated 820,000 hp at 285 ft net head. Best turbine efficiency desired at 305 ft net head and approximately 750,000 hp. Grand Coulee Third Powerplant.
Do.	Furnishing, installing, and testing three 600-mw, 97.5-power-factor generators for Grand Coulee Third Powerplant.
MRBP, Kansas	Constructing a 16-ft bottom width open drain about 1,000 ft long; a double 54-in. corrugated-metal-pipe culvert; and compacted earth lining 4,800 ft of the Main Canal. Cedar Bluff Unit, near Ellis.
MRBP, Montana	Right abutment slide area repairs at Yellowtail Dam will consist of resloping a portion of the slide area, constructing an anchored retaining wall about 12 by 220 ft, installing a drainage system, and placing free-draining backfill. About 45 miles southwest of Hardin.
MRBP, Nebr.	Constructing about 14 irrigation wastewater disposal ponds; about 5 miles of open drain; and 3 miles of grassed waterways. Near Ainsworth.
MRBP, N. Dak.	Constructing an office building, a 10-stall garage, and a shop and warehouse building for Oakes Permanent O&M Headquarters Building. Work will include furnishing and installing two buried fuel tanks, and landscaping and gravel surfacing. Near Oakes.
Do.	One 230-kv power circuit breaker for Bismarck Substation, State 06.
MRBP, Wyo.	Constructing the outdoor-type Hanover Pumping Plant No. 5. Near Worland.
Weber Basin, Utah	Earthwork, pipeline, and structures for a 4- to 14-in. pressure pipe system, with 150 turnouts, to provide service to 150 acres. Near Bountiful.
Do.	Earthwork and structures for about 6.6 miles of buried pipe drains, and 1,500 ft of open drain outlet channel. Near Farmington.
Yuma, Calif.	Earthwork, concrete lining, and structures for relocating about 5,800 lin ft of the Seminole Lateral, about 2 miles northwest of Yuma.

* Subject to change.

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U.S. Department of the Interior/Bureau of Reclamation

February 1968

RECLAMATION ERA

February 1968 • Vol. 54, No. 1

RECLAMATION

ERA

Gordon J. Forsyth, Editor

CONTENTS

COVER PHOTO. More such cattle views as this and better steaks for dinner tables will result from the water control systems of the Oahe Irrigation Project, S. Dak.
(Photo by Lyle C. Axthelm)
For other values of dams see Commissioner Dominy's article: "Dams Save and Serve," on next page.

United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C., 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

Commissioner's Page

Better the Bulwark

It is an operation as old as man: Put a dam across a stream, cut the bank, and water flows on thirsty land.

As time passed, dams came far from the first primitive innovations. The construction of dams evolved into a science which has brought many of the great rivers of the world under control. In a large number of arid and semi-arid regions now flourishing, dams are the bulwark of a better life.

Since coming into being 66 years ago, the Bureau of Reclamation has built more than 200 storage dams in the West. These structures bring not only irrigation benefits, but also provide flood control, power generation, pollution reduction, fish and wildlife enhancement, municipal and industrial water supplies, and recreational opportunities.

A vital part of the Reclamation effort has always been an insistence on structural adequacy in all its dams. This agency has developed a comprehensive system of testing and instrumentation, provided surveillance and instructions for operation under both normal and emergency conditions. In progress, particularly at older dams where new streamflow data have accumulated, are studies on the adequacy of spillways and other facilities.

But there is a related area of need. Many dams, which are not Bureau of Reclamation structures, are on our rivers and streams—some operated by organizations with a responsible safety maintenance program, and some without. An upstream storage dam not properly cared for, if it gives way, might seriously affect a well-managed downstream structure. Then a stair-stepping, or domino reaction, could result in one or more dam failures downstream bringing disaster to a whole settled valley. Thus, dams which do not have a safety maintenance program are a critical threat.

For this reason, I feel it necessary to emphasize the stand this agency has long affirmed: That the earliest possible date is none too soon for all owners of dams, who have not done so, to recognize their responsibility of adopting careful surveillance and maintenance programs to prevent and correct conditions which could become dangerous to other important water structures—and to an unsuspecting public.

Floyd E Dominy

Floyd E. Dominy
Reclamation Commissioner

Large and Small—

Dams Save and Serve

by FLOYD E. DOMINY, RECLAMATION COMMISSIONER

SEVERAL months ago our First Lady, Mrs. Lyndon B. Johnson, said Glen Canyon Dam is a "dramatic element in the whole story of water conservation."

The noteworthy dedication commemorated the full operation of that conservation giant in storied canyons of northern Arizona. The 710-foot high structure takes its place among such other large Bureau of Reclamation dams as Hoover, Grand Coulee, Trinity, Yellowtail, Hungry Horse, and Shasta.

These dams have appropriately been called engineering wonders because of their size and design. And in terms of their usefulness in generating power and impounding water, they also are water conservation giants. The capacities stagger the imagination. Their operations are multiplying benefits and opportunities in large proportions over their costs—and their direct costs are being repaid to the U.S. Treasury. Reclamation dams also contribute significant advances useful on other dams now being and yet to be built, both here and in many parts of the world.

Reclamation's 66 years of dam building shows, however, that dams need not have gargantuan stature to achieve giant goals. For example, Altus Dam in southwestern Oklahoma could scarcely be considered giant-sized. This concrete structure, a rare product of World War II construction, rises only 110 feet above its foundation on the North Fork of the Red River, and it has no power generation features. Yet it serves as the key unit of a valuable reclamation project:

- Altus Dam provided water to irrigate nearly 38,000 acres of lands in 1966 which produced crops valued at more than $4.3 million.
- It has storage capacity of 10,000 acre-feet of municipal water reserved for the City of Altus.
- It helps to control flood threats of the Red River system.
- And it provided over 900,000 visitor-days of recreation in 1966.

Water Salvage

One of the newest additions to the Bureau of Reclamation system is Senator Wash Dam, a 94-

Learning something about harvesting potatoes are little Celia and Estelia Martinez, whose father worked nearby on Reclamation's Colorado-Big Thompson Project. (*Photo by A. E. Turner*)

This scene in Oklahoma last August showing water flowing both left and right from Altus Dam and reservoir, is an example of how the dam makes it possible for people in the valley to grow valuable crops every year. It also supplies recreation, flood control and municipal water for the city of Altus.

foot-high, offstream pumped storage dam on the California side of the Colorado River. Completed in 1966, this project is planned to salvage 170,000 acre-feet of water each year and makes possible improved deliveries to irrigated farms in the United States and Mexico.

Economically speaking, the dam and regulating reservoir provide conservation benefits totaling nearly $5.5 million annually. The water conserved by this project is sufficient to serve the municipal and industrial needs of a city the size of Denver or Phoenix, or to irrigate 27,000 acres of land.

No staggering dimensions of height, bulk, or girth are for Minidoka Dam, but this senior member of Reclamation's family of dams rates high in production.

Arizona, New Mexico, and Oklahoma were not yet States; Theodore Roosevelt was in the White House, and San Francisco was just recovering from its tragic earthquake when Minidoka began her long years of uninterrupted service to southeastern Idaho. That was in 1906, and Minidoka Dam continues to serve.

First Reservoir

Minidoka was the first of Reclamation's storage reservoirs to be completed, the forerunner of 269 Bureau storage facilities which now help to meet the Nation's ever-growing needs for water.

As the dams have grown in size and number, so, too, has their design and construction become far more sophisticated than their predecessors. An example of one of these updated achievements is Flaming Gorge Dam on the Green River in northeastern Utah. A thin-arch concrete structure, it is a key multiple-purpose unit of the Colorado River Storage project.

Flaming Gorge Dam was 7 years in the building. It has a huge water storage and hydroelectric power capacity. In the first full year following the dam's completion in 1964, more than 800,000 visitor-days were recorded, and Flaming Gorge Reservoir surrendered 1.9 million sport fish to anglers—this from an area that had no recreational appeal, and no fish to pursue with rod and reel in its natural state.

There is considerable education, experience, research, and time represented in the graceful facade of a dam. To bring this investment to bear on every assignment, the Bureau's Engineering and Research Center in Denver is organized for the most efficient possible coordination among such disciplines and responsibilities as: project investigations, design, research, engineering geology, drainage and groundwater engineering, irrigation operations, power operations, and construction. Like a delicate instrument of many parts, each of these services are vital to the others. No multiple-purpose Reclamation project could reasonably be assembled with any of these services missing.

Many Functions

So, too, is a dam a single structure of many tested functioning categories.

In Flaming Gorge Dam, for example, the construction schedule required 238 separate line items ranging from track for a 65-ton gantry crane to 535 tons of liquid asphalt; from handrails to special thermometers. Although it may be a thin-arch structure saving more concrete than some other designs, nonetheless the dam required 987,000 cubic yards of concrete—enough to build a two-lane highway stretching from Los Angeles to San Francisco.

Long before the first rock was blasted or the first concrete form filled, work was underway on other stages of Flaming Gorge Dam.

From 1957 until 1964, men representing various professions and trades, using great amounts of materials and equipment swarmed unceasingly over the remote canyon site. They magically brought the structure rising from bedrock of the river it was to master.

Expensive though they may appear at first glance, modern dams enjoy economic distinction throughout their long service. They are, first of all, mature at birth. In the case of Flaming Gorge Dam, it and its powerplant represent an investment of $65 million—roughly equivalent to the cost of eight modern jet airliners or 30 miles of Interstate highway.

Full-Blown

From the cradle of their concrete forms, dams step out full-blown and robust as working, producing members of the region's and the Nation's economy. They store valuable water for farmlands whose increased productivity means food for the world's dinner tables—water for growing towns and cities—for fish, wildlife, and public recreation—for producing hydroelectric power used in farm operations, homes, and industry.

Dams regulate the rivers downstream, minimizing or even preventing floods which otherwise would result in costly damage. Their lakes may act as settling basins preventing silt from choking rivers and making them more capable of supporting fish and wildlife. They sometimes form important highway crossings over the rivers.

Rollin' Along

Just as "Old Man River Keeps Rollin' Along," as the song goes—so do dams stand remarkably indifferent to the passing years. Sometimes they contribute a great many more benefits than their designers dreamed.

This was true with Grand Coulee Dam in Washington. When this structure was started in 1933, not even the far-seeing eye could predict the wartime contribution it would make a decade later. Grand Coulee's first turbines—344,000 kilowatts put on the line in 1942—played the key role in the aluminum industry which was needed for airplane production and the rise of the greatest air force in this history of the world.

And the future bounds of Grand Coulee's immense service is nowhere in sight.

As in years past, water problems still pose challenges. The scope is broadening. Reclamation is now engaged in comprehensive planning of far-reaching programs to meet the needs of river basins in Western States for the next half-century.

Handling the atmospheric water resources program of augmenting usable streamflow by increasing precipitation through cloud seeding also is a significant role. Dams in place and others to be built, will be important in storing the runoff resulting from this artificially induced snow and rain.

As Reclamation takes on such added responsibilities, as are designated by the U.S. Congress, we are mindful that our multiple-purpose water resource developments, large and small, are the modern symbols of the pioneering spirit, and have played an integral part in the wealth of this country. Our long experience in this field is urgently needed, and the goal for our projects is to continue to SAVE AND SERVE. # # #

Today's fun is tomorrow's water—IF you have a dam at a lower elevation to catch and hold the melting snow when it flows during short spring months.

Dig this—A COOL MINK PAD

FLOWER persons of the present hippy set may not dig fur bearing ways. But to other people, valuable pelts are produced at a certain mink pad—like from COOL WATER, Man.

For the nonhippy reader interested in gainful pursuits, the foregoing possibly means—Cool water pays bigger dividends than warm water does to the owner of a mink farm.

Mink farming challenges one's ingenuity to obtain a profitable harvest. And it has been found that sprinkling cool water on the roofs over the animals will cool them in hot summers, causing the mink to eat more and grow bigger pelts, in the case of the 14,000-mink farm of Albert Larson near Spokane, Wash.

The water now available—being about 30 degrees cooler than formerly—makes the mink harvest even more efficient and profitable. New pumps bring the water from wells at 47°. Previously the source was the Spokane River at 77°.

Wells now tapping an extensive reserve under ground lake, plus a system of elevated tanks and over 86 miles of buried pipelines provide the water service to the Spokane Valley area where Larson's farm is located. The farm is on the Bureau of Reclamation's Spokane Valley project. With construction starting in 1964, the recently completed features of the Reclamation project include a distribution system for municipal and industrial water and irrigation service to 7,250 acres of land. The new facilities replace a deteriorated system of canals and flumes relying on direct diversions from the Spokane River that became prohibitively costly to maintain.

Mink Man's Needs

The successful mink farm requires a large capital outlay, long hours of work, patience, individual care, a thorough knowledge of the environmental habits of the small furry animals, and a "crystal ball" on the variances of the market. However, in return for this attention to their needs and their VIP status, mink give their best—shirts off their back, so to speak.

Larson started his operation modestly 26 years ago in the Greenacres area of Spokane Valley with a few animals and a single shed. He has been using the sprinkler system to cool his facilities for 10 years.

In colors of blue, pearl, violet, and various shades of brown furs, Mr. Larson's minks are raised in individual wire mesh cages in the long sheds with open ends and sides. On each shed roof is a line of low head sprinklers. Just as irrigation water boosts the yield of crops grown in the ground, sprinkling on the mink sheds brings about 1½-inch longer pelts for a better market price. Sprinklers reduce the temperatures inside the sheds at a more constant 20 to 30 degrees, which is most important during the maturing phases of the crop.

Because the water makes grass grow heavily between pens, calves are ranged in the area to keep the grass eaten down. Then in the fall, all the employees get a beef, said Mr. Larson.

March is the mink breeding season and the new litters are expected in May. Litters vary in number from one to 12 kits, with an average of four to five. The young are retained in the breeding pens until they are weaned, then they are moved to the furing pens. Of the 14,000 adult minks on the farm, the carryover crop is 2,200 females and 450 males after the pelting in December and January.

The once-a-day feedings include 8 ounces for the female and 12 ounces for the male, totaling

14,000 mink think it is raining——it's birds——the air-conditioning?

about 5 tons of feed served to the population. On the menu is ground-up parts of unsalable chicken, beef liver, fish, and cereal.

Feed Locker

The feed preparations are done on the west coast where raw materials are readily available at a reasonable cost. Also, Mr. Larson maintains a 100-ton frozen food locker on his Spokane spread. The feed is removed from the locker for thawing, and the next day it is mixed to a formula and distributed to the animals with semi-automatic machinery.

The handling of the sacks at the mixing hoppers and distribution of the feed is done by hand. A special dolly cart carries the mixed feed under pressure. An operator riding the cart down an aisle between the cages is able to direct the feed into the cages through a flexible hose with a hand-operated nozzle. The aisle also is wide enough for small motorized spray tanks and service vehicles.

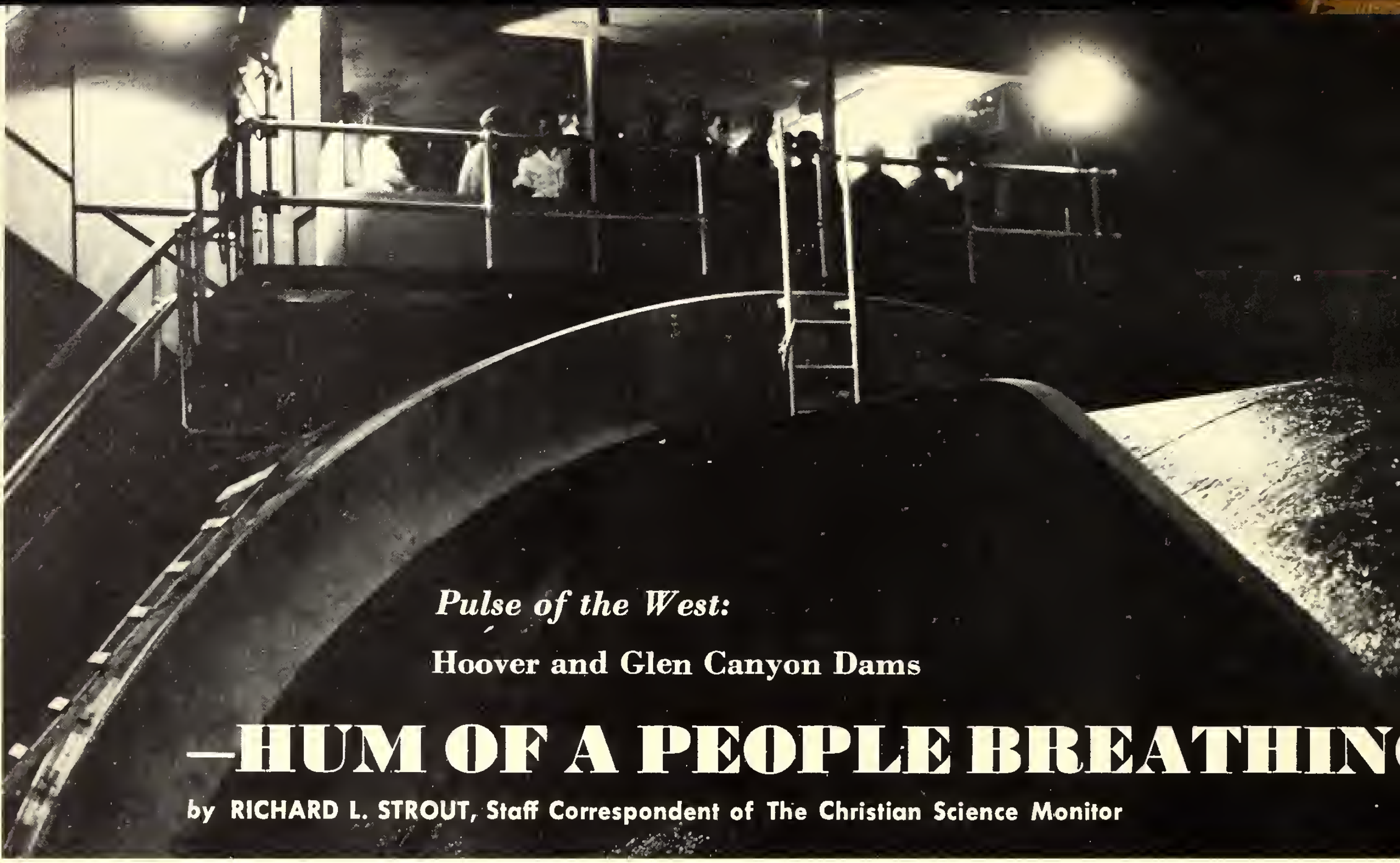
Water is not only made to rain on the roofs of this 20-acre farm. It also is brought to each cubical through pipes and individual taps. During hot weather, the pelt animals can, in addition to getting a cool drink, take a refreshing dip whenever they feel like it.

Nine full-time men are employed during summer at the farm, four in winter and 12 during pelting. Larson said women employees are assigned to tailoring the pelts as the women are more particular than men in this process. Because 60–65 pelts make one mink coat, the tailoring process is a very important step.

The pelts are shipped to Seattle, Minneapolis, and New York where they are sold at auctions. The cost of raising a mink is $15 (1966 figure) which pays for its food, the labor, and the processing of the pelts for market. Some pelts bring up to $75 each, and cool water helps this to happen.

# # #

A thorough knowledge of the small furry animals is essential to make profit on a mink farm. Use of heavy leather gloves protects from sharp captive teeth. Mr. Larson, right, is holding a brown mink and Oscar Liere holds one that is pearl colored. When taking the mink out of their pens, the tail gets used as a handle to keep the showoffs in tow.



Pulse of the West:

Hoover and Glen Canyon Dams

—HUM OF A PEOPLE BREATHIN

by RICHARD L. STROUT, Staff Correspondent of The Christian Science Monitor

The small bomber circled till it pinpointed its target and then, at 300 feet, a quarter of a million live rainbow trout Niagara-ed into the air for a free fall. As they descended, one fingerling said to another, "I do hope Lake Powell is all that Bobby Kennedy says it is!"

Like most Easterners, Mary and I didn't know much about the Colorado. They plugged the river in 1936 with the Hoover Dam and created Lake Mead, and they plugged it again at Glen Canyon in 1963, farther north, and created Lake Powell.

This superb curved 700-foot dam at Glen Canyon (2 miles away from Page) is as lovely as a Greek sculpture.

But the statistics to remember are that the 1,400-mile Colorado River, fed by Rocky Mountain snows of Colorado, Wyoming, Utah, and New Mexico, flows south through Arizona, Nevada, California, and Mexico to the Gulf of California—a vertical drop of more than 2½ miles—and it drains one-twelfth of the area of the 48 contiguous States.

An Eerie Appeal

As to fish, they're the simplest part of it. The Government has impounded one of the most astonishing recreation areas in the world. The strange combination of blue-green water flowing through arid cliffs, produces eerie appeal. The authorities have shrewdly accentuated this by giving a non-parachute descent so far to 14 million trout and large-mouth bass. The fish that don't survive the trip, motorboat examination indicates, wouldn't fill a bathtub.

Very well, then, here is another anecdote of this singular place. The receptionist at Art Greene's motel at Wahweap (just above the dam) turned around and here was this large gorilla who said to her, "Will you please check my guitar?"

Mr. Greene says the receptionist jumped a foot, but she says it was only so much.

It was the latest Hollywood team using this extraordinary setting for a picture that hasn't been released yet, "Planet of the Apes," or something like that.

Ed Lonergan (Edward R. Lonergan, City Administrator of the Bureau of Reclamation's planned community at Page) told Mary and me that he hadn't been able to follow "The Greatest Story Ever Told." He spent the whole show iden-

Public on tours reach a platform in the depths of renowned Hoover Dam, 560 feet from the top. They look down on a giant penstock and view many inner workings. *(Photo by John Miles)* tifying the local peaks and buttes where Jerusalem and Bethlehem and the rest had been erected. He plans to see the film a second time and concentrate on the drama.

Camels and Donkeys

If you have ever been to Petra in Jordan, the "rose-red city, half as old as time," you will see the same red sandstone as here in which a forgotten race carved its temples in living rock.

What a place to name-drop! That's the motel where Princess Margaret and Lord Snowden stayed, and here's where the Bobby Kennedy kindergarten and Art Buchwald started their down-river course, and over there was where they kept the camels and donkeys and Hollywood stars for "The Greatest Story," and Lady Bird was here, and now this new picture, "McKenna's Gold," or something like that, is being made.

For me, though, it's the hum of the generators.

There are eight of them here and 15 at Hoover. The huge smooth curve of the dam is a poem, of course. And the sight of cars tugging motor boats through the tortured rocks of a desert, well, you have to see that to believe it. But the hum of generators is the breathing of a people.

Folks go to sleep, and some of the generators shut down from midnight to 7 a.m., and the sluices close, and the water backs up a bit. (Power isn't lost; the water that whirls the turbines is just impounded.)

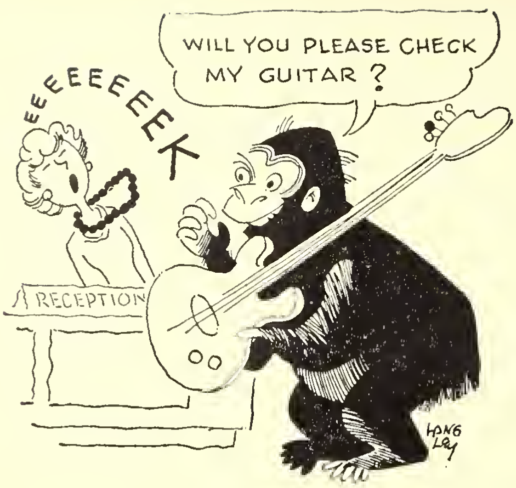
Then in Denver and Salt Lake City and Phoenix and Tucson the electric toasters switch on for breakfast. And from the big, windowless, laboratory-clean operations room, backed up against a sea of pushing water, the engines advise central control, "We need another generator."

Pulse of the West

The heat of the day increases, and Tucson will take more current for air conditioning, or the pumping starts on irrigation miles away, and the two aluminum wires spun round a steel core that go marching off to Phoenix, 180 miles away, carry the load.

Provo, Utah, or Cheyenne need more power.

An aerial fish planting in Lake Powell above Glen Canyon Dam, Ariz. *(Photo by Mel Davis)*



Cartoon—Hollywood characters arrive.

The quiet man can read the pulse of the West—here comes the afternoon peak at Shiprock or after sundown, another peak as mom does the dishes. Dad settles to his paper, and the children switch on TV.

The generators respond to the mood of the hour, the month, and the year. Daylight saving made a big change. You can tell the temperature the state of the crops, the drought, or the Saturday night bulge by those dials. There's power here for a city of a million and a half, whether for the gaudy "Strip" at Las Vegas or the lonely light twinkling on the prairie.

Another striking thing: The central control isn't here but at Montrose, 250 miles off. There an IBM calculates power, river flow, and demand of all the interconnected Upper Colorado powerplants, of which Glen Canyon is largest.

Uncanny Supervision

The automatic supervision is uncanny: Montrose sent word that an elevator at Glen Canyon needed attention; they could tell by a jiggle on some dial, and noticed it before the local boys did.

With all this electricity about you would think the local rates would be low, but no, that never happens, no more than you can get cheap orange juice from a quick-lunch in Florida.

The Government doesn't retail any of its power; it all goes wholesale to private or municipal companies. But recently an intercontinental intertie has been setup. Time zone by time zone. The Colorado plays its part. The great rogue river has been tamed. # # #

(*We extend our appreciation for this article to author Mr. Strout, and for the illustration on this page to Gene Langley. The report is tenth in a continuing summer series from Correspondent Strout assigned to tour the United States. Reprinted by permission from* "The Christian Science Monitor," *© 1967 The Christian Science Publishing Society. All rights reserved. Printed in the Aug. 4, 1967 issue.*)

On First Evaporation Reduction Film

The Bureau of Reclamation is preparing a documentary film report on its research efforts to reduce the enormous evaporation losses from large lakes and reservoirs.

A joint effort by the Bureau and the Environmental Science Services Administration, the 30-minute motion picture is believed to be the first on this subject. It will detail the Bureau of Reclamation's 1966 evaporation suppression research program at Lake Hefner, Okla. The full-color film is expected to be available to technical audiences by early 1968.

Bureau Reservoirs Avert Flood Losses

The dams and reservoirs of California's Central Valley project during the past 17 years have prevented downstream flooding which would otherwise have caused $285.4 million in damage.

The flood control benefits from the CVP were the greatest among the estimated benefits derived from any flood control or reclamation project in nine Western States.

The next largest estimates of savings through flood control were $96.2 million from the mainstem reservoirs of the Colorado River Storage project.

During the 17-year period from 1950 to 1966, flood control operations on the Bureau projects have prevented a total of more than $600 million in flood damages. The figure is well above the $556 million allocated to flood control costs on all projects authorized as of June 30, 1966. The value of damages prevented has exceeded greatly their cost of construction.

Planning a Huge Project
In North Dakota

Know HOW to Switch to Irrigation

Few sights quicken one's heart more surely than a well-developed farm in a good location. One such favorable location is in North Dakota. But agricultural beauty, such as irrigation water would provide, has only been dreamed for 75 years by most families in that area; now it is being planned in every way possible.

In addition to an irrigation system bringing a stabilized and diversified agriculture to 250,000 acres of semi-arid but fertile land, and ultimately to over a million acres, the multiple-purpose initial stage of this Bureau of Reclamation, Garrison Diversion project in North Dakota will supply municipal and industrial water for 14 towns and cities and four industrial areas.

Initial efforts, which may take about 25 years to complete, also will enhance fish and wildlife resources at 36 major areas and numerous smaller areas, and will develop recreational opportunities at nine major water impoundments.

Authorized by the U.S. Congress in 1965, the Garrison Diversion Unit of the Missouri River Basin project got underway last July with an order for three large water pumps and motors to be completed in 1971.

In the next few years, as water becomes available to them, landowners who have holdings designated as irrigable lands will be deciding just which changes to make. Irrigation will be new to most farmers in the project area. It will mean integrating, or operating a combination of both dry farming and irrigation.

Water levels will go back up this pole as developments get underway on the Garrison Diversion Unit. The unusual marker in the Devil's Lake area shows the lake at 1,437 feet elevation in 1870, but it receded an important 25 feet by 1963.
(Photo by T. R. Broderick)

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Irrigation Know-How

To accomplish this, the farmer will need more know-how for irrigation than he has for dry-farm operations. But there is considerable evidence to show that today's modern farmer will have little or no difficulty to adapt either himself or his operations to these changes.

In fact, he will probably be more efficient and successful because he does not have unproductive customs or ideas to contend with. He can readily accept proven irrigation methods.

The farmer of today recognizes that his farm, in fact, is a business. He knows his earnings result from selling his goods for more than the cost of production. His decisions, many of them daily, not only govern his work but likewise affect his income.

Abandoned and not at all in good shape is this old farm on land in North Dakota to be developed with irrigation.

Any change in operations, such as a transition to irrigation on some lands will require careful planning. The businesslike way is to: (1) assemble facts, (2) seek expert advice and guidance, (3) decide on how and when to proceed, and (4) go ahead, based on the plans.

Farmers now relying upon small grain production will likely find other crops more rewarding and a better chance of stabilized income with irrigation. In some instances the size of the farm may change, and cash crops to be grown will need study. Some new machinery and specialized irrigation equipment will be needed.

Becoming imporant are the timing of irrigation water delivery, and how fast the farmer will want to develop his land during the 10-year development period when advantages on proposed charges are a premium. Probably of most importance will be his financial capability to handle the added investments involved in irrigation.

Getting Facts

One of the best ways for the potential irrigator to get facts on transition is to learn directly from an irrigation farmer. Usually irrigation projects offer a good chance to see a wide variety of operations.

Many of the potential irrigators in North Dakota have already visited several irrigation projects. They have been able to talk to many farmers, businessmen in irrigation communities, and persons engaged in the processing and marketing of diversified farm products.

Among projects being operated for irrigation and other purposes which they have visited are the Lower Yellowstone project in western North Dakota, the Columbia Basin project in central Washington, the Colorado-Big Thompson project service area of Colorado, the North Platte project in southeastern Wyoming and western Nebraska, and the Niobrara-Lower Platte projects in Nebraska.

An irrigation specialist who will be employed to provide individual guidance is a service to be provided by the irrigation district.

At the start of planning, one of the first "tools" needed will be maps of the farm showing the potentially irrigable lands. Such maps show soil and drainage characteristics, the topographic relief, and proposed layout including turnouts for the incoming water and outgoing surplus waters. As such information is discussed it is seen that physical land characteristics have much more significance under irrigation than under dryland farming operations.

For example, soil textures, depths and structure are especially significant considerations. Soil is like a tank—it has a capacity to hold and store water.

Soil Intake

Also important is the rate water will move through the soil, and its intake rate. Soil textures often dictate the crops which can be successfully grown, and depth of soil has influence on root development as well as capacity to hold water. Knowing such things are among the first concerns of a new irrigator.

Sizing and shaping of fields can be determined from topographic maps. This can dictate the type of irrigation that should be employed—surface or sprinkler irrigation. Reviews with the irrigation technician will make known the merits of gravity or sprinkler irrigation and the proper water control on the farm.

This examination for an individual farm should also take care of acres of dry farming. And it should include cropping data, soil management, machinery and equipment requirements, and certainly not least, an estimate of costs involved.

The joint review needs to be done at an early date. Even though the farmer may activate his plans in a period stretching over several years he will be making sure it all fits into the overall plans.

The irrigation reviews bring other dividends. The farmer's plans can have an effect on the project system and its construction. Because of his experience, the irrigation technician working with individual farmers will probably be the same person who will, from time to time, confer with construction forces on water deliveries for the entire service area.

Leveling

The landowner planning irrigation likely will call on the conservation district representative to arrange land-leveling operations. Fields would be staked to get proper grading. Staking would also be done for construction of the irrigation ditches, structures, and drainage ways.

Then the farmer will arrange for work by a leveling contractor which would be supervised and inspected by the Soil Conservation Service. If, on the other hand, a farmer decides on a sprinkler system, it would be probable that, with technical help, he will complete his deal with a local supplier.

A number of State and Federal agencies now have programs to help farmers establish irrigation. To assure that all assistance programs are

When the Reclamation project causes return of water, such alkali beds as the one shown will be returned to usefulness, and fish and wildlife habitats improved.

coordinated and available when needed, the various agencies have pledged their cooperation and participation in an Irrigation Council.

Engineers and various agricultural experts have been organized to provide team effort and make the overall irrigation project successful. The Council will function through work groups.

Each work group will have specific areas under study and will develop recommendations regarding farm irrigation methods, irrigation farm management, financial assistance, engineering assistance, community impacts, development of markets and processing facilities, and other irrigation matters. Work groups, reporting to the Irrigation Council, will make their recommendations available to all other agencies, but more importantly for use of individual farmers developing irrigation.

Council In Garrison

The Irrigation Council of the Garrison Diversion Conservancy District is expected to provide handbooks, circulars, and other means of presenting technical information on irrigation, tillage, soils management, variety and fertilization recommendations, crop management, and other details of irrigation cropping. No doubt the farmer will also have this type of irrigation guidance and information available from his county extension agent.

In the Garrison Diversion Unit, water charges have been scheduled at the time of water availability in such a way that a farmer's average ultimate water charge in the first year would start at 10 percent. Thereafter it would increase 10 percent each year until reaching the full charge. In this way, any farmer who develops his land at a faster rate than scheduled would find his average per acre water charges to be cheaper. A farmer developing irrigation will want to investigate cost-sharing programs.

In many Western States, development of gravity irrigation is partially financed by payments as a soil conservation and stabilization practice. This varies with localities, and, of course, must be approved as a practice in local programs.

Getting Ideas

A year or two of irrigation experience for a dryland farmer gives him a "wealth of ideas" on how irrigation water is controlled, together with other techniques of water application. He is then ready to make plans for his entire acreage. He gradually becomes more proficient in utilizing this "new resource" to his inherently productive land.

As the new irrigator becomes an experienced and seasoned irrigator, his entire outlook undergoes a tremendous change. He soon learns that his irrigated land is most important, and gives it priority in his farming. This happens because irrigated crops enjoy an insulation from unpredictable rainfall, and there is more flexibility—a better chance to shift crops according to market conditions.

The irrigator also will find that his farm, like in many other Western areas where bringing water to the soil is now a "way of life," is good for him, his family and his country. Each year this life-sustaining resource will be more important than ever—it becomes a more valuable legacy for the generations which follow. # # #

Highly Sensitive Testing Device

An elephant's foot may be mighty sensitive, but not as sensitive as a 10,000-pound research tool designed and built by the Bureau of Reclamation's Engineering and Research Center at Denver.

This ponderous unit will enable engineers to detect movements as slight as one ten-thousandth of an inch deep inside a rock wall when pressure is applied.

The new device is a radial jacking test unit which may be employed at the sites of proposed dams to determine if the surrounding rock structure can support the extreme pressure generated by the dam and the water it impounds.

TO SAVE frequent renewals to the *Reclamation Era*, subscribers may boost orders up to 3 years for $3 (foreign mailing requires 25¢ more a year).

See order form on page 23.

Habitat Management Near Yellowtail Reservoir Is Paying Big Dividends for Bird Hunters

Birds by the Acre

Story and photos by TIM BRITT of Wyoming Game and Fish Dept.

One of the newest and largest developments for outdoor recreation in Wyoming is already paying dividends for Wyoming sportsmen. This new recreation area centers around Yellowtail Reservoir.

The dam, completed in the fall of 1966, is located on the Big Horn River in Montana. Behind the dam structure a reservoir 70 miles in length has been formed. A large portion of the new Yellowtail Reservoir is located in the spectacular Big Horn Canyon. In Wyoming, however, the lower end of the reservoir (upstream end) widens to form a relatively shallow body of water 2 miles wide.

The Yellowtail project, carried out by the Bureau of Reclamation, forms a nucleus for tremendous opportunities in outdoor recreation. Campers, tourists, rockhounds, boaters, sightseers, and hikers will find the area rewarding. The potential, at this time, has barely been touched, however. Future years, accompanied by careful planning and wise development, will bring the realization of the many values of the Yellowtail project.

Hunters and fishermen are already reaping many benefits from the area. Because fish and wildlife play an important role in the overall recreational potential of the Yellowtail area, the Wyoming Game and Fish Department has been intimately involved with the project since its beginning.

Maximum Wildlife

In order to realize the ultimate in wildlife benefits from the area, a special unit, comprising almost 9,000 acres, has been established. This area, known as the Yellowtail Habitat Unit, is managed for maximum wildlife production.

Approximately 9,000 acres on the Big Horn and Shoshone arms of the reservoir have been assigned to the Department for management as a habitat unit. Over 500 acres were purchased by the Wyoming Game and Fish Department, 2,700 acres were acquired for habitat management under the Fish and Wildlife Coordination Act from the Bureau of Reclamation, and 5,300 acres were acquired from the Federal Government under the same act.

The topography is such that the land features establish a natural boundary around the unit. The Habitat Unit lies in the shape of a "delta" formation. With the exception of two or three packets

Game birds like this juvenile pheasant have a much better chance of survival when habitat is properly managed.

there is no deeded land within the naturally bordered area. The entire unit is surrounded by arid, barren, rolling hills with the exception of the upper end of the Shoshone Arm.

Irrigation and Marsh

Within the unit there are 2,100 acres of fertile farmland and several irrigation ditches make crop production possible. Approximately 246 acres of marsh in several locations are located within the project boundary. Two major rivers, the Big Horn and Shoshone, are located within the Yellowtail Wildlife Unit.

The Big Horn traverses the area from south to north and the Shoshone River enters the unit from the west. The main river bottoms contain about 4,000 acres of dense trees and shrubs. The remainder of the unit consists of arid, barren fringe lands and hills.

Development of the Yellowtail Unit began on June 1, 1965. Wayne Darnall was named unit manager by the Game and Fish Department. Prior to this assignment Wayne had been manager of the Whiskey Basin and East Fork elk winter ranges near Dubois. Until recently he was assisted by Ken Asay who is now manager of the Ocean Lake Unit. Bob Larson is currently assistant manager at the Yellowtail Unit.

According to Manager Wayne Darnall, the development of a new unit is no easy task. "When I first arrived at the Yellowtail Unit things were pretty indefinite. The unit consisted of what remained of several farms that the Bureau had purchased in the impoundment area. The reservoir had not filled and we had only a vague idea of where the shoreline would be located."

Unlimited Potential

"The unit is managed primarily for upland game bird and waterfowl production," the unit manager explains. "The lay of the land, the proximity of water, the agricultural development, and the natural vegetation provide the unit with an almost unlimited potential for upland game bird and waterfowl species. The basic objective of the unit is, of course, to provide as much recreation as possible for the sportsmen of Wyoming."

Pheasants, chukar, and Hungarian partridge, bobwhite quail, sage grouse, sharptail grouse, wild turkeys, Canada geese, mallards, redheads, bluewing, and greenwing teal, as well as many other species of waterfowl, are all present on the unit.

Habitat management usually means habitat manipulation. The theory behind the fact calls for providing the life requirements of game so that the game will derive the greatest benefits from the land. This means that food and water, nesting areas for production of broods, and cover for protection against predators and weather are planned and arranged to produce the greatest number of birds.

An example of habitat manipulation would be a square mile planted to corn. The field would produce only a few pheasants each year. Although food would be plentiful during specific times of the year other life requirements would be lacking. If this same field were broken up into small patches of cereal grains, legumes, and brush, and water were made available, the same area would produce many more birds. An area producing all of the life requirements of a species in close association demonstrates what is known to game managers as the "edge effect."

State's Finest

The Yellowtail Unit displays what is probably the finest natural pheasant habitat in Wyoming. With the use of habitat manipulation, the carrying

Unit Manager Wayne Darnall and Bob Larson inspect a goose nest built in the marsh development. Many species of waterfowl prefer shallow marsh areas for feeding and nesting.

capacity of the area can be greatly increased to provide even more birds for the hunter's bag.

Part of the challenge of developing a unit such as Yellowtail is the proper management of the land. The "edge effect" does not merely happen. Months of study and preparation go into the final product. This is the problem of the unit managers.

The actual farming and use of the land is carried out on a sharecropping basis. Wayne Darnall and Bob Larson must figure out what fields are to be farmed, what crops would be most beneficial to the game bird species present in the area, and contact individuals to work the land. The farmers retain 70 percent of the cereal crops and 60 percent of the hay for their efforts. The remainder of the crops are left in the fields for wildlife food and cover.

It is the duty and responsibility of the unit managers to see that crops are planted and cared for according to the wildlife management plan, that irrigation waters and facilities are available and properly used and that the game's share of the crop is left in the field.

Design for Ringneck

Ring-necked pheasants and quail are almost totally dependent upon agriculture for their existence. Pheasants are the most popular and most abundant species of upland game birds on the Yellowtail Unit and the agricultural areas of the unit are designed with the ringneck in mind.

Bobwhite quail were introduced to the unit in March 1961, and a subsequent release was made during the fall of the same year. Although quail have not been planted since it appears that this species has taken hold. The quail have extended their range naturally since their first introduction and the population seems to be increasing.

Chukar partridge were introduced into the Big Horn Basin areas in the early 1930's. The arid sagebrush land edging the cultivated lands is well populated with chukars and they often move into the cultivated lands to feed. Hungarian partridge are also found on the unit and become fairly numerous during some years. Sage grouse and sharptail grouse occur on the unit but their populations are low.

Lots of birds and plenty of room—8,700 acres—make the Yellowtail Habitat Unit a bird hunter's paradise.

Turkeys

During November of 1966, 13 wild turkeys were introduced on the unit. At least seven of the birds survived the winter and several are known to have nested this past fall.

Although dense cover definitely benefits the upland game birds during various periods of the year it can be a definite handicap to the hunters in the fall. In order to help attain a proper harvest livestock grazing is utilized to break up some of the dense cover. The reduction of cover permits hunters better access to hunting areas and allows hunters to flush birds. In extremely dense areas access and flushing trails are cut through the brush

Yellowtail Unit displays what is probably the finest natural pheasant habitat in Wyoming.

with a mower. Grazing is allowed after crops are harvested and the hunting season has ended in cultivated areas. In other areas livestock is permitted throughout the year.

Habitat management for waterfowl also involves habitat manipulation. Three methods are used extensively on the Yellowtail Unit. These include construction of marshes, production of food, and development of nesting areas.

400 Acres

At the present time six marshes have been built, and the unit has a potential for 400 acres of marshland. Duck species that do not feed on cereal grains prefer marsh areas where the water depth does not exceed 12 inches for feeding. The marshes are constructed so that each may be drained to allow vegetation to grow during the summer. The marshes can then be flooded when the fall migration of waterfowl reaches the area.

Food for waterfowl is also produced on the cultivated areas of the unit. In the spring nesting, geese graze on the tender shoots of cereal grains. The cereal grains produced on the unit and left in the field attract migrating waterfowl in the fall. Unlike upland game birds, larger fields are more appealing to waterfowl. Geese especially like large fields, harvested short, for their fall and winter fare.

Before the impoundment area was flooded approximately 100 large trees were left standing. These trees are currently being topped above the maximum water line and fitted with halved 50-gallon steel barrels. In early spring these structures will be lined with straw so that they may be utilized by geese for nesting structures. Other off-the-ground structures will be built in the marsh areas to increase goose production. These structures reduce nest destruction by predators, nest flooding; and the honkers seem to like a home with a view.

Whistles

Bob and Wayne are optimistic about this fall. The fruits of 2 years' work are beginning to show. The birds, especially pheasants, are numerous. Evening whistles from the thickets testify that quail are near.

"Last year we had to extend the hunting season," Wayne said. "After the first few weeks of the season hunters were few and far between. It seems that in most years the most lucrative pheasant hunting takes place after the first snow. The cover has thinned out somewhat, snow holds the scent so hunting dogs can work better and the birds bunch up after the first cold spell."

"Pheasant hunting on the Yellowtail Unit is no snap," Bob added. "The birds are here all right, but the cover is thick and the birds are wise. You won't get your birds the first 15 minutes but if you like to hunt the illustrious longtails, I can't think of a better place than Yellowtail." # # #

(*Appreciation for reprint permission of this article and photographs is extended to the author and "Wyoming Wildlife" magazine.*)

Reclamation Publishes Second Edition of Water Measurement Manual

Second edition of the Bureau of Reclamation's Water Measurement Manual, first published in 1953, is available for purchase.

The hardcover publication is a standard reference work for designers, system operators, and water users involved in water measurement technology.

Copies are available at $2.50 each from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, and from the Bureau of Reclamation, Engineering and Research Center, Denver Federal Center, Denver, Colo. 80225.

10th Anniversary of "Operation Westwide"

On Purpose—
A BETTER WAY TO TAKE WATER

Taking a drink of water because of thirst is commonly done, of course. But a risk, which has been with man as long as thirst itself, is that of taking water accidentally—drowning—the times water fills the lungs instead of the stomach.

Drowning is something we have to learn all about how *not* to do. Young or old, the safety information has to be found out, but somehow, not all of us do. Drowning represents the fourth leading cause of accidental death in the United States. Some 7,000 persons each year die from it, and the toll continues to climb.

To help people *not* drink water accidentally, at least around open bodies of water, are such slogans as DANGER—BEWARE OF DROWNING! THINK SAFETY! Going further than such signs to prevent water tragedies are various educational programs undertaken to vividly impress people on which personal precautions to take to avoid the problems. Also physical barriers to prevent happenings, and handling devices to aid in rescues have been constructed.

This is what "Operation Westwide" is for—and this is the 10th anniversary of the movement. It helps supply ideas and programs attacking water accident and drowning problems. In the 18 Western States, it is a joint program of the American Red Cross and the Bureau of Reclamation.

Rescuing sailboaters when their craft overturned was needed one windy day on Pineview Reservoir, Utah. No play in this incident, even though it happened during an Operation Westwide water safety show. *(Photo by Stan Rasmussen)*

Such a concrete-lined canal as this would be more dangerous to drownings if it were not for the chain-link fence border, the warning sign, safety net hanging across the canal and the iron escape ladder at left. This is at Epharata, Wash.

It seeks community support for continuing operation and success, one of the prerequisites of volunteer programs. In its 10 years, many people in its area of operation have become more enlightened about water safety. Results are encouraging that the use of water safety regulations have been stepped up, also drownings in some areas have declined.

Launched in 1957, "Operation Westwide" is intended for effect in the areas around and on Reclamation reservoirs and canals. Reclamation water development projects have a total of over 11,000 miles of shoreline and 219 water-related recreation sites. As these facilities grow, the hazards for water sports and recreation increase. The facilities attracted recreation seekers at the rate of 45 million visitor-days in 1966. Also there is a recognized risk with youngsters, for example, who are unprepared for safety around Reclamation's 6,755 miles of irrigation canals.

Reclamation's policy on recreation is to encourage public use of its facilities which are particularly adaptable to such use, and the public widely accepts the opportunities.

Supervision Problem

However, there is seldom opportunity for the kind of close supervision of an urban recreation center because Reclamation facilities are relatively isolated and uncrowded. For this reason, the Bureau simultaneously widely promotes safety and constant personal carefulness for accident-free enjoyment.

One or more water safety rules have not been learned and tragedy is imminent, for instance, if a wind-tossed boat capsizes on a lake spilling its occupants into the chilly waters.

—or if an angler, intent on an eddy in a stream, blunders into a deep hole and panics.

—or if a youngster ignores a fence or warning sign and jumps into a fast-flowing irrigation canal for a swim.

Operation Westwide is designed to be practical and to emphasize such logical hazards associated with water recreation—what they are, where they are most frequently encountered, how to avoid or eliminate them. Also it provides information that it is the responsibility of each individual to act for his own safety and that of others accompanying him.

To test the program, pilot organizations known as Community Water Safety Councils were established in areas with pronounced water hazards. The first were the Yakima Valley Water Safety Council on Reclamation's Yakima project in central Washington, and the Boise Water Safety Council on southwestern Idaho's Boise project.

On the Yakima project, there are six major reservoirs, all providing recreational opportunity for some 100,000 valley residents. In 1958, the year

Words of warning painted in large letters should prove to alert some of water dangers. This is at the All-American canal facilities, Yuma, Ariz.

Operation Westside went into operation, Reclamation and Red Cross representatives arranged and attended meetings with government and business leaders, with service and civic groups, Boy and Girl Scout units, schools, sporting organizations—with anyone, who would listen and lend support. The proposal met with a warm response both in Yakima and Boise. Civic-minded residents came forward and moved rapidly to implement the water safety program.

Safety Materials

Using materials prepared by the Red Cross, the National Safety Council, U.S. Coast Guard, Bureau of Reclamation, and others, plus material adapted or original, the two pilot water safety councils conducted intensive programs in swimming and rescue instructions, boating safety and inspection, local and State safety legislation. The information-education effort also gained the enthusiastic cooperation of local press.

Encouraged by this early response, the Bureau of Reclamation moved to establish water safety councils in other hazard areas. The Governors of the respective States were advised, and offered their backing. Three additional councils were established in 1959, still more the year following. Today there are 30 Water Safety Councils in 14 of the Western States, actively dedicated to "waterproofing" the public.

Not for some time did the full impact of the program become apparent. Harold E. Wersen, Safety Engineer for the Bureau of Reclamation's regional office at Boise, Idaho, was among those who steered the organization of the first councils and watched their progress.

"In the 5 years before the Yakima Valley Water Safety Council was organized," Wersen recalls, "there was an average of 11 drownings a year in the area. During 5 years after the council was formed, drownings average 1.8 per year. There's no question that this organization has saved lives by developing real, genuine awareness among the public."

"Learn to Swim"

In many areas, "learn to swim" programs had trebled and quadrupled in enrollment. Lifesaving classes were filled. Demonstrations were held throughout the summer at beaches and swimming pools, there were workshops for parents and children, safety displays in local stores, school essay contests, Government proclamations, posters and decals, continuing publicity in all press media, surveys to locate and correct hazards. Also talks and demonstrations before civic, service, church and school groups on the urgent need to practice safety.

Everywhere, cooperation was excellent. In the Bureau of Reclamation's Region 1 area, for exam-

Self-rescue steps constructed into the end of this siphon on the Weber Basin Project, when in full use with water, will be helpful for persons or animals (such as deer) to climb out more easily.

ple, a brief safety reminder is printed on bills sent to water users by irrigation districts and water companies. Under the heading "Operation Waterproof," the message reminds of the dangers of irrigation canal, reservoir, stream, and pool, and adds:

"You can cooperate in this lifesaving program by instructing your own children in water safety, encouraging them to learn to swim, calling our offices if you observe children engaged in hazardous activity in our waterways, and permitting our personnel to use your telephone to promote this program . . ."

Safety officials of the Imperial Irrigation District in southern California created a Hollywood-type cartoon character named Dippy Duck, and made him a popular and easily identified safety symbol. He was prominently displayed in films, booklets, and posters circulated in the schools to encourage youngsters to "think safety." In Reclamation's Region 7, east of Denver, Colo., a "safety-pin" character was devised for poster use and circulated widely among school systems.

Construction Improvements

It also was evident that more physical improvements should be constructed in, on and around water recreation sites.

In 1963, the Department of the Interior established a special task force which directed a survey of conditions at 157 reservoirs and 46 canal or irrigation districts. At more than a third of these reservoirs, for example, there were no safety or rescue organizations. Most such organizations which were in operation were sheriff's departments or similar agencies located as far as 20 miles away.

Of 566 fatalities listed over a 10-year period at the places surveyed, the leading causes were swimming in unauthorized areas, inexperienced swimmers, lack of supervision among children, storms, and unsafe boats and equipment.

Among the survey's conclusions:

1. The Bureau of Reclamation itself lacks authority to enforce any ban on unauthorized and dangerous water activities.

2. Most State agencies have inadequate funds and personnel to enforce State water safety laws.

3. Long reservoir shorelines compound the problem of restricting swimming to authorized areas only. Because many visitors are from out-of-town or out-of-State, local education programs are not always the solution.

4. Major enforcement problems result from nonuniformity of boating laws.

The findings pointed the way toward new courses of action, and the safety councils, again with the full cooperation of other agencies, took appropriate steps. Water safety laws were enacted by State and local government bodies. Enforcement agencies were clearly identified and given power. More funds became available. Citizen response swelled, and both through government action and volunteer support, improved beaches, lifeguards, first aid stations, designated recreation areas, boating ramps and other facilities were provided.

Signs Posted

Mile upon mile of fencing and railings were erected, and gates were installed. Warning signs, sternly worded and often in two or more languages, were posted at key locations.

Facilities known as self-escape devices were provided. A provision that escape ladders be provided at 750-foot intervals in concrete-lined canals was written into the Bureau of Reclamation's general design standards. Ropes and floats, nets and safety screens were installed above siphons or other inlets to underground works or to outlet works located in populated areas. In areas of heavy wildlife population, ribbed devices which give secure footing for deer, antelope, and other game were placed because of concern for the welfare of four-footed animals.

The Bureau of Reclamation is currently involved in converting open canals and drains to closed conduits, with immediate emphasis on those canals in urban areas. Reviewing this recent proposal, Commissioner of Reclamation Floyd E. Dominy noted that the cost of converting open channels to closed conduits varies according to the size of the channel.

"In some instances," he reported, "such costs have ranged from $200,000 to $500,000 per mile.

"But the benefits of social significance—the lives saved, the peace of mind of parents of small children, beauty enhancement and sanitation improvement, although difficult to evaluate, would fully justify the costs involved."

Whether making such large alterations, or the matter of imposing rules for boating on a small lake, it is obvious that conflicts sometimes develop. Experience indicates that it's a rare occasion when a proposal is given 100-percent support.

Speed Limits

Some time ago, for example, one of the councils recommended that safety regulations be enforced regarding motorboat speed limits, prohibited areas for fishing, swimming, and daylight hours for water skiing. A number of resort owners and operators objected, claiming that stringent rules and regulations would hinder the recreationist and hamper their own operation. But the council's State Legislative Committee worked with the resort operators, came up with a few simple but effective rules that accomplished the goals and smoothed the ruffled feathers.

On another occasion, a safety council enlisted members of a local boat club to write the safety rules for a major Reclamation reservoir whose operation had been transferred to a local group. The reservoir has as many as 16,000 boat launchings a year, and water safety had been a major problem. The boating and swimming rules were prepared and quickly implemented. Results? It was 6 years before the reservoir experienced a fatal boating accident.

Council officials past and present view the councils' representative membership—parents, businessmen, law enforcement officials, scout leaders, recreation enthusiasts, sporting goods suppliers—as major assistants in the success of the program.

But if this 10-year success has been emphatic and significant, it represents only a short advance along a long road. Thousands more Americans seek out water recreation areas each year, and for each and every one, there is need to warn of the dangers. Safety problems lurk in, around, and on every lake, stream, and pool in the Nation. The work of water safety councils has only begun. But a fitting word of advice from them could well be:

If you're going to have a drink of water, try not to take it accidentally. # # #

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IDAHO (Except SE tip)
WASHINGTON
MONTANA (NW corner)
OREGON (Except Southern wedge)
(Region 1)
Fairgrounds, Fairview Ave. & Orchard St.
Boise, Idaho 83707

CALIFORNIA (Northern & Central)
NEVADA (Northern & Central)
OREGON (Southern wedge)
(Region 2)
P.O. Box 15011, 2929 Fulton Ave.
Sacramento, Calif. 95813

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CALIFORNIA (Southern)
ARIZONA (Except NE tip)
UTAH (Sw tip)
(Region 3)
P.O. Box 427
Boulder City, Nev. 89005

UTAH (except SW tip)
COLORADO (Western)
NEW MEXICO (NW tip)
WYOMING (SW tip)
IDAHO (SE tip)
(Region 4)
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OKLAHOMA
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COLORADO (Southern wedge)
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NORTH DAKOTA
SOUTH DAKOTA
WYOMING (Northern)
(Region 6)
P.O. Box 2553
316 N. 26th St.
Billings, Mont. 59103

COLORADO (Eastern)
NEBRASKA
KANSAS (Northern)
WYOMING (SE)
(Region 7)
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Denver, Colo. 80225

John Wesley Powell Centennial To Be in 1969

The vast Colorado River canyon country was unknown to man until John Wesley Powell in the summer of 1869 one-handedly led an expedition of 10 men and four boats down the wild waters of the Green and Colorado Rivers, from the Green River in Wyoming, to the mouth of the Virgin River in Nevada. A veteran of the Civil War who lost his right arm at the Battle of Shiloh, Powell wrote a report on the expedition, "Report on the Lands of the Arid Regions," which, according to Secretary Stewart L. Udall "showed clearly that water was the key to land use, and that shortages of water supplies demanded classifications of land for use and management."

Preliminary plans have been announced by three organizations influenced by Powell's vision—the Department of the Interior, the Smithsonian Institution, and the National Geographic Society—to stage a national centennial in 1969 of the explorer's heroic feat and to pay homage to a great American. Events would include a re-enactment of the 1869 river voyage, establishment of a John Wesley Powell Conservation Award, issuance of a commemorative postage stamp, and release of a motion picture depicting the Powell story for showing in classrooms throughout the Nation.

Powell died in 1902, the year in which the Reclamation Service, a direct result of his theories on water resources, was established as part of the Geological Survey. This agency became the independent Bureau of Reclamation in 1907.

NEWS BRIEFS

Bird's Eye View

Visitors to the Bureau of Reclamation's giant Glen Canyon Dam near Page, Ariz., are able to view 15,000 square miles of spectacular canyon country in northern Arizona and southern Utah as if from an airplane 50,000 feet above the earth.

The panorama is featured in a three-dimensional terrain model which represents more than 15,000 square miles of the drainage areas of the Colorado and San Juan Rivers above Glen Canyon Dam. The model was completed in Denver and placed in the Glen Canyon Visitor Center.

NATIONAL WILDLIFE WEEK TO BE MARCH 17–23

"Learn To Live With Nature," the theme for National Wildlife Week, March 17–23, 1968, will focus emphasis on the importance of nationwide conservation education. It will provide a reminder that learning about conservation can begin with appreciating resource benefits such as clean air and water, scenic landscapes, and the Nation's rich wildlife heritage.

Attention also will be directed to conservation education as a meaningful way to protect natural resources by teaching that "wise use" will keep them in supply. Heading the annual observance this year will be Honorary Chairman Dick Van Dyke, television and motion picture star.

National Wildlife Week 1968 urges that conservation be made a part of local school programs and community projects. The concept of "learning to live with nature" means educating against pollution, waste, litter, and misuse of all natural resources.

Sponsored jointly by the NWF and its State affiliates, the observance has become an annual community event through the cooperation of State wildlife and conservation agencies, civic groups, and schoolchildren. This will be the 30th annual observance. It was first established by Presidential proclamation in 1938.

The Wildlife Week message points out past accomplishments of conservation. They include the rescue from extinction for the whooping crane, buffalo and key deer, the soil conservation of prairie farmlands, and the continuing efforts to protect irreplaceable marshlands and other natural areas.

Wildlife Week materials are available from the National Wildlife Federation, Department 103, 1412 16th Street NW., Washington, D.C. 20036.

# # #

"Learn to Live with Nature," 1968 theme.

Cost Saving

Automatic controls that include computers and closed-circuit television are helping the Bureau of Reclamation to reduce the average expense of operating and maintaining its 49 powerplants despite rising wage rates and more costly materials.

The Bureau reports its average operation and maintenance costs have declined from $1.15 per installed kilowatt in fiscal year 1963 to only $1.05 in 1966, or over $600,000 a year.

Underground Sampler

A unique tool which enables soils scientists to remove soil samples virtually undisturbed from depths as great as 50 to 100 feet has been developed at the Bureau of Reclamation's Engineering and Research Center in Denver.

Known as a double-tube auger sampler, it consists of two steel barrels, one inside the other, with a cutting head and flights of augers on the outer barrel. It operates without need of air or water injection, which disturb the soil sample and make laboratory tests unreliable.

New Swift Dam in Montana Dedicated

The recently completed Swift Dam in western Montana, built by the Bureau of Reclamation in double-quick time after the disastrous 1964 floods had washed out the old Swift Dam, was dedicated last July 16.

The new Swift Dam is a graceful, nonsymmetrical, double curvature, thin arch structure on Birch Creek that depends for its strength on pressure against the solid rock canyon walls rather than on gravity. Only 22 feet thick at its base and 9 feet at its crest, it is 205 feet high and 573 feet long.

The old Swift Dam, built for the Pondera County Canal and Reservoir Co. over 50 years ago, was a rockfill gravity structure that collapsed when one of the worst floods in Montana history transformed Birch Creek from a shallow, 30-foot-wide stream into a roaring torrent half a mile wide.

The new structure symbolizes the great advances that have been made in the art and techniques of dam design and construction during the past half-century.

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Huge "Tree Crusher" Aids in Phreatophyte Clearing

An 80-ton "tree crusher" was used in the recently completed first contract for clearing 9,500 acres of salt cedar and other phreatophytes—deep-rooted, water-loving growths—from the flood plain of the Pecos River Basin near Roswell, N. Mex.

The tree crusher is a self-propelled machine which fells, splinters, and crushes trees and undergrowth. The machine has a movable push bar at ground surface.

A serrated edge of the bar grips the phreatophytic growths sufficiently to uproot most of them. Large blade-studded steel rollers of the machine then splinter and compact the crushed plants into a compressed mat. Two of the 7-foot-diameter, 10-foot-long rollers, spaced 6 feet apart, are in front of the machine and a third roller of the same size is at the rear.

The Bureau's eradication of salt cedars and other phreatophytes is in a 150-mile-long area along the Pecos River from above Roswell, south to below Pecos, Tex., which will make available about 150,000 acre-feet of additional water per year.

The Pecos River Basin Water Salvage Office at Carlsbad was opened in February of last year to carry out a continuing program to reduce the nonbeneficial consumption of water in the basin, including that by salt cedar and other undesirable phreatophytes.

Oso Tunnel Drilling Crew Sets New Record

Using a giant earth boring machine called a "mole" the crew of Boyles Bros. Drilling Co. set a new single-day record for tunnel drilling when they excavated 403 feet of the Oso Tunnel on the Bureau of Reclamation's San Juan-Chama project on June 16, 1967.

The graveyard shift accounted for 116 feet of the total of 403 feet while the day shift advanced 143 feet and the swing shift climaxed the record-breaking effort with 144 feet. This exceeds the previous known record of 375 feet in 1 day and 132 feet per shift set in March 1967, on Blanco Tunnel on the same project with the same diameter. The 5.3-mile-long Oso Tunnel is being excavated to a diameter of 10 feet, 2 inches, through a formation of Lewis Shale.

The San Juan-Chama project is designed to make possible an average annual diversion of about 110,000 acre-feet of water from the upper tributaries of the San Juan River in the Colorado River Basin, through the Continental Divide, for utilization in the Rio Grande Basin, N. Mex. The imported waters will provide a full supply of irrigation water for 39,300 acres of land in the Rio Grande Basin, a supplemental supply for an additional 81,600 acres, and municipal water for the city of Albuquerque.

"Rivers in the Sky" Film Award

The Reclamation weather modification film entitled: "Rivers in the Sky" received a Golden Eagle Award last November. Given in recognition of high cinematic quality, the film also enabled "Rivers in the Sky" to be one of 157 American films competing in foreign film festivals during the summer of 1967.

Iowa State University To Study Irrigated Lands

Iowa State University will undertake a 5½-year research study for the Bureau of Reclamation to develop improved methods of evaluating the productive capacity of irrigated farmlands in the Western United States.

The research program will include field experiments, to be conducted cooperatively with other universities, at selected sites on Reclamation projects in the Western States.

The program is expected to develop better correlation between physical soil characteristics and crop yields under given conditions of irrigation in a wide range of geographic locations.

Improvements in land classification, crop responses, general production functions, economic returns, the capacity of irrigation developments to repay project costs, and more efficient use of water and land resources are expected to result from the studies.

Different crops and widely varying soils will be analyzed to develop data for use by the Bureau of Reclamation in planning and evaluating new irrigation projects.

The experimental sites will be selected jointly by Reclamation and Iowa State University, and progress under the contract with the university will be reported semiannually.

This study is expected to yield new concepts and methods that will improve Reclamation's procedures in land classification and economic analysis of irrigation projects.

U.S. GOVERNMENT PRINTING OFFICE: 1968 O—283-905

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DC-6563	Missouri River Basin, S. Dak.	Nov. 24	Construction of stage 02 and 03 additions to Pierre substation.	A. G. Proctor Co., Inc., Aurora, Colo.	$282,918
DS-6564	Colorado River Storage, Colo.	Dec. 14	2 segregated-phase bus structures, 2 protective equipment assemblies, and 2 switchgear assemblies for generator units 1 and 2 for Morrow Point powerplant, Schedule 2.	Westinghouse Electric Corp., Denver, Colo.	278,382
DC-6566	Weber Basin, Utah	Dec. 6	Construction of Farmington equalizing reservoir for Davis aqueduct and West Farmington trunkline.	Miya Brothers Construction Co., Ogden, Utah.	277,433
DC-6569	Colorado River Storage, Colo.	Dec. 8	Construction of Midway substation, stage 01	Ets-Hokin Corp., San Francisco, Calif.	510,042
DC-6570	Central Valley, Calif.	Dec. 1	Construction of 48.9 miles of pipelines for Westlands Water District distribution system for laterals 13, 15, and 17.	Hood Corp., Whittier, Calif.	4,244,595
DC-6571	Minidoka, Idaho	Oct. 16	Construction of additions to Minidoka 138-kv Interconnection substation.	C-L Electric Co., Pocatello, Idaho.	152,946
DC-6575	Central Utah, Utah	Dec. 1	Construction of 4-mile Water Hollow tunnel, with machine-bored tunnel section and 1 mile of channel No. 2, Strawberry aqueduct.	Boyles Brothers Drilling Co., and Gibbons & Reed Co., Salt Lake City, Utah.	5,594,828
DC-6577	do	do	Construction of 5 miles of Water Hollow access road and improvements for 9.7 miles of Currant Creek road.	Strong Co., Springville, Utah.	359,523
DS-6579	Missouri River Basin, Iowa.	Dec. 21	One 120,000/160,000/200,000-kva autotransformer for Denison substation, stage 04.	ASGEN-Ansaldo San Giorgio-Compagnia Generale S.p.A., Genova-Cornigliano, Italy.	180,000
DC-6580	Missouri River Basin, Mont.	Dec. 8	Foundation grouting of left abutment for Yellowtail dam	Eagle Construction Corp., Loveland, Colo.	964,950
DC-6584	Missouri River Basin, Wyo.	Dec. 15	Construction of Hanover pumping plant No. 5	Rognstad-Olsen Construction Co., Casper, Wyo.	200,320
DC-6587	Central Valley, Calif.	Dec. 1	Excavation for 6 exploratory tunnels and a shaft for Auburn dam.	Emil Anderson Construction Co., Ltd., Sacramento, Calif.	728,925
DC-6590	Columbia Basin, Wash.	Dec. 5	Initial excavation for forebay dam, including construction of cofferdam and bridge, for Grand Coulee 3d powerplant.	Green Construction Co., Des Moines, Iowa.	12,524,517
DC-6592	Missouri River Basin, Mont.	Dec. 1	Construction of auxiliary outlet works and spillway cofferdam for Tiber dam.	Foley Brothers, Inc., and Winston Brothers Co., St. Paul, Minn.	3,394,953
DC-6599	do	Nov. 27	Repairs and modification of spillway tunnel for Yellowtail dam. (Negotiated Contract.)	A & B Construction Co., and COP Construction Co., Helena, Mont.	483,810
100C-949	Columbia Basin, Wash.	Oct. 20	Construction of concrete lined Potholes canal, Sta. 1903+00 to 1908+00 and 1958+50 to 1966+40.	S & S Sand and Gravel, Inc., Ephrata, Wash.	109,580
100C-963	do	Dec. 5	Construction of 9.8 miles of buried pipe and 1.2 miles of open ditch drains, Block 82.	M & J, Inc., Moses Lake, Wash.	182,781
300C-252	Boulder Canyon, Calif.	Nov. 6	Construction of Coachella canal siphon barrel extension, Interstate Rte. 10 crossing, All American canal system.	B.W.B. Constructors, Inc., San Bernardino, Calif.	115,536
300C-266	Colorado River Front Work and Levee System, Calif.-Ariz.	Nov. 22	Clearing 357 acres and stockpiling riprap and gravel for channel levee and retention dike areas near Blythe, Calif.	Hunter Contracting Co., Gilbert, Ariz.	273,817

In its assigned function as the Nation's principal nature resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. Department of the Interior
Bureau of Reclamation

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U.S. GOVERNMENT PRINTING OFFICE

May 1968

RECLAMATION era

A WATER REVIEW QUARTERLY

May 1968 · Vol. 54, No. 2

RECLAMATION era

Gordon J. Forsyth, Editor

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United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

COMMISSIONER'S PAGE

WILDLIFE

Perpetuation and enhancement of wildlife and fishery resources has been a major national concern—but more so now than ever before as our population expands and more leisure time is taken in outdoor activities.

A meaningful forward stride in the enhancement of wildife came just 60 years ago. A reservoir area developed by the Bureau of Reclamation was utilized to establish the first Federal Wildlife refuge for waterfowl. This refuge was on the Lower Klamath project in California and Oregon.

Subsequently, other Reclamation-developed areas were used as refuges. Until today, more than 20 national refuges comprising more than 300,000 acres are operating on Bureau lands and water acreage. In addition, more than 40 reservoir areas, many including attractive recreation features, are administered by State fish and game agencies.

This is an increasingly important dividend of the Reclamation program. Although the stored waters are primarily for irrigation, hydropower, and other multiple purposes, appealing man-made lakes in the country's arid zone are immediately appreciated for hunting, fishing and water-oriented recreation. Through recent legislation, the Bureau is authorized to develop projects to make the most of existing and potential fish and wildlife resources.

As we mark the sixth decade of wildlife enhancement on our projects, we point with pride to substantial benefits and accomplishments. Looking ahead we intend to continue cooperative planning and development efforts with the related management agencies both Federal and State, and the result will be more enjoyable surroundings and the enhancement of valuable areas for our fish and wildlife neighbors.

Floyd E. Dominy

FLOYD E. DOMINY
Commissioner of Reclamation

COVER PHOTO. Like "bombs away!"—trout fingerlings fall with a spray of water from low flying plane into Lake Powell below.

(Photo by Vern Jetley)

AN AFRICAN river named Limpopo, meaning crocodile, is bordered by large fertile land areas suitable for expanded irrigation opportunities.

Instead of producing crocodiles in the Limpopo project area, the irrigated valley is a major producer of the same kinds of crops grown in the United States—rice, cotton, corn, wheat, tomatoes, and potatoes. Six to eight cuttings of alfalfa per year also are common.

The lady has an empty barrel in carrying position. When filled with water for domestic use, the barrel is rolled to its destination. An irrigated field on the project is in the background.

Promise for LIMPOPO

by FLOYD E. DOMINY, COMMISSIONER OF RECLAMATION

Construction of the Limpopo project started in late 1963. Already Limpopo valley is the main agricultural "Show Place" of Mozambique, a Portuguese province in southeast Africa.

Like other progressive countries of the free world, which are taking action about providing important water developments for the future, efforts by the Government of Portugal will result in profitable expansion of the irrigated area of the Limpopo project from 77,000 acres to 160,000.

On invitation of Portugal, I was able to make a study-tour of the Limpopo project and other water developments in Africa last October. Accompanying me were Harold G. Arthur, Chief Designing Engineer of the Bureau of Reclamation from its Engineering headquarters in Denver, Colo., and J. Laginha Serafim, president of an engineering firm in Lisbon, who is an alumnus of the Bureau of Reclamation foreign trainee program.

Mozambique is bordered on the east by the Indian Ocean where the climate and land conditions affecting the Limpopo irrigation project make it similar to Reclamation's Central Valley project in California. The province is equal size to the combined States of Washington, Oregon and California, and has a total population of about 7 million, of which 97 percent are Africans. Major exports are agricultural products.

Intently going over designs for future water developments for the African nation are Mr. Serafim, left, who is a project designer from Lisbon; Commissioner Dominy, also in white shirt; and two local water officials.

Support 1,500 Families

Of Mozambique's large land and water resources available for agricultural development, the most significant will be utilized in the Limpopo project. Its 77,000 acres support 1,500 families. The families live together in groups or villages, each with its own European-style community facilities.

Also different from usual rural living customs in the United States, the 14 such villages are part of the government development and are located around the perimeter of the project area. Headquartered at Vila Trigo de Morais, is Manuel Teixeira Duarte, chief engineer of the project, and his staff.

Water service is from a major diversion dam on the Limpopo River flowing along the north side of the project. In addition to diverting project water into about a 30-mile-long main canal, the dam serves as a bridge over the river for both a highway and a railroad. A conventional system of secondary canals and laterals extend from the main canal to irrigate the project area by gravity.

Topped only by the Zambezi River, which is about 500 miles north in the same province of Mozambique, the Limpopo River is the second largest river in Africa emptying into the Indian Ocean. However, because of not having storage reservoirs, droughts in recent years have lowered flows below the amount needed either for full irrigation of the present project, or for the needed increase in acreage. In 1961, the river flow was only 25 percent of average, and in 1962–63 it had receded to 7 percent of average.

To solve these vagaries, construction will begin soon on Massingir Dam on Elephants River, an important tributary joining the Limpopo River about 25 miles upstream from the present project. This new dam will regulate the flow and provide the necessary carryover storage for more than doubling the size of the irrigated area.

Massingir's Design

Massingir Dam was designed by Mr. Serafim's consulting engineering firm from Lisbon. It will be an earthfill structure rising 120 feet above riverbed. Long dikes extending on the sides of the dam will make the total crest length over 2 miles, and its powerplant will have a capacity of 60,000 kilowatts. The bulk of its power generation will be marketed in the provincial capital, Lourenco Marques, 140 miles to the southeast. This modern seacoast city has a population of 200,000, making it the province's largest.

Early explorations along the 1,000-mile long Limpopo River make a story similar to some rivers in this country. It was first traced in 1869 and 1870 by foreign adventurers seeking a waterway to the sea from the Tati gold fields upstream. In modern times, Mozambique's transportation system is a vital asset to the shipment of products to and from several African Nations, particularly Rhodesia, in the interior. The province's seaports also are used considerably.

The reservoir created by Massingir Dam will extend 5 miles into Kruger National Park of South Africa as agreed by that Nation and Portugal. This will be a 2 million acre-foot reservoir about the size of a South Carolina reservoir named Lake Murray, or the reservoir behind Canyon Ferry Dam in Montana.

Cost $20 Million

Massingir Dam will cost about $15 million to build, and the powerplant and transmission lines will be an additional $5 million. A third of these costs will be repaid by revenues from the Limpopo project, one-third from the sale of power, and the other third from the proceeds of water for other lands and uses.

While industry has mainly been in processing agricultural products, another major dam and powerplant, soon to be under construction, is expected to expand industrialization in the important mineral resources area of the Zambezi River. This is the Cabora Bassa project north of Limpopo.

In Angola

Our review of the water and land resources on the west coast of Africa, in Angola, showed that this rain-belt province recognizes its great potential. In addition to its present developments, far reaching basinwide planning for multiple purpose water developments is underway.

In South Africa

The Department of Water Affairs of the Republic of South Africa gave us a review of their major water developments including their *dream* project of 40 years, the Orange River project. Now under construction on a river strikingly like the Colorado River in Western United States, is Hendrik Verwoerd Dam, the initial and key structure of the project. This 280-foot high concrete dam will be completed in 1971. Also planned for the next three decades in this great Orange River project are 2 other major dams, a 51½-mile long water tunnel, 20 hydropowerplants, thousands of miles of canals for irrigation, and power transmission networks throughout the country from the Atlantic to the Indian Oceans. # # #

Flows from the diversion dam on the Limpopo River formed an interesting sand bar which residents find useful.

Major exports from Mozambique to trading Nations are sugar, cotton, cashew nuts, copra (which is dried coconut meat yielding coconut oil), sisal (a strong durable white fiber from a sisal plant), and tea.

In the future, Mozambique will have larger exports and other dependable advances as its developments achieve greater usefulness of the valuable land and water resources.

DIRTLESS

FARMING (*Hydroponics*)

IN

COLORADO

by NELLO CASSAI, Region 7 Information Officer

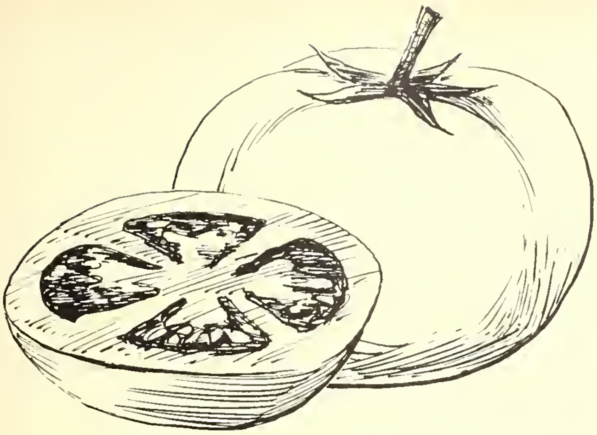
NEARBY they're fishing through the ice in a sharp wind off the Rockies and here's this fellow in a warm building picking ripe tomatoes from vigorous 8-foot vines.

An ex-Nebraska farmer, he is engaged in year-around gardening in Loveland, Colo.; and although he is using water from the Colorado-Big Thompson project, it is not in a manner envisioned by the men who designed the famous development more than 30 years ago.

Rollin F. Clark is a hydroponics farmer and he measures his operation in metered gallons of water, not headgate flow, and in square feet instead of acres.

Clark puts his delicions, vine-ripened tomatoes on the Colorado market in the dead of winter as well as other seasons. He get 35 cents a pound for all the tomatoes he can produce but he can't begin to keep up with demand.

Ripening fruit is abundant on tall vines.



There is nothing new about hydroponics—the growing of plants in nutrient solutions—but it still mystifies those who long have regarded the good earth as something sacred.

In hydroponics, the same chemical nutrients found in good soil are dissolved in water and fed to plants or seed sprouts which are held in place by screens, sand, gravel or other material. Temperature and humidity are carefully controlled.

The rate of growth is startling. Barley "planted" on Monday may be 5 inches tall on Saturday. Tomato seedlings placed in Clark's greenhouses begin to produce marketable tomatoes in 2½ months and continue to produce for another 3 months.

Gaining Momentum

Although dirtless farming has long been established in other sections of the country, it was only about 3 years ago that it made its appearance in Colorado. And despite criticism and skepticism in some quarters hydroponic operations are gaining momentum.

The Denver zoo produces from 700 to 1,000 pounds of barley grass daily, mostly as waterfowl feed. The U.S. Fish and Wildlife Service grows about 1,800 pounds of barley grass a week at the Denver Federal Center as supplementary feed for deer and antelope kept for research purposes.

At Deer Trail, Colo., a dairy owner grows 1,000 pounds of barley grass daily to provide green feed for his herd of 40 cows.

The real emphasis in Colorado, however, is on hydroponic tomatoes and Mr. Clark is one of the pioneers.

He came to Colorado from a Lexington, Nebr., farm in 1965, developed a hobby interest in hydroponics and later formed the firm of Kelly-Clark, Inc., of Loveland.

Working full-time now, Clark not only produces tomatoes but he also sells a franchise package that includes equipment, plant nutrient, training at Loveland for the grower, supervision and advice on planting, growing, harvesting and marketing and advertising benefits from the firm's trade name tomato, "Gourmato."

So convincing has Clark's operation been that a Denver supermarket chain has gone into hydroponic tomato production in Loveland, with Clark as consultant.

Kelly-Clark has three greenhouses, made of translucent fiberglass and measuring 30 by 150 feet (4,500 square feet) each. Clark said 30,000 pounds of tomatoes are produced yearly in each building, from two crops.

23,200 Pounds

The average yield *per acre* (43,560 square feet) of field-grown tomatoes in the Loveland area is 23,200 pounds a year. (Each of Clark's greenhouses embraces a little over one-tenth of an acre.)

A fully-equipped building purchased from Kelly-Clark costs about $17,000, and Clark said a franchise owner with four buildings—the recommended number—can turn a tidy profit. He pointed out that the profit can fluctuate, of course, with the cost of labor, and stressed that a family operation is ideal.

Each greenhouse holds 1,600 plants, 11 inches apart.

Kelly-Clark franchises thus far have been set up near Boulder, Grand Junction and the Glenwood Springs-Rifle areas in Colorado. Clark also has shipped a building, with franchise, to oil-rich Kuwait on the Persian Gulf.

Clark is by no means exclusive in his hydroponic tomato operations in Colorado. There are a number of other individuals and firms in the business. And for good reason.

Better known for its skiing and trout fishing, the Colorado area has a comparatively short growing season and local vine-ripened tomatoes are available only for a limited period in late summer and early fall.

Flavor and Texture

"For the rest of the year we have been forced to rely on tomatoes from California or Mexico," Clark said. "They are packed green and allowed to ripen during shipment or in storage at this end. The flavor or texture won't compare with a vine-ripened tomato.

"A hydroponic tomato tastes like one right out of the garden; in fact, it is right out of the garden."

Loveland residents, including Bureau of Reclamation employees who man the South Platte River projects office there, agree that the "Gourmato" sold in Loveland, and sometimes Fort Collins stores, not only look like a tomato but also smells and tastes like a tomato.

"And there are other factors which make hydroponic farming a good bet for the future," Clark continued. "As our population increases there will be a decrease in the amount of tillable land. Good farmland is giving way to huge shopping centers, subdivisions and highways.

"Equally important is the consideration of Colorado's vital water supplies, which are being stretched further every year."

Clark said each of his greenhouses weekly uses about 2,800 gallons of water, which with its nutrients is recirculated numerous times before it is discharged. The total of the three units, thus, would be 436,800 gallons a year.

Under average conditions it takes between 1½ and 2 acre-feet of irrigation water per acre to produce tomatoes in the field, according to a bulletin of the Agricultural Extension Service at Colorado State University. An acre-foot represents 325,850 gallons.

Multipurpose Water Project

Clark's water comes from the Loveland system, 1 of 11 municipalities served by the multipurpose Colorado-Big Thompson project—early showpiece of transbasin water diversion development.

Constructed by the Bureau of Reclamation over a 21-year-period (1938–59), it transfers water through the spine of the Continental Divide from the Pacific to the Atlantic watersheds.

It was designed primarily to provide supplemental irrigation water for 720,000 acres of rich farmlands in eastern Colorado and to produce electricity, but ever greater demands are being made by growing municipalities and industries.

Due in large part to the delivery of water and the ensuing urbanization, the assessed valuation in this, the Northern Colorado Water Conservancy District, climbed from $288 million in 1953, to $468 million in 1965 and to $493 million in 1966.

Total gross value of crops in the district was $97.3 million in 1966.

Over a long haul, the gross value of crops produced in the area from 1951 through 1966 totaled more than $1.2 billion—seven times the project construction cost of $162.7 million.

Principal crops are sugar beets, alfalfa, small grains, corn, vegetables and fruit. And important among the vegetables are field tomatoes.

Good Bartender

In discussing hydroponic tomato solutions, Clark is like a good bartender or chef in that he will publicly list ingredients but not quantities. He disclosed only that his nutrient formula contains such standard fertilizer grade chemicals as nitrogen, phosphate, potash and small amounts of trace elements.

Ralph Beede of Berthoud, Colo., gently fastens cord supports.

From vats in the center of a greenhouse, pumps with automatic timing devices force the nutrient-laden water to gravel beds holding the plants. In the beds are plants and pea gravel, nothing else.

When the pumps are cut off, after about 15 minutes, the water slowly returns to the vats by gravity from the sloping beds. This water is recirculated until the sodium content reaches a critical point.

Cord is gently tied around the stem of the small plants and anchored to a wire 8 feet above the bed. Suckers are nipped as they appear, confining growth to the single main stem.

No smoking is allowed in the greenhouse. In fact, Clark won't hire a man who smokes, a precaution against tobacco mosaic—a deadly virus smokers may carry on their hands and transmit to tomato plants. Insect and fungus problems also are magnified in the near tropical climate of a greenhouse.

The tomato plants are pollinated merely by shaking the string on which they climb. When they reach a height of eight feet the plants are topped so that they may devote themselves to production of fruit instead of foliage and so that they don't shade out the valuable sunlight.

Seed types? Clark prefers three hybrids—floradel, manapal and tuck-cross, which are started in a separate building.

Its Detractors

As was noted earlier, the science of hydroponics is not without its detractors in Colorado and among them is Extension Horticulturist Charles M. Drage of Fort Collins.

"I'm acquainted with a number of these units and I haven't found one that is practical, considering the costs and risks involved," Drage said. "I handled over 80 consultations last year with people interested in hydroponic tomatoes and I suggested to them that there might be a more efficient way to grow greenhouse crops."

Drage explained that, in his opinion, the old-fashioned greenhouse is a better answer to those seeking to market tomatoes in the off-seasons.

He cited a circular (Hoagland and Arnon) issued by the College of Agriculture, University of California at Berkeley, which states in part:

"Water requirement is no less in nutriculture . . . Tomatoes grown side by side in soil and in water culture in the same greenhouse afforded an opportunity to measure the relative amounts of water utilized. The number of gallons of water used to produce 100 pounds of fruit were as follows: soil, 222; water culture, 257 . . . The nutritional quality of the products was the same. The two could not be consistently distinguished in a test of flavor and general quality. No significant difference could be found in the content of vitamins."

Clark didn't want to enter the conventional greenhouse-versus-hydroponics debate, but said that most of the hothouse tomatoes he has eaten apparently were shipped green "because they simply haven't had the flavor."

"Although I get no encouragement from Fort Collins, scores of other land-grant colleges and universities in the country are keenly interested in my operations. I am conducting numerous seed tests for them and constantly exchanging other information," Clark said.

Wildlife biologist Ed Knittle examines barley grass grown in automatic operation at the Denver Federal Center, Colo.

Deer eat the dirtless grass, roots, paper lining and all. These animals and antelope are kept for research purposes by the Fish and Wildlife Service.

Kansas State U.

Kansas State University at Manhattan works actively with hydroponics and has even held clinics for greenhouse tomato growers.

Dr. Gary Paulsen, nutritional researcher, KSU Agronomy Department, has summed up his views as follows:

"Nutrient culture (hydroponics) for commercial production is practical only when the soil, climate, or other factors give it an economic advantage over conventional means of plant production.

"In indoor installations, such as greenhouses, use of nutrient cultures is often preferred to use of soil. Advantages of nutrient culture over soil culture include greater uniformity of plant growth, greater control of nutrient supply, and pH (acidity), decreased incidence of plant diseases, and the potential for automation of production.

"Not all these advantages may be realized at the same time, however, and they may not offset the disadvantages associated with nutrient culture.

"Among these disadvantages are high cost of facilities, limited area of production, increased severity of plant diseases, and the need for considerable technical knowledge to manage installations."

In barley production, the buildings are windowless metal units with artificial lighting. The seeds are soaked and then placed in metal trays lined with perforated paper placed on a screen to hold the sprouted seeds. Temperature and humidity also are carefully controlled for this crop.

In the U.S. Fish and Wildlife operation in Denver, 4 pounds of seeds produce 30 pounds of grass in five days. The entire mat of thickly grown roots, grass and paper is removed from the tray for feeding and the tray is immediately replanted.

The grass, high in protein, is considered an excellent nutritional aid and cuts the animals' consumption of grain and alfalfa. But like indoor tomato growing, the dirtless way still mystifies the man with the high regard for the good earth.

# # #

For Dams

"Electrocardiographs"

Do Inside Job

Sensitive to any new pressure . . .

A treasury of information

As a doctor uses his electrocardiograph to examine the heart of the human body, the hearts of dams built by the Bureau of Reclamation are carefully examined by electrical instruments for the same reason—to find symptoms which may need attention.

Like the medical specialist, "House calls" by Reclamation "doctors" have increasing benefits because of improved instruments for dam inspection.

In fact, like reports of medical advancements, considerable value is placed on Reclamation's advances in the water resources development field. Such reports are extensively utilized by other designers and builders of dams in many nations.

One of the more recently developed examining instruments—used like an electrocardiograph—is the strain meter. The sensitive section of this instrument when unmounted, resembles a large electric etching pen with a long power cord dangling from one end. When mounted for service and embedment in wet concrete, the other end is fastened to about 11 other strain meters forming a star shaped cluster.

These meter clusters perform difficult inside jobs. They are installed at selected locations deep in a dam in the freshly placed concrete at the time of construction. They are forever inaccessible after the concrete sets, but remain sensitive to any change in pressure. The electric cords extending from all strain meters, are marked individually so

they may be immediately identified on their respective gauges at the inspection terminal located in a gallery or other accessible location.

Structural Performance

Technicians take meter readings at these terminals as part of the dam's surveillance program to evaluate performance of the concrete throughout the dam. The effort enables correction to keep the structure from developing major problems.

Another instrument, important for evaluating behavior of Reclamation dams, has been success-

Above. This man is placing a strain meter (which performs like an "electrocardiograph") in position in wet concrete.

Right. Some strain meters are in Morrow Point Dam, shown near completion on the Gunnison River, Colo.

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ful without exception in the six decades of the agency's inspection experience. It is a surveying instrument, known as a theodolite.

To many people, a similar surveying instrument known as a transit is familiar atop a tripod used for locating exact corners of plots of land such as city lots. In checking a dam with the more accurate theodolite, which is set up at permanent marks on the ground near the dam, its crosshairs are lined up on tiny target marks, located at many points on the crest and other exterior surfaces of the dam.

Surveys make it possible to determine whether and how much the dam has settled, or shifted in any way. Using this precise theodolite, it also is possible to detect structural deformations in the large interior galleries of dams.

A significant chapter in extending safety and economy to the construction of dams was the the Stevenson Creek Test Dam built in southern California in 1926.

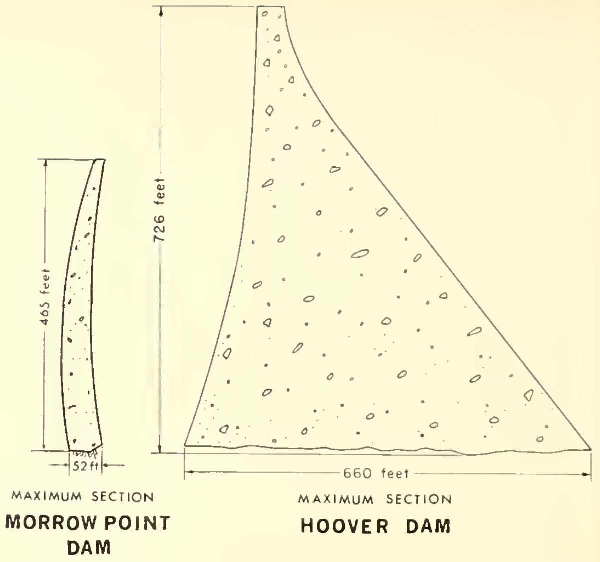
Ideas Developed

Numerous instruments and ideas were included in that dam. The test structure was a newly designed thinarch type, constructed with the economical and versatile portland cement concrete. Effects of generation and dissipation of heat, resulting from chemical reaction of portland cement and water, were analyzed. Methods were developed for cooling concrete during construction, and for minimizing increasing temperatures.

Many trial instruments were embedded in the concrete during construction of this dam to measure movement, strains, and deformations. The effects of varying pressures on the dam due to the rapidly filling and emptying reservoir were measured.

The first major structure, which the Bureau of Reclamation undertook after participation in the test work at Stevenson Creek Dam, was Hoover Dam on the Arizona-Nevada boundary—started in 1931. About 500 of the most useful measuring instruments, like those used in the test dam, were embedded in Hoover during its construction. A veritable treasury of valuable behavior information has been gathered from responses of the meters in Hoover Dam, from readings taken both during construction and since completion.

Information from instruments has become increasingly useful during the existence of Hoover Dam. A limited number of strain meters were



Comparison of design and amount of concrete are shown in profile views of two dams. Pressure exerted from reservoir would be at left.

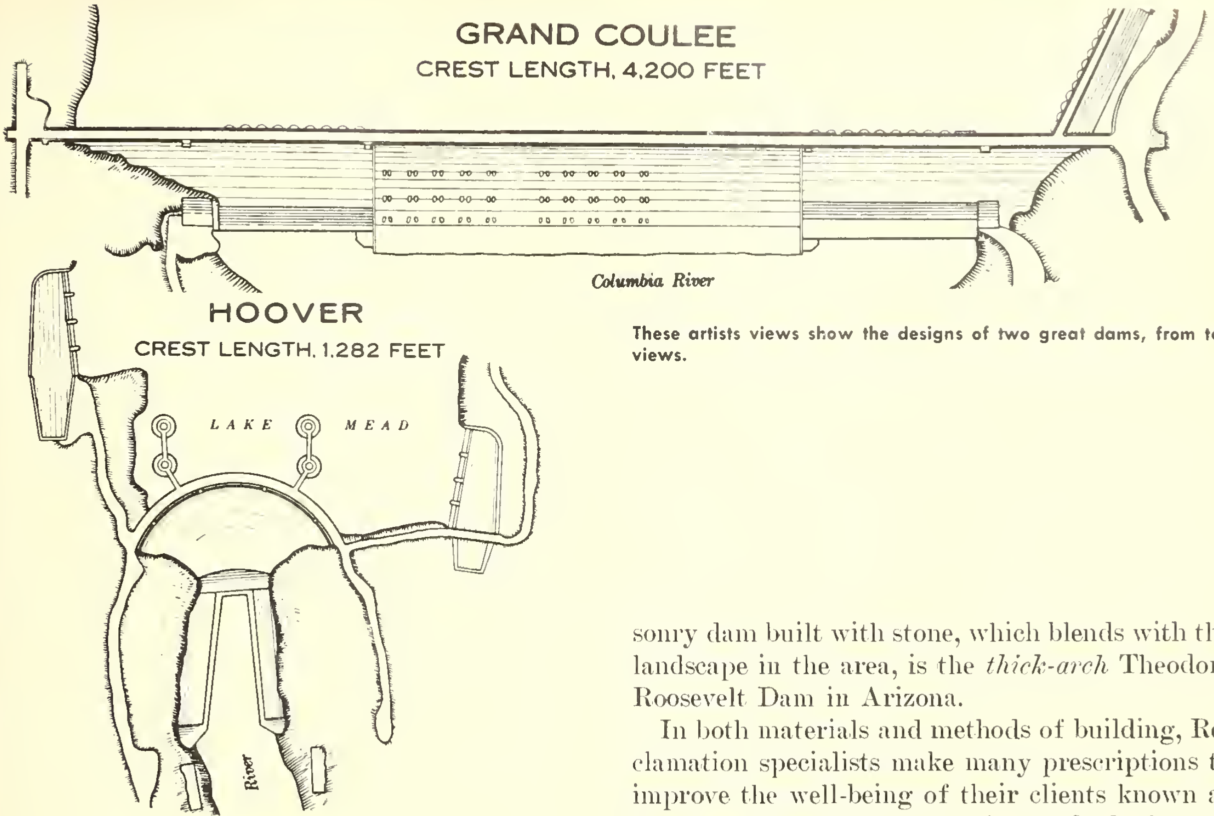
strategically placed in Grand Coulee and Shasta Dams in Washington and California, respectively. Results confirmed Reclamation's design experience on those structures, and gave increased confidence for new designs which has meant saving millions of dollars in use of concrete without sacrificing effectiveness.

Similar instrumentation is used in earthen dams to accomplish high standards of performance.

Recent Solution

A problem relating to the voluminous information furnished by the new pace-setting instruments has been solved since the early 1950's. Prior to that time, readings from the various meters required computations by desk calculating machines demanding extensive manpower and time to make the information fully useful. But with the coming of high-speed computers, the design engineer can utilize the technical data sooner and more beneficially. New concepts for improved structures—which might not have been achieved for 30 years or more, before the advent of computers—can now be initiated with full confidence plus multiplied effectiveness in as little as three years. The computer has been a great boon to water resource developments.

The strength and the amount of concrete needed in a dam depends on design—whether it will be vertically *curved*, horizontally *arched*, or simply



These artists views show the designs of two great dams, from top views.

straight. For use at some sites for dams, a savings of millions of dollars can be realized by building the thin-arch dam needing less concrete with more, or no loss of, strength.

The drawings with this article show comparisons of the sections of several dams and an idea of the relative amounts of concrete needed to build them. The design of Grand Coulee Dam is the *straight* type which derives its great water holding power from the heavy downward force of gravity, or weight of the structure.

Graceful Lines

Although its graceful lines are only partly visible, Hoover Dam is called a *thick-arch* and it required a comparatively large quantity of concrete. Recently completed Morrow Point Dam in Colorado, on the other hand, has even more artful lines, and a tremendous amount of concrete was saved through its *thin-arch double-curvature* design. Glen Canyon Dam in Arizona as an *arch* design, saved much expense for concrete, and is widely known for its beauty. Before the extensive use of concrete, the masonry-arch Pathfinder Dam in Wyoming, built in 1909, was constructed of indigenous stone quarried near the site. Another masonry dam built with stone, which blends with the landscape in the area, is the *thick-arch* Theodore Roosevelt Dam in Arizona.

In both materials and methods of building, Reclamation specialists make many prescriptions to improve the well-being of their clients known as dams, and related structures in the field of water resource developments—and the medical profession is not the only one, nowadays, which uses the delicate electrocardiograph. # # #

Superhighway for Kilowatts

Public and private electrical systems in 11 Western States will be linked by the Nation's largest single electrical transmission development with completion of the Pacific Northwest-Pacific Southwest Intertie, now under construction.

The Bureau of Reclamation says the intertie will transmit 4,600 megawatts of power over two direct-current, extra-high-voltage (750 kv) lines, first of their kind in the Nation and the longest in the world; two alternating-current (500 kv) lines; and a system of shorter lines. The EHV lines will originate near The Dalles Dam in Oregon and terminate at substations near Los Angeles and near Hoover Dam in Nevada.

The intertie will permit marketing of surplus peaking capacity and surpluses of secondary energy and exchanges of power and energy between the Northwest and the Southwest.

IDEA "HOME" for BALLOON TESTS

A giant polyethylene balloon tugged gently, but firmly, at the truck that held it earthbound on the runway, and the transparent bag stretched like a crosswise cloud 600 feet tall above the airport at Page, Ariz. Launching crews made last minute checks of the balloon's helium content.

They gave a final examination of the telescope and remote-control radio system in the gondola. Late afternoon shadows already covered Glen Canyon Dam, 2 miles away. To the east, on this March day, the last of the day's sunshine transformed a length of red sandstone into a horizon of frozen fire along the shore of a shining Lake Powell.

The balloon will be 600 feet high when filled with helium.

This was the scenic desert setting, and technically favorable climate for the Polariscope launching last year. It was only a short distance from the successful launchings of the huge altitude-studying balloons starting about 5 years ago in the depths of the canyon between towering, perpendicular, sandstone walls of the Colorado River. At that time, the balloon made a silent ascension from a stationary clamp.

On the airport runway, however, the balloon was to be launched as perfectly vertical as possible, matching the force of any light wind by driving the truck downwind at a speed equal to the breeze. The balloon was quickly released from the jaws of a steel clamp on the truck, which was halted at the instant it was seen that the balloon stood vertical. Then like a trained tiger, the gondola leaped away, rising swiftly.

To 22 Miles

Within an hour, the balloon reached 60,000 feet. In 2 more hours it climbed to its float height of 120,000 feet—more than 22 miles above its adopted home on a Bureau of Reclamation water resources development project.

The 15-hour flight of the Polariscope had several purposes: To study the planet Mars, vibration, polarization of light in ultra-violet rays and various other atmospheric effects.

The tests are by the National Center for Atmospheric Research. In recent years, many such flights have been made from Page, Ariz., by the NCAR in cooperation with programs of the University of Arizona, Louisiana State University, Jet Propulsion Laboratory, Massachusetts Institute of Technology, and the University of California at San Diego.

The gadget-packed gondola was brought down by parachute at noon the day after it was launched. Although the return package landed in a tree many miles south of the launching site, and there was damage to the sensitive instruments, it was a successful mission.

The NCAR plans to install permanent facilities at Page, because the weather is favorable for launchings 3 days out of 5, as compared to about 1 of 5 at other locations. # # #

A Fisherman looks at Reservoirs

by CHARLES E. MOST

The trees on the western bluffs had stretched fingerlike shadows almost to the other side of the reservoir when a fast-moving outboard rounded the point and abruptly slowed down to approach the floating dock.

The lone man cut the motor and deftly guided the boat into the slip. After making fast to a cleat, he placed a large tackle box and his rod and reel on the dock. He then lifted a stringer of fish and stepped from the boat onto the wooden walkway.

His weathered features showed he had spent many hours outdoors and his eyes had the look that comes from seeing things at a distance.

However, a young man on the dock ignored the boatman's features; he was looking at five big bass on the stringer. Forgetting his angling manners, he blurted, "Where and how did you catch fish like that?"

"You might say I caught them in the lake," the older man curtly replied.

John, the young man, caught the rebuff and explained, "I've been fishing here for a week and all I've caught were a few bluegills; why your smallest fish is almost four pounds and I couldn't guess what the big one weighs."

The fisherman, recalling similar experiences when he was younger, softened, "Yes, the smallest one will go around four and I think the big one may top seven pounds. Sorry to hear about your bad luck. What part of the lake were you fishing?"

John related his fishing activities of the past week, describing just where he had concentrated his efforts. As the two men continued to chat about various fishing experiences, the rapport that always seems to exist among sport fishermen became apparent.

Meet Me Here

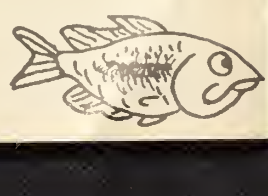
Finally the older man said, "My name is Bert and if you would like to meet me here tomorrow morning about sunup, we'll see if we can stir up some action."

The morning sun had burned the last traces of mist from the surface of the manmade lake when Bert shut off the motor and let the boat coast in toward a snag standing in the water 50 feet out from a rocky bluff.

"Tie the boat to that snag, John," he directed, rigging up John's rod with a small sinking lure. "Now cast right up against the rocks and retrieve very slowly." John made the cast and cranked the lure back to the boat. "That's not what I call slow," Bert said. "Try it again—only this time, I want you to feel that lure bounce from ledge to ledge as it sinks toward the bottom."

John made a second cast and slowly dragged the lure off a ledge, stopping the retrieve to let it sink until he felt it bump the next ledge. When the lure was about 10 feet down, a dark shape detached itself from the shadow of a huge boulder. With slowly moving fins, the fish followed the lure for a few feet and then struck savagely. John felt the strike, set the hook, and after a few hectic moments of keeping the fish away from the spectrallike submerged trees, boated a nice bass.

John was elated as he put the fish on the stringer.



"How did you know the fish would be so deep, and in this particular spot," he asked.

Cold Blooded

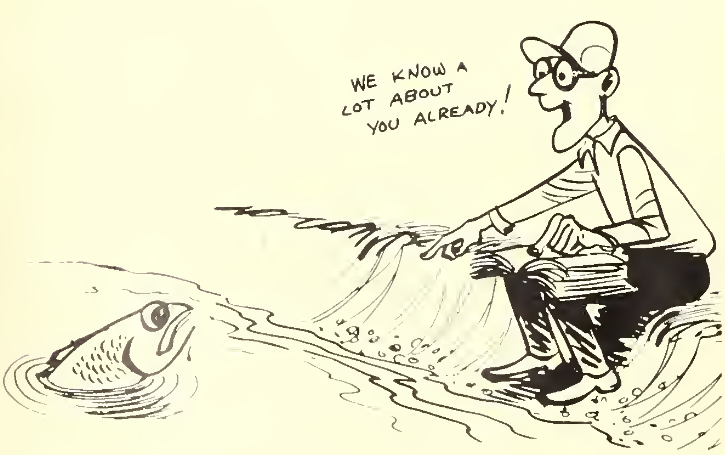
"Well, we've had several weeks of hot weather and it's warmed up the water," Bert explained. "Fish are cold-blooded animals and their body takes on the temperature of their surroundings. The deeper water is cooler so the fish go deeper to get more comfortable. Also these sunken trees attract smaller fish allowing the bass to pick up a meal here without too much trouble. The jumbled boulders make this place even more attractive because they provide cover from any enemies the bass may have.

"What more could a fish want? Here he has a comfortable home, protection from enemies, and a supermarket just outside the front door. Fish aren't really so different from people when it comes to getting along in the world," Bert concluded.

The two fishermen managed to take three more bass from the base of the cliff before Bert announced that it was time to move on to another spot. He seemed to know the best places and John commented on this.

Bert shrugged, "Since I retired 3 years ago, I've been spending every summer here. It took me several weeks to find some of the most productive spots and I still locate new ones from time to time. A reservoir is a lot harder to read than a stream. Most fishermen can look at a stream and tell where the fish are likely to be, but a big lake is tougher. There's so much of it to learn."

Then Bert grew more pensive, "There aren't as many good fishing streams now as there used to be and most of the ones that are left are overcrowded.



"It's pretty obvious that with the population growth and the numbers of fishermen increasing, more people are going to turn to reservoirs for their sport. The other day, I was talking to one of the fishery biologists conducting research on this lake and he told me that because of reservoirs, there is now more fishing water in the United States than at any time in history. He also said that over one-third of America's anglers fish in reservoirs."

You Showed Me

"Why are they doing research on this lake?" John wanted to know. "My success wasn't too good until you showed me where to fish, but that was ignorance, not a shortage of good fish to catch."

"For one thing," Bert replied, "This is a relatively new lake. They want to compare it with older lakes where fishing has started to decline. A lot of reservoirs provide great fishing during their early years but then it drops off. These biologists want to know why the fishing declines."

As blazing July sun reached its zenith, Bert suggested finding a shady spot for lunch and a "siesta."

When they had finished eating, Bert leaned back against a large rock and said, "Might as well relax a while. We would probably pick up a fish or two but it will be better later on."

"Why?" John asked.

"Big fish are pretty wary," Bert replied, "and they seem to know that their greatest danger is during the brightest hours of the day. Those biologists I was telling you about have found that fish populations are usually nearer the surface during the night."

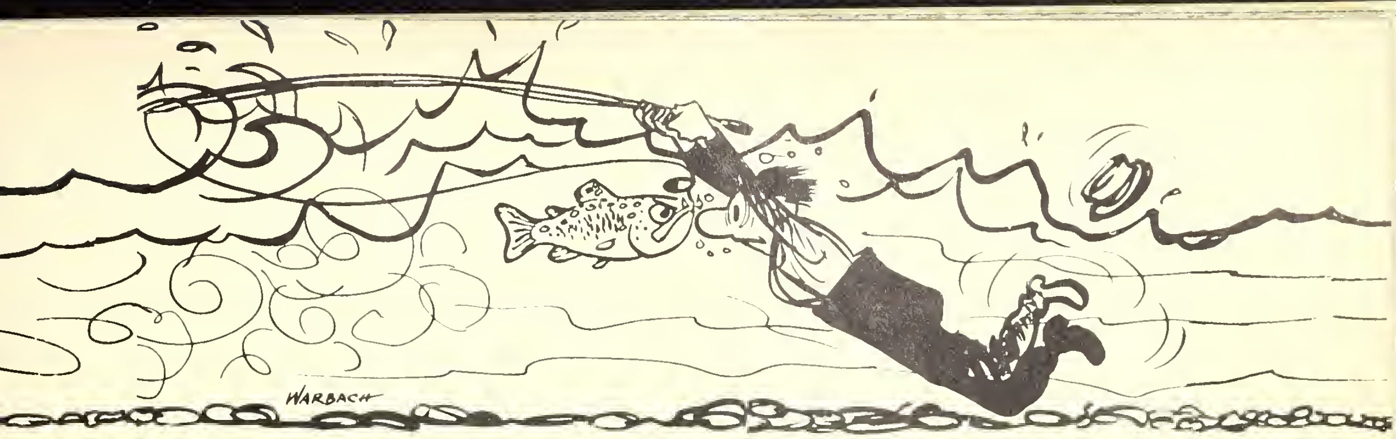
"How do they find out things like that—with a crystal ball?"

"They have special equipment. For example, they can locate fish with a sonar-type instrument, similar to those developed to locate enemy submarines during the war.

Finding Comfort

"Water temperature would certainly affect fishing in a lake," John ventured. "You said earlier that fish go deeper to find a more comfortable temperature during hot weather. The average water temperature could determine the kind of fish in a reservoir because a cold water fish such as trout could not live in a warm water lake."

"That's true except where a lake has the cold water for trout in deeper areas and warmer water



near the surface for bass. There are a number of lakes like that in the United States.

"The biologists aren't limiting their studies just to the kind of fish you and I like to catch. They're also studying what they call forage species—the little fish that big ones eat, and also nongame fish.

"They even found 'sleeping' fish on the bottom during some of the night studies. This may be an important factor in night fishing for bass."

"Judging from the fight the fish gave us this morning, I don't think I could land one at night unless it was asleep," John laughed.

"These fish are in fighting trim. They grow very fast in this lake."

A splashing sound broke the afternoon stillness, interrupting Bert's remarks. A short distance up the shore from where the two men were sitting was a rocky point that jutted into the water. A large fish had swirled on the near side of the point where a small feeder stream entered the lake.

"Say, that's a good fish," Bert said. "It acted like it was chasing minnows. I suppose the cool water from the brook has attracted the little fish. There he is again. That fish is asking to be caught and I think we should accommodate him. The fishing ought to be picking up about now anyway."

Bert stepped over to the boat and extracted a battered rod case from under the front seat. He removed a fine old fly rod from the case and quickly joined the sections together. Next he took a fly reel from the depths of the big tackle box, mounted it on the rod, stripped off about 20 feet of line and threaded it through the guides.

"That's the first fly rod I've seen since I came here," John remarked.

Prefer Fly Rod

"I prefer to fish with a fly rod," Bert replied, "But it's not as versatile on reservoirs as some other methods. For one thing, you can't fish deeply with it as easily as with other types of tackle. I keep this rod in the boat just in case I run into a lucky situation like this. That fish is after minnows in shallow water and this streamer fly should imitate a minnow enough to do the trick."

Bert asked John to use the paddle to position the boat for the cast. "Don't bump the side of the boat," he cautioned, "fish are easily frightened when they're in shallow water."

When the boat was about 40 feet from where they had seen the fish, Bert tossed the line into the air, false cast once and dropped the fly right at the mouth of the little stream. The minnows scattered wildly as the fly landed. Bert was just starting the retrieve when a large bass surged into the shallows, grabbed the fly, leaped once and then turned for deeper water. The reel screeched in protest as the fish bored for the shelter of some rocks along the point. Bert felt the leader grate against the sharp rocks and then the line went slack. The fish was gone but Bert had a happy grin on his face. "If I won all the battles, I'd give up fishing," he said, summing up his philosophy that sport fishing is for fun and not just for food.

The two men changed places in the boat and Bert started the motor, heading the boat back up the lake. They passed several spots that looked good to John but when he pointed them out, Bert only shook his head.

Finally after cruising for several miles, Bert turned the boat into a broad cove and cut the motor.

Good Place

"This is a good place to fish late in the day," he said. "This cove is pretty shallow. You can tell that by looking at the banks. They are low and the gentle slope continues right on under the water. A steep bank usually indicates deep water near shore. Big bass will move into a shallow area

like this in the evening and at night because there are usually plenty of small fish, frogs and other things they can eat. Last year this cove was dry by the end of summer due to the demand for more water farther downstream."

"Does that sort of thing happen often?"

"No, it doesn't. There was little rain last year to help maintain water levels, but the people controlling the dams have been very cooperative. Federal agencies like the Bureau of Reclamation, Tennessee Valley Authority, and the Army's Corps of Engineers, as well as private power companies, want to provide the best possible fishing in reservoirs under their jurisdiction.

"As the biologists learn more about reservoir fish they will probably come up with some management recommendations. State game and fish departments and the reservoir construction agencies will play the major role during this management phase.

"According to the needs of a particular lake, reservoir agencies might be able to coordinate drawdowns with fish spawning seasons. This could control nongame fish such as carp or help maintain good conditions when game fish are spawning. Drawdowns can also be used to control unwanted water plants and to help clear up muddy lakes.

"The work that's done on a reservoir site before the lake is filled can also have considerable influence on future fishing. It wasn't many years ago that construction agencies cut every tree in a reservoir area, right up to the high water mark. Cleared areas in deeper water are important for boating, water skiing, swimming, and commercial fishing, but leaving trees in shallow areas is also important.

Trees Help

"These trees hold down wave action and this helps to prevent shore erosion and roiling of the water. Timbered areas also provide good cover for many kinds of fish. White bass, for example, prefer open water areas but most fresh water fish like trees, rocks and other kinds of cover.

"The biologist told me two other ways that flooded timber can help fishing in reservoirs. These submerged trees go through a slow rotting process that releases carbon dioxide into the water. Apparently sediment is held in suspension by an electrical charge. The carbon dioxide helps to neutralize the electricity and the tiny particles settle to the bottom. This helps keep the water clear. Also, standing timber, and the twigs, bark and other forest litter in the water promotes the growth of microscopic organisms. These tiny plants and animals are eaten by larger creatures, which are in turn eaten by aquatic insects and small fish which then feed larger fish and so on. This is called a food chain and all of it is affected when one link is weak.

"The reservoir construction agencies are generally in favor of leaving trees in many parts of a reservoir because it's good management and it reduces construction costs."

Seen the Dam?

"Have you driven down for a look at the dam since you came here," Bert asked.

"Yes. It sure took plenty of cement to build one that big."

"Notice anything of particular interest to fishermen?"

"Well, the river below the dam certainly looks nice. The water is really clear. Any fish in it?"

"That river is one of the top trout fishing places in the country."

"How could that be? This is a warm-water lake."

Bert laughed. "Remember earlier when we were talking about the deeper water being colder? The water that runs the turbines in the powerhouse at the dam comes from deep down in the lake. The temperature hardly changes between winter and summer and it's just right for trout. I hear it's still cold enough for them thirty miles downstream.

"Streams just below dams are called tailwaters and they usually fluctuate quite a bit because of power plant operation, irrigation needs downstream and for other operating reasons. Because of these fluctuating water levels, trout normally don't spawn in such areas. The Federal Government has built National Fish Hatcheries at a number of these dams and they've really paid off. Tailwaters are rich in food and trout stocked in them usually grow very fast. Because of the fast water, tailwater trout are well conditioned fish and they really give you a fight. Trout weighing more than

15 pounds have been caught in the river below here."

"Fifteen pounds," John exclaimed. "I didn't know trout grew that large in civilized waters. I'd like to fish that stream."

"If you do, I'd suggest you use a boat. The water can come up pretty fast when power releases are made from the dam and there is some risk when wading."

No Strike Yet

The two fishermen had been casting and retrieving various lures through the shallow cove, but neither had had a strike. Suddenly, John saw a fish take something from the surface near an old decaying stump. He pointed it out to Bert who told him to try and bounce the floating lure off the stump so it would appear that some small animal had jumped or fallen into the water. John made a near perfect cast, bouncing the lure into the water about 3 feet from where they had seen the fish. "Let it lay there for as long as you can stand it and then give the lure a light twitch," Bert instructed. John watched the motionless lure for about 30 seconds; then his nerves got the best of him and he gave the rod a slight jerk.

Although both anglers had anticipated the strike, they were both startled when it came. A big bass hit the lure so hard that John almost lost his grip on the rod. "Don't let him get into that brush," Bert yelled, frantically backing the boat toward deeper water. The big fish tore across the shallow cove, alternating long runs with crashing leaps. John hung on grimly as the bass threw his weight and power against the drag of the reel. "Don't horse him now," Bert cautioned as the fish began to show signs of tiring. "Try to keep him away from the boat until he's thoroughly played out."

The big fish stubbornly circled the boat, but his strength was just about gone. Finally the fight was over and John eased the fish in toward Bert who had picked up the landing net. Bert held the net under the water until the fish was over it and then lifted him into the boat.

John started moving toward the rear of the boat and Bert had to tell him to sit down before the boat capsized. Bert then reached into the net and got a grip on the fish's lower lip, a hold that keeps bass from wiggling too much. He handed the fish to John and the awe-stricken look on the young man's face was ample reward for the old angler's advice. "I think he'll weigh around 8 pounds, John," he said quietly, trying not to break the spell.

The Thrill

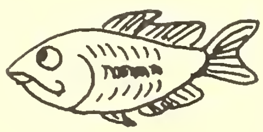
As John began to recover from the thrill of catching the largest fish of the day, he started talking about the battle. Bert interjected comments of his own for a few minutes and then cranked up the outboard and made the long run back to the boat dock.

John took the large bass over to the boat dock operator's weighing station while Bert unloaded the boat, then filled and lit his pipe. The slap of waves created by the boat's wake had died down.

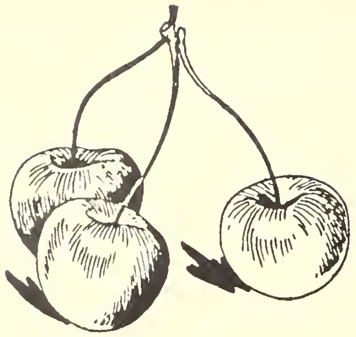
He mused over the day's fishing and the thoughts and ideas he had passed on to the young fisherman. The shortage of fine fishing streams was to be regretted and Bert was sure the growing human population would create even more demands on America's fishing waters.

With reservoirs expected to absorb a large part of this increased fishing pressure, Bert knew that the keys to proper reservoir fishery management, geared to individual reservoirs or regions, would have to be found. He was glad the search was already underway.

With a last look at the lake, Bert turned to join John at the weighing station. He hoped the big bass was heavier than eight pounds. # # #



ABOUT THE AUTHOR. *When he wrote this interesting story on fishing in reservoirs (the article here is condensed for the* Reclamation Era *from pamphlet form), Charles E. Most was employed with the Bureau of Sports Fisheries and Wildlife of the Department of the Interior. He was an Information specialist in Washington, D.C., before moving to his present position as Assistant to the State Director of the Bureau of Land Management for Montana.*



Orchard Trend on the Columbia Basin Project

Growing Cherries, Prunes, Peaches, Pears and Plums

Spring spreads her magic over the fertile lands of the Columbia River Basin, Wash. Nowhere is this truer than on the Royal Slope area where the landscape colors run the gamut from the deep green of winter wheat to the pale lace green of carrot tops.

To complete the spell delicate petals in shades of the palest pink to deep rose burst forth in a number of orchards on the Slope.

One of these orchards, is operated by Kay Newell and her mother, Mrs. L. C. Keylon. This orchard, which is just reaching the productive age, was the dream of Kay's father, L. C. Keylon, a veteran developer of new orchards in the Yakima area.

It was 1961 when Mr. Keylon decided to select a piece of land on the Columbia Basin project on which to start a soft fruit orchard. After a careful study of the Royal Slope area, considering such things as air drainage and soil—key elements in a successful fruit operation—Mr. Keylon concluded that farm unit 263 in Block 87, of the Bureau of Reclamation project area, was the land he wanted. The next step was to purchase the unit and the Keylon-Newell Orchard was fact.

Mr. Keylon's daughter, Kay, a corporation tax consultant at the time, came from California to work with her father. Shortly after the farm was purchased, however, Mr. Keylon died. Kay and her mother, determined to carry out the man's wishes, developed the orchard according to his plans. They now have approximately 90 acres planted to cherries, prunes, peaches, pears, and plums.

First Plantings in 1962

First plantings of some of each fruit were made in 1962, and other plantings followed each year since. The first harvest was from the peaches which produced fruit in just 2 years.

Cherry trees planted at 40-foot intervals cover approximately 50 acres. Miss Newell says that in 1966 they sold their first cherries on June 9 and picked the last of their crop 2 weeks later when other orchardists were just beginning to pick. Early ripening is a prime consideration as the early fruit nearly always commands a higher price on the market. Miss Newell credits ideal location and soil, which her orchard possesses, for the early maturity of her fruit.

Interplanted with cherries are early Italian prunes. Long-range plans are that in 15 or 20 years, when the cherry trees have reached full growth, the prune trees will be removed. In the meantime, the approximately 40 acres of the Keylon-Newell orchard are the largest concentration of prunes on the Columbia Basin project.

The orchard has about 20 acres of pears, mostly Bartlett, and some Anjou. There are also 10 acres of President plums. The President plum is a large dark plum which draws a premium price on the New York market. According to Kay Newell, Mr. Keylon was the first to introduce this variety to the Yakima Valley.

The ranch is maintained with part-time help and the full time services of a superintendent, Harry Idell. He and his wife live on the ranch year round.

The operation and lightened work of the winter months gives Miss Newell and her mother an opportunity to vacation in the South. They have a home near San Diego, Calif., where they usually spend the time between Thanksgiving and Easter.

The Keylon-Newell Orchard is only one of several young orchards now producing soft fruit or apples on the Royal Slope and each year the acreage increases. This has been the trend through-

Kay Newell stands amid flowering peach trees in her orchard on Royal Slope, Wash.

out the Columbia Basin project. According to the 1966 crop census, a total of 1,836 acres were devoted to fruit production. Among the delicious northern varieties reported were apples, apricots, berries, cherries, grapes, peaches, pears, plums, and prunes.

Another Orchard

Zane Newton, whose farm in the Columbia Basin Project's Irrigation Block 79 has 41 acres of young fruit trees. Newton has come up with a solution to the difficult pruning problem which all orchardists face. Knowing he must establish a scientific pruning program for his trees if his young orchard operation is to succeed, Newton began searching for a way to overcome the high costs and scarcity of skilled pruners, which cost about $20 an acre in the project area.

Being a man of imagination and mechanical skill, Newton surveyed his farm for equipment and set about converting several machines that normally lie idle most of the winter. In his farm shop, Newton completed a pruning machine that can be operated from the farm tractor.

The dual purpose piece of equipment is used both for topping the trees and for hedging the sides. Its cutting bar can be adjusted to top anywhere between 6 and 13 feet, and hydraulic lifts change the verticle angle of the sickle for hedging the sides of trees. The sickle bar moves at the rate of 800 strokes per minute, giving a smooth clean cut to the tree branches.

Basically, the machine is made up of a 9-foot sickle bar from the hay mowing machine which is powered by a three-horsepower chain driven gasoline motor from the farm roto-tiller. Three hundred pounds of tractor wheel weights are used as a counterbalance to offset side thrust of the cycle bar. These parts were assembled on an iron framework costing $40 for materials—the only cash outlay for the entire project.

Attaches To Tractor

When needed, the whole machine is attached to the tractor—a job which can be done in less than an hour. Since none of the equipment used in the machine will be needed until summer, pruning and hedging which are usually done in the winter do not interfere with other work.

Newton now has 21 acres of pears and 20 acres of apples which are planted in 20-foot row spacings. He says the apple trees in the hedge row planting will be topped at 8½ feet and the pears at 10½ feet. According to Newton, it is hard to make an estimate of the savings which will result from using the new machine in lieu of hand pruning, but he expects them to be considerable even though some hand pruning will be necessary to properly shape the trees.

Both the apple and pear orchards are young and just beginning to bear fruit, but this progressive grower-inventor feels that it is important to start training the trees early. He believes that if topping and hedging are begun when the trees are young, it is possible to control height and width indefinitely. This, of course, means decreased production costs over the years as labor and equipment costs for followup pruning and harvesting are lower for smaller trees.

Newton seems to have found an answer to one of the basin orchardist's most pressing problems, but he is not stopping there. Now he is turning his thoughts to developing some type of picking platform equipment that will reduce the labor costs for harvesting fruit.

This kind of spirt is common on the Columbia Basin project where progressive, efficient young farmers don't sit back and wait for somebody else to do it, but get busy and find their own solutions, even if it means building a brand new machine.

# # #

Nestmakers in Kansas—
a Reclamation flood control
and irrigation project becomes
a home for waterfowl.

KIRWIN—Where Birds Came to Stay

by NAOMI L. HUNT, Washington, D.C.

Farsighted people, back in the 1930's, envisioned the possibilities of reclaiming flood and drought-ravaged lands of north-central Kansas. Conservation was planned for land, water, and wildlife—through flood protection, water shortage and irrigation. Also in 1952, the Kirwin Unit, Solomon Division of the Bureau of Reclamation's Missouri River Basin project was started.

Kansas lands, watered by Kirwin Reservoir, are highly productive now, and a wide variety of field crops is replacing "soil bank" crops and surplus wheat production. Corn, grain, sorghum, and alfalfa hay flourish on this once arid land.

Today, 3,650 acres of land receive water directly from canals and 7,850 acres are served by lateral branches. The Kirwin National Wildlife Management Area, under the Fish and Wildlife Service, includes reservoir water surface and 10,684 acres of adjacent land.

Old-time conservationists say that 30 years ago, wildfowl were seldom seen nesting in this area. Prolonged droughts and soil-eroding floods had caused a decline in agriculture and natural cover. There was little to attract migratory flocks. However, in nature nothing is so constant as change, and when a more suitable environment was developed, a greater abundance of waterfowl resulted.

Nesting Sites

In a number of years before the Kirwin Reservoir was built, it was found that artificial nesting sites on manmade lakes could successfully replace lost natural sites. Mated pairs of waterfowl, with wings clipped, nested in unlikely locations. Propagated birds attracted wild birds on their northward flight, and new flocks, bounded by instinct to the place of their hatching, returned to perform the rites of spring amid unusual surroundings.

Wildlife managers first experimented with artificial islands of dirt near the shoreline and birds nested on them. Metal frames, wire netting, and other kinds of barricades were used to keep away foxes, raccoons, and skunks. Later, "crib islands" of huge logs were piled up on the ice during winter. When the ice melted in spring, the logs floated on the water and offered nesting places, safe from the "long arms" of predators.

The Canada goose will choose a nesting site only if it affords a 360° angle of vision for at least a quarter of a mile. For this reason, parent birds have found "boxes" placed high above water in isolated trees to be safe nesting sites.

Mallard Nests

Wild mallards, normally ground nesters, will use open or well-lighted nests on or near water, and will also use elevated, boxlike nests in places where artificially propagated birds have been released.

Honkers will nest in washtubs, in treetop platforms, and even in old tractor tires. When one observes the unusual, inconvenient, and dangerous sites sometimes chosen by nesting birds to conduct their family affairs, it appears that almost any facility, however crude, might serve as an inducement to nesting.

The Kirwin Reservoir offers an unequaled opportunity for waterfowl management. Tens of thousands of birds visit the area each year, including such rare species as the whooping crane, white-fronted goose, and white pelican. Rolling prairie lands and croplands surrounding the reservoir provide excellent habitat for prairie chicken, pheasant, and bobwhite quail.

In Dead Trees

Last year, to increase nesting sites for expanding flocks of geese at Kirwin Refuge, nine platforms of baled-hay were placed in dead cottonwood trees left standing when the lake filled. Five of these platforms were used by nesting geese. A wild mallard laid a clutch of nine eggs in an old goose's nest. Even more surprising, it was reported that five blue heron nests and five cormorant nests were built in that same tree, and the parent birds were busily incubating their eggs.

More and more frequently, tiny woodies, greenheads, and honkers tumble from "artificial" nests placed where no natural sites or cover formerly existed. Shoreline vegetation provides protection from inclement weather and predators. Planting and encouraging suitable aquatic plants such as buttonbush, spatterdock, and certain rushes helps supply a variety of insects and seeds for feeding. Loafing sites of anchored rafts and protruding logs further enhance the appeal of this manmade lake for nesting waterfowl.

The attractive total environment maintained at Kirwin Reservoir is resulting in a home for thriving broods of waterfowl species never before known to nest in that area—an invitation for them to stay. # # #

Diversified maternity tree used by several geese, a mallard, five herons and five cormorants.

Drownings Reduce But More Safety is Needed

What has been done about the tragic drownings at water areas where people seek recreational pleasures?

Results of campaigns for water safety over a 6-year period are significant—

For each one-million visitor days at water resource facilities operated by the Bureau of Reclamation in 1961, there were three drownings.

In 1966, only 0.9 people drowned per one million visitor-days.

This is a significant reduction, especially in view of both the booming use of lakes by recreationists and the increasing availability of such bodies of water. Unquestionably, much credit for the improvement results directly from stepped-up safety efforts.

(A visitor-day is defined as a significant time span spent by a visitor during a 24-hour day.)

Although the improvement shows Operation Westwide as succeeding, there are still problems, and the effort to curb drownings is continuing.

Operation Westwide is a plan for supplying ideas, leadership and programs in an attack on the drowning problems. Launched jointly by the Bureau of Reclamation and the American Red Cross in 1957, Reclamation's water safety efforts since that time steadily increased. This includes the construction of several kinds of physical barriers and devices to prevent drownings and aid in rescues around many of its structures. It also includes helping to set up education programs enlisting individual and community support.

The 10 years of effort of this Federal agency in the program is described in an article entitled: "On Purpose—A Better Way to Take Water" in the February 1968 issue of *Reclamation Era.*

(Continued on page 49)

Two close down: Centers in Lewiston, Calif. and McCook, Nebr.

7 Conservation Centers Keep Going

by CHRISTOPHER W. IVUSIC, Washington, D.C.

It was 3 years ago this spring that the Bureau of Reclamation opened its first Job Corps Conservation Centers in California, Colorado and Wyoming. Hundreds of youths, many from the crowded Eastern cities, arrived in Casper, Wyo.; Lewiston and Toyon, Calif.; and Collbran, Colo., to begin the work and training that would give them their "great second chance."

Of these first four Conservation Centers activated in April and May of 1965, one, the Lewiston Center, is now closed due to a cutback in antipoverty funds. The McCook, Nebr., Conservation Center also was shut down last March and put into "mothball" status. But the young men have not been retired, or put away for future use. They have been assigned to other Conservation Centers, where they may continue to learn a trade that will help them find a worthwhile job.

(This effort is now called the Civilian Conservation Center program.)

Like the enrollees themselves, the Bureau's Job Corps Centers are still young. Later this year four more will reach their third birthdays: Arbuckle, in Oklahoma; Columbia Basin in Washington; Marsing in Idaho; and Weber Basin in Utah.

The staff at each of these facilities is improving day-by-day in its knowledge and capability of handling the Nation's school dropouts, society's potential troublemakers and turning them into productive citizens.

As one Job Corps leader said, "Don't underestimate the ability of these kids. They want status. The trouble is no one has ever considered them important enough."

Another, expressing a feeling of fairness and equality that is found in the very core of American life: "It is not at all uncommon to see a young Caucasian man from the deep hills of Tennessee patiently teaching a young Negro lad from the Bronx the art of tying a fly."

The chance to work and live in the great outdoors! Many young men thrill over the West's vastness, beauty, and opportunity. Many youths, however, had not the money to buy a ticket, nor the language or reading ability to find their way West before joining the Job Corps.

These youths are repaying their benefactor for the chance to find a new life in the land of the big sky. The conservation, recreation, and community service projects they have completed or are now working on are worth millions of dollars to the Federal, State, and local governments, whose citizens now have the opportunity to enjoy camping and lakeside facilities built by Job Corps.

By now, probably most people know how the Job Corps program works, of how it takes school dropouts from the ages of 16 to 21 and gives them the equivalent of an eighth grade education while teaching them a useful trade. These trades are their tickets to a better life. But not many Americans are aware of how the Job Corpsman himself works.

Arbuckle, Okla.

At the Arbuckle Center, under the direction of Leroy Anderson, Job Corps youths have learned carpentry, welding, custodial maintenance, landscaping, heavy equipment operation, truck driving, and automotive mechanics. They have a good reading program, with the library in Sulphur at their disposal. Their math program has 13 steps, and their "World of Work" program, used at other Centers, teaches them about jobs and salaries and other vocational factors.

Many at Arbuckle Center have passed the State of Oklahoma's driver examinations, and scores trained to fight forest fires. The area in which they live and work is a friendly one, and citizens of Sulphur and the Job Corpsmen have a mutual respect and confidence. With their knowledge of vo-

Signs for areas near a Reclamation reservoir are being completed here by two youths and Supervisor J. R. Norton at Arbuckle.

cational skills, they have built and assembled hundreds of useful facilities for the recreation and conservation enhancement of Platt National Park and Lake of the Arbuckles.

Casper, Wyo.

In Casper, Wyo., Job Corpsmen started from scratch to learn the use of hand tools, axes, shovels, picks, saws, and then progressed to the use of machinery, from concrete mixer to power shovel, in order to develop the recreation and conservation improvements at Cottonwood Recreation Area at Alcova Lake.

Local and county officials, who are to operate the recreation area, value the Job Corps work at $250,000. The Casper Job Corps youths planted 16,000 potted Ponderosa trees around Alcova, Seminoe, Kortes, and Glendo Reservoir areas, with an additional 25,000 seedlings due to be planted each spring for the next several years. They have aided the Bureau of Land Management, another Federal agency, by clearing fire breaks in mountain forest, and developing springs for livestock.

In April 1967 Casper Job Corpsmen were stranded in a blizzard in Lusk, Wyo. Instead of standing by idly, they volunteered to shovel streets in the business district, and earned the gratitude of the town officials.

The Corpsmen have been held together by an excellent staff, directed by John D. Anderson, selected for its keen interest in youth. In Casper, a Citizens Community Council was organized in July 1966 to maintain close communications and relations between the community and the Job Corps Center.

Collbran, Colo.

At the Collbran Center, directed by Paul Kirt Carpenter, Corpsmen have built a trail for the blind near Independence Pass in Colorado; and a Nature Trail in the Grand Mesa-Uncompahgre National Forest. When youths first went "out in the field" after reporting to the Center in May 1965 they had to learn how to use chainsaws and axes in order to clear the area surrounding Vega Reservoir of many dead aspen trees.

Since, then, Collbran enrollees have become skillful in building a campground for Cottonwood Reservoir No. 1, Grand Mesa, on the Collbran project; performing beautification work along the 50-year-old Highline Canal on the Grand Valley project; and cleaning up the muck and debris following the flooding of irrigation canals on the Paonia project and of the town of Lamar, Colo. Many of the youths at this center have been trained as firefighters, and some have taken a course in wilderness survival, which has taught them rescue operations.

Carpentry on their own recreation facilities is underway here by Weber Basin Corpsmen, from left, Kenneth Ingersoll and Curtis Alfred.

Columbia Basin, Wash.

At the Columbia Basin Center, which unlike the other centers has not been dedicated, Corpsmen have concentrated their conservation and recreation work on developing trails, camps sites, and boating facilities at Potholes Reservoir, Banks Lake, Soda Lake, and Soap Lake on the Columbia Basin project; and in the area of O'Sullivan Dam and in Coulee Dam National Recreation Area.

Over 100 youths, trained in fire suppression, saw action in three Washington forest fires during 1967. The center held its first open house in February 1967, and Director Benjamin Pease and the 184 Corpsmen welcomed visitors from as far away as Henry, Nebr.

Besides their reading and math programs, the Columbia Basin youths have found time to set up basketball and football programs, as well as learning trades such as heavy equipment operation, cooking, general maintenance, painting, concrete laying and form setting, truck operation, television repair, and land management and utilization services.

Marsing, Idaho

The Job Corps Center at Marsing, Idaho, has developed a recreation complex at Lake Lowell, Boise project, that antipoverty officials term "a show window which few Job Corps Centers have." But Corpsmen are also extremely proud of their newspaper, "The Snake River News," which won awards at the Idaho State High School Press Association convention in April 1967.

Marsing Job Corpsmen also are proud of one of their graduates, a Montana youth named Gerald T. Greeno, Jr., who was the only youth from a Department of the Interior-run Job Corps Center selected to receive a $1,000 scholarship to work and study in Washington, D.C.

Since their first Christmas in Marsing, when Corpsmen serenaded several homes in Marsing with Christmas carols, the youths have cultivated a cooperative, healthy attitude to their community neighbors, and have proven that "stopping poverty from spreading from father to son, from mother to daughter" is certainly not a wasteful effort. This center is under the direction of Cleve Bolingbroke.

The youths have earned the respect of the area's citizens by taking part in a search effort for a lost girl, fighting area forest fires, and volunteering to help with the aged and handicapped at a Marsing nursing home.

Toyon, Calif.

At the Toyon, California Center, youths alternate with 1 week of schooling, and 1 of work, as at other centers. They have used their acquired skills to build a nature trail on Whiskeytown Lake, a trail near Brandy Creek, and the Judge Francis Carr Memorial at Whiskeytown Lake, Central Valley project. Center Director Granville W. Tilghman says this conservation work is worth some $215,000. Youths have put in over 4,000 man-hours of fighting fires, planted 40,000 trees, and cleaned up Shasta Union Cemetery and the community cemetery at Redding, their "home" community.

Blood donated by Corpsmen to the Toyon Job Corps blood bank has been used to treat leukemia and to aid members of the Veterans of World War I in Redding. Last October (1967) over 400 youths from Toyon and the now defunct Lewiston Centers took part in a massive search for 3 persons lost in the rugged mountain terrain of Trinity County following the crash of their light plane.

Weber Basin, Utah

The last of the Bureau's Conservation Centers to be activated, and one which already has significant achievements, is the Weber Basin Center in Utah, near Ogden. Youths there under the direction of Richard A. Ulrich completed much valuable conservation and recreation work on the

Weber Basin project, particularly around Willard Bay and Causey Reservoirs. The Center held an open house last December to take note of their 2 years of active operations.

Marked by a staff that demands strict discipline and an abiding respect for property among the Job Corps youths, the Center bested 50 other Conservation Centers throughout the United States with its safety record of having nearly 3 million man-hours of work performed without any lost time. The record won the Center the Department of the Interior's Certificate of Safety Achievement.

Corpsmen themselves, at Weber, won the distinction of being above average nationally in their length of stay at the Center, averaging 6.7 months. They have fought forest fires in Utah and Idaho forests; torn down old, unused houses in Layton, Utah, which will save taxpayers about $5,000; and in their sign shop at the Center have made over 400 signs for recreation areas.

For a number of community service projects at Christmas time and other times during the year, and for maintaining good community relations, the Council of Ogden City, Utah last January passed a resolution commending and congratulating "all those concerned with the Weber Basin Job Corps for providing a new future for some of the underprivileged youth of America." # # #

Drownings Reduce *(Continued from Page 45)*

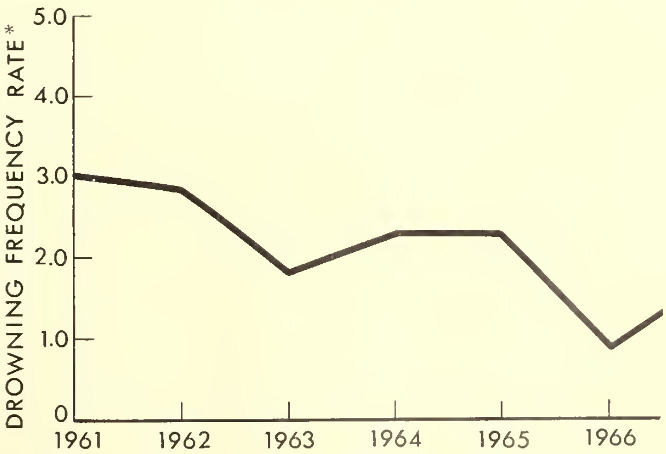
Out of Trend

Although the accompanying chart is helpful in noting a general downward trend of drownings, it is seen that the rate rose in 1964 and 1965. Correction of the rise for the future may require the important application of more public support in certain areas.

The figures were made available from water based recreation facilities which the Bureau of Reclamation built, and are being operated either by Reclamation, State or county governments, or irrigation and water districts. The figures do not include the Reclamation facilities operated for recreational purposes by other agencies of the Federal Government such as the National Park Service or the Forest Service.

Safety programs also are particularly active around canals, the effects of which are not shown above nor in the graph, because they are generally not recreation areas. Persons are not usually supposed to visit or make use of canals for recreation purposes, and no visitor-days are recorded for them. However, the general trend is a reduction in canal drownings from what it was seven years ago: 44 in 1961; 38 in 1962; 29 in 1963; 31 in 1964; 35 in 1965; 27 in 1966; and 24 in 1967.

In both reserviors and canals for 1967, there were 13 drownings on Reclamation facilities operated by irrigation and water districts, 19 on facilities operated by Reclamation, and 37 under State or county operation. Of this total 69 occurrences, 21 were due to swimming accidents, 20 by falling, 13 by boaters, none by fishermen—which is usually the lowest group, but this is the first total zero since at least 1962—and 15 from other water related activities. # # #



Drowning frequency rate is the number of drownings which occur for each 1 million visitor-days in the water recreational area.

Out of the Blue . . .

FLYING FISH

by W. L. (BUD) RUSHO, Region 4 Information Officer

Being a fish in these modern times can get to be pretty exciting—like being flown for a thousand miles or so across the mountains and then being suddenly ejected without a parachute into a strange canyon lake that didn't even exist a year or two earlier.

In the stodgy old days of fish history, a young fingerling could at most count on a tank truck ride, winding up by being gently eased into a lake from along the shore. But that was before the Bureau of Reclamation started putting mammoth reservoirs into inaccessible canyons that hardly anyone had ever seen before. There simply weren't any roads to get fish-bearing trucks to the shorelines.

The answer, of course, was air drops. Once in a while, a fingerling can still manage to get aboard a truck. But more and more the trend is to the massive drops (1 million fish each trip) from low-flying planes.

Trout and Bass

Lake Powell, the serpentine blue lake that winds about 170 miles up the Colorado River from Glen Canyon Dam, has received most of the fish so far. Both rainbow trout and large-mouth black bass have been dropped into the lake repeatedly since 1963, totaling some 12 million trout and 5 million bass. Kamloop trout, kokanee salmon, and black crappie have also been planted in limited numbers as an experiment.

Navajo Lake, which lies across the Colorado-New Mexico border above the Navajo Dam, received 714,000 large-mouth black bass in the spring of 1967.

One of the longest flights was made from the Bureau of Sport Fisheries and Wildlife's fish hatchery at Uvalde, Tex., to Willard Reservoir in northern Utah. About 800,000 bass were carried on this occasion in 1966. Willard Reservoir is the new fresh water lake carved from an arm of the Great Salt Lake to supply irrigation water to lands of the Weber Basin project.

The first fish dropped into Lake Powell were lucky. No predator fish were waiting for them as they plunged into the rising waters. Since then, both the bass and the trout in the lake have grown tremendously—reaching 7 pounds in the case of one rainbow trout. The bass, however, are the predators.

The pilot of the plane dropping fish these days must take care to be over deep water before giving the drop signal. When the fingerling trout hit the warm surface water they will instinctively dive to cooler depths, which also gets them away from the hungry bass.

Tasty Guests

If an error is made and the fish are planted in shallow water, the fingerlings merely become tasty tidbits for the bass. Bass are also cannibalistic, finding their own kind as tasty as the young trout.

As an experiment, the Bureau of Sport Fisheries and Wildlife planted some 6-inch trout in Lake Powell last fall, in the hope that the larger trout can compete more successfully with the bass. (Normally, 2 inches is the planting size.) Recent tests on Lake Mojave, below Hoover Dam, proved that 6-inch trout can withstand being dropped from a plane.

The shock of the violent transplanting apparently wears off rapidly, for the fish find plenty of food in the new lakes and rapidly grow into healthy, adult fish.

For many of them, there is to be one final traumatic experience—that of grabbing the wrong piece of food and finding a hook in it. Another violent transplant, this time into a frying pan.

But after all, like the gingerbread man in Aesop's fable, what is a fish for except to eat?—from the human point of view, that is. # # #

WATER SURPRISES

Thai Village

While exploring subsurface conditions for the giant Pa Mong project in Southeast Asia, a joint Bureau of Reclamation-Thailand drilling crew has inadvertently brought in an artesian well, thereby providing the surprised villagers of Ban Nong Waeng in northeastern Thailand with a welcome supply of clear, pure water for their local "Wat," or temple.

The drill team made its "unimportant" find over a year ago and then moved on, still investigating foundation materials instead of natural fountains.

Recently Mr. Jesd Liongsuthisakon, a Thai geologist working with the Pa Mong USBR project returned to the scene and reported that the villagers had piped the water by gravity to the village and to the Wat, using hollow bamboo as pipe for a conveyance system. The villagers requested that the drill hole not be plugged.

Above. Hollow bamboo pipe carrying water to the temple is shown above the heads of the two men. At right. A fellow can take a refreshing drink at this junction in the pipe.

Mr. Jesd went the villagers one better and recommended to the U.S. Operations Mission in Thailand that they make a small expenditure for pipe and technical assistance to further improve the windfall water supply and the villagers' impromptu delivery system.

The new Ban Nong Waeng water supply is a good small-scale deal, involving a dependable flow of 20 liters a minute—about 5,000 gallons a day.

But the proposed Pa Mong project is immense. It involves the multiple purpose development of the Mekong River, one of the largest in the world, with an average annual discharge of about 400 million acre-feet of water annually. The project envisions development of some 5 million acres of irrigable lands and the production of 20 billion kilowatt-hours of electricity per year at the Pa Mong damsite alone.

Although the 20 liters of water a minute is no match for the development of the vast supplies of the Mekong River, it means something to the villagers of Ban Nong Waeng. JDW

Biggest Earth-Moving Project

Biggest earth-moving project in the history of the Bureau of Reclamation is the San Luis Canal, a part of the massive Central Valley project in California. This 123-mile-long canal involves the excavation of 57 million cubic yards of earth and rock—the equivalent of a trench 16½ feet wide and 10 feet deep stretching from Denver to Boston. When completed, the canal will form one of the largest "manmade rivers" in America.

Also on the Central Valley project, Contra Loma Dam was completed and a banquet held celebrating also the 30th anniversary of the start of construction on Reclamation's CVP.

The Contra Loma Dam will be used to provide greater dependability for the Contra Costa Canal system which supplies water to the Pittsburgh-Antioch area. Water from the canal will be pumped into the reservoir to provide an alternate source of supply should anything go wrong with the system between the intake to the canal and the Antioch area.

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MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award Date	Description of Work or Materials	Contractor's Name and Address	Contract Amount
DS-6564	Colorado River Storage, Colo.	Feb. 12	1 isolated-phase bus structure, two 1,000-kva station-service transformers, and one station service switchgear assembly for generator units 1 and 2 at Morrow Point powerplant, Schedule 1.	Brown Boveri Corp., North Brunswick, N.J.	$139, 310
DS-6582	Columbia Basin Wash.	Jan. 19	12 solid-state and 7 miscellaneous relay cabinet assemblies and 1 lot of transfer trip tone equipment for 230-kv consolidated switchyard, Grand Coulee third powerplant.	Westinghouse Electric Corp., Denver, Colo.	196, 888
DC-6585	Chief Joseph Dam, Wash.	Jan. 8	Construction of Toats Coulee Creek diversion dam and 6.5 miles of Sinlahekin Creek siphon.	A&B Construction Co., Helena, Mont.	1, 205, 781
DS-6588	Columbia Basin, Wash.	do	Furnishing only, 2 armature windings for generator units at Grand Coulee powerplant.	Allis-Chalmers, York, Pa	337, 492
DS-6591	Pacific Northwest-Pacific Southwest Intertie, Ariz.	Mar. 1	Parts and materials for uprating existing 230-kv oil circuit breakers at Hoover powerplant, Metropolitan Water District switchyard. (Negotiated Contract.)	Westinghouse Electric Corp., Denver, Colo.	239, 845
DC-6595	Southern Nevada Water, Nev.	Mar. 26	Construction of River Mountains tunnel, with machine-bored tunnel section, and outlet portal structure.	Utah Construction & Mining Co., San Francisco, Calif.	3, 946, 619
DS-6597	Columbia Basin, Wash.	Feb. 21	Architectural design of Grand Coulee third powerplant, forebay dam and appurtenant structures. (Negotiated Contract.)	Marcel Breuer and Associates, New York, N.Y.	250, 000
DS-6606	Central Valley, Calif	Mar. 26	Three hundred 10-, 12- and 14-inch vertical flowmeters for Westlands Water District distribution system.	Emerson Electric Co., Brooks Instrument Division, Hatfield, Pa.	768, 350
DC-6611	Central Valley, Calif	Mar. 13	Construction of 7-mile San Luis drain, Sta. 6855+00 to 7237+00.	Darkenwald Construction Co., Inc., Sacramento, Calif.	246, 433
100C-969	Columbia Basin, Wash.	Feb. 15	Construction of 11.8 miles of buried pipe drains and 0.04 mile of open ditch drain, Blocks 42 and 43.	Equipco Contractors, Inc., Ephrata, Wash.	225, 918
200C-687	Central Valley, Calif	Jan. 24	Construction of interceptor drain along San Luis canal between Sta. 123+90 and 192+75.	Syblon-Reid Co., Los Banos, Calif.	124, 157
200C-690	Central Valley, Calif	Jan. 11	Gravel surfacing O&M road along Reaches 3 and 4 of San Luis canal.	Huntington Brothers, Napa, Calif.	123, 660
300C-268	Colorado River Front Work and Levee System, Ariz.	Jan. 30	Construction of 3.8 miles and surfacing of 6.4 miles of haul roads for Arizona bankline and Topock Marsh dike and furnishing and placing riprap for bank protection.	Earth Movers, Inc., Oracle, Ariz.	165, 980
300C-271	Colorado River Front Work and Levee System, Ariz.-Calif.	Mar. 8	Construction and surfacing of 4.2 miles of haul roads and bank protection structures, Sta. 280+00 and 449+00.	Lloyd R. Johnson, Rialto, Calif.	321, 753
300C-272	Colorado River Front Work and Levee System, Ariz.	Mar. 22	Furnishing and placing riprap for bank protection, Sta. 1872+50 to 2026+70, and constructing haul roads and tieback levee.	Paul J. Hubbs, dba Paul Hubbs Construction Co., Rialto, Calif.	315, 767

In its assigned function as the Nation's principal nature resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.

U.S. Department of the Interior
Bureau of Reclamation

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Major construction and materials for which bids will be requested through May 1968*

Project	Description of work or material
Central Valley, Calif.	Constructing 33 miles of 12- through 66-in.-diameter pipeline with heads varying from 25 through 100 ft, and 5 reinforced water screen and recirculating structures. Westlands Laterals 19, 21, 23, 25, and 26, near Mendota.
Chief Joseph, Wash.	Constructing the Whitestone Flats and North Branch Pumping Plants of reinforced concrete. The Whitestone Flats Plant will have a capacity of 15.44 cfs with three pumping units and about 950 ft of 27-in. buried discharge line. The North Branch Plant will have a capacity of 8.2 cfs with 2 pumping units and about 115 ft of 18-in. discharge line. At Spectacle Lake, about 7 miles northwest of Ellisford.
Colo. Rvr. Front Work & Levee System, Ariz.-Calif.	Constructing haul roads for access to and along the bank protection structures; clearing and shaping river bank; constructing training structure embankment; quarrying, loading, hauling, and placing rock riprap along bank protection structures. Palo Verde and Cibola Divisions, from 8 to 18 miles south of Blythe, California.
Columbia Basin, Wash.	Initial excavation for Grand Coulee Third Powerplant. Work will consist of common and rock excavation for future Forebay Dam and third powerplant, including cofferdam, service and access roads, parking area, and a concrete anchor block between the existing right powerplant and the future third powerplant (excavated materials are to be transported and placed along the river bank downstream of the dam in river bank stabilization embankments); constructing a concrete anchor block and placing concrete for the foundation of a cellular cofferdam; constructing a steel sheet piling cellular cofferdam, including timber crib retaining walls and a timber crib roadway over the top of the cofferdam; relocating a 12-in. waterline for the city of Coulee Dam; removing existing structures and improvements, including concrete structures, steel transmission line structures, electrical equipment and materials, and all or parts of existing commercial buildings and residential houses and improvements and services thereto; erecting about 3 miles of 115-kv transmission line; and miscellaneous work, including pumping and piping modifications and concrete repairs in left and right powerplants. (Prospective bidders may visit the site after Mar. 1, 1968. Arrangements to visit the site may be made by contacting: Third Powerplant Construction Engineer J. R. Granger, P.O. Box 155, Coulee Dam, Wash. 99116. Telephone: (509) 633-1360.)
Do.	Constructing 9.2 miles of buried pipe drains, Block 20, west of Basin City.
Do.	Constructing about 15 miles of buried pipe drains, Block 46, east of Othello.
Fryingpan-Arkansas, Colo.	Clearing, earthwork, culverts, and gravel surfacing for about 8.2 miles of relocated county road. At Turquoise Lake, about 5 miles west of Leadville.
Gila, Ariz.	Replacing cast-in-place concrete pipelines with 6.8 miles of 25-ft-head, reinforced concrete pressure pipe in sizes from 27- to 48-in. diameter. Extending from Yuma to about 8 miles east of Yuma.
Kendrick, Wyo.	Spillway repairs at Alcova Dam will consist of constructing a 12-in. thick reinforced concrete slab over the existing spillway chute floor; repairing areas of deteriorated concrete in walls, piers, and stilling basin floor; and unwatering and cleaning the stilling basin. About 30 miles southwest of Casper.
MRBP, Kans.	Glen Elder Reservoir clearing will consist of removing and disposing of all buildings and other improvements on 38 farmsteads; demolishing all foundations and concrete or masonry walls; filling in to natural ground surface all basements, storm cellars, cisterns, silos, and caves; capping all wells; removing all existing windmills and pumps; removing about 18.5 miles of fences; and constructing about 7.5 miles of 3-strand barbed-wire fence. Between Downs and Cawker City.
MRBP, Nebr.	Constructing VHF radio facilities will consist of grading and fencing; constructing concrete foundations; and furnishing and erecting radio towers and radio buildings at sites near Orchard, Spalding, and Wolbach. Work near Hartington will consist of grading and fencing the site and furnishing and erecting a radio building.
MRBP, N. Dak.	Furnishing and erecting 5 radio towers, constructing 5 radio huts, and associated earthwork, concrete, and electrical work. Near LaMoure, Bantry, Oakes, McClusky, and Harvey.
Do.	Constructing Killdeer Substation will consist of constructing a 20- by 20-ft concrete masonry service building; concrete foundations; furnishing and erecting steel structures; and grading and fencing the area.
Do.	Constructing Snake Creek Pumping Plant No. 1, a 2,055-cfs, 3-unit plant consisting of a reinforced concrete substructure; a superstructure of structural-steel frame with brick walls; a 170-ft, 2-span access bridge; 2,000 ft of access road; a substation; three 11-ft-diameter, 250-ft-long, steel-lined monolithic concrete discharge pipes; three 90-ft-long transitions; and a reinforced concrete discharge structure. Work will also include installing a 50-ton bridge crane; three hydraulically operated fixed-wheel gates and hoists; three pumping units with electric motors and vertical-shaft mixed-flow pumps. Between Garrison and Coleharbor.
MRBP, Wyo.	Constructing Glendale Substation will consist of constructing a 20- by 20-ft concrete masonry building; concrete foundations; furnishing and erecting steel structures; furnishing and installing one 5,000-kva, 69–4.16/2.4-kv, 3-phase power transformer, one 500-kva voltage regulator, one 4.16-kv circuit breaker, and associated electrical equipment; and grading and fencing the area. Furnishing and installing about 2 miles of single-circuit, 69-kv, wood-pole Cody Tapline. At Cody.
Parker-Davis, Ariz.	Constructing a 500,000-gpd water filtration plant. Parker Powerplant and Community, about 14 miles northeast of Parker.
Pacific Northwest-Pacific Southwest Intertie, Ariz.	Drilling, casing, and developing an 8-in. well, 800 ft in depth to provide domestic water for Liberty Substation. Near Phoenix.
Southern Nevada Water, Nev.	Excavation and constructing intake facilities for Pumping Plant No. 1 will consist of 12,000 cu yd of common excavation and 27,000 cu yd of rock excavation above site elevation, 230 ft of vertical 9- by 20-ft access shaft, 1,500 ft of intake tunnel which may be 13.5-ft-diameter unlined or 11.5-ft-diameter lined, 160 ft of 10- by 22-ft tunnel under bored raises, 20 bored raises of 205-ft length by 48-in. diameter each, 7,500 cu yd of rock excavation for structures and a surge chamber at yard elevation; placement of 500 cu yd of miscellaneous concrete work; and construction of 3,800 ft of access road to the site. 6 miles north of Boulder City.
Do.	Constructing 2.4 miles of 96-in.-diameter reinforced concrete pipe with heads varying from 25 to 550 ft; one 5-million-gallon reinforced concrete earth-covered forebay tank, 198 by 230 ft; 1 reinforced concrete forebay tank, 176 ft in diameter and 19 ft deep, with reinforced concrete roof; 1 reinforced concrete regulating reservoir, 176 ft in diameter and 16 ft deep, with reinforced concrete roof; 1 reinforced concrete surge tank, 28 ft in diameter and 57 ft high, with reinforced concrete roof. About 6 miles north of Boulder City.
Weber Basin, Utah	Constructing a concrete-lined lateral system and a buried pipe drainage system. About 7 miles northwest of Ogden.

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RECLAMATION era

A WATER REVIEW QUARTERLY

August 1968 • Vol. 54, No. 3

RECLAMATION
era

Gordon J. Forsyth, Editor

CONTENTS

COVER. Three underwater inspection men inspecting San Luis Canal where it is 257 feet wide, 36 feet deep.

United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy
Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

COMMISSIONER'S PAGE

Tangible Headway

Consider what has been accomplished by just one Federal agency, the Bureau of Reclamation, during the past 9 years.

Capital investment in dams, canals, powerplants, irrigation systems, and other features totaled $2.9 billion, nearly a third larger than any preceding 9-year period.

Irrigation lands under ditch increased 1.5 million acres, a sizable area renewed by life-giving water from reservoirs, of which there are 50 new ones.

Water for homes, gardens, parks, and industry doubled; as did recreation at the attractive man-made lakes.

Work started on the first large-scale projects utilizing Missouri River water, and on the world's largest powerplant at Grand Coulee Dam.

Bureau scientists, collaborating with the rest of the scientific community, launched a program to milk the rivers of the sky.

All along the line problems loomed up, as they always will in multiple-purpose water developments. But they were overcome and betterments made real by persistence and cooperation.

Moreover, this is a reimbursable program—nearly 90 percent of the construction costs are returned to the Treasury.

It all requires people who are interested in and willing to work cooperatively to develop our God-given natural resources. It also requires plenty of that old, never-say-die western spirit. And it spells, I am pleased to report, tangible headway in the herculean challenge, and keeping an eye to the future of meeting the water requirements for the arid and semiarid West.

Floyd E. Dominy
Commissioner of Reclamation

Central Valley Project and its new features top records as facilities for water control

Goliath CVP Grows, San Luis Dedicated

FROM wherever it is viewed, or with whatever device it is measured, Central Valley Project comes out big—one of the largest such water developments in the world.

The land area it covers, the cost to build the huge features, the size of its dams, canals and powerplants are a few of the items where measurements are startling.

But other Goliath-sized items are its contributions: The amount of irrigation, municipal and industrial water which it delivers, the electrical energy it produces, the income from sale of water and power, or even its affect on the national economy.

The Central Valley Project is located in 28 of the 58 counties in California, and project facilities have been built in 22 counties. With a length of over 400 miles and an average width of 120 miles, the project limits exceed the combined areas of eight Eastern States—Rhode Island, Delaware, Connecticut, New Jersey, Massachusetts, New Hampshire, Vermont, and Maryland.

A great many umbrellas would be seen outdoors if the stored waters of the Central Valley Project could be changed into rainfall. We would have a refreshing one-inch soaker over all of England,

The 103-mile long San Luis Canal carries water for irrigation and municipal use, which previously flowed unused to the ocean.

This shows the 3 ½-mile San Luis Dam with the water level as it was last March.

Scotland, Wales, Ireland, Belgium, Holland, and Denmark. This unusual wetting could also include a good shower over Delaware, Rhode Island, Massachusetts, New Jersey, and Connecticut.

However, in the Central Valley Project, this vast amount of water is moved through big canals. The excavation for the San Luis Canal, which was recently completed, is the equivalent of a trench 16½ feet wide and 10 feet deep, stretching from Denver to Boston. At the head of this canal, which actually is 103 miles long, the water is almost as deep as the Suez Canal and wide enough to pass any vessel that can go through the Panama Canal.

152-Mile Canal

Even longer than the San Luis Canal is the Friant-Kern Canal—152 miles, and the Delta Mendota Canal at 117 miles. Extending from northern California to the southern end of the great CVP, this is the longest major water transport ever accomplished by man.

To get this water into canals and move it by gravity flow, it frequently has to be pumped uphill. The Tracy and Dos Amigos Plants pump it up 197 feet and 125 feet respectively—comparable to the 167 feet that water at Niagara Falls tumbles down.

The largest distribution system which the Bureau of Reclamation has ever built is now under construction. This is the Westlands system with 1,000 miles of pipelines to carry water to about two-thirds million acres.

Three large storage dams play a key role in this water supply project: Shasta is still one of the world's largest. When Trinity Dam was completed it was the world's highest earthfill dam. Now San Luis Dam, completed a year ago, is the largest earthfill dam ever constructed by Reclamation. A walk across the latter amounts to a 3½-mile hike, and it contains about as much fill as 50 of the great pyramids of Egypt.

The harnessing of plunging water for power also is impressive. An example is Shasta Dam, where the water rushes into the powerplant through penstocks 15 feet in diameter—pipes so large a bus could be driven through them. In this and other Central Valley Project powerplants, the 5.7 billion kilowatt hours of electricity produced last year would easily have met all the power needs of a million homes.

Seven Powerplants

Power from the seven plants speeds along 1,200 circuit miles of transmission lines. Last year the power sales were more than $22 million and the water sales about $7 million.

More than 1¼ million acres of land received a supplemental supply of water for irrigation last year and over 40,000 acres received a full supply. For municipal and industrial use, over 35 billion gallons were delivered. To cite only one example of people using a reservoir for recreation, almost 3.4 million visitor days were counted at Folsom Lake in 1967.

The project will have a favorable effect on the national economy. That it will pay for itself in sale of power and water is assured, but that by no means tells the complete economic story. Crops raised on project lands last year had a value of about $600 million. Three years ago the project prevented $85 million in flood damage. Such benefits as the expanding industry made possible by low-cost power, or the power and water delivered to national defense installations, or salinity control in the delta area, will occur year after year. Taken altogether, the Central Valley Project, like the Golden State itself, IS tremendous!—WMD

Sec. Udall Dedicates

Secretary of the Interior Stewart L. Udall dedicated the $312 million joint-use San Luis Unit of the Central Valley Project last April 20. Water control structures in this unit include giant dams, canals, generators, and pumping plants which link together the two joint-use projects of the Bureau of Reclamation and the State of California.

"We have erected a structure," Secretary Udall told the crowd of 3,000 gathered for the ceremonies, "which can proudly bear a sign: Man was Here!"

If such a sign were erected, it would be dwarfed by the sheer bulk of San Luis Dam. This structure is the sixth largest ever built, and has a crest 3½ miles long. San Luis Canal is 103 miles long, 257 feet wide and 36 feet deep, one of the few manmade structures expected to be identifiable by astronauts who reach the moon.

Superlatives must be used to describe other San Luis facilities as well:

San Luis Reservoir is an offstream reservoir so big it can hold enough water to meet every need in the city of New York for an entire year.

10,000 Gallons a Second

San Luis Pumping-Generating Plant contains eight generators with a total capacity of 424,000 kilowatts, greater than the nameplate capacity of the mighty Shasta Powerplant located more than 200 miles north. When reversed, these pump-generator units become huge electric motors each of which can lift 10,000 gallons of water 320 feet in 1 second.

O'Neill Dam is 2½ miles long, 86 feet high, and 420 feet thick.

The six pumping units in the Dos Amigos Pumping Plant lift nearly 100,000 gallons of water each second.

The name Dos Amigos, meaning "two friends," is symbolic of the close cooperation between the State of California and the Federal Government and their unique partnership in the construction and operation of San Luis.

"Nowhere else has the Federal Government cooperated so closely with the government of a State on so large a development," said Secretary Udall.

In 1930's

The Central Valley Project was first authorized as a State project in the 1930's, but when financing was made impossible by the Great Depression, the State called upon the Federal Government for help. In 1937, the Central Valley Project was authorized for construction, operation, and maintenance by the Secretary of the Interior.

The job of building the dams, canals, powerplants, and pumping plants which now make water and power available for use throughout California's great Central Valley thus was given to the Bureau of Reclamation. The investment in the CVP facilities in operation, under construction and authorized to date is more than $2 billion.

The State Water Project, authorized by the California State Legislature in 1960, bears a similar price tag. Construction is expected to be completed on the major features of the State Water Project by 1972. Basically, the plan of the State Water Project, like the Central Valley Project, will take surplus water from northern California streams, which once ran largely unused to the ocean, and put it to beneficial use in the southern part of the State. Much of this water will be for the rapidly growing metropolitan areas from Los Angeles to San Diego.

Contract Efficiencies

Because the Bureau of Reclamation was able to adhere closely to its construction schedule—and because of tight competitive bidding—construction costs of the joint-use facilities were held to $312.5 million, instead of $433 million previously estimated. Since the joint-use cost agreement was 55

Delicious casaba melons being harvested on Reclamation's CVP project near Los Banos, Calif., typify the high value crops in the area.

percent for the State and 45 percent Federal, the savings amounted to $66.3 million for the State and $54.2 million for the Federal Government.

In addition, many more millions of dollars will be saved by both the State and Federal Government through single unit operation and maintenance of the San Luis Unit facilities.

Bureau of Reclamation water flowing through the San Luis Canal will serve 614,000 acres of agricultural land, most of it in the Westlands Water District. Because of the fertile soil, it is expected that the value of the crops grown on the land, will increase by more than $210 million a year.

For every dollar spent in construction, operation, and maintenance of the San Luis Unit, Bureau economists expect return benefits of more than $6.

Other Works

Although the San Luis joint-use facilities are virtually complete, the Bureau still has some $208 million worth of Federal-only facilities to finish as part of the unit. This includes the $193 million Westlands distribution and drainage system, the Pleasant Valley Canal and Pumping Plant and the San Luis Drain.

Secretary Udall indicated in his dedicatory remarks that while the cooperation between the State of California and the Bureau of Reclamation in building San Luis is unique as of today, it may have set a pattern for future major water resource development in California.

"I anticipate there will be other such joint ventures," the Secretary said: "This San Luis Unit we are dedicating is good evidence of what can be done when we share an idea and put our talents and energies constructively to work to make it a reality."

IMPACT IN OTHER STATES FROM SAN LUIS CONSTRUCTION

"Certificates Of Shares In San Luis," which recognize the dollar benefits of several States as a result of construction efforts, were presented at the dedication by Reclamation Commissioner Floyd E. Dominy.

The dollar figures were based on the materials and equipment purchased for the construction of the San Luis Unit by the Bureau of Reclamation and its contractors.

Million-dollar plus "shareholders" are California having $26.4 million in purchases; Illinois with $12.9 million; New York, $9.3 million; Ohio, $6.9 million; Texas, $3.5 million; Wisconsin, $3.3 million; Washington, $2.7 million; Pennsylvania, $2.1 million; Massachusetts, $1.3 million; and Michigan, $1.1 million.

The 11 other States where significant purchases were made include: Oregon, Idaho, Utah, Colorado, Indiana, Kansas, Oklahoma, New Jersey, Maryland, Alabama, and Missouri.

Commissioner Dominy said that continuing nationwide benefits would result from the project's increased production in various forms: More abundant food and fiber because of more irrigation, various water-oriented recreation activities at unit areas, and development of related industries.

# # #

Shaggy, hardy cattle and flavorful meat

Big Blacks from Galloway

by CAROL PROHASKA, Ephrata, Wash.

A HARDY breed of cattle from Scotland, which had fallen into near oblivion, have made an appearance on a ranch in Washington.

These old pioneers are Galloway cattle, and David Holm, who came to the area last September, is raising them for breeding stock on his irrigated farm on the Columbia Basin Project.

The Galloway herd, which was started about 4 years ago on Mr. Holm's ranch at Naselle, Wash., now has two herd bulls, 50 cows, 12 yearling bulls and six new calves. The bulls are Forest Range Zenith Drawl and his offspring Blue Peter of Pacific, both originally from the Forest Range in California owned by George Daniels, one of the foremost breeders of Galloway cattle in this country.

Mr. Holm is already achieving some measure of success as a breeder and one of his entries at the Montana Galloway Association show at Billings in March was selected Reserve Champion Female.

Galloway cattle are natives of Scotland. They were mentioned in writing as early as 1530, when they were referred to as the "big blacks from Galloway, after the province where they were first raised. Since then, the name has been shortened to mere "Galloway."

First Shaggy Breed

The first of the shaggy breed to cross the Atlantic was a herd brought to Ontario, Canada, in 1853. Some of their descendants made their way to the United States in 1866 when Michigan State College purchased a small herd for experimental work.

Partly because of the college's work, the breed gained followers in the Midwest from the turn of the century until the early thirties. However, a series of misfortunes, including a train fire which wiped out the show herd of one of the leading breeders, started them on the decline, and between 1935 and 1950, they were little heard of in the United States.

Standing taller than this hardy Galloway cow and her furry new calf are young farm hands, from left, Mike and Lisa Holm and Kay York.

There were a few cattlemen, particularly in the West, however, who continued to breed the animals because of their great hardiness and suitability to range life. Some of this hardiness derives from an extremely heavy coat of hair which appears in the fall and makes them resistant to extremes in winter weather, and from their strong feet and legs permitting easy foraging where other cattle have problems.

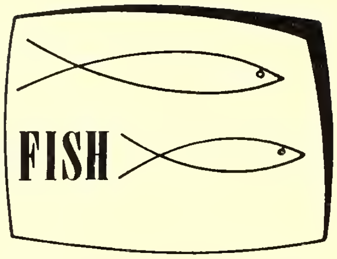
Galloways have been bred over the years for this vigor, and for their fine carcasses which are noted for having less external fat than other breeds and a high percentage of beautifully marbled, flavorful, lean red meat. According to Mr. Holm, these are the qualities which have made them popular for cross breeding.

Heavy Calves

Holm says they produce calves that add more pounds with less cost and care. For instance, although the Galloway is not known as a particularly good milker, they produce exceptionally heavy weaning calves. It is not uncommon for calves from a mature cow to wean out at more than 600 pounds. At 1 year of age, steers often reach the thousand-pound mark.

Now that Galloways are back in the picture, Mr. Holm feels sure they have a bright future. If it is anything like the increase in overall livestock production, which has taken place on the Columbia Basin Project in the last 10 years, this is a safe prediction. # # #

TV Show Stars FISH



THE stars on two television screens located at the Bureau of Reclamation's Red Bluff Diversion Dam across the Sacramento River, Calif., are all fish—salmon, steelhead and rainbow trout, shad, striped bass, squawfish, suckers, and other rough fish, plus the eel-like lamprey.

The Bureau of Sport Fisheries and Wildlife catches their image on the two TV cameras of a closed-circuit system as they pass through a lighted, specially designed viewing chamber at the head of each fish ladder.

Most of these fish are on the way upstream to spawn, but some go back and forth several times through the viewing chamber before completing their final trip.

In the approximately one-fifth of a second an image appears on either screen, a trained observer identifies the species, tallies it on pushbutton counters, and enters the information hour by hour in a log book. The screens are watched 16 hours a day 7 days a week.

A few night counts are planned as the movements of the fish during the hours of darkness are unknown.

The facility is reported as the only one in the world where fish are counted by television. The Bureau contemplates adding a video tape system, hopefully in color, which can be run unattended and viewed the next day. The tape could also be shown to the public in a visitation center planned for the recreation area to be developed at the dam.

Possible Video Taping

An additional feature now in the experimental stage would be the automatic activation of a video tape system as the fish pass the camera. It would turn itself off when the fish passed out of viewing range. The feasibility of such a system has been demonstrated in the laboratory, but a practical field application remains to be worked out. Video tape counting could cut the personnel requirements by more than half.

The televised fish counting at Red Bluff has been so successful that similar TV installations are being considered at several locations on the Columbia and Willamette Rivers.

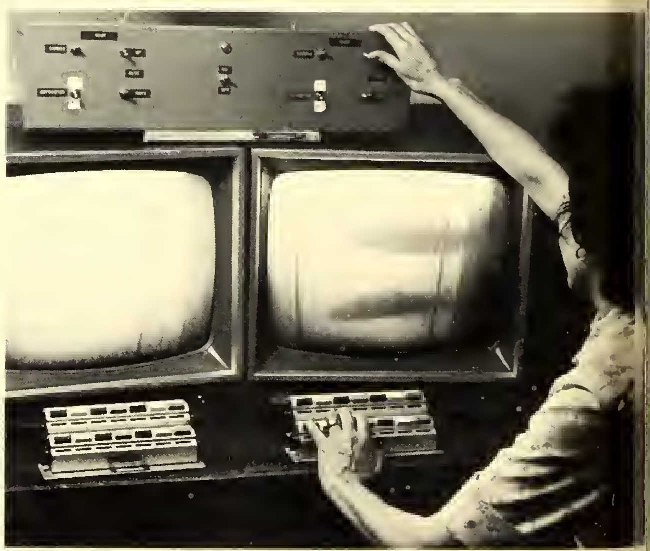
Prior to fish counting by closed circuit television at Red Bluff, fish counters entered one of the small, cold underground counting rooms by climbing down an open hatchway 20 feet to the concrete floor. A 3-foot by 5-foot observation window gave them a view of the 1½-foot-wide channel the fish use to bypass the dam.

Feature attraction on these television screens is the upstream migration of the parade of important commercial and sport fish whose sole interest is reproduction. The viewer's job is to record their passage through the dam.

Between July 1, 1967, and January of this year, 104,000 fish were counted, including 56,000 king salmon, 14,500 steelhead, 1,200 rainbow, 129 shad, 600 squawfish, 4,000 suckers, and 1,000 lampreys. Other fish counted included 15,800 grilse or downstream migrants of various species, 10,000 rough fish and one striped bass.

The fish facilities were designed and built by the Bureau of Reclamation, using criteria developed by the Bureau of Sport Fisheries and Wildlife, and the Bureau of Commercial Fisheries and the California Department of Fish and Game. # # #

Television cameras for the fish counting operation are located at the top of the fish ladders on each end of Red Bluff Diversion Dam on the Sacramento River.



1868 to 1968—A Centennial of Federal Participation in Water Resources Planning

Daring Scientist J. WESLEY POWELL *Spurs Water Saga*

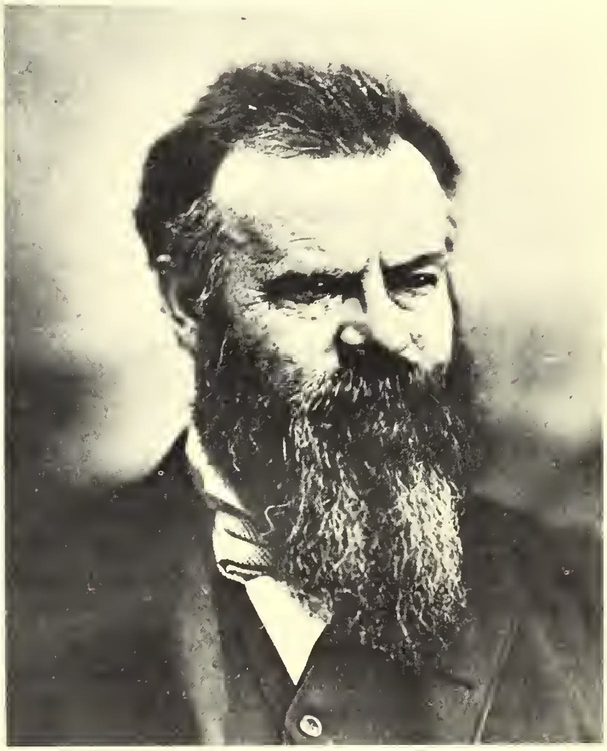
Editor's Note: Last June 11 was a significant legislative milestone in the development of the American West that went virtually ignored by the academic community and the press. It was the centennial of Federal assistance in evaluating the water resources and reclamation potential of river regions, ultimately to be a major factor in the amazing growth of the modern West.

On June 11, 1868, the first President Johnson signed a Congressional Act authorizing the Secretary of War to furnish supplies to the John Wesley Powell expedition to explore the unknown Colorado River in 1868 and 1869. (The first irrigation development to receive funds for construction from the U.S. Government was on the Colorado River Indian reservation, Ariz., in 1867.)

The modest Federal provisioning for Powell made scarcely a dent in the national budget of that time, but it resulted in valuable reports and mapping of the Colorado River and some of its tributaries. It also helped make a nationally known figure out of the self-taught, one-armed soldier-scientist, Major John Wesley Powell, whose centennial as an intrepid explorer will be observed next year. And it was the forerunner of continuing Federal participation in, and assistance to, water resource development for irrigation and other purposes in the arid and semi-arid states of the West.

Some of these still little-known activities and contributions will be reviewed in a special issue of *Reclamation Era* in 1969 as a feature of the Powell Centennial year.

Glimpses of the energy and inquiring mind of Powell, the scientist, are visible in the brief excerpt on these pages from one of the excellent biographies on this great man, *Powell of the Colorado*, by W. C. Darrah. This excerpt recounts Powell's preparations for his first Colorado River expedition, including references to his interest in hydrological and irrigation studies and to the 1868 Congressional Act that helped make his explorations possible.



Major John Wesley Powell

And lest this emphasis on a chapter in Powell's exploring achievements gives an unbalanced picture of one of the greatest scientific minds of 19th century America, we also are reproducing appraisals of Powell by the late Bernard DeVoto and Melville Bell Grosvenor, which should help keep the man and his profund achievements in perspective.

"a great man . . . now we are beginning to understand him"

"His career was an indomitable effort to substitute knowledge for the misconceptions and to get it acted upon. He tried to repair the damage they (the misconceptions) had done to the people and the land and to prevent them from doing further damage. He tried to shape legal and political and social institutions so that they would accord with the necessities of the West. He tried to conserve the West's natural wealth so that it could play to the full its potential part in the future of the United States. He tried to dissipate illusions about the West, to sweep mirage away. He was a great man and a prophet. Long ago he accomplished great things and now we are beginning to understand him . . . even out West."

BERNARD DeVOTO

(Excerpt from the late Mr. DeVoto's introduction to the book entitled: *Beyond the Hundredth Meridian*, by Wallace Stegner, published by Houghton Mifflin Co., Boston, Mass. Reprinted with permission.)

"was in a quest for knowledge—not thrills . . . vision of . . . the need to irrigate"

"Most important of all, Major Powell was in a quest for knowledge—not thrills. A man of ideas, as well as a man of action, he crossed the dry, trackless prairies many times, seeking to learn how man could wrest a living from the 'Great American Desert'. Major Powell was the first to recognize its potential. He also stood alone in his clear vision of the problems that Americans would face—the need to irrigate, for instance—in their inevitable mass migrations into the strange new lands of the frontier.

"Not the least of Major Powell's talents was that of organization. He not only took a key role in the formation of two great government bureaus; he was instrumental in the founding of the National Geographic Society, the Cosmos Club, which he served as first president, and the Geological Society of America."

DR. MELVILLE BELL GROSVENOR
Editor-in-Chief and Chairman of the
Board of the National Geographic Society

1868—ACROSS THE CONTINENTAL DIVIDE

Powell spent the winter of 1867–1868 making preparations for a more ambitious expedition to culminate in a passage of the Grand River to its junction with the Colorado. (Mr Powell had been West and returned. This discussion is on his preparations to actually explore the Colorado River area for the first of two times.)

Barely 2 weeks after returning to Normal (Illinois State University) he appeared before the annual meeting of the board of education and with characteristic enthusiasm stated that his explorations and collecting had been successful beyond expectations. The total expenses amounted to more than $2,100, more than half of which Powell paid himself.

The board, considering its financial support judiciously expended and efficiently used, promptly appropriated $600 to finance a second trip, and promised further aid in the prosecution of the Professor's Rocky Mountain explorations.

The many boxes and parcels of specimens which had been shipped back to the museum were opened and rough sorted, but only a general inventory could be made in the limited time available.

"We confess our surprise at the amount of material there collected. . . . The Professor and four assistants were busy unpacking and preparing the various specimens. . . . Too much credit cannot be given to Professor Powell. He works 16 hours a day and pays his assistants out of his own meager salary." *Daily Pantagraph*, Jan. 25, 1868.

As many duplicates as possible had been collected so that they could be distributed among the various cooperating institutions.

By agreement, any unique specimen of a given kind was retained for the Normal Museum. The field catalogue showed that they had found nine hundred birds, several hundred plants, and thousands of insects. There were smaller series of rocks, minerals, and fossils, and reptiles and skeletons of mammals. It had been a successful summer.

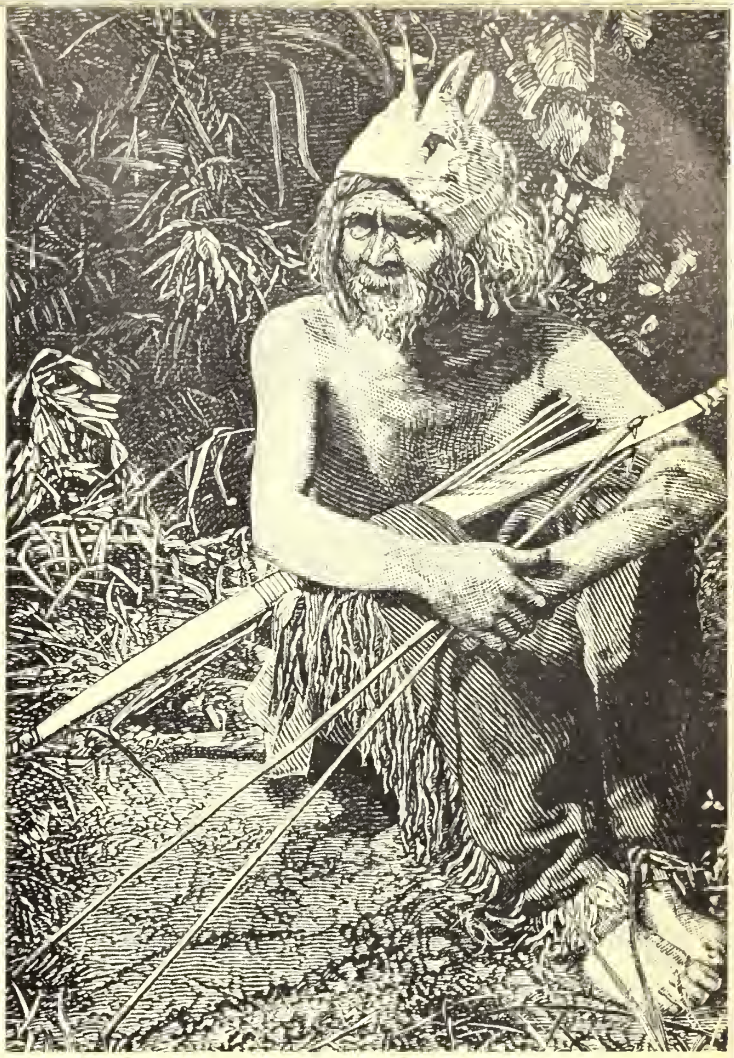
Enthusiastic Lecturing

Powell discharged his obligation to lecture in geology with scintillating enthusiasm. He had large classes of eager students who wanted to hear of his adventures and firsthand observations. His descriptions of Pike's Peak, Mount Lincoln, and the mountain parks were eloquent and vivid. There were few photographs or stereopticon slides in those days, and a lecturer had to rely on words and crayon sketches to capture the imagination of his listeners.

Although Powell enjoyed his lecturing and teaching, apparently he was not satisfied. Perhaps he mused on the profession of teaching students, many of whom would return to their farms or in a few years enter business and give up the intellectual pursuits for which they had come to college—a thought which must arise eternally in the minds of teachers. Never bored, Powell was nevertheless searching passionately for something else to engage his energy.

In March, Major Powell spoke before the annual meeting of the board of the Illinois Industrial University on his Rocky Mountain expedition. The immediate purpose was to appeal for additional aid, but it so happened—probably after preliminary negotiations of which there are no records—that John Wesley Powell "was unanimously elected to the Professorship of Natural History, his term of service to commence at such time as may be agreed upon between himself and the committee on Faculty and Courses of Study." (Ill. Ind. Univ., 1st Ann. Rep. Trust., 1867–1868, p. 127.)

This offer and his tentative acceptance was not announced because the Major was in no position to leave Normal, not only for his prior commitment there, but also because of his advanced plans to return to the mountain country.



Reported to be an Indian acquaintance of Powell.

Consulted With General Grant

In April, Powell went to Washington and consulted General Grant concerning the possibility of drawing rations again from western outposts, this time for a party of 25 men. The General suggested that he put his request in writing and state the purpose of the proposed expedition. The letter, dated April 2, 1868, was a routine request except that in it Powell mentioned two significant ideas:

It is believed that the Grand Canyon of the Colorado will give the best geological section on the continent. . . .

And the other:

Nor is it necessary to plead the value to the War Department of a survey of that wonderful region, inhabited as it is by powerful tribes of Indians that will doubtless become hostile as the prospector and the pioneer encroach upon their hunting grounds.

Grant gave his approval and sent Powell's letter with one of his own to Gen. A. B. Eaton, who was commissary general of subsistence. To their mutual surprise, General Eaton declined to give his consent, assuming that it would be illegal to issue such rations since Powell was neither a civilian employee of the government nor a member of the military service of the United States.

Persevering With Officials

Eaton in turn suggested that Professor Powell obtain the enactment of a law which would accord him the aid that he desired. It was far more difficult to gain congressional approval for a private venture than to obtain the consent of a general or even the Secretary of War to certain privileges at army outposts. Nevertheless, Powell called on Rep-

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resentative Shelby M. Cullom and Senator Lyman Trumbull, both of Illinois, to gain their support.

On April 15th Mr. Cullom introduced in the House a joint resolution which would authorize the Secretary of War to furnish supplies to the Powell expedition. There was little opposition in the House though considerable antagonism was encountered in the Senate. Accordingly, Joseph Henry, secretary of the Smithsonian Institution, wrote a letter of introduction for Powell to James A. Garfield, then Representative from Ohio and a most influential Member of the House.

Secretary Henry explained that no personal or pecuniary interests were involved and that the venture was to be a survey of little-known country in one of the most interesting regions of our continent. He noted that Professor Powell intended to give special attention to the hydrology of the mountain system in relation to agriculture and that the water might be reclaimed for use in agriculture by a judicious system of irrigation founded on a critical knowledge of such hydrology.

Support Came

Although the Smithsonian Institution had no funds to give support to Powell's party, Secretary Henry did provide various scientific instruments. Mr. Garfield was a useful ally and, although a Member of the House, was able to gain the cooperation of various Members of the Senate.

Finally on May 25th, while Powell was anxiously awaiting some answer to his request and was forced to delay final preparations for the expedition, the Senate took up the joint resolution and began the debate. After the usual questions concerning Powell's identity and the objectives of the expedition, the main criticisms of the bill crystallized. The objection was that such a precedent might invite other individuals to seek financial support from the Federal government for projects which were equally deserving and equally costly.

Admittedly, as Mr. Trumbull stated, the area that the professor intended to explore—six or seven hundred miles along the Colorado River—was marked upon the Federal maps as unknown and perhaps never before seen by a civilized man.

Powell's Modest Request

He called to the attention of his colleagues that Powell did not ask for a military guard, such as many other parties had required, because "his knowledge of the Indians and his acquaintance with the country is such that he is willing to take care of himself."

Finally the opposition was reduced to the single objection that the bill was not limited—that the professor by asking a carte blanche might obtain support for a hundred men—whereupon an amendment was offered limiting the supplies to 25 persons. Then, without further restrictive amendments, a vote was taken and the measure passed, 25 to 7, with 20 Senators absent.

Inasmuch as the presidential signature was assured, Powell returned to Normal even though final passage did not take place until President Johnson signed the bill on June 11th.

Powell organized a larger party, again representing different branches of natural science, especially geology, botany, ornithology, and entomology. The Smithsonian Institution had furnished a sextant, barometers and chronometers, and a few other facilities. All personal expenses were to be borne by individual members of the party.

To Illustrate Resources

The main purpose of the expedition was to gather a large collection of specimens representing the different sciences and illustrating the resources of the country. Also, before leaving Illinois it was understood that whatever else might or might not be accomplished, ascent of Long's Peak would be attempted. Repeated efforts to climb this 14,000-foot peak had failed. In fact, some argued that Long's Peak would never be ascended.

The party for the 1868 expedition (boat party actually left Wyoming in 1869) included 21 persons. Two or three were professional biologists; the remainder were amateurs and upperclassmen at Normal and Wesleyan.

Rev. George Smith accompanied the party as an ethnologist and Dr. George Vasey as a botanist. Dr. Henry Wing, a physician going west for his health, and Mr. J B. Taylor were interested amateurs.

Rev. J. W. Healy and Rev. W. H. Daniels, both from Chicago, joined as historians and correspondents to keep the newspapers informed of the progress of the expedition. Mrs. Powel was the only woman member, as in the first trip (not a Colorado River trip). Walter Powell, the Professor's younger brother, was taken along as a zoologist.

The other members were E. D. Poston, John Aiken, Henry Wood, Rhodes C. Allen, W. H.

This is part of the Green River, an October 1956 view, through which Major Powell boated. After this photo the multipurpose Flaming Gorge Dam was built on the site.

Bishop, S. M. Garman, L. W. Keplinger, Lyle Durley, Ned E. Farrell, William Woodward, John Wheeler, and—Chamberlain.

Just Before Leaving

Just before taking leave of the college to begin the trip, Powell appeared before the board on the evening of its spring meeting on June 24th to give an account of his past work and a description of the proposed route of his second expedition. Following a short address he took the members of the board to the museum and explained briefly the many additions to the collections which had been made during the preceding season. Much of the material had not yet been prepared nor classified, but the size of the museum's collections had already been doubled.

The board of education of the State of Illinois appropriated an additional four hundred dollars to purchase instruments which could well be used in the expedition to the Colorado River. This appropriation came too late to benefit the 1868 party, but it did enable Powell to place orders for valuable instruments which could be used in subsequent expeditions.

Before daybreak on Monday, June 29th, the party . . . left Normal for Chicago, arriving there at five o'clock in the morning. Almost the entire day was idled away waiting for a special car on the Chicago and Northwestern Railroad which was to take them to Omaha, Nebr.

After a tedious delay, during which a large banner lettered "Colorado Scientific Exploring Expedition" was nailed to the side of the railroad car, they boarded the train, which pulled out at three o'clock in the afternoon.

WILLIAM CULP DARRAH

(*Powell of the Colorado*, by William Culp Darrah (Princeton University Press, 1951): excerpts from chapter 6.)

PECAN SUCCESS IN NEW MEXICO

Photographed by H. L. Personius, Amarillo, Texas

A variety of equipment is used to hasten the pecan harvest at Stahmann farms near Mesilla, N. Mex.

[1] These farms are irrigated by water from the Bureau of Reclamation's Rio Grande Project. While a farm operator turned water into the lettuce rows last March, nearby pecan trees also got irrigated.

A number of other agricultural products are efficiently produced there by well coordinated irrigation and management methods, some of which are described in former issues of the *Reclamation Era.*

[2] The arm of the treeshaker reaches several feet into the branches, grips one branch at a time, vibrates it, and makes pecans come pelting down.

[3] In areas where the trees are young, cotton is grown in the spaces between rows of trees. To efficiently net the pecans from among such plantings, large deflecting screens mounted at a slant on the side of two tractors, follow beside the tree shaker and bounce the falling pecans away from the rows of cotton. The screens eliminate the step of recovering the pecans by hand from the cotton, which would add considerable time and expense to the harvest operation.

[4] After the trees are cleared and the pecans are on the ground, a sweeper comes along, picks up the pecans as well as leaves and twigs, and puts them to one side in windrows in readiness for the harvester.

[5] Then the harvester enters the grove. This apparatus separates the pecans from the leaves and twigs by forced gravity. Because of their weight the pecans enter a chute and fall into the wire mesh trailer towed behind.

When trailers are full they are unhooked from the tractor, wait for a return trip, then are pulled, one or more at a time, to the grading and storage plant.

At the plant the trailers are raised by elevators about 50 feet where they are overturned, spilling their contents into a hopper.

6 Inside the husking and grading plant, employees at machines with conveyor belts grade the nuts after husks have been removed. The next containers are bins directly below where the pecans fall for the next step.

7 Large plywood boxes, which hold 1,800 pounds of graded shell pecans, are placed in storage rooms with a motorized fork lift prior to shipment to the packaging and processing plant. This warehouse is refrigerated and the nuts stored for prolonged periods are kept at an ideal $-10°$ **F.**

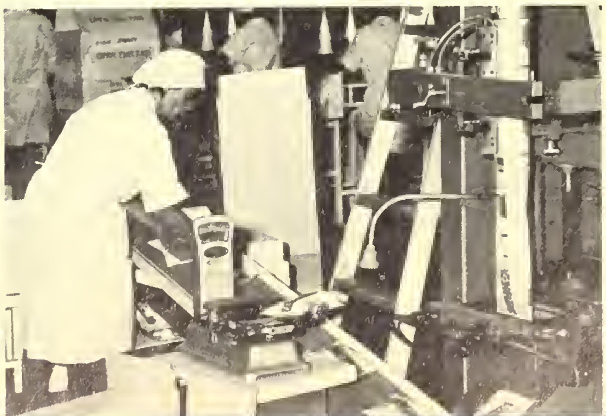
At the packaging and processing plant, are the nut cracker machines. Shells and meats are carried by conveyor to workers upstairs where they are separated by hand. Conveyors then carry meats to hoppers, which will return them downstairs for another grading and packaging.

8 Workers also make final inspection prior to bulk packing, making certain no shell fragments remain.

Highest grade pecan halves are sorted on another conveyor for Christmas package tins. These are the largest and best produced by Stahmann farms.

9 Anoher machine fed from above, drops shelled pecans of preset quantities into endless see-through bags. After the machine cuts, fills, and seals the bags, each one slides onto a belt which travels by a lady who checks their weight on a scale and puts them into cartons.

Stahmann farms consider their pecans to be quality products, and competitive in price. They are purchased from many consumer markets under an attractive trade name. # # #



YOUNG NAVAJOS IN TOWN

by W. L. (BUD) RUSHO,
Information Officer,
Salt Lake City, Utah

VISITORS to Page, Ariz., may be surprised these days to see young, clean-cut Navajo men and women in town, shopping in stores, mowing their lawns, or depositing money in the bank.

While they will also see other Navajos dressed in traditional Indian costume, the presence of the young Navajos is due to the coming of industry to Page. An electronic packaging firm opened its doors last July with an ambitious program designed both to earn a profit for the company and to assist the Indians.

The story of how this industry and the Navajos got together actually began years before, when this land of sun-swept rocks and sand was disturbed by little but the voice of the wind.

A dozen years ago Page, Ariz., did not exist. The low mesa on which the town now sits was visited only by occasional Navajos herding flocks of sheep through the sparse grass. Through the canyon below coursed the muddy, erratic Colorado River, so barren of life that it was called by the biologists an "aquatic desert."

The Bureau of Reclamation and the dam builders arrived in 1956. They were but the vanguard of a change that was to engulf the river, the land, and the Navajos. Glen Canyon Dam became the prime mover, the key facility around which repercussions were spun off like spreading circles from a rock thrown in water.

Page Was Built

First, the town of Page was built as an adjunct to the dam, where workmen could live, shop, and send their children to school. Although construction of the dam is now finished, the town continues to provide accommodations to operators at the power plant, to National Park Service employees, to businessmen, and to the teachers. In the last few years Page has grown as a tourist accommodation center.

The spreading circles of the dam's influence did not stop at the Page city limits. In 1957, nearby Navajos, so long isolated in the most remote part of their reservation, found they had a convenient city at the reservation border.

From the time the first store opened its doors, one could always find Navajos in Page. Some were products of white man's schools and were therefore "educated" in his sense of the term, but others, particularly the older generation, were true unsophisticates characteristic of the entire Navajo Nation 25 years earlier.

Isolated by mountains, canyons, and desert sands, and served by poor or almost nonexistent roads, people from this part of the reservation had lagged in adopting the white man's ways. In the early years of Page, many Navajo wagons were seen in town driven by men whose long black hair, wrapped in white string, protruded from beneath broad black hats.

Use Laundromat

Nowadays at the laundromat, rows of Navajo women, many dressed in full-length velveteen skirts, do the family wash, while nearby their babies sleep peacefully in cradleboards.

For neighboring Navajos, Page is an economic center, a place to purchase almost every necessity or luxury. The Page school system absorbs Navajo youngsters. When an Indian becomes sick he can go to a doctor or to the town's modern hospital.

During construction of the dam, many Navajo men worked for the contractor as highscalers, vibrator operators, and laborers. A point was made to hire an Indian wherever he was qualified for the job. (See article: "American Indians—Helping To Build A Nation," *Reclamation Era*, November 1962.)

Until recently, not many Navajos lived in Page. Since the whole reservation was open to them, they preferred to build a hogan or a small cabin within commuting distance.

Now that the construction work is finished, the future of Navajos in Page looks brighter than ever. This is due to the unusual cooperation between the

Two young Navajo ladies leaving their place of employment after a day's work.

Annie Benallie, right, receptionist at an office in Page, visits her friend May Betoney at her hogan 16 miles away, in the Navajo reservation.

Bureau of Reclamation, the Bureau of Indian Affairs, and the electronic corporation.

Building Available

Early in 1967, the Bureau of Reclamation, with a smaller office staff caused by completion of work at the dam, decided to move to new offices then becoming available in the Glen Canyon Powerplant. The large administration building in the center of Page was made available to the Bureau of Indian Affairs if that agency could find some use for it. Within a few months, the BIA located a client who would rent the building and who would hire Navajos to assemble uncommon devices—electronic modules. The company was located in Anaheim, Calif.

Suddenly, the space age had caught up with this land of stone, sand, and blue sky. Although the idea seems somewhat strange, having Navajos construct electronic parts has worked out well in practice. As Joe Guthrie, Manager of the electronics plant, says:

"Our company came to Page, and the Navajos, as a gesture of altruism and a desire for business success. Not only could we help the Navajos, but they are a stable work force when we have trained them."

The BIA pays for the on-the-job training, which usually requires 36 weeks. Since the work is fairly technical, a minimum of an eighth grade education is required for job applicants. At present, there are 24 Navajos employed, half of them women. Guthrie hopes to expand by stages until he has over 200 employees at the Page plant.

Citizenship

Training is in more than the mechanics of jobs. For instance, once a week Guthrie holds discussions with the Navajos on the responsibilities of citizenship—voting, keeping abreast of current events, and on participation in community affairs.

Jack Foster, left, senior lead man, assists Linda Silver, inspector, with final inspection of an electronic product.

Employees have their own recreation organization, for which they plan and arrange social functions.

Only two of the plant employees still live all year in the traditional Navajo dwellings called hogans. Some of them, however, return to the well-insulated and cool hogans in summer or for brief visits with relatives.

Does all this training in the ways of white men mean that Page Navajos are losing their tribal customs and beliefs?

"Yes, to some extent, Navajo culture is being replaced with white culture," says Guthrie, "but we cannot deny to the Navajos the advantages of a more healthful and higher standard of living."

Years ago, Navajo children who were given a white man's education often grew up to find themselves in a no man's land between two cultures and accepted in neither. Frequently, such a frustrated Navajo would "return to the blanket" and deny all knowledge of the white man's world, or he would seek the oblivion of alcohol.

In the Navajos working at Page, there is evidence that jobs in a typical "white" economy is no longer stigmatized by the problems of the past. One such man, Leo Sheppard, age 23, who hopes to become an architectural draftsman, has parents who live in a hogan, raise sheep for a living, and practice the Navajo religion. Leo states:

Visit Parents

"I take my wife and baby to visit my parents in their hogan quite often. I help with the sheep and do other chores, but my parents are happy to have me working in Page and are encouraging me to improve my education."

Last summer Leo took his parents on their first motorboat ride, a trip up spectacular Lake Powell. "They enjoyed the trip and still talk about it," Leo reports.

Annie Benali, who works for the BIA in Page, lived during her childhood near Glen Canyon. "To get water, we used to take our sheep down steep trails cut into the cliff to the Colorado River," she says. "When I was about 8 years old we moved, and I spent time in other parts of the reservation and in San Francisco. I first saw Page when I returned to this area in 1962. Now we have Lake Powell, new highways, and many tourists. I'm not sure I like all the changes, but I do appreciate the good roads and stores. I am now building a home on a hillside a few miles south of Page."

Joe Guthrie, who is partly credited for new opportunities for Navajos, is willing to meet them half way. He is learning the language of these Indians, one of the most difficult in the world.

"If my Navajo employees are willing to learn my language of electronics, I should be willing to learn theirs," said the Manager.

Guthrie summed up a situation of progress at Glen Canyon Dam, the town of Page, his company, and with the Navajos by repeating the traditional Navajo greeting, *Yá át ééh*, "It is good." (*Photographs by Mel Davis, Salt Lake City, Utah*) # # #

This 6-week-old Navajo baby is right at home in the traditional cradleboard. Pleased parents are Mr. and Mrs. Leo Sheppard who are like others from the reservation with homes in modern transahouses at Page.

A trend, the start of evaluations, and an idea of the potential in underground waterways

Emphasis on Pipe

by GUNNAR N. THORSKY, Chairman of OCCS Committee
(Photo on this page courtesy of United Aircraft Corp.)

IS there an emphasis on putting water conveyance systems into underground pipe?

Both emphasis and a trend are apparent. Just as other technologies change with time, developments in transporting water also change.

Water supplies are becoming more and more valuable, and losses must be reduced in its various distribution systems. To meet the challenges in this field, the Bureau of Reclamation has gradually shifted research emphasis from open conduit systems of carrying water to the idea of pipe, or the closed conduit.

It is evident that significant advances are being made in the manufacture and installation of pipe, and it is undisputed that its use results in smaller water losses than in open facilities. Regarding operation and maintenance, costs on open systems have been increasing.

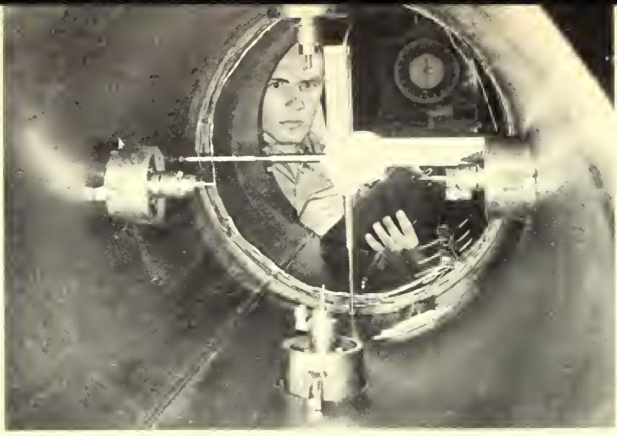
Guiding Reclamation's research and development activities is the Committee on Open and Closed Conduit Systems which was established during the summer of 1967 in the Chief Engineer's office, Denver, Colo. Major role of the committee is coordinating studies on closed conduits, but they will also continue some work in the 21-year-old effort called the Lower Cost Canal Lining Program. It has made many contributions in lowering the cost of canal lining.

Advantages of Pipe

There are many other advantages in using pipe. It provides the possibility of constructing short routes in rough terrain. The pipe system prevents loss of water due to evaporation or phreatophytes. It has minimal seepage loss, fast response to operational demand, virtual immunity to variances in climate, and it requires less right-of-way land.

There is no loss of productive land which would have been occupied by an open system, and soil is not damaged by seepage. Weed cleaning and maintenance costs are lower, and water contamination is more easily avoided than in open canals. With drownings becoming a matter of increasing concern, pipe prevents people and animals from falling into flowing water and losing their lives by drowning as too frequently happens in open canals.

The OCCS Committee is starting to evaluate many such factors as those above in the economic study of pipeline systems. The foremost deterrent to the use of pipe, however, is its higher construction cost, under average conditions, than for an open lined system. Reductions in cost of maintenance, the value of water saved and other factors offset part of these costs, and the committee is coordinating a Bureau attack on this problem.



Reclamation engineer is taking a reading of instruments in an 18-inch steel pipe.

Pipe Testing

Five major types of pipe are being investigated.

One is a half-mile test section of reinforced plastic mortar pressure pipe recently installed on a California project. Being monitored to determine field performance, this adaptation of a product used in the space industry to the water resources field shows much promise. Laboratory tests on commercial samples are also being made on this 15-inch diameter conduit. Other field tests have been initiated to evaluate large diameter pipe of this material, the effects of cold climate, and low covers.

Theoretical behavior of flexible steel type, having diameters of up to 30 inches, is being tested by applying pressures to it in a soil load box in the laboratory. Protective coatings and linings for this product are also being investigated as a continuing research program.

Sulfate resistance tests and soil burial tests are underway on a third kind of pipe. This is a small diameter, corrugated, perforated polyethylene drain type. Further development of filter theory and mechanized construction practices indicate the possibility of tremendous rewards in the field of plastic pipe for drainage. Liaison is being maintained with other agencies involved.

Specifications for reinforced concrete pressure pipe are being updated. These revisions are the result of tests, analysis, Reclamation's experience, and recommendations of industry.

The possibility of extending the size limits of the fifth major pipe—of asbestos cement materials—used on Reclamation projects is being investigated.

Also under study are pipeline joints, bends, valves, and devices and structures for measuring the flow of water.

Industry Helps

While Reclamation's contribution is in testing, evaluating, and analyzing new products, it is dependent upon the development of new materials and products of private industry. In fact most technical achievements in this endeavor will be the result of cooperation between the people whose activities are directly concerned with using water, contractors, manufacturers of material and equipment and Reclamation staff.

How much pipe will be used on future projects of the Bureau of Reclamation? This depends on the amount of funds available; however, the trend is clear.

Some 20,000 miles of drainage pipe in sizes ranging from 4 inches in diameter to 30 inches are estimated to be needed on foreseeable Reclamation projects in the future.

Mainly because of high maintenance costs of open unlined canals, more distribution systems with capacities less than 50 cubic feet per second (c.f.s.) will be constructed in pipe.

And because of safety problems on open canals, it is estimated that 500 miles of existing canals having capacities of 50 c.f.s. or less, 120 miles of 50 to 100 c.f.s., and 270 miles of 100 to 500 c.f.s. should be replaced with pipe.

More in All Sizes

An increasing demand for high value municipal and industrial water, in the West, also points to this need of more conduits in all sizes.

Presently the Bureau has under construction about 150 miles of pressure pipelines for water conveyance. The longest pipe system Reclamation has completed to date is 322 miles of both large and small pipe carrying municipal and industrial water to 11 cities in the Texas Panhandle.

Indicative of the trend towards large sizes is the distribution system for the 600,000-acre Westlands Water District in California, currently under construction. It will ultimately require 1,000 miles of pipeline in diameters up to 84 inches.

Such future projects as the Auburn-Folsom South Unit in California, the Southern Nevada Project near Las Vegas and the Garrison Diversion Unit of the Missouri River Basin Project in North Dakota will have combined requirements of hundreds of miles of pipelines.

Between 1970 and 1975, an estimated total of 2,000 miles of pipelines will be required on Reclamation projects. # # #

Snowmelt Efficiently Caught for Summer Use on Arizona Project

PROP Minute Men and Dams Get Water on Hand


Some reservoir action is evident in this scenic view of Stewart Mountain Dam, Arizona.

by BING BROWN, Senior Press Representative for SRP

THE Salt River Project's balancing act may never make Broadway, but last season's run can only be termed a success.

During the water storage months of January through May, the SRP walked a tightrope of suspense. Decisions on water control to be made would favorably, or unfavorably affect nearly a million people and about 250,000 acres of land in and around Phoenix, Ariz.

Setting the scene for this real-life drama were the record snows which fell across the Project's 13,000-square mile watershed, creating a potential water runoff far in excess of the capacity of the SRP's six storage reservoirs. Features of the SRP have been constructed or rehabilitated by the Bureau of Reclamation.

Suspense was heightened by whatever the unpredictable weather might be—would temperatures climb slowly causing a gradual runoff from the higher altitudes or would they rise rapidly creating a rapid runoff?

The featured performer was the Salt River Project. Job of the SRP staff was one of constant surveillance, seeking the slightest indicator which would foretell what the nature of the runoff would be.

As the water continued to pour into Project lakes, information flowed into Project offices. Around the clock data was received showing the snow depths throughout the watershed, water content of the snow, riverflow rates, lake contents, and weather conditions. Each valuable statistic was checked, evaluated, and incorporated in the ever-changing total picture.

PROP Committee

Overseeing the situation and making recommendations for handling the runoff was the responsibility of the 2-year-old Project Reservoir

Operations Program (PROP) Committee, which is comprised of six SRP specialists in watershed and reservoir operations.

Spotters throughout the watershed reported to the committee each change in the weather, the snow pack, and streamflow in their areas.

"This type of early warning system," explained PROP Committee Chairman Ezra Vines, "gave us a number of hours to verify any trend before the resultant change in runoff reached our lakes.

Salt River Project employees, Ken Vineyard, left, and John Wescott, check weight of snow in tube to determine the quantity of moisture in the snow—this helps the project predict potential runoff.

"For example," he continued, "it takes about 15 hours for water to flow the more than 30 miles from the Verde Valley into Horseshoe Lake—the northernmost reservoir on the Verde River. By spotting a change in the rate of flow of the river as it flowed through the Verde Valley, we had ample time to analyze the situation and make recommendations to the Project's top management.

"The upstream spotters," Vines said, "allowed us to determine if a particular increase was a momentary peak which would have little effect on the storage capacity of our lakes, or if it was the beginning of a real trend toward greater inflow."

Others Helped

In addition to the Project's own spotters, personnel from a number of other agencies, including the U.S. Weather Bureau, the U.S. Forest Service, Arizona State Highway Department, and Arizona Public Service Co., also forwarded information to the committee. In all, the SRP received information from more than 25 separate points on the watershed.

Augmenting the hour-by-hour reports were complete snow surveys made every 2 weeks by the U.S. Soil Conservation Service, and partial surveys made as required.

"The Project's obligation is to try to fill its reservoirs, thereby providing an ample supply of municipal, industrial, and irrigation water for the Valley," declared Vines. "Any unnecessary release of water would be a violation of that responsibility."

The PROP Committee's plan, if making releases from dams became imminent, was to try to make them at a small rate of flow for a relatively long period of time. This would permit more of the water to seep into the ground, recharging the water table.

January Survey

In late January, 1968, the snow survey showed that if average precipitation fell on the watershed through the remainder of the runoff period ending May 31, the Project's lakes would receive about 920,000 acre-feet. However, the Project could only handle, through usage and storage, about 700,000 acre-feet of runoff during the period.

The question came back to weather.

Would precipitation be normal? Considerably less than normal precipitation would be sufficient to fill the reservoir.

Would there be a sudden rise in temperatures, possibly accompanied by warm rains? If there was, much of the expected runoff would occur in a short period of time rather than being spread throughout the runoff period.

Could the weather be predicted accurately enough? Any great variance from predictions could force immediate reevaluation of the PROP Committee's recommendations.

As the days turned into weeks and the weeks into months, the PROP Committee's ability was at work. Six times indicators showed that runoff into the SRP's six reservoirs would make spilling imminent.

Releases of water from project dams soon finds its way into the Arizona Canal, shown above in the city of Scottsdale.

Followed Formula

Six times the PROP Committee, following its carefully established formula and operating procedure recommended the Project's management order small releases of water from the reservoir system. Six times the recommendation was accepted and residents of metropolitan Phoenix were treated to the rare sight of water flowing in the Salt River as it cut through the center of the Valley.

In all, the quantity released totaled slightly more than 100,000 acre-feet. At no time did the rate of release reach 5,000 cubic feet per second. (The river channel has been rated as capable of containing a flow of 82,000 cubic feet per second.) Only roads in the river channel were closed. Those with bridges or culverts remained open at all times.

Careful manipulation continued and on March 22, 1968, the Salt River Project's six reservoirs contained more water than ever before in the Project's history. With 2,024,000 acre-feet in storage, the lakes were at 98.4 percent of their maximum operating capacity.

Climax of Act

Here the Project's delicate balancing act headed for its climax. It could be upset in an instant by the weather.

But the vigilance and planning of the PROP Committee paid off. Once more the spotters reported trends. Once more the committee evaluated data. And again a small flow of water was released from Project reservoirs. Estimates were correct!

On April 16, storage in the reservoirs peaked at an unbelievable 2,043,000 acre-feet—99.33 percent of maximum operating capacity. As the runoff period ended June 1, 1968, the Project would have set still another record. Storage would total about 1,985,000 acre-feet, an excess of 35,000 acre-feet more than ever before on that date.

For the Salt River Project, it was another statistical achievement. For the six members of the PROP Committee it meant even more. During the past 5 months they had given uncounted hours, day and night, to the cooperative project effort. Now they could point with pride to its successful conclusion. # # #

Farmer Builds Rock Picker

You have heard of cottonpickers and peapickers, but awhile back on the Eugene Zeigler, Jr. farm we ran into a rock picker—the first of its kind as far as we can find out.

The rock picker was designed and built by Eugene's dad, Mr. E. W. Zeigler, Sr., who owns an adjoining farm, on the Columbia Basin Project, Wash.

This rock digger and picker consists of two pronged magnesium forks attached to the power boom of a standard backhoe tractor. Each of the forks can be operated separately. After the forks are pushed into the ground beside the rock to be removed the operator closes the forks around the rock and lifts it out of the ground.

Mr. Zeigler says they have removed rocks weighing up to approximately a ton with the machine, but that anything over about 1,500 pounds must be pushed and pried out rather than lifted.

The invention came about because much of the 122 acres in the younger Zeigler's farm was filled with large submerged rocks. Removing them by conventional methods would have been very difficult and costly. Therefore, during the winter Zeigler went to work in his shop and came up with this useful machine, which, incidentally, has a patent pending.

Zeigler's earlier experience as a welder and machinist on heavy construction jobs came to his aid in designing the equipment. The picker now being used is essentially the first model tried, although some reinforcement has been added to make it capable of lifting the larger rocks.

In the hands of a skilled operator (Joe Rogers in the photograph), removing the rocks is done quite speedily. The Zeiglers estimate that in a week and a half they cleared about 30 acres of around 80 percent of the rocks present. After the rocks are laid on the top of the soil with the picker, a truck and loader haul them to a nearby borrow pit.

Mr. Zeigler says the cleared land, which has quite a good loamy soil, will be planted to dry white beans as soon as the clearing is completed. The owner also hopes that some of the land that is now nonirrigable can be reclassified and become eligible for some of the project's irrigation water. # # #

Crew Wins at County Fair

Beautification programs pay big dividends, and if there is doubt in your mind about this, better check with the crew at Black Canyon Dam on Payette River, near Emmett, Idaho.

A few feet of area between the recently constructed warehouse and the power substation fence was a problem of unsightly weeds and rocks—until a retaining wall was built and topsoil hauled in. Then there was the problem of what to grow there.

Because the Bureau of Reclamation takes pride in practical things, it was decided to try tomatoes and watermelons, neither of which are in the surplus crop category. Also with an eye on a higher degree of beautification, gladiola in various colors, marigold, and for sentimental reasons, a little sagebrush were planted.

Not just some, but much of this gardening effort paid off. To prove that their Reclamation products were appreciated at the Gem County Fair, a photographer caught a pose of Wilbur Currier, Powerplant Superintendent, showing off the five ribbons while proudly standing in the lush growth of the garden. First place ribbons were awarded for pear tomato, klondike watermelon, and a pink gladiola. Second place ribbons were awarded for Texas watermelon and a red gladiola. Dividend: $2 prize money.

Oh yes, and one surplus commodity—free gardening advice. # # #

Cleaning Off Algae

Green algae, or microscopic plants, will thrive year-around and form on the banks of some canals when water flow, sunlight and nutrients are sufficient to maintain growth.

Once each year, Pole Hill Canal on the Colorado-Big Thompson Project, Colo., is drained and the accumulation of dead algae is cleaned from the concrete lined slopes. The accumulation on the bank caused a serious cleaning problem prior to the fabrication of a special scraper and a sweeper.

Because the algae scrapes off easier when water-soaked, the cleaning operation should begin as soon as possible after the canal is drained. The disk scraper consists of 12 blades in two rows of six each of the type used on a farm disk machine. Each of these are attached to a rectangular metal frame with a bolt and coil spring. The scraper does its work when lowered over the side of the canal with a chain, then drawn back and forth by a pickup truck on the top of the bank.

After scraping, it usually takes about 24 hours for that portion of the algae still adhering to the concrete to dry sufficiently for brushing with the sweeper. The sweeper consists of a row of 14 wire brushes, size 7¼ inch, and a row of six fiber bristle stable type brooms, size 16 inch, mounted to a wooden frame. # # #

Top Photo. The scraper does its work when pulled along the side of the canal. The next step is brushing as seen in the center photo. At bottom is a before and after scene.

Bureau of Reclamation
Water Headquarters Offices

COMMISSIONER'S OFFICE:
C St. between 18th & 19th Sts. NW.
Washington, D.C. 20240

CHIEF ENGINEER'S OFFICE:
Bldg. 67, Denver Federal Center
Denver, Colo. 80225

IDAHO (Except SE tip)
WASHINGTON
MONTANA (NW corner)
OREGON (Except Southern wedge)
(Region 1)
Fairgrounds, Fairview Ave. & Orchard St.
Boise, Idaho 83707

CALIFORNIA (Northern & Central)
NEVADA (Northern & Central)
OREGON (Southern wedge)
(Region 2)
P.O. Box 15011, 2929 Fulton Ave.
Sacramento, Calif. 95813

NEVADA (Southern)
CALIFORNIA (Southern)
ARIZONA (Except NE tip)
UTAH (Sw tip)
(Region 3)
P.O. Box 427
Boulder City, Nev. 89005

UTAH (except SW tip)
COLORADO (Western)
NEW MEXICO (NW tip)
WYOMING (SW tip)
IDAHO (SE tip)
(Region 4)
P.O. Box 11568
125 S. State St.
Salt Lake City, Utah 84111

TEXAS
OKLAHOMA
KANSAS (Southern half)
NEW MEXICO (Except W third)
COLORADO (Southern wedge)
(Region 5)
P.O. Box 1609
7th & Taylor
Amarillo, Tex. 79105

MONTANA (Except NW corner)
NORTH DAKOTA
SOUTH DAKOTA
WYOMING (Northern)
(Region 6)
P.O. Box 2553
316 N. 26th St.
Billings, Mont. 59103

COLORADO (Eastern)
NEBRASKA
KANSAS (Northern)
WYOMING (SE)
(Region 7)
Bldg. 20, Denver Federal Center
Denver, Colo. 80225

MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6538	Nam Mun and Nam Chi, Thailand.	May 15	Feasibility investigations, studies, designs cost estimates and reports. (Negotiated Contract)	Harza Engineering Co. Chicago, Ill.	$971,211 and equivalent of $111,860 in Thai currency.
DS-6596	Southern Nevada Water, Nev.	Apr. 10	Eleven motor-driven turbine-type pumping units for pumping plant No. 1, Schedule 1.	Layne and Bowler, Inc. Memphis, Tenn.	$755,383.
DS-6596	Southern Nevada Water, Nev.	Apr. 10	Eleven cone valves and one valve operating system for pumping plant No. 1, Schedule 2.	Guy F. Atkinson Co., Willamette Iron and Steel Co. and Bingham Pump Co. Divisions Portland, Ore.	$232,724.
DC-6600	Central Valley, Calif.	Apr. 25	Construction of Pleasant Valley pumping plant, discharge line and switchyard.	C. R. Fedrick, Inc., and M. M. Sundt Construction Co. Novato, Calif.	$5,231,253.
DC-6605	do	Apr. 2	Replacement of control equipment for Contra Costa canal pumping plants No. 1, 2, 3 and 4, and construction of switchyards No. 1 and 4.	City Electric, Inc. dba Trans-Pacific Electric, Inc. Menlo Park, Calif.	$279,371.
DC-6612	Central Valley, Calif.	Apr. 26	Construction of 6.3 miles of concrete lined Pleasant Valley canal, 1.6 miles of intake channel and structures.	Clyde W. Wood & Sons, Inc. Burbank, Calif.	$2,819,186.
DC-6613	Missouri River Basin, S. Dak.-Neb.	Apr. 5	Construction of 118 miles of Fort Thompson-Grand Island 345-kv transmission line, Section 1, Parts A and B.	Commonwealth Electric Co. and Dominion Construction Co. Lincoln, Neb.	$5,337,924.
DC-6619	Central Valley, Calif.	Apr. 23	Construction of a fish trap and modifications for Red Bluff diversion dam.	S & Q Construction Co. South San Francisco, Calif.	$360,127.
DS-6620	Missouri River Basin, S. Dak.-Nebr.	Apr. 26	Four 345-kv autotransformers for Fort Thompson, stage 05, and Grand Island, stage 01, substations, Schedule 1.	Hitachi New York, Ltd. New York, N.Y.	$925,664.
DS-6620	do	Apr. 26	Two 50,000-kva shut reactors for Fort Thompson, stage 05, and Grand Island, stage 01, substations, Schedule 2.	Federal Pacific Electric Co. Newark, N.J.	$279,180.
DS-6621	Missouri River Basin, S. Dak.-Nebr.	Apr. 30	Two 230-kv and three 345-kv power circuit breakers for Fort Thompson, stage 05, and Grand Island, stage 01, substations.	Ets Merlin & Gerin. Grenoble, France.	$496,500.
DC-6623	Chief Joseph Dam, Wash.	Apr. 22	Replacement of spillway and modification of crest of Conconully dam.	Equipco Contractors, Inc. Ephrata, Wash.	$533,057.
DC-6624	Columbia Basin, Wash.	Apr. 22	Construction of 26.8 miles of earth-lined laterals and wasteway and 3.6 miles of unlined wasteways and drain, Block 25 laterals, Wahluke Branch canal and laterals and Wahatis wasteway.	Equipco Contractors, Inc. Ephrata, Wash.	$1,270,366.
DS-6625	Colorado River Storage, Ariz.	May 10	Four 345-kv series capacitor banks for Glen Canyon-Pinnacle Peak transmission line.	Westinghouse Electric Corp. Denver, Colo.	$1,661,768.
DC-6627	Central Valley, Calif.	June 3	Construction of 5.6 miles of pipelines for Bella Vista Water District.	Glen W. Shook, Inc. Redding, Calif.	$240,424.
DC-6628	Gila, Ariz.	May 6	Construction of pipelines for South Gila Valley unit distribution system, Schedule 4.	M. M. Sundt Construction Co. Tucson, Ariz.	$757,965.
DS-6630	San Juan-Chama, N. Mex.	May 6	Four 4-foot by 6-foot outlet gates for outlet works at Heron dam.	Steward Machine Co., Inc. Birmingham, Ala.	$210.876.
DS-6631	Central Valley, Calif.	Apr. 2	Furnishing and installing one new armature winding for existing generator unit 3 at Folsom powerplant.	Westinghouse Electric Corp. Denver, Colo.	$192,588.
DS-6632	Central Valley, Calif.	May 24	Furnishing and installing one new armature winding for existing generator unit 5 at Shasta powerplant.	National Electric Co., Division of McGraw-Edison Co., Columbus, Ohio.	$230,573.
DC-6633	Chief Joseph Dam, Wash.	May 13	Enlargement of Spectacle Lake dike and outlet works.	A & B Construction Co. Helena, Mont.	$280,512.
DC-6634	Missouri River Basin, Nebr.	May 3	Construction of 124.3 miles of Fort Thompson-Grand Island 345-kv transmission line, section 2.	Commonwealth Electric Co. and Dominion Construction Co. Lincoln, Nebr.	$6,067,578.
DS-6637	Southern Nevada Water, Nev.	June 7	Twenty-three motor driven, centrifugal-type pumping units, 23 cone valves and four valve operating systems for pumping plants No. 1A, 2A, 4 and 5.	Hitachi New York, Ltd., New York, N. Y.	$920,300.
DS-6642	Columbia Basin, Wash.	June 12	One 230-kv power transformer for Grand Coulee powerplant.	Federal Pacific Electric Co. Newark, N. J.	$112,085.
DS-6647	Columbia Basin, Wash.	June 7	Repair of two power transformers for Grand Coulee powerplant.	Westinghouse Electric Corp. Denver, Colo.	$147,714.
DC-6648	Kendrick, Wyo.	June 20	Repairs to Alcova dam spillway	Etlin Peterson Construction Co. Mills, Wyo.	$320,547.
100C-977	Columbia Basin, Wash.	Apr. 1	Construction of 17.4 miles of buried pipe drains for D77-78, -78-1 and -114 drain systems, and D77-114-1 and -114-2 drains, Block 77.	M & J, Inc., Moses Lake, Wash.	$328, 852.
100C-979	Columbia Basin, Wash.	Apr. 4	Construction of 10.5 miles of buried pipe drains for D19-10 and D19-133A drain systems, Block 19.	Digger Dan and Sons and Pfaff Brothers, Inc., Moses Lake, Wash.	$138,183.
100C-987	Columbia Basin, Wash.	Apr. 17	Construction of 9.2 miles of buried pipe drains for for D20-114 drain system, Block 20.	Equipco Contractors, Inc., Ephrata, Wash.	$162,535.
100C-989	Columbia Basin, Wash.	Apr. 26	Construction of 15.5 miles of buried pipo drains for D46-24, -36 and -41 drain systems, Blocks 45 and 46.	Equipco Contractors, Inc., Ephrata, Wash.	$264,224.
200C-712	Central Valley, Calif.	June 6	Surfacing of O&M roads along San Luis canal, Reaches 3, 4 and 5.	Huntington Brothers, Napa, Calif.	$699,162.
300C-275	Colorado River Front Work and Levee System, Calif.	June 21	Constructing and surfacing 4 miles of haul roads, surfacing existing roads, and placing riprap for bank protection for Palo Verde and Cibola divisions.	C. W. Bailey, dba Bailey Engineering, Marysville, Calif.	$179,906.
400C-365	Colorado River Storage, Ariz.	Apr. 26	Extension of Glen Canyon airport runway	Nielsons, Inc., Doloras, Colo.	$229,229.
400C-372	Weber Basin, Utah	June 3	Construction of 4.3 miles of closed pipe and .3 mile of open drains for Farmington area "A" drains.	R. C. Tolman, Centerville, Utah.	$146,088.
500C-263	Pecos River Basin Water Salvage, N.M.	Apr. 8	Clearing 630 acres of phreatophytes from Pecos River flood plain, Lake Arthur area.	Bates, Inc., Albuquerque, N.Mex.	$187,600.
603C-73	Missouri River Basin, N. Dak.	Apr. 22	Construction of office building, shop and warehouse building, garage, and oil house for O&M headquarters.	Scherr Construction Co., Valley City, N. Dak.	$214,904.

U. S. GOVERNMENT PRINTING OFFICE : 1968 O - 308-859

RECENT BID REQUESTS

Project	Description of work or material
Central Utah, Utah.	Constructing two dams and one dike, all earthfill structures. North Dam will be about 53 ft high, 475 ft long, and will contain about 107,000 cu yd of material. South Dam will be about 69 ft high, 600 ft long, and will contain about 147,000 cu yd of material. The dike will be about 11 ft high, 790 ft long, and will contain about 8,800 cu yd of material. Appurtenant features will include a combined spillway and outlet works structure, a feeder canal, and an access road. The combined spillway and outlet works structure will consist of a 3-ft inside-diameter pressure conduit, a combined spillway and gate structure, a downstream 4-ft modified horseshoe conduit, a stilling basin, and a Parshall flume. The feeder canal will consist of a turnout structure, about 1,700 ft of open canal section, about 450 ft of 36-in. precast concrete pipe chute, and a stilling basin structure. The access road will be about 2,700 ft long. West of Fort Duchesne.
Central Valley, Calif.	Constructing about 17 miles of earth dikes with an average height of 5 to 6 ft throughout the 1,300-acre reservoir area; and earthwork and structures for about 23 miles of concrete-lined open drain having a bottom width of 8 ft and a lining height of 10 ft. Kesterson Reservoir, First Stage, and San Luis Drain to Mile 105. Five miles east of Gustine to 2.5 miles southwest of Dos Palos.
Do	Extending Tehama-Colusa Canal section about 760 ft; constructing about 950 ft of 18.5 ft-diameter siphon under Thomes Creek; and constructing 6,000 ft of dike along Thomes Creek. About 15 miles south of Red Bluff.
Do	Constructing 41.4 miles of 12- through 96-in.-diameter pipeline with heads varying from 25 through 125 ft; four slide gate structures; and two reinforced water screen and recirculating structures. Westlands Laterals 27 and 28, near Mendota.
Do	Clearing, earthwork, culverts, fencing, guardrail, and bituminous surfacing for about 2.8 miles of 40-ft-wide relocated county road. Auburn-Foresthill Road, about 1 mile north of Auburn.
Do	Preconsolidating 3.5 miles of lateral and two pumping plant sites. The preconsolidation will be done by sprinkling, ponding, and ponding with infiltration wells. Westlands Water District, about 12 miles south and five miles west of Mendota.
Do	Constructing 19 pipe crossings for Interstate Highway No. 5 which will consist of 6,200 ft of 18- through 60-in.-diameter pipe for 300 ft of head. On Interstate Highway No. 5, from 10 to 60 miles northwest of Kettleman City.
Chief Joseph, Wash.	Construction two small pumping plants of reinforced concrete. The Whitestone Flats Plant will have a capacity of 17 cfs with three pumping units and about 850 ft of 27-in. buried discharge line. The North Branch Plant will have a capacity of 9 cfs with two pumping units and about 105 ft of 18-in. discharge line. At Spectacle Lake, about 7 miles northwest of Ellisford.
Columbia Basin, Wash. (Third Coulee).	Constructing a 200- by 45-ft structural-steel framed building with a garden level reinforced concrete basement. Building exterior walls are to be brick with a window wall and insulated panel system covered with aluminum sun screen. Work will include electrical, plumbing, heating, and air-conditioning installations. About 1 mile east of Grand Coulee.
Do	Constructing a 58- by 85-ft reinforced concrete visitor center building. The building will be partially buried in a hillside with earth backfill on the roof and on three sides. Work will include electrical, plumbing, heating, and air-conditioning installations. Adjacent to the left powerplant road at Coulee Dam.
Columbia Basin, Wash.	Placing about 7.5 miles of concrete lining and buried pipe in the W3F lateral. Block 70, east of Soap Lake.
Do	Constructing about 30 miles of buried pipe drain. Block 46, east of Othello.
Do	Constructing about 22 miles of buried pipe drain. Blocks 18 and 47, west of Connell and east of Othello.
Do	Constructing about 19 miles of buried pipe drains and a pumping plant. Block 75, south of Quincy.
Do	Constructing about 15.1 miles of buried pipe drains. Blocks 20 and 85, west of Basin City and North of Royal City.
Do	Three single-phase, 400-mva, 500/230-kv autotransformers for Grand Coulee Third Powerplant.
MRBP, No. Dakota.	Constructing Killdeer Substation will consist of constructing a 20- by 20-ft concrete masonry service building; concrete foundations; furnishing and erecting steel structures; furnishing and installing one 110/41.8-kv, 3-phase power transformer, two 46-kv oil circuit breakers, two 115-kv interrupter switches, one 115-kv horn gap switch, eight 46-kv disconnecting switches, and associated electrical equipment; and grading and fencing the area.
MRBP, Iowa	Stages 04 and 05 additions to the Creston Substation will consist of constructing concrete foundations; furnishing and erecting steel structures; furnishing and installing one 161/69-kv, 50,000-kva autotransformer, one 16,200-kvar shunt capacitor bank, one 161-kv and three 69-kv power circuit breakers, and associated electrical equipment, major items of which will be Government furnished; and grading and fencing the extension to the existing substation.
No. Platte, Wyo	Two 5,000-kva, 3-phase, 34.4/2.3-kv transformers for Guernsey Powerplant.
Parker-Davis, Calif.	Constructing about 65 miles of single-circuit, 3-phase, 161-kv Parker-Blythe Transmission Line will consist of clearing right-of-way; furnishing and constructing wood-pole structures; and furnishing and stringing three 954 MCM, ACSR conductors and two overhead ground wires. Extending from Parker to Blythe.
Pecos River Basin Water Salvage, New Mexico.	Clearing phreatophytes along the Pecos River Basin in the Avalon area from McMillan Dam to the Pecos River flume. Near Carlsbad.
Southern Nevada Water, Nevada.	Constructing Southern Nevada Pumping Plant No. 1, a 600-cfs, 20-unit plant consisting of a reinforced concrete substructure; a superstructure of precast concrete wall panels and columns and prestressed concrete roof beams; one 45-ft-diameter, 46-ft-high reinforced concrete surge tank; one reinforced concrete anchor; one encased special bend; one 120-in. flowmeter; and 3,225 ft of 120-in.-diameter monolithic or precast concrete pipe with heads varying from 50 to 125 ft; and a switchyard. Work will also include installing 10 motor-driven, vertical-shaft, two-stage, turbine-type pumping units, and 10 hydraulic cylinder-operated, 24-in.-diameter cone valves; and furnishing and installing a 40-ton crane. Six miles north of Boulder City.
Do	Constructing Southern Nevada Pumping Plant No. 1A, a 315-cfs, 10-unit plant consisting of a reinforced concrete substructure; a superstructure of precast concrete wall panels and columns and prestressed concrete roof beams; and a switchyard. Work will also include installing 10 pumping units with electric motors and horizontal, centrifugal-type pumps. Constructing a 5-million-gallon, reinforced concrete, two-compartment forebay. The forebay is to be trapezoidal in cross section with reinforced concrete slab cover supported on circular columns. It will have a sand and gravel underdrain system, an emergency wasteway which will spill into a 54-in.-diameter reinforced concrete pipe running about 0.25 mile to Lake Mead. Attached to one end of the forebay will be reinforced concrete inlet and outlet structures and a wash water pump structure with two 96- by 120-in., two 120- by 96-in., one 108- by 108-in., and one-96- by 96-in. cast iron slide gates with motor-operated lifts. Six miles north of Boulder City.
Do	Constructing 7.2 miles of 36-in.-diameter, reinforced concrete pipe with heads varying from 50 to 575 ft; 0.4 mile of 27-in.-diameter, reinforced concrete pipe with heads varying from 50 to 175 ft; reinforced concrete Surge Tank No. 5, 12 ft in diameter and 92 ft high; reinforced concrete Surge Tank No. 7, 10 ft in diameter and 39 ft high; and air valves, blowoffs, anchors, and manholes. Boulder City Lateral, from 6 miles north of Boulder City to vicinity of the water treatment plant in Boulder City.
Do	Three horizontal, double-section, side-inlet, centrifugal pumping units with a capacity of 5 cfs at a total head of 80 ft for Pumping Plant No. 7.
Do	Three horizontal, double-section, side-inlet, centrifugal pumping units with a capacity of 9.6 cfs at a total head of 190 ft; and three 12-in. hydraulic cylinder-operated cone valves with valve-operating system for Pumping Plant No. 3. Three horizontal, double-section, side-inlet, centrifugal pumping units with a capacity of 34.5 cfs at a total head of 175 ft; and three 20-in. hydraulic cylinder-operated cone valves with valve-operating system for Pumping Plant No. 6.
Yuma, Calif	Earthwork and structures for about 5,800 ft of concrete-lined Seminole Lateral. About 2 miles northwest of Yuma.

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November 1968

RECLAMATION era

A WATER REVIEW QUARTERLY

November 1968 • Vol. 54, No. 4

RECLAMATION
era

Gordon J. Forsyth, Editor

CONTENTS

COVER. If the fishhook is as loaded as the determined poses of Mac, with bread wrapper around broken foot, and David, who peers 'neath nose-low hat—Treadway brothers of Gunnison, Colo.—even a wary Blue Mesa lake fish might lose his cool under such persuasive powers.

United States Department of the Interior
Stewart L. Udall, Secretary

Bureau of Reclamation, Floyd E. Dominy
Commissioner

Issued quarterly by the Bureau of Reclamation, United States Department of the Interior, Washington, D.C. 20240. Use of funds for printing this publication approved by the Director of the Bureau of the Budget, January 31, 1966.

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 30 cents (single copy). Subscription price: $1.00 per year (25 cents additional for foreign mailing).

COMMISSIONER'S PAGE

No Ghettos

Over a million rural Americans a year—though little prepared for the change—migrate to our already congested cities to add to the problems of inner city decay.

Rural America also reveals a strong appeal. A recent poll showed a marked increase over just the last two years in the number of urbanites and suburbanites who would prefer to live in small towns or on farms. Because this reverse migration is productive and relieves troubled conditions, its results are noteworthy.

Some of these moves have been in areas of western multipurpose water projects developed by the Bureau of Reclamation. Water control features and wise use of western rivers have paved the way for stable economies and attractive rural and small town living in the Reclamation sectors of the West.

These projects create personal cooperative relationships between people, the land, the community, churches, schools and business enterprises. By their very nature, growth of smaller communities and family-sized farms are encouraged.

Reclamation projects have meant a steady source of irrigation water which allows farmers to diversify their operation and take full advantage of their land. The projects have meant new water and power to support new industries and new towns. They have created scenic lakes which are popular for a variety of recreation uses and have encouraged tourist travel and use.

There are no depressed areas, no ghettos, no decaying inner cities on Reclamation projects. But there are many kinds of opportunities for those who seek them and will make the most of them.

Floyd E. Dominy
Floyd E. Dominy
Commissioner of Reclamation

A water supply system which is a credit to its direct beneficiaries, Colorado, and the Nation as a whole

"STARTLING changes have taken place," is the anniversary theme of the 30th annual report of the Northern Colorado Water Conservancy District.

"Farming practices of 1938 bear little resemblance to the operations of today. A way of life disappeared . . . a way remembered with nostalgia but which had to yield to increased economic pressures for more and more efficiency," further describes the NCWCD's tone of progress.

Created by the Colorado Legislature in 1937, ours is the first such district ever organized. It also was the first to enter into a water repayment contract with the U.S. Government, and the first to be served by a wholly supplemental water project.

The large and productive NCWCD is served by the Bureau of Reclamation's multiple-purpose Colorado-Big Thompson Project, which is a showpiece of operational design in transmountain water diversion.

Displaying the size and quality of sugar beets he grows on his farm is Henry Ashenbrenner of Longmont, Colo.

30 Years with the "BIG-TOM" Showpiece

by J. R. BARKLEY, Secretary-Manager, Northern Colorado Water Conservancy District

Construction on the "Big Tom" began in 1938 and—curtailed during World War II—its first limited water deliveries were made in 1947.

Supplemental water supplies to more than 700,000 acres of irrigated lands, to various municipalities, industries, and rural domestic water users' associations are provided by the "Big Tom." Flowing via the 13.1-mile-long Alva B. Adams tunnel, an average 260,000 acre-feet of water is diverted annually from the Colorado River on the western slope of the Continental Divide, located north of Denver.

Total costs of construction of the project were $163 million.

Cost Repayment

By contract, the District is obligated to return $29 million of the construction cost to the Federal Government over a 45-year period, including a 5-year transitional water rental period which began in 1957. The remainder of the project cost will be repaid from power revenues.

The NCWCD area embraces 1,481,000 acres in Boulder, Larimer, Weld, Morgan, Washington, Logan and Sedgwick Counties. The first valuation of the District in 1937, was $120.8 million. In 1966 it had grown to $493.5 million, and for 1967 it had climbed to $546.3 million—the latter 1-year increase of more than 10 percent.

However, both the number of farms and the farm population have decreased. Thirty years ago, 6,400 irrigated farms supported a farm popula-

Barley is given a March planting in this field near Berthoud, Colo.

tion of about 40,000 people in the District. Today the number of farms is 4,000 and the on-farm population dropped to 17,000.

Meanwhile, the average size of the irrigated farm more than doubled—from 97 acres to more than 180 acres during that period. Approximately one-half as many people are now operating two-thirds as many farm units and producing vastly greater quantities of farm products from the same total acreage.

For the farmer and livestock feeder, this change is not as rosy as it might appear. While the dollar value of crops produced in the District rose from about $26 million in 1938 to about $95 million in 1967, the purchasing power of the dollar sank by 50 percent or more. Then, too, prices the farmer and feeder must pay for essential goods and services went up much more than the prices he now receives for his products.

Explosive Growth

After World War II, the rapid growth of the American economy and the almost explosive growth in population created rising demands for every commodity on the market. Increased demand for meat and meat products, especially beef, was no exception. In 1938, the value of sheep and cattle fed for market within the District was a little more than $18 million. Today, that value is at an annual rate of more than $250 million.

The market for livestock feed created by the feeding industry, plus the economic factors previously mentioned, resulted in significant changes of cropping patterns within the District.

In 1938, 195,000 acres, or almost one-third of the harvested irrigated land within the District, was used for small grain production. In 1967, only about one-tenth of the total irrigated land, or 71,000 acres, was used for this purpose. Corn acreage for grain and silage jumped 400 percent, and alfalfa hay acreage increased from 147,000 to 180,000 during the same period.

There were also significant acreage changes for other important crops not directly related to the livestock industry. For example: Sugar beet acreage decreased from 107,600 to 75,200; dry bean acreage increased from 42,000 to almost 65,000; and potatoes declined from 31,000 to 22,000 acres.

With the shift in crop acreage, there was also a marked increase in yields for most crops.

The use of more fertilizers, improved seed, better equipment, plus improved cultivation and irrigation techniques were all factors that helped the farmer increase his efficiency.

212 Percent

Average yields for the major crops grown in the District increased during the 30-year period by as much as 212 percent. These crops include corn for ensilage, corn for grain, alfalfa, irrigated dry beans and sugar beets. The increased yields and the shift in irrigated acreages could not have taken place without an increased and more dependable water supply.

Development of a stable water supply was, of course, the reason for the creation of this District and for the construction of the Colorado-Big Thompson Project.

Horsetooth Reservoir is cradled between lofty mountain walls behind Horsetooth Dam.

What accounts for the sharp acreage increase in some crops and the decline in others?

First, a number of crops are more adaptable to irrigation than are wheat, oats, and barley. These small grains thus were largely relegated to the rolling foothills areas. Much of this is land of thinner soils and less productive than the land to the east.

There are three reasons for the phenomenal increase in corn acreage for grain and silage:

1. The introduction and improvement of hybrid corn which matures adequately in 110 to 140 days for use as ensilage;

2. The mounting demand for ensilage by the livestock industry;

3. A new and unique arrangement between the livestock feeders and the farmers.

To fulfill his feeding requirements, the feeder contracts with the farmer to grow X number of acres of corn at X dollars per acre. With seed furnished by the feeder, the farmer plants, irrigates, and cultivates—and then he has no further responsibility. Through his own agronomist, the feeder picks the time to cut the corn for ensilage.

Favoring Corn

However, corn does not require the labor needed in sugar beet production. Beet growers also contract with sugar companies but they are paid by weight and sugar content—and also must supply the cultivating and harvesting equipment, as well as the labor and seed. Another factor favoring corn is that farmers can follow corn with corn while successive annual plantings of sugar beets on the same ground has not proven successful.

There's a twist of irony here because it was the sacred sugar beet that really developed the area. Also, corn was a dirty word only a few years ago, nationally, when the United States had a surplus.

Sugar beets were introduced in what is now southern Colorado in 1841—35 years before the State was admitted to the Union. The Great Western Sugar Co. was organized in 1900 by Charles Boettcher of Denver. Five years later there were six sugar factories in the District.

Other contract production is carried on with canneries for such vegetables as peas, sweet corn, cucumbers, tomatoes, potatoes, and snap beans. Moravian barley also is being grown under contract with a Colorado brewery.

The history of the once lowly pinto bean is interesting. Once a dryland crop, it was a staple of the farmer, section hand, cowboy, sheep herder, and poor city dweller of the west and southwest. During the chili and bean soup days of the drought and depression of the 30's, it was discovered that the crop responded miraculously to an occasional irrigation.

Pinto beans today are regarded as a profitable irrigated crop in the District and production is fantastic. A dryland yield of 15 to 20 bushels per acre was considered good; production under irrigation regularly ranges from 70 to 80 bushels per acre, and the beans do not require as much water per season as do corn or sugar beets.

Almost no poultry is now seen on farms in the District but the commercialized poultry business is thriving in a specialized form. If you live in Boston, Baltimore, or Seattle, it is not unlikely your holiday turkeys, as well as your T-bone steaks, come from the land just east of the Colorado Rockies.

Business Records

It is human nature to resist changes, and farmers are no exception. In the past 20 years, farmers have been compelled to improve their managerial ability in order to stay in business. It wasn't too long ago that farmers were keeping their books and crop records on the two-by-fours in the barn.

Nor does it seem very long ago that our farmers conducted their own "eyeball snow surveys" by watching the glacial notch in Longs Peak, a towering sentinel on the Continental Divide. When the snow in the notch disappeared, they stopped irrigating the alfalfa and thereafter reserved all the remaining water they had for row crop finishing.

Operation of a meat packingplant in the project city of Greeley, Colo.

With imported supplemental water and with the improved water supply forecasts of today, of course, we can advise them in April just about how much water they can expect in August.

It is only fair to note that it has been the individual adaptability to farming changes which has contributed greatly to the present production levels within the District and made it possible to produce, from 1951 through 1967, a total gross crop value of nearly $1.5 billion—over eight times the project construction cost.

The availability of water—while fluctuating both up and down somewhat—has lured thousands of people and many new industries into the District.

More Uses

Although the original quest was for supplemental irrigation water, our repayment contract with the United States also specifies that the water may be used for domestic, municipal, and industrial purposes, as well as for the production of electric power.

Eleven cities now receive part of their municipal water from the project as a means of bolstering their in-basin water supplies.

Between 1950 and 1960, the population of all seven of the counties within the District increased by more than 45,000—from 207,230 to 252,300. The 8-year increase since 1960 is estimated at more than 50,000.

Certainly, there have been more dramatic population jumps in other U.S. areas, but it must be remembered that this area was formerly almost purely agricultural land that measured its success by the rain guage and not by the number of shopping centers.

Pacing the urbanization is the university city of Boulder whose population spurted from 20,000 in 1950 to an estimated 55,000 today. Boulder, Fort Collins, Longmont, Greeley, and Loveland together have experienced a population increase of 43 percent in the last 8 years—from 110,300 in 1960 to an estimated 158,000 today.

A new development since 1960 has been the formation within the District of 14 rural domestic districts or associations to which we furnish raw water for treatment and distribution as rural domestic supply.

Chief among the new industries is a huge IBM plant near Boulder with 4,200 persons on the payroll. The plant manufactures magnetic tape and magnetic tape drives. Products of other manufacturers, attracted to the area, range from plastic toys and hydroponic tomatoes to cement and aerospace components.

Few To Cities

Yes, people are moving off the farm, but few here are heading to the troubled major cities. Most have found the good life in the smaller communities where there is space to work and play. Many of the newcomers, in fact, are people who work in the Denver metropolitan area. There may be a lesson here in planning programs to relieve poverty, racial strife, and other ills of our current U.S. civilization. A three-bedroom house with double garage to accommodate a boat is commonplace fulfillment to thousands who have come here from the big city jungles. The formula is basic: adequate water plus productive soil equals the production of new wealth and a stabilized or growing economy.

Up to now, comparatively little of the richest agricultural land has been taken out of production to achieve the rapid urbanization. Land along the foothills, though less productive, has greater appeal for the homebuilder who is more interested in vistas than in vegetables.

Original allottees obtained their water allotment contracts at no cost. Ordinances published by the municipalities today—30 years after this District was created—reveal that the cities have paid the agricultural users as much as $150 per contract acre-foot to achieve the described allotment contract transfers.

Actually, the ability to transfer water from one locality to another, anywhere within the District, and to change the class of water usage are, of themselves, factors which contribute to the asset value of District allotments.

In summary, it is my personal and humble opinion, that the Bureau of Reclamation constructed, and the District operates, a system for water supply distribution in a manner which is a credit to both agencies. In addition it is a source of new wealth for its direct beneficiaries, the State of Colorado, and the Nation as a whole. # # #

This is Longmont and adjoining fields with Longs Peak, the highest in view with elevation 14, 256 feet.

Increased Demand

It is obvious from the urban, rural domestic, and industrial growth which I previously cited that there is an attendant increase in the demand for water supplies to fulfill those purposes. Although the quantity of water allotted by the District for those uses has more than doubled since the early 1950's, nearly 80 percent of our total water supply remains allocated to irrigation usage.

To retain the greatest possible flexibility in system operation and to permit water supplies to be shifted to new and changing uses, the District adopted procedures which allow amendment and transfer of allotment contracts. Thereby a method was established which allows municipal, domestic and industrial water users to obtain project water allotments by transfer from agricultural uses.

ABOUT THE AUTHOR. *For 10 years J. R. (Bob) Barkley has been Secretary-Manager of the Northern Colorado Water Conservancy District. During this time, and for 25 years leading up to that appointment, his talent and energies in water resources matters have been plied to use in and beyond the borders of Colorado. Mr. Barkley was Chief Engineer and Assistant Manager of the NCWCD for 13 years. He recently was appointed as Colorado member of the Board of Directors of the National Reclamation Association, has served in other advisory capacities of that organization, as well as with other organizations having to do with water resources in the Missouri River Basin. He is a registered professional engineer in the State of Colorado.*

Wrestled for years with bad water problems—now hope is on the way

Water for Coalinga

by JOYCE HOFF, Sacramento, California

PEOPLE in Coalinga will soon need only two faucets at their kitchen sinks instead of three. They now have taps for hot and cold water, but they are using a separate one for drinking water.

It looks clear and sparkling and even tastes all right, but the water in Coalinga, Calif., is full of boron and other salts, sulfates and minerals. It is harmful to drink.

By December of 1969, however, Coalingans will have good quality water from the Pleasant Valley Canal now being built by the Bureau of Reclamation as part of the San Luis Unit of the Central Valley Project.

Coalinga is a town of 7,000 in Fresno County. Its name was "Coaling Station A" when, around 1887, oil shale deposits there were used as fuel for railroad locomotive fire boxes.

Before "Coaling A" was incorporated, essential good water was wheeled in by horse-drawn water wagons and delivered to the homes. Most people had 80-gallon barrels in their front yards to hold it. Later on, this water was brought in from the town of Armona 40 miles away by railroad tank cars, but it was still delivered by wagons to the individual houses.

Pipelines were laid for delivering the hard water in 1922, and pipelines for delivering potable water for the third water faucet were laid in 1931.

At Railroad Station

Also, at the Railroad station it was "pump-it-yourself for 10¢ a bucket." Even today, farmers buy water from the old station for 7¢ a cubic foot (a penny a gallon).

In 1917 the city built a small water tower and pumped water into it from the railroad tank cars. During this same year the first of the wells which produce the hard water was drilled in the city. Today the wells are 1,300 feet deep, where the standing water level is at 270 feet. The pumps are set at 500 feet. Since 1958 the water table has dropped 80 feet.

In 1959, Ionics Inc. installed for Coalinga the first municipal electrodialysis plant. The plant takes the salts out of the water and softens it, making it safe to drink. This furnished enough water to meet the needs of the city—28,000 gallons a day—until the city began to grow as a result of San Luis Unit construction.

Then UCLA put the world's first municipal reverse osmosis desalting plant in Coalinga on an experimental basis, producing 10,000 gallons of good quality water a day. This method uses a series of pipes with a membrane inside the pipes. Water is forced through the membrane at high pressure, causing it to permeate the sides of the membrane leaving the salts and bacteria inside the membrane.

The good water costs 7¢ a cubic foot, with a minimum of $1.75 for 25 cubic feet. Occasionally a family will run up a monthly bill as high as $350 because of an undetected leak in a pipe.

Predicted Ghost Town

Eighty years ago crewman on the train which brought in water to Coalinga predicted that the town would become a ghost town since it didn't have its own supply of good water. But Coalinga has survived and grown, mainly because the area around it had large reserves of oil, the world's largest deposit of asbestos, the Nation's largest supply of commercial chrome ore, plus cinnabar, gas, magnesite, manganese, gypsum, and mercury.

Residents of Coalinga do not need to fetch their drinking water from this water service station, but others who live out of town do.

It also has the only supply of aggregate on the west side of the San Joaquin Valley which meets State and Federal specifications for reinforced concrete.

Most of the minerals are considered by the Department of the Interior to be of national importance, but they have not been developed substantially because of the brackish water that eats away at machinery, pumps, and valves. Also, asbestos companies which use the wet process for their asbestos can't use the brackish water.

The oil fields at Coalinga are about 60 years old—some of the oldest in California. They have lost their pressure and the oil remaining is heavy. About 20 percent of the oil has been pumped out. Were it not for the corrosive water an additional 40 percent could be taken out by pumping steam into the wells, thus making the oil movable. Without water from the Pleasant Valley Canal now under construction, the oil companies would be forced to abandon the wells.

"Housewives will be just as happy as the oil companies to get good quality water," according to Glenn H. Marcussen, Coalinga's city manager and engineer. "They have to soften the water to wash clothes. Even then the water is so hard on washing machines that they last only a couple of years.

Hard Water Troubles

"Water faucets dissolve. You can't wash windows with the hard water; it etches them. Service stations can't even use it to wash car windows. If you get some of the water on your house while watering your lawn, it makes the paint on the house turn white. There isn't even a commercial laundry in Coalinga because of the water problem."

In addition to the cost of water, it costs another $20 a month for a small house and $30 to $35 a month for a large house for maintenance needed due to the hard water.

Farmers in Coalinga have been persistent. Using naturally available waters for irrigation, they can grow salt-tolerant crops such as cotton and melons and have developed ingenious ways of protecting the seeds and roots. It has been found possible, for instance, for row crops to grow when the seed is planted half way up the mound. Even some farmers have put seeds in capsules to protect them from the salt until they get a start. Even then, it is difficult to grow vegetables and there are many plants that just won't grow with the water that has been available in the area. Apricot trees last only 3 or 4 years before dying from salt damage and willow trees won't grow at all.

In 1966, 10,000 acres of canning tomatoes were grown, but they had to be trucked to Stockton and other towns to be canned because of a lack of suitable processing water near Coalinga. There are 5,000 acres in an area where semitropical fruit can be grown, with good water.

Coalinga's good water will come from the Bureau's San Luis Canal. An intake channel about 1½ miles long will take water from the San Luis Canal to a pumping plant where it will be lifted 180 feet into the Pleasant Valley Canal. The city will pump water out of the canal into a filtration and water treatment plant, then 20 miles of pipeline will take the water into Coalinga.

Cost of Works

The city's water works will cost over $5 million, $2.3 million of which will come from a grant from the Economic Development Administration. Another $2.8 million will come from municipal revenue bonds. When the city voted for the bonds, they were favored 1,973 to 34.

The Pleasant Valley Canal will be over 11½ miles long when completed and will range in capacity from 1,100 cubic feet per second at its beginning to 350 cubic feet per second at its southern terminus. Work has begun on the first reach—scheduled for completion the end of 1969. This 6.3-mile-long canal will be concrete-lined and have a bottom width of 12 feet. Besides providing water for Coalinga, it also will furnish irrigation water to Pleasant Valley farmers and to a portion of the Westlands Water District.

Third tap is to turn on water for drinking and cooking. It won't be needed when Pleasant Valley Canal is completed. This is Mrs. Lou Niboli.

The pumping plant is being constructed of concrete, brick, and steel, will be 193 feet long and 71 feet wide. It will have nine 1,250 to 7,000 horsepower pumping units. A switchyard is being constructed next to the pumping plant. Construction costs for the pumping plant, a discharge line, and the switchyard will be approximately $10.3 million.

Coalingans plan to start pumping from Pleasant Valley Canal on the first day water is available in that structure. Shortly thereafter they probably will have a contest to decide what to do with the third water faucet that will be useless in every home.

With water, Coalinga should become a booming city, as the Interstate 5 freeway, which will connect Coalinga with northern and southern California markets, is being built nearby, and as oil lines, gas lines, and 500,000 volt transmission lines serve and go through the area. New industries will soon be moving in, and houses will be built with only two faucets per sink. # # #

Recreationists will now enjoy better scenery and facilities

Recreation Sites Improved by Job Corps

BOAT launching ramps, camp and picnic areas and various other recreation facilities have been built at scenic reservoir sites in seven Western States by the Jobs Corps Civilian Conservation Centers administered by the Bureau of Reclamation.

People from the communities near the attractive new recreation developments have publicly demonstrated appreciation to the young Job Corps men for their efforts. Highlights of the State programs, which are still going forward at seven centers on Reclamation's multipurpose water development projects, include:

California.—Completion of 28 picnic sites and other facilities at the Judge Carr Memorial Park on the shores of Whiskeytown Lake near Redding. Construction of the only boat launching area yet developed on Lewiston Lake in Trinity County. Construction of the 28-unit Junction City Campground on Trinity River, Trinity County. Development of parking, access routes, and picnic sites at Fisherman's Point near Shasta Dam. Completion of eight family units at Old Man Campground on north shore of Shasta Lake. Addition of eight family campsites and several picnic sites to Douglas City Campground.

Idaho.—A 54-acre recreation area, with 10 acres of beach and a 50-unit modern campground, is under development at Lake Lowell, southwest of Caldwell, Idaho. Twelve modern campsites are under construction and other improvements are in process at Marsing, Idaho's Island Park on the Snake River.

Nebraska.—Heavily-used camping and picnic facilities have been developed at the Macklin Bay recreation area on Swanson Reservoir west of McCook. Picnic sites, access roads, utilities and parking areas also were completed at Hugh Butler Lake, north of McCook. Roughly 100,000 seedling trees were planted at four Bureau reservoirs and 30 acres seeded to grass.

Oklahoma.—At the Buckhorn Recreation Area, Arbuckle Reservoir, near Sulphur, 509 picnic tables, 254 fireplaces, and 222 trash stations were installed on 50 cleared acres at an appraised value of $53,600. A breakwater, boat ramp, parking area, and service area were constructed at Guy Sandy Recreation Area, Arbuckle Reservoir, at an appraised value of $107,500. Job Corps trainees also completed an attractive concrete-stone bridge at Platt National Park, also near Sulphur.

Utah.—Picnic facilities, including tables, grills, and shelters, have been completed at one marina and are well underway at Willard Reservoir, in northern Utah. At the East Canyon Reservoir, east of Salt Lake City, roads, parking areas, shelters and comfort stations have been completed and additional facilities are planned. Many smaller projects, such as water systems, access roads and trails, reseeding, and erosion control, also have been completed by trainees.

Washington.—On May 17, 1968, recreation facilities valued at $80,000 were dedicated at Summer Falls Park on the banks of Billy Clapp Lake. The newly-completed facilities include a 5-acre picnic area, parking for 200 cars and boat trailers, boat ramp and utilities. A trash fish barrier was installed in the Gloyd Seeps area. A 300-unit campground is under development at Potholes State Park at Potholes Reservoir, also in the Columbia River Basin. Center workshops have fabricated 200 steel picnic stoves, and 400 picnic tables for the Roosevelt Lake Recreation Area.

Wyoming.—Recreation areas have been completed at Cottonwood and Black Beach on the once remote south shore of Alcova Reservoir and at Pathfinder Reservoir, near Casper. Facilities completed include 141 picnic sites, 30 shelters, 62 fireplaces, 68 trash stations, four boat ramps and three boat docks, access roads and parking areas.

# # #

Graduate Job Corps youth, Robely George of Louisiana got this job on the tie gang of the railroad out of Ogden, Utah. Beginning pay is nearly $23 per day.

Corpsmen from the Marsing Center volunteered to make a search for a lost 2-year-old boy.

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A Tour at Shasta Dam

by NAOMI L. HUNT,
Washington, D.C.

WHAT is the fascinating story behind the Shasta Dam and Powerplant?

Curious about this massive monument to progress, Mr. and Mrs. Lawrence W. McClure with their two children, Karen and Kenny, from Red Bluff, Calif., took the self-guided audio-visual tour through Shasta Dam.

Last May, as they stood before the dam's spillway, which creates a waterfall three times higher than Niagara Falls, they were awed by its proportions. They went deep inside the dam, 67 feet from the upstream face and over 400 feet beneath its crest.

Passing through its eight tour stations, the McClures walked along the galleries inside the structure. At the specially designed stations they could hear tape-recordings over a loudspeaker. They saw topographic maps, colored slides, and other interpretive devices.

The large welcome sign at the first tour station included a drawing of Shasta Dam and Powerplant and presented the structure as the "Keystone of the Central Valley Project." The recorded voice introducing the tour was started by a button mounted low enough on the board for young Kenny McClure to push.

The McClures looked on as the narration added statements of interest about the three visuals at that station.

Purpose of Shasta

The construction of Shasta Dam demonstrates man's desire and ability to control his environment. Built as a barrier to tame the Sacramento River, the dam is 9 miles north of Redding in the heart of Shasta National Forest.

Torrents of water from cascading mountain streams pour into Shasta Lake during the rainy winter and wet spring. This water is stored and distributed throughout the year through a series of dams and canals, and is pumped nearly 500 miles to the southern tip of the thirsty San Joaquin Valley in the south.

The Sacramento River changed from a capricious stream which sometimes burst its banks, and sometimes barely trickled, into a year-round navigable waterway with near-ideal conditions for spawning and survival of ocean-going fish. Devastating floods which in the past threatened the valley on the average of once every 4 years have been virtually ended.

From the river, irrigation water is furnished to produce crops extending from Redding to Bakersfield.

Construction of the Shasta Unit began in 1938. The dam is 602 feet high, base to top; 487 feet above streambed to crest of spillway. It is 3,460 feet long and 30 feet thick, at crest. Shasta's spillway, the central portion of the structure, is larger than six fooball fields; and contains 6.5 million cubic yards of concrete. It is a Bureau of Reclamation structure. The Federal investment of nearly $200 million will be repaid by water and power users.

At Station 2

The automated display at the second tour station featured the dam's five huge generators. Each of these awesome machines, which the McClures actually saw in operation, is rated to produce 83,662 kilowatts. Each is spun by 85 tons of water per second rushing out of 15-foot diameter penstocks. This powerplant generates enough electricity to fill the needs of a city of almost half a million people.

By lifting the children up to his height at station three portholes in the wall, Mr. McClure was able to give them a dramatic view of the outside of Shasta's five giant penstocks (pipes) which convey water to the turbines.

Visitors actually walk outside the dam at station four, where they are treated to a worm's eye view of the towering dam.

Back inside the structure at station five, the McClures find the lounge is a welcome feature, and the recorded voice provides more of the Shasta story while visitors are resting.

Shasta Lake—one of the largest manmade lakes and one of the most interesting and diversified recreational areas in the world—is formed behind Shasta Dam. It can hold enough water to cover 4.5 million acres to a depth of 1 foot; has 365 miles of shoreline; and is 35 miles long.

Because the flow of water from Shasta Dam is irregular, another dam forming Keswick Reservoir was built to store extra water, to meet power loads, and to regulate its flow into the Sacramento.

Some of the water in the river is used to meet needs in the Sacramento Valley; the rest is carried downstream to the Sacramento-San Joaquin Delta. At the delta, power from Shasta Dam is used to pump water into the Delta-Mendota Canal, through which it flows southward into the San Joaquin Valley.

Galleries and Tunnels

There are 4½ miles of galleries and tunnnels inside Shasta Dam. The self-guided tour of course, does not include all of the long, lighted galleries. But they are intriguing and the voice echoes from wall to wall. The McClures took one such tile or cement gallery en route to station six. Kenny laughed to hear the sharp echoes when he clapped his hands. At that point they were 428 feet beneath the dam's crest.

Station seven gives a close-up view of the power transformers, massive and imposing in appearance. They step up the 13,800 volts from the powerplant to 230,000 volts for transmission overland.

Station eight provides a view of the old diversion tunnel through which the Sacramento River had been diverted to avoid its interfering with the construction of Shasta Dam.

The principal function of Shasta Dam and the other facilities of this unit is to provide a dependable, ample, year-round supply of water. There are, however, many other benefits, including flood control, power production and recreation.

Through the summer the reservoir becomes a playground for hundreds of thousands of water recreation enthusiasts. Because of Shasta Lake's excellent fishing, boating and camping facilities, many resorts and service businesses have been established to provide for the need of recreation seekers.

Navigable River

The controlled releases of water also increase the Sacramento River's value as a navigable waterway. Commercial shipping on the Sacramento has increased threefold due to the steady supply of water from Shasta, which maintains the required depth of the ship channel.

Water for municipal and industrial use is another benefit resulting from this construction, particularly in the Contra Costa area.

Fish conservation, too, owes much to the regulated flow of cool water into the Sacramento River. Late each fall, thousands of king salmon, seeking their ancestral spawning grounds, head up the Sacramento River. Those that reach Keswick Dam enter a specially constructed trap, are raised to the top of the dam, and placed in a waiting tank truck.

The captured salmon are carried 30 miles to Coleman fish hatchery—built by the Bureau of Reclamation—where they are artificially spawned. The hatched offspring are cared for until they are large enough to be released to swim downstream and renew their life cycle. Thus Shasta Dam is helping to revive an important salmon fishery, valuable for both sport and commercial fishing.

The new self-guided tour at Shasta Dam is free and open daily. For 30 years, however, hundreds of visitors have been coming daily to tour this great multipurpose structure. They come to learn why it was built, how it works, and what it means to them. They come to be educated in modern water resource development and to be inspired as they stand before this major feat of engineering skill—a living monument to man's dreams and competence. # # #

TRAINING EXPERTS OF OTHER NATIONS

***by* CHRISTOPHER W. IVUSIC, Washington, D.C.**

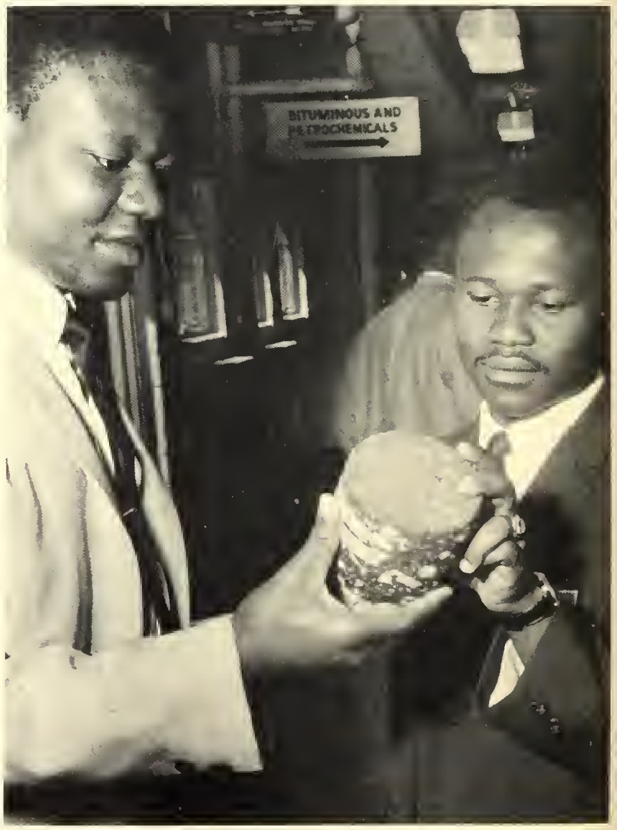
AMERICA is a free Nation dedicated to the ideal of self-help, but it is also committed to fostering freedom and progress for peoples whenever and wherever possible.

In this spirit, the U.S. Bureau of Reclamation has built hundreds of water and power development projects in the arid and semiarid Western United States since the early 1900's.

In recent years, Reclamation also has sent more than 250 technical "missions" to some 54 countries in response to requests by foreign governments for technical assistance in water resources development. It has welcomed thousands of foreign professional and a few subprofessional men and women for training at Reclamation's offices, laboratories and field projects. And, since 1949, it has been host to visits of over 5,000 water resources engineers and specialists from foreign countries at these same laboratories and field installations.

Today, as in the past, Reclamation assists people in a dual role—one domestic and the other foreign—in creating beneficial water use programs which promise steadier, richer economies.

While training has been continuing and the results in improved use of water resources are evident, some nations, which have high potential



Examining a core sample used in canal linings are, from left, Jean-Gustave Yameogo of Upper Volta, and Job Komguen of Cameroon, who once took foreign training at the Reclamation Engineering and Research Center.

and critical need for the benefits of water management, are not aware that they too can share in the experience acquired in the 66-year-old Reclamation program. This is to let them know that such help is available, and how to go about obtaining it.

Search for Growth

In the vast regions of the West, men and women of many nations and creeds settled and contributed to the amazing growth of the area. The Mormons in Utah and the Basques in Idaho, are two examples. In a similar search for room to grow and experience, Suleyman Demirel, a young engineer from Turkey, came to this country to study with the Bureau of Reclamation as one of the first two trainees sponsored by the Marshall Plan.

Demirel learned how Reclamation projects work, and he also discovered how Americans relaxed and made use of their free time. When he returned to his homeland, Demirel had broadened his knowledge and outlook. Eventually, he became Prime Minister of Turkey, a position he holds today.

For all young men and women who wish to learn how water resources development helped make the American West possible, Suleyman Demirel may serve as an example. There are four basic ways open for a foreign technician to receive training by the Bureau of Reclamation.

First, if the foreign national lives in a country where there is an Agency for International Development mission, he may ask his government to request AID to arrange for his training by the U.S. Government. The AID mission will review the request and process it through AID/Washington. Upon approval of the application by Reclamation, funds will be transferred to the Bureau to pay the costs of training.

Second, the individual may request training through diplomatic channels. This request would be processed by the Department of State, under terms of the Information and Educational Exchange Act, Public Law 402, a landmark law in fostering international cooperation through technical exchanges of personnel and information.

Under this law an individual may arrange through his own government to pay his way to the United States, and his other expenses in order to learn a specialized aspect of water resources development, which will fit his needs at home.

Third, the foreign national may request a fellowship from the United Nations or from one of the several private foundations which work in economic development abroad. Such fellowships also are handled through the Department of State.

Personal Requirements

The requirements are that the foreign national be proficient enough in the English language to use and understand both technical and nontechnical terms. He (or she) must be of sound health, of good moral character and able to meet the security clearances, and visa requirements prescribed by the State Department. He must also be employed, or be a prospective employee, in a field of work in which the Bureau is engaged, and must be a graduate of an institute of higher education or qualified by other training and experience to carry out the proposed training activity.

Costs of such training or observation cannot be borne by the Bureau. The U.S. Congress appropriates money to the Bureau to plan, design, construct, maintain and operate projects in the United States, essentially in 17 Western States. By the sale of power and water to project users, most of

Land classifier Ivan Woodworth, with shovel, is discussing Columbia Basin project soils with Makham Liengphilavanh of Laos, and Pinit Mengveah of Thailand.

the money advanced eventually will be paid back to the Federal treasury. In view of this reimbursability, no funds are available in the Reclamation program to pay for the training of foreign nationals.

Guiding Hands

Once they arrive in the United States, a few participants in the Bureau's foreign training program have even learned how to square dance. But square dancing usually has to wait until the trainee gets out West. Initially, he reports to the Division of Foreign Activities in Washington, D.C. for orientation and a review of his training program.

The week of orientation is conducted at the Washington International Center, a private institution partially supported by AID. Here a friendly and guiding hand is extended. He is invited to American homes, goes sightseeing around the Nation's Capital, and is told about the nature of American government, school systems, religion, social customs, and other aspects of life here.

Coping with problems of language, climate, separation from his family, and possibly of wearing a different form of dress, the trainee frequently needs sympathetic understanding and time to adjust.

After 1 week in Washington, the trainee usually travels to Denver, Colo., a mile-high city located at the base of the snow-capped Rocky Mountains of the Continental Divide. At the Bureau's Office of Chief Engineer, the agency's engineering and research center, detailed training programs and field assignments are arranged. The training programs usually provide between 5 and 12 months for in-service *training* and up to 4 months for official *observation*.

The trainee is assigned to a selected office and/or field unit, and is given individual guidance and instruction that will best augment his background and experience. The guidance is provided by Bureau employees in conjunction with their normal duties.

May Attend Courses

Although the Bureau does not give classroom instruction, the trainee may be able to attend the Bureau's courses for its employees in concrete, engineering materials, land drainage, operations and maintenance, and land classification; the latter being taught at Colorado State University at Fort Collins, Colo.

Foreign nationals who come to *observe* Reclamation projects normally are experienced engineers and administrators. Office studies, combined with visits to field activities in project planning, design, research, construction, and operation, make up the major part of these observations.

One of the most vital subjects in the training activities, which ranges from dam and canal engineering to atmospheric water resources research, is instruction in project investigations. More and more throughout the developing nations of the world, money must be borrowed to plan and build water use projects. Economic justification studies must show how the proposed project will pay for itself. The Bureau tries hard to impress upon trainees that overall river basin planning—the multi-purpose concept of water development—is vitally important in this day and age.

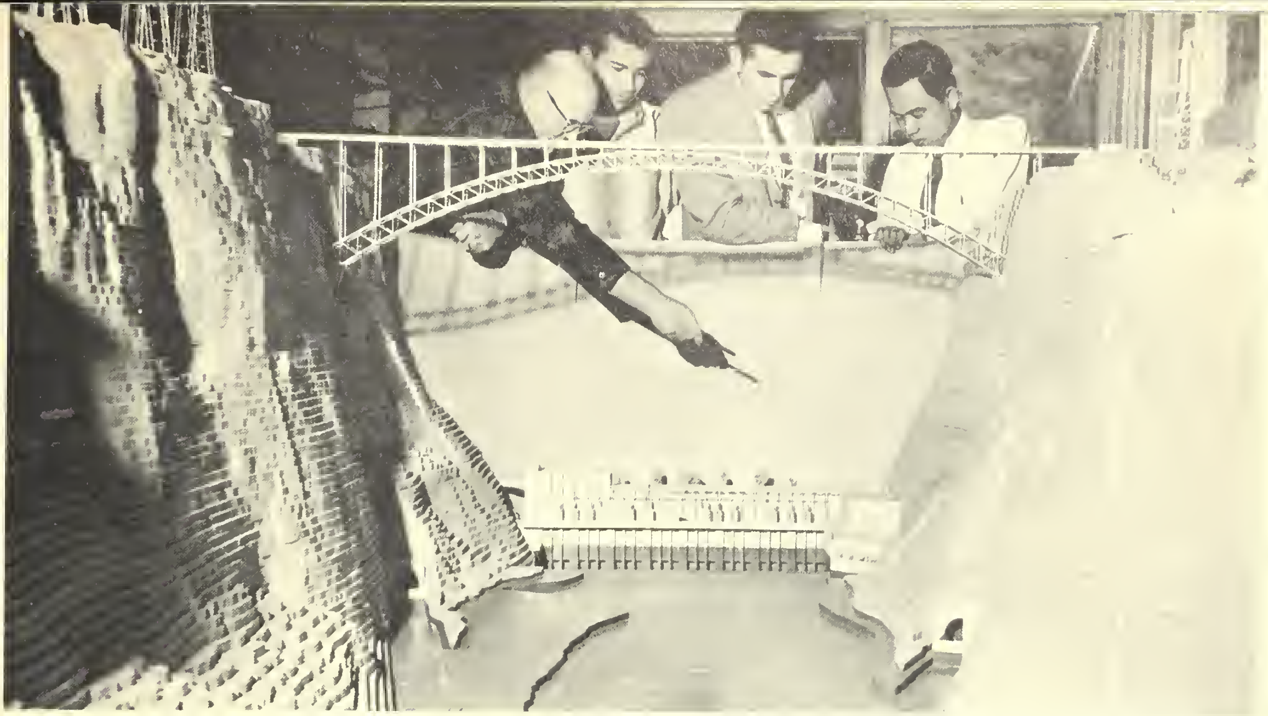
Reclamation projects in the United States especially the smaller multipurpose ones, generally are used to illustrate the many complex factors involved in water resources development. The Yuma Project in Arizona, the Weber Basin Project in Utah, or one of the Colorado River Storage Participating Projects, are among the projects used to give on-the-job training in the fields of power, irrigation and drainage, fish and wildlife conservation, municipal and industrial water supply, recreation—and all other aspects of multipurpose development.

Throughout his training, the participant is encouraged to see America and to enjoy its cultural, social, and economic benefits. For some this may mean a visit to the larger cities in the West, such as San Francisco; or simply making friends with people in our country.

Outstanding Trainees

One of the outstanding foreign trainees with Reclamation is David Chu from Taiwan, who was sent in 1953 to Reclamation's Billings, Mont., office for training at Canyon Ferry Dam and then to the engineering center in Denver. Mr. Chu returned home to work on a $110 million dam and reservoir project. He came back to the United States in 1961 to visit the American friends he had made in Billings, Mont.

Despite the fine example of Mr. Chu, it is not always possible for the Bureau to determine whether the participant will actually have opportunities to put his or her water resources education to work for their native land; nor is it possible al-



Demonstrating on a model of a dam (Glen Canyon) at the Denver center is Gilbert L. Brown. Trainees are Wiland Gundersund of Guatemala, Pedro F. Arroyo of Venezuela, and Kamol Chitakorn of Thailand.

ways to find out whether the participant has found a professionally satisfying role in the development of his country's water resources. The answer to both of these questions frequently must be delayed for several years due to the necessity for reorganization or reorientation within the home government, including recognition by those in authority in his home land of the ever-increasing need for water resources planning, and the urgency of starting the planning at the earliest possible date.

Nevertheless, the difficulty of determining post-training activity cannot dim the record of outstanding participants who have trained with Reclamation and then returned home to rise to positions of responsibility.

Some of these successful trainees and observers include: Neset Akamandor, who became Director General of Turkey's State Department of Hydraulic Works (DSI); M. L. Xujati Kambbu, Vice Minister of Development in Thailand; M. L. Jeongjan Kambbu, Director General, Royal Irrigation Department in Thailand; and Kasme Chatikavanij, Director General of the Yanhee Electric Authority in Thailand.

Other Leaders

Also, Julian A. Buendia, Chancellor of the University of the Philippines; Agapito Alano, Director General of the Department of Public Works (retired) in the Philippines; Tomas de Guzman, who became Director General of the National Irrigation Administration in the Philippines; and Mahmoud Gadein, former Deputy Minister of Irrigation and Power in the Sudan, and now an official of the African Development Bank.

Another outstanding trainee is J. Laginha Serafim of Portugal, now president of an engineering firm in Lisbon, who accompanied Commissioner Floyd E. Dominy and Associate Chief Engineer H. G. Arthur on their tour of African nations in October 1967. Mr. Serafim returned to the United States last May to visit his friends in Reclamation, and was escorted on a tour of the Bureau's Glen Canyon Unit by Commissioner Dominy.

Although meeting the technical needs of the men and women coming here to learn about water resources development is the primary goal of Bureau training, of almost equal importance is the instilling in each trainee of a sense of warm social acceptance and "belonging." We consider these people as friendly neighbors from developing nations. Reclamation personnel join the rest of the people of our country in wishing them wholehearted success in their struggle for peaceful relations, economic development; and progress in their part of the fight against poverty and hunger. # # #

Fisherman Ben Snyder puts another fish on his string.

Things being done by Colorado to maintain this large fish-stocked Reclamation reservoir

FISH VARIETIES AT BLUE MESA

by WILLIAM J. WILTZIUS

If you drove on Highway 50 between Gunnison and Montrose, Colo., last year, you probably already know about Blue Mesa—the long, narrow reservoir which impounds the famous Gunnison River and is the uppermost of the three reservoirs of the Curecanti Unit, Colorado River Storage Project.

It also is noted for being the largest lake—natural or man-made in Colorado. (Blue Mesa reservoir forms behind a dam of the same name constructed by the Bureau of Reclamation.)

But even if you didn't immediately pull off the highway and try your fishing luck, many questions probably came to your mind. What kind and how many fish had been stocked? Why? Were the fish growing well and what were your chances of catching them? What was being done to maintain this large fishery?

To gather data that would form the basis for the fishery management of Blue Mesa reservoir, as well as Morrow Point and Crystal reservoirs which together make up what is known as the Curecanti Unit, the Game, Fish and Parks Department initiated a preimpoundment research study in July of 1964.

This study was supported by Dingell-Johnson funds (¾ Federal, ¼ State) until July 1967. Since then, the funds have come from the section 8 monies, a totally Federal fund which, among other uses, allocates to participating States all finances for approved fishery investigations on the federally built reservoir units of the Upper Colorado River Storage Project. Curecanti, Navajo, Flaming Gorge and Glen Canyon are the largest units of this project.

Colorado's investigations at the Curecanti Unit have been concerned primarily with Blue Mesa reservoir because it was the first reservoir of the unit to be completed. However, since Morrow Point reservoir started filling early in 1968 and the construction of Crystal Dam may begin soon, fisheries investigations probably will continue for several more years at the Curecanti Unit.

Five Objectives

The more important objectives of Colorado's investigations have been: (1) To determine the species of fish and fish-food organisms present; (2) to determine the chemical properties of the water

Yonder picturesque backdrop at Blue Mesa Lake is Killon Craigs.

in the Gunnison drainage ; (3) to determine the availability and potential fish-spawning activity; (4) to determine the initial fish-stocking procedures for the reservoirs, taking into consideration the basic characteristics and operations of the reservoirs; and (5) to develop management plans for the reservoirs.

Preimpoundment investigations indicated that the waters in the upper Gunnison drainage were for the most part favorable for trout production. The greatest drawback, however, was, and still is, the enormity of well-established sucker populations. Suckers have long been the thorn in the fishery biologist's side. Generally, when a body of water contains large and rapidly expanding numbers of suckers, there is less food and space available for the trout each succeeding year with the result that trout members become progressively limited.

Fish Stocking

Fishery biologists usually prefer to poison the water and start anew. However, we do not have a selective poison for suckers, and this means that the trout would also be killed. On top of this, total kills of all the fishes are seldom realized, and the suckers are the ones that best survive the poison. Fish eradication was deemed infeasible and uneconomical, but did we therefore, admit defeat to the suckers? No, not entirely.

Anticipating the heavy initial stocking plan for Blue Mesa, the Game, Fish and Parks Department made exceptionally heavy plants of legal-sized rainbows in the Blue Mesa site of the Gunnison River during the summer and fall of 1965. In addition, a plant of 50,000 kokanee fry was made in April 1965, but this plant is believed to have migrated downstream before the closure of Blue Mesa Dam. Just after the dam was closed in 1965, the department planted 328,150 rainbow fingerlings ranging in size between 2 and 5 inches. When the ice went off the reservoir in March of 1966, the stocking schedule was greatly accelerated. This acceleration was enhanced by the addition of federally reared rainbows to our State-reared fish. The plants were made when the fish became available, and by October 1966, almost 3 million fish had been planted (about 2,500,000 rainbow and 500,000 kokanee).

Growth was very good. Rainbows planted in October 1965 averaged about 11 inches 1 year later. Those planted in March and April of 1966 as 2- to 4-inch fingerlings were averaging almost 10 inches by October of that year. No samples of kokanee were taken during 1966.

Expecting Blue Mesa to continue filling, considerable stocking was again done in 1967.

Establishing Kokanee Runs

Only about 275,000 of the total kokanee stocked have gone directly into the reservoirs; the remainder have been planted in selected streams above the reservoir for the purpose of establishing annual fall runs to permit easier snagging for the fisherman, and to facilitate the collection of spawn by the department.

As you may know, kokanee, like other salmon, have a very strong tendency to return to the stream or location of their birth or stocking. Despite this homing tendency, we have found that natural reproduction of kokanee in Colorado is almost entirely prevented by heavy icing of the streams and turbid runoff in the spring. Consequently, the department has had to annually collect kokanee spawn to perpetuate the species.

Our entire egg source comes from the kokanee running out of Granby Reservoir to the Shadow Mountain Spillway on the Colorado-Big Thompson Project. Recently the demand for these fish has nearly approached our supply. Much of this, of course, was due to the stocking of Blue Mesa Reservoir, and we are therefore attempting to establish spawning runs there.

We have made plants of kokanee fry in both 1966 and 1967 in the Lake Fork of the Gunnison and the Cebolla River. During 1966, 75,000 fry were also planted in Beaver Creek just above Blue Mesa Reservoir.

Emphasis, however, is placed now, and will be in the future on the East River, an important tributary of the Gunnison River above Blue Mesa Reservoir. Located on the west bank of this river about 20 miles from the high water line of Blue Mesa, is Roaring Judy Hatchery, one of our newest units. In 1967, 500,000 kokanee fry and 100,000 fingerlings were released into the East River at the hatchery.

Can you imagine the excitement of fishermen in November and December 1970, and annually thereafter, when about 50,000 12 to 16 inch kokanee spawners start to ascend the Gunnison River, pass directly through the City of Gunnison, enter the East River at Almont, Colo., and proceed the last 2 miles of their 20-mile journey toward Roaring Judy Hatchery?

Of course, the magnitude and success of this run depends on adequate numbers of the fry reaching the reservoir, surviving and growing to maturity, and then returning. If successful, it certainly will be something to look forward to, especially for Gunnisonites.

What Can I Catch?

Before impoundment, rainbow and brown trout dominated the trout composition of the Gunnison River. However, natives and brooks were also present, so now a fisherman at Blue Mesa can catch any of these species. But, as only rainbow and kokanee have been stocked in the reservoir and in large numbers, your chances of catching the other species are quite slim. In fact, rainbows have made up about 97 percent of the catch at Blue Mesa in its first 2 years of existence. Browns have made up most of the remainder (1.4 percent).

Well then, where are those kokanee? Kokanee seldom show up in the fisherman's catch until they have grown to about 10 inches and have completed at least 2 years of life. Since the earliest kokanee plant of any significance was in April 1966, and the fish from this plant had grown to only about 9 inches by October 1967, is there still doubt why so few have been taken?

Many of you are probably thinking, "Weren't most of those 11 to 13 inch silvery, pink-meated fish that I caught at Blue Mesa last year, kokanee?" The answer is no! They were almost all rainbows. Coloration usually is a poor characteristic to identify fish species, because changes of color frequently occur. These changes may be hereditary, environmentally induced, or due to the maturing of the creature, just to name a few.

Often, changes in fish coloration are associated with the protection of the animal. For example, in a shallow trout stream, the fish are most vulnerable to predation from the shore or from overhead—man, bears, fish-eating birds, etc. These fish enhance their protection by developing colors on their backs and sides which blend more with the stream bottom.

Danger Below

In large, deep reservoirs where the fish are feeding in open water much of the time, they are quite vulnerable to predation by other fishes from below. Consequently, these reservoir fishes develop lighter bellies and sides which blend with the light penetrating from above. Their backs may be darker because of the added protection it affords from the overhead type of predation. Is it any wonder, for example, that the normally dark rainbows from Gunnison River became silvery a short time after being in Blue Mesa?

Many Colorado fishermen still associate pink-meated, silvery fish as being only kokanee. It is certainly true that kokanee have such characteristics but so do the rainbows in Blue Mesa as do rainbows in other large reservoirs. The pink-meated condition is believed due to these fishes consuming large amounts of food items containing the pigment carotene.

This yellowish-orange pigment is prevalent in the plankton which both rainbows and kokanee primarily feed on in many large reservoirs. During the winter when plankton is most scarce, the fish flesh tends to be less pink.

The crossing of U.S. Highway 50.

The best visible characteristics for distinguishing between rainbows and kokanee is found in the differences in their fins. The large fin on top of and in the middle of the fish's body (dorsal fin) contains many round black spots in the rainbow. The kokanee's dorsal fin has no spots. The tail of the kokanee is less spotted and more deeply forked than the rainbow.

Most reliable but more difficult, is counting the rays in the anal fin, the fin between the tail and the vent on the underside of the fish. Rainbows usually have 9 to 11 rays, but never over 12; whereas kokanee generally have 14 or more rays but never less than 13. Overall spotting of the body is not reliable since it may vary from none to many on either species.

About the Catch

Despite the harvest not equaling what we had anticipated, most of the fishermen at Blue Mesa last year had better than average results. Many limits were taken, but the average angler creeled 3.43 fish while fishing 4.44 hours—a catch per man hour (CPMH) of 0.77.

Most large reservoirs in Colorado seldom have an average CPMH of over 0.30 and the fish usually average slightly smaller than at Blue Mesa where they averaged 11.1 inches during 1967. On a monthly basis, fishing success at Blue Mesa was best during April and June when the CPMH averaged 1.18 and 1.04, respectively. The lowest CPMH of 0.58 was recorded during August, but August was also the month when the average size of the fish was largest (12.7 inches).

When you first start catching kokanee, rather than continuing trolling along aimlessly, circle around and troll several times over the area where you got your first strike or fish. The reason for this is that Kokanee are almost always in schools, and you can easily move right over or out of their area.

In the spring and fall when the waters are cooler, the kokanee probably will be feeding in the upper 20 feet of open water. However, in the middle of the summer they will seek the cooler depths, say 30 to 70 feet in Blue Mesa, and therefore, you must fish these depths if you expect to catch kokanee. Trolling slow, in a zig-zag fashion, or better yet, just drifting with the predominantly westerly winds, in areas between Center Point recreation area and the dam, should yield most of the kokanee at Blue Mesa in 1968.

The use of lead lines, rigged with popgear, snubber and worms is suggested. Similar rigs or spoons on regular lines being trolled slightly faster, will yield primarily rainbows.

Brown trout will enter the catch more frequently earlier in the spring and summer. Look for shallow areas containing an abundance of sagebrush which allows protection for the small sucker and fathead minnows that the browns will be feeding on. Some of the large rainbows may be here, too. The browns will be in very close to the shoreline; or if you fish from shore, you will probably spook them.

Cast Near Shore

The most productive method should be from boats within casting range of shore. Cast your lure almost hitting the shore and swiftly retrieve it for a short distance. Vary the retrieving speed constantly and work small areas of the shoreline in this manner several times. You will probably lose both lures and hooked fish in the sagebrush, but the action will be much faster and you will occasionally land a lunker. Best times for such activities are early in the mornings and evenings.

If you are exclusively a "fair-weather-sunshine" angler you will be missing some of the best fishing at Blne Mesa. Many of the larger trout have been caught between 8 p.m. and 2 a.m.

One of the preferred localities is the area near the main Gunnison inlet where large stone fly nymphs, commonly and erroneously called hellgrammites, drift into the lake from the river. These nymphs are immature forms which give rise to the famous Gunnison River willow fly.

True hellgrammites are immature forms which give rise only to Dobson flies and such flies are not found even in the upper Gunnison drainage. Call these stone fly nymphs whatever you like, but they are excellent trout getters. I do not recommend their use in areas any great distance from the inlets because they are not born, nor do they develop and hatch in waters other than swift-flowing streams.

Some Blue Mesa fishermen have consistently taken 2- to 3-pound trout in the inlets by simulating stone fly nymphs or small minnows with artificials such as the brown bear, gray goose, or longshank wooly worms of various colors. I prefer to use the gray goose and wooly worm tied on No. 4, 2X hooks, sometimes weighted. The lure is tied onto about 5 to 7 feet of 4-pound level leader.

Stringing Line

I then pass my spinning line through a small waterfilled plastic bubble and tie a small swivel to the line. After the leader is attached to the swivel and the fly wetted somewhat, the rig is ready to be fished.

Shortly after the sun goes down, I anchor my boat in the channel of an inlet over water 4 to 10 feet deep where the current is not swift enough to lose anchor. The bubble rig is cast directly upstream and allowed to sink momentarily. I quickly make three to five turns of the reel, pausing very briefly between each full turn. This is followed by very slowly and continuously retrieving the line for another five to eight turns. I then go back to the fast-jerking retrieve and alternate thereafter until the current moves the rig behind the boat.

If you do not keep a fairly taut line while retrieving, you will not feel the trout strike and will miss many fine fish. This, of course, is easier said than done, but if you master the technique, it will produce where other techniques fail.

One last tip for you fishermen—avoid being an excessive "spot changer." Some fishermen are under the impression that the fishing at Blue Mesa is always better in some spot other than the one they are fishing. They constantly move around the reservoir and spend most of their time in transit. The result is usually less time fished and fewer fish in the creel. The above does not apply to most trollers, but some tend toward racing to cover as much territory as possible. This accomplishes little other than the boat ride.

Up-to-Date Management

This year 100,000 kokanee salmon fry were released in a newly constructed channel between one raceway of Roaring Judy Hatchery and East River. Also schools of kokanee were located by using echo sounders and marked with bursts of fluorescent granules useful for tracking and learning the movements valuable for fishermen. Next year tiny radio transmitters will be attached to some kokanee in schools for that purpose.

Besides making the regular large plants of local rainbows and kokanee in Blue Mesa in 1968 and 1969, kamloops rainbows, silver salmon and mackinaw trout will be stocked in 1969. The kamloops strain is a good one because of their tendency for greater longevity, ability to establish spawning runs, and preferred habitat being that of the Blue Mesa reservoir.

Silver salmon and mackinaw trout will be stocked for the purpose of aiding in the control of rough fish and to add variety to the fisherman's creel. # # #

WILLIAM J. WILTZIUS, *a fisherman, has worked for the State Department more than 3 years. He is presently an assistant wildlife researcher stationed at Montrose and is involved in post impoundment studies on the Curecanti Unit in Colorado.* *We extend our appreciation for this article to author, Mr. Wiltzius, and* Colorado Outdoors *magazine, where it appeared in longer version in the May–June issue.*

Analyze Accidents

There are six main points in analyzing an accident. An accident causes:

1. Immediate lost time while getting an injured employee to first-aid treatment and several other employees may have to leave their jobs temporarily to render assistance.

2. If the injury is serious, production drops sharply because everyone has the accident in mind and can't give full attention to the job, and a bad accident may affect the work program for several days.

3. Something has to be done about the injured employee's work. A temporary replacement may be required.

4. If the employee's accident is serious, he may not be able to do his full job when he returns to work and a light work program has to be arranged. This will affect production and efficiency.

5. If you have to substitute a less experienced worker for a regular employees, he may damage expensive equipment or machinery and he, too, might have an accident.

6. A serious injury lowers the morale of other workers and it may change the attitude of the injured employee and reduce his efficiency after he returns to the job.

Can you stand to have these six things happen? If not, then there are things that can be done. Set up a safety program for your organization.

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How it was done six decades ago

First Dam on the Wild North Platte

by NELLO CASSAI, Region 7 Information Officer

A 22-horse freighter hauling cement from the town of Casper, 45 miles to the damsite in 1907.

ON a spring day in 1909 a crew of common laborers could look at a mighty engineering marvel spanning a deep canyon in south-central Wyoming and say with pride, "We built that with our own hands."

Under professional guidance and with a minimum of primitive mechanical help, they had indeed.

Engineers today still gaze with awe at Pathfinder Dam on the North Platte River 47 miles southwest of Casper, Wyo., one of the first four or five dams constructed by the Reclamation Service.

Built of huge granite blocks extracted from nearby quarries, this masonry arch dam rises 214 feet from bedrock in the canyon floor and has a crest length of 432 feet. It tapers from a base width of 97 feet to a top width of 11 feet.

Unskilled immigrants and sons of immigrants bearing such names as O'Toole, Morelli, Weder, Kajntis, Geko and Moore alternately sweat and froze for about 35 cents an hour between 1905–09 to erect this unique structure, consisting of almost 55,000 barrels of cement and 60,210 cubic yards of masonry. The stone was hard, coarse-grained granite quarried within 1/4 mile of the dam.

Face stones were cut 2 or 3 feet thick and were laid in about 2 inches of mortar. The backing stones, irregular in shape, weighed up to 10 tons. It took a lot of prying and lifting to bed them properly and mortar them in place. The inner portion of the structure was filled with waste rock and mortar.

Water gushing through the rock at left, in this 1958 photo, was to be cut off after rehabilitation of the dam.

Rock for Dam

Narrow gage tracks connected cement sheds and quarry to the end of the dam and mixing house. There was a slight grade to the track and two men could handle a 10-ton rock from the quarry to the tramways which lowered the rock to the dam.

Pathfinder was the first dam built on the once-wild North Platte River in Wyoming by the Reclamation Service, now known as the Bureau of Reclamation. The dam and adjoining dike create a reservoir with a capacity of 1,016,000 acre-feet, almost exactly the size of Folsom Reservoir, Calif.

North Platte Project features presently in operation supply irrigation water for 335,000 acres in Wyoming and Nebraska. They also produce electricity, control floods, and provide significant outdoor recreation opportunities. Eight other Bureau reservoirs in the North Platte Basin have a combined storage capacity of 2,119,455 acre-feet.

The original plan, in 1902, was to build a storage dam at Devil's Gate on the Sweetwater River about 20 miles above its junction with the North Platte in Wyoming.

This natural site had been noted by the returning Astorians in the fall of 1812 and it later provided a passageway in the trade route to the West beyond the Rockies.

Surveys, however, revealed that the Sweetwater did not supply enough water to justify construction of a big dam at that point.

In 1903, State Hydrographer A. J. Parshall, of Wyoming, reported to Chief Engineer F. H. Newell of the Reclamation Service that there was an excellent dam site in the "Big Canon" just below the junction of the Sweetwater and the North Platte.

The ordinary traveler was not aware of its existence because the Oregon Trail passed some distance north of the canyon.

Lt. Fremont

Some said the "Great Pathfinder" Lt. John C. Fremont, had passed through the canyon in a boat and had lost his surveying instruments in the river near the present Pathfinder Dam.

At any rate, the Reclamation Service established a diamond drill crew at the dam site August 1, 1903. However, boats and roads had to be built first and then machinery lowered into the canyon. The drill work was slow and costly, principally because the drills were mounted on boats which, although firmly anchored and tied, could not be prevented from surging. This presented a danger of crushing the diamonds.

In February 1905 the Reclamation Service awarded a contract for construction of a diversion tunnel—even before plans for the dam were completed.

The tunnel, 480 feet long, was worked from two headings with crews laboring 11½ hours per shift. All drilling initially was done by hand but soon four electric drills were installed and later two steam drills were added. The best average daily progress for a full week was 5½ feet per day for one heading.

The two headings met on May 21, 1905, but 2 days later the spring runoff flooded the tunnel and deposited 2 feet of silt.

This was the first of many incidents that marked construction of Pathfinder, a pioneer development which proved a useful field laboratory for the infant Reclamation Service.

A chief designer of Pathfinder Dam was George Y. Wisner, consulting engineer for the Reclamation Service.

He noted at a conference in Ogden, Utah, in September 1903, that the Reclamation Service would be required to build masonry dams of great height and emphasized the importance of accurate data to determine stresses to which these structures would be subjected.

Wisner was authorized to hire Edgar T. Wheeler of Los Angeles and together they made careful computations that led to the design of Pathfinder Dam. The magnitude of the job and the remote location of the site introduced many problems in a plan that was intended to assure the utmost in efficiency, safety, and economy of construction and maintenance.

Start of Construction

A contract totaling $626,523 with the Geddis and Seerie Stone Co. of Denver finally was signed and work was started on the foundation excavation in September 1905.

This work too was flooded and it was August 15, 1906, when the first stone was set in the foundation of the dam.

The upper 27 feet of the structure were reinforced horizontally with steel bars placed just back of the stone face and work on the dam—modified many times from the original design—was completed on June 14, 1909.

Construction of the dike, 1,650 feet long with a maximum height of 38 feet, was started March 4, 1910, and was completed May 12, 1911.

The greatest crisis of all, however, occurred during preparation of the site of the dike, designed to close a gap south of the dam.

Shortly after the work got underway, the spring runoff of 1909 became a deluge, rose almost to the top of this low stretch and threatened to change the course of the river—leaving the dam high and dry in the canyon.

The late Alfred James Mokler, a Casper newspaperman-historian, stated in an early written report:

> Men and teams worked night and day for several weeks, piling brush, wood and sacks of sand and dirt in the low place. The flood gates were turned wide open and arrangements were made to blow out a section of the dam with dynamite if the water could not be otherwise prevented from running over this low land.
>
> For 3 or 4 days it was a hard struggle between the men and teams and the gradual rise of the water, and at one time it was thought there was no hope except to blow out a section of the masonry in the dam.
>
> Just at this time, however, seemingly an act of Providence, the water commenced to recede and then all danger was passed.

Explosives Left

The explosives were left in five holes drilled in the downstream face of the dam and the holes were capped with mortar. The dynamite remained in the dam until 1949 when the Bureau decided to install an elevator on the downstream face to replace an old concrete ladderway that led from the south rim of the canyon to valve control stations directly below.

The delicate task of removing the explosives was performed by a Casper oil field torpedo man.

Project Manager Andrew Weiss made no attempt in his excellent *Project Histories* to dramatize his work or the hardships of engineering in the

Pathfinder Dam nearing completion in 1909.

rugged land of the cowboy shortly after the turn of the century.

Weiss accepted all conditions philosophically, if the workmen didn't. Many of the laborers lived in tents in a region of intense winter cold, searing summer heat, blizzards and high winds.

There were few women in the "Equality State" in the early 1900's and perhaps only a dozen or so living near the dam site. More will be said of this later. (Wyoming's population in 1900 totaled 92,500 in a State embracing 97,914 square miles.)

It is believed that the laborers worked a 6-day week, leaving little time for play. Hunting and fishing were excellent and there were occassional Sunday brawls triggered by booze smuggled into camp on the wagon trains.

But there certainly weren't many "nights on the town," since the nearest town of Casper was at least a day's ride for a good horseman—which the laborers probably weren't.

Commented Weiss in his written observations:

> Due to this long distance from the railroad or town, the contractor had considerable difficulty in keeping a full force on the work, especially during 1906 and 1907, when he was paying 35¢ per hour for common labor and skilled labor in proportion. During 1908 and 1909 he paid only 30¢ per hour, and at that rate secured more and better help than could be had during the previous 2 years at the higher rate.

(Industrial warfare accompanied by widespread unemployment in both the gold and coal fields in neighboring Colorado undoubtedly influenced the labor situation at Pathfinder.)

At another point Weiss wrote:

> It was necessary to ship almost all men from Denver (300 miles to the south) and on the average a poor grade of labor was secured. The force was continually changing, many of the men not staying long enough to work out their transportation advanced.

Daily Wages

Average wages per day for experienced workers: masons, $5.63; blacksmiths, $5.56; foremen, $4.17; stone cutters, $4; drivers with teams, $4.64; drill-men, $2.94.

Several Pathfinder women, wives of officials, lived rather comfortably in homes at the construction camp, just downstream from the dam. But there were also a number of wives of workmen who lived in dugouts, tents and makeshift shacks in the gullies nearby.

An interview was conducted for this article with Mrs. Emily Mosher of Casper, who was born November 4, 1906, in a tent a few hundred yards upstream from the dam. A lady of great humor and charm, Mrs. Mosher was the daughter of Charles T. Demarest, who had subcontracted for the haulage of cordwood and sand.

Mrs. Emily Mosher of Casper remembers the greasing of freight wagon wheels at night. She was born at Pathfinder Dam; the photo was taken this year.

Mrs. Mosher, delivered by a full-time doctor employed by the contractor, was told that she was "placed in the oven of our cooking stove for some time to keep me warm."

Mrs. Mosher left with her parents when she was 4 and reconstructs the life at Pathfinder from accounts of her mother and father.

"I do remember that my mother was deathly afraid of snakes at the dam and that I got a great thrill out of watching the men greasing the wheels of the freight wagons when they finally arrived at camp from Casper, usually late in the evenings," Mrs. Mosher said.

Contrary to legend, there were no known fatalities in construction of Pathfinder Dam itself. On February 9, 1912, however, five workmen were knocked off the south rim of the canyon by a loosened cable and plunged 160 feet to their death.

Two of the victims, whose relatives could not be located in the United States, were buried on a barren shelf overlooking the dam. The graves are there today.

These deaths occurred during construction of the concrete ladderway on the canyon wall.

During construction of the dike there were 120 horses on the job at one time, along with 200 men.

Horse and mule teams hauled all materials, equipment and supplies for the camp from Casper. The cost to the Reclamation Service early in 1910 was $1 per hundredweight for general freight and $1.10 for hay and explosives.

Prized Steam Shovel

A prized piece of equipment was added during construction of the dike—a Marion steam shovel, Model 40, 1½-yard dipper. It was dismantled in Casper and erected again at Pathfinder.

The average price of cement delivered at Casper was $2.68 a barrel but the contractor was paid an additional $3 per barrel for haulage.

Two overnight stops usually were made by the freight outfits out of Casper—the first at the Rollin Clark ranch on Bates Creek, about 21 miles upstream, and the second at the old settlement of Alcova, about the same distance beyond. Rollin Clark was the father of Charles D. Clark, who retired recently (1968) as foreman of the Bureau's Alcova Powerplant.

Another problem at Pathfinder was fuel to fire the boilers that produced the steam to run all the stationary machinery. There was no timber on the sage-covered prairies around the dam and it thus became necessary to haul in pinewood from Pedro Mountain, about 12 miles to the south.

From February 1 to June 1, 1910, there was never enough wood on hand to run the plant 48 hours.

A camp then was established on Pedro Mountain and wood again became available at $11 per cord. Coal and crude oil also were tried but they proved too expensive.

Built at a cost of $2,225,000, Pathfinder Dam was but the first of five storage dams and related multipurpose water structures eventually to go on the North Platte Project in its six decades. The Project crop values have grown to $926 million.

# # #

College students lived with, worked with and taught migrant workers

Arkansas Students Take Challenge in Idaho

by WILLIAM SANDERSON, Realty Office, Minidoka Project, Idaho

TWENTY college students from nine Arkansas college campuses came to the Minidoka Project last summer. They learned to communicate and become friends with the Mexican migratory farm workers.

Chaperoned by Mr. and Mrs. Gerald Counds, there were nine boy and 11 girl students. Mr. and Mrs. Counds both speak Spanish fluently and recently returned from a tour of duty with the Peace Corps in South America. Mr. Counds is now Baptist Student Director at Arkansas A&M.

All the students paid their own expenses to Idaho and they worked in the beet fields to support themselves.

This summer challenge was at the labor camp on Hynes farm of the Bureau of Reclamation's Minidoka irrigation project, near Paul in south-central Idaho.

Each day three of the college girls stayed in from work and operated a day-care center, free of charge, for the 30 or 40 Mexican children. Health, music, and some school subjects, including English, were taught in the care center. Sewing classes were also given to both adults and children desiring to learn.

Started Recreation

The students inaugurated an evening recreational program of volleyball, baseball, and soccer, in which they participated with the Mexican people. Three of the group are accomplished guitarists, and singing sessions were held with folk songs and sentimental favorites predominating. A "coffee hour" to which anyone could come and play games, or just visit, was one of the activities.

The group lived in five of the labor camp units which were the same as those for the Mexican people. As in most labor camps in this area, there was nothing pretentious about the facilities. They meet only the necessities.

The three student teachers and the class look happy. Mrs. Counds and her young son are at left.

In the beginning, the students' attempts to be friendly with the Mexican people were not well received. Then the Catholic Priest of Rupert, Idaho, helped "break the ice." He persuaded the migrant workers that the intentions of the students were good.

The students were serious in their objectives of establishing friendship and understanding with the migrant workers and to learn their language. Most of the adults and children now look forward to such associations.

On August 1 the group returned to their respective college campuses where they would again pursue their studies in medicine, social science, liberal arts, and other chosen fields. Perhaps only a small dent has been made in reducing racial barriers which exist, but there will be considerable warm satisfaction for the good intentions of the people involved. # # #

This is the way to reduce the work on rows of beets—each person takes a row at a time.

Weed growth multiplying. Apply herbicides at low concentrations

Stop Waterweeds With Chemicals

by DEAN M. SCHACHTERLE, Natural Resources Specialist, Bureau of Reclamation, Denver, Colorado

WATERWEEDS are on a rampage throughout the West. These plant pests, particularly troublesome in irrigation canals and laterals, are increasing at alarming rates.

Aquatic weeds clog waterways every year, and each year thousands of dollars are spent in control work and chemicals. While increasing use of herbicides offers improved weed control, there are restrictions to introducing the chemicals into water.

The limitations include possible toxic effects on humans and other warm blooded animals. Toxicity could also extend to fish and other aquatic animals and plants. A herbicide's effect on all crops to be irrigated is a consideration, as is its persistence level in water and soil.

Up to the present, most farm crops in Colorado, and the other Western States, are not extremely sensitive to the aquatic herbicides being used in irrigation water. Also, most seasonally operated irrigation canals are not considered important public fisheries.

However, misuses could cause severe restrictions to be placed on the use of chemicals in water, and the only other means of cleaning weeds from ditches is by mechanical apparatus. It is to our benefit to find a satisfactory application of herbicides, or it may become necessary again to use only the more costly and cumbersome mechanical methods of control and removal.

Aquatic plants may be classified into three main categories: submersed, emersed and those that float or attach to surfaces of rocks or concrete structures.

Troublesome Types

Submersed weeds are rooted plants which grow mostly under water. They are troublesome in irrigation canals and drains, in recreational waters and in some potable water reservoirs. Examples of submersed weeds are pondweeds, chara, elodea and watermilfoils.

Emersed aquatic weeds are also rooted but extend most of their foliage and seed heads above the water surface and are quite troublesome along banks and shallow edges. Cattails, Tules, reeds, and other tall watergrasses are examples.

These specialists are making a herbicide test in a model irrigation canal. They are from left, Naman Otto and Thomas Bartley.

All of these weeds restrict or prevent waterflow in canals, laterals or drainage ditches. They also cause excessive deposits of silt to accumulate thus reducing the free flow and capacity of the channel and finally causing water pollution associated with poor drainage of lowlands and partially restricted drainage channels.

Filamentous green algae are threadlike plants without roots, leaves or flowers which float on water or may attach to objects. The floating kind often form dense mats and may plug sprinkler irrigation systems, siphon tubes and irrigation canal water control structures and farm outlets.

Algae are also commonly found growing on water measuring structures such as Parshall flumes, weirs, sparling meters and on the wetted surfaces of concrete lined irrigation canals. Presently antifouling paints fortified with slow releasing toxicants, copper or tributyl tin oxide, are being successfully used to help prevent algae growths on water measuring structures.

Considerable progress has been made in the past few years in discovering and developing effective herbicides for controlling most of the weeds that grow in and on water and on banks adjacent to aquatic sites. There are now some 20 kinds of her-

A plant specialist is shown examining a weed test in an experimental irrigation lateral at the Denver Federal Center.

bicides registered for control of aquatic and bank weeds. Some 11 of the 20 herbicines do not harm fish at concentrations necessary to control weeds.

Users Pay

Control measures for aquatic weeds on irrigation systems are generally paid for by the water users. This payment comes in the form of operation and maintenance charges. The cost varies with the herbicide being used and the concentration being applied.

Herbicides are applied in water on a basis of cubic feet per second of flow. Hence, the more water involved, the higher the costs. All aquatic herbicides are applied at low concentrations to avoid many harmful side effects.

Average costs of the common chemical controls in Colorado are:

Copper sulfate applied for control of filamentous green algae in irrigation canals varies in cost from 10 cents to 35 cents per cubic foot per second of water flow depending upon hardness of the water and the amount of infestation.

Xylene applied in irrigation canals and laterals for control of most pondweeds costs from $5 to $6.25 per cubic foot per second of flow of water.

Dalapon applied to cattails costs about $28 to $30 per acre.

Aquathol applied in small lakes and ponds to control watermilfoil, most rooted pondweeds and green algae cost about $25 per acre-foot of water in the pond or lake at the time of treatment.

Residue Considerations

When choosing a herbicide it is important to consider residues which remain not only in water, soil and fish, but also residues in crops irrigated with treated water, and the toxicity of each herbicide to domestic and wild animals and humans. Caution is recommended. The potential dangers of herbicides in flowing water are much greater than when herbicides are applied to soils.

The threat of aquatic weeds is real. They are increasing because of marked increases in nitrates and phosphates found in most water.

These nutrient buildups are greater where domestic sewage, industrial wastes, runoff from livestock feedlots, fertilized farm fields and other wastes from urban and rural areas are carried into the irrigation system. Increased growth of weeds is going to necessitate increased control measures if the waterweed problem is to be solved.

Because pollution is fertilizing waterweeds, our aquatic program must tie in with our clean water programs. While so far we've only scratched the surface, extensive studies are being made to determine the extent of residues and to help develop less hazardous herbicides and safer application techniques. # # #

CONTROL AGENTS FOR SUBMERSED WEEDS

Years of field testing with acrolein and copper sulfate as control agents for submersed aquatic weeds indicates that both chemicals, used correctly, are effective in suppressing rooted forms of aquatic weeds in irrigation canals.

Use of acrolein over a 5-year period in the Pacific Northwest showed the liquid herbicide to be effective and economical in suppressing five varieties of pondweed, elodea, water buttercup, and filamentous green algae.

Pondweed suppression was excellent along a 15- to 20-mile reach when acrolein was added to the channels at a concentration of 0.10 part per million over a 48-hour period on a 2- to 4-week schedule. Flows ranged from 700 to 2,000 cubic feet per second during the treatment schedule.

Field work conducted by the Bureau of Reclamation and the Agriculture Research Service demonstrated, however, that the effective concentration of 0.10 part per million (p.p.m.) in large canals gives inadequate suppression in streams carrying less than 700 cubic feet per second.

Concentrations of 0.6 to 15 p.p.m. are required in these small streams. The failure of acrolein to suppress horned pondweed was a significant finding in these field applications.

The Bureau's field work with copper sulfate showed it to be effective in controlling leafy pondweed and sago pondweed along a 9-mile reach of unlined channel in an irrigation canal near Loveland, Colo. Dry crystals of copper sulfate were dispensed by a screw-type volumetric feeder with a timing device.

34-Day Delay

Tests in 1966 began in early June, when weeds already had reached lengths up to 10 inches in the canal. Not until 34 days after the start of the application of copper sulfate was the first significant injury observed on leafy pondweed downstream.

In 1967, feeding was started in May on the same day water was first turned into the canal. Pondweed suppression was more effective than during 1966, but the effects of residual copper in ditch bottom soil and cooler water temperatures in early season might be important factors in this observation.

Copper sulfate experiments was planned to continue this summer on the same canal near Loveland, Colo.

A technical paper by W. Dean Boyle of the Boise, Idaho office, and Thomas R. Bartley of the Denver, Colo. office, on the control agent tests was presented last February at the Weed Science Society of America Conference in New Orleans. Also Reclamation has published a report (WC–32) detailing results of the 1966 copper sulfate study, and is preparing a similar report on the 1967 activities.

# # #

Cheering spectators line the ice covered lake as racing snowmobiles fly down homestretch during the first annual Blue Mesa Snowmobile Rally Races held last January. This is on part of Reclamation's Curecanti project and the National Recreation area supervised by the National Park Service. (Also see Blue Mesa article and photos on page 96.)

FEBRUARY PUBLICATION ON POWELL CENTENNIAL

The February 1969 issue of the quarterly *Reclamation Era* will be a special issue devoted to the 1969 Powell Centennial.

Observance plans for the 100th anniversary with the theme: "1869–1969 A Century of Achievement, Our Debt to John Wesley Powell," are moving forward.

The zealous career of this amazingly prescient scientist and organizer led to Powell conducting the irrigation surveys which became the basis of the Bureau of Reclamation, created in 1902. He established the Geological Survey and the Smithsonian Institution's Bureau of Ethnology.

Joining the Interior Department in suitable observances for the Powell Centennial next year are the Smithsonian Institution and the National Geographic Society. Chairman of the Powell Centennial Committee is C. S. Denny of the Geological Survey, U.S. Department of the Interior, Washington, D.C. 20240.

Individuals and organizations interested in Western history are asked by the cooperating agency heads to join in paying homage to the remarkable American, Major Powell.

BENEFITS OF DAM TOLD BY MONTANAN

(*Editor's Note:* This excerpt of a letter about a Reclamation dam was received by Hon. Mike Mansfield, U.S. Senator from Montana.)

For some time, I have wanted to write to you regarding how well the Clark Canyon Dam in Beaverhead County has worked out and of the many benefits it has brought to our economy here and to the State of Montana, as well as to the United States as a whole. This excellent project has paid for itself twice already in benefits that could be definitely determined. Once, when the dam controlled the Beaverhead River in 1964 when the rest of the State was flooding and when the added inflow from the flooding Beaverhead River would have compounded the disaster many times had it not been for the Clark Canyon Dam. Again, in 1966, when our county suffered the worst drought in its history, water from this project filled the needs of all who were under (downstream from) the dam and once again a complete disaster was avoided.

(Signed) CARL M. DAVIS
Dillon, Mont.

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Leave Sunken Car Safely

Some men who must drive vehicles on the sides of ditches or on canal roads should be alert to the dangers of the vehicle going into the water. One man reportedly drove a tractor into a canal, the machine rolled over pinning him under it and he drowned.

If a car does go into an irrigation ditch, occupants should stay in it until the car gets to the bottom. This may not sound reasonable, but it was found the best way to solve the most critical problems during tests conducted in Mississippi and Louisiana where cars were purposefully sunk. People in the cars tried to get out when the car was floating, but there was too much pressure against the doors at that time. When the occupant calmly remained inside until the car got to the bottom, the pressure was equalized and they could open the door and float to the surface.

Coat With Fluorescent Paint

A light reflecting fluorescent paint is suggested to coat the inside of underground valve boxes and also the pipe inside the boxes that protects valves and other equipment. This makes it much easier to see a reasonable depth in the usually unpainted box or where the box and pipe have a protective coat of unreflecting or even light-absorbing paint.

By shining a beam of light into the fluorescent painted interior, reflection makes it possible to clearly see the position of valves and other equipment.

Dye for Weed Control Chemical

Most weed control chemicals, particularly those of the soil sterilent type, are colorless. Because rain is needed to activate them, these chemicals do not usually affect the weed foilage immediately after spraying.

It is not uncommon that field operations of an urgent nature may interrupt the weed spraying job and several days lapse making it almost impossible to see where the spraying stopped. To avoid a chance of overlapping the area already sprayed or missing an area entirely, a dye could be mixed in the control chemical to make a clear outline show where spraying ended, even after several days.

Accordingly, no solution is wasted or motion lost, and the possibility of overactivating an area with control chemical is eliminated. Although some people have used this idea, many have not known of it.

The "pig" shown part way out of the pipe, and the motor winch at left, which does the pulling, is the equipment needed for this type of pipeline inspection.

Pig Inspects Pipe

One kind of pig is for pork. But there is also a "pig" not so well known; it is for locating blockage in newly laid, closed-drain systems.

The usual method of inspecting a new drain pipe for possible obstructions, which would prevent flow of the desired amount of water, is to float a ball through it. This method is satisfactory providing there is sufficient water flowing through with the ball, and the pipe is clear. If the ball gets caught somewhere in the line, it occasionally becomes expensive for the constructing organization to excavate and break into the line on a "trial and error" basis in an attempt to locate the obstruction.

Preparing for a more efficient method is threading a light-weight aeroplane control cable through each section of pipe as it is laid in place. This cable should be of sufficient length to reach through the pipeline, from manhole to manhole, or from manhole to the end of the drain. The cable is reeled off a small spool carrier winch.

When the pipeline is ready for testing, the "pig"—a metal frame designed like a short, large-diameter pencil sharpened on both ends—is fastened to the end of the cable. Another cable, a trailing line, is fastened to the back end of the "pig" and the device is started on its way through the pipe by pulling on the first cable.

When being pulled the "pig" might remind one of the movement of a real pig or perhaps a slow torpedo.

If an obstruction is encountered along the line, the pulling halts. The trailing cable is then marked at the pipe entrance, and the "pig" is pulled out of the pipeline backwards.

The distance to the obstruction can be transferred from the marked cable to the surface of the ground, and repair work can get underway with no loss of accuracy.

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MAJOR RECENT CONTRACT AWARDS

Spec. No.	Project	Award date	Description of work or material	Contractor's name and address	Contract amount
DS-6607	Columbia Basin, Wash.	July 3	3 hydraulic turbines for Grand Coulee 3d powerplant.	Guy F. Atkinson Co., d.b.a. Willamette Iron & Steel Co., Portland, Oreg.	$19,537,543
DS-6608	do	Aug. 23	Furnishing and installing 3 615,385-kv.-a. generators for Grand Coulee 3d powerplant.	Westinghouse Electric Corp., Denver, Colo.	22,044,000
DC-6635	do	July 29	Initial excavation for powerplant, including construction of a cofferdam and access road, Grand Coulee 3d powerplant.	Gordon H. Ball, Inc., Danville, Calif.	12,503,593
DS-6638	do	July 30	2 pump-turbines for Grand Coulee pumping plant, units P7 and P8.	Nydqvist & Holm Aktiebolag, Trollhattan, Sweden.	730,000
DC-6644	Missouri River Basin, N. Dak.	July 1	Construction of Snake Creek pumping plant No. 1.	White Bros. Construction Co., Inc., and L. D. Shilling Co., Inc. Walla Walla, Wash.	7,403,627
DC-6645	Central Valley, Calif.	Aug. 2	Construction of 32.7 miles of pipelines for Westlands Water District distribution system laterals 19, 21, 23, 25, and 26.	W. M. Lyles Co., Fresno, Calif.	3,223,526
DC-6650	Missouri River Basin, Wyo.	July 15	Construction of Glendale substation, stage 01, and 69-kv. South Cody tapline.	Raymond P. Mayeaux, d.b.a. Capitol Electric & Engineering Co., Denver, Colo.	193,246
DC-6651	Southern Nevada Water, Nev.	July 9	Construction of intake tunnel, underground construction and opencut excavation for pumping pumping plant No. 1.	S. S. Mullen, Inc., Seattle, Wash.	2,813,060
DC-6654	Missouri River Basin, Nebr.	July 24	Modifications of upstream slope for Merritt Dam.	Abel Construction Co., Lincoln, Nebr.	109,134
DC-6655	do	July 17	Construction of stage 02 additions to Stegall substation.	Raymond P. Mayeaux, d.b.a. Capitol Electric & Engineering Co., Denver, Colo.	310,667
DS-6656	Minidoka Area, Idaho	July 5	Furnishing and installing 1 new armature winding for generator unit 1 at Palisades powerplant.	Westinghouse Electric Corp., Denver, Colo.	159,978
DS-6659	Missouri River Basin, South Dakota-Nebraska.	July 26	15 shunt reactors for Fort Thompson, stage 05, and Grand Island, stage 01, substations.	General Electric Co., Denver, Colo.	143,880
DC-6664	Parker-Davis, Calif.	Aug. 27	Construction of 64 miles of Parker-Blythe 161-kv. transmission line No. 2.	Interstate Electric Co., Inc., Salt Lake City, Utah.	1,467,072
DC-6667	Missouri River Basin, Iowa.	Sept. 19	Construction of stage 04 and 05 additions to Creston substation.	Electrical Builders, Inc., Valley City, N. Dak.	459,165
DC-6670	Missouri River Basin, Nebr.	Sept. 5	Milburn diversion dam dike protection	Bushman Construction Co., St. Joseph, Mo.	105,815
DC-6674	Central Valley, Calif.	Sept. 18	Construction of Interstate Highway No. 5 lateral crossings for Westlands Water District distribution system.	Charles Eugene McLaughlin, d.b.a. Gene McLaughlin Construction Co., Fresno, Calif.	252,394
DC-6679	Canadian River, Tex.	Sept. 27	Modification of main aqueduct structures, stations 2975+90 to 8090+00.	Brown-McKee, Inc., Lubbock, Tex.	110,841
100C-1012	Columbia Basin, Wash.	Sept. 11	Construction of 30.5 miles of buried pipe drains, block 46.	John M. Keltch, Inc., Pasco, Wash.	486,268
400C-392	Colorado River Storage, Utah.	Sept. 26	Furnishing and erecting protective fencing, rock bolts, railing and ladders for Flaming Gorge Dam.	E. V. Chettle, Salt Lake City, Utah.	104,121
602C-52	Missouri River Basin, S. Dak.	Aug. 8	Erecting steel towers, stringing conductors and ground wires for Fort Thompson-Fort Randall and erecting steel towers for Utica Junction-Sioux Falls and Oahe-Mobridge 230-Kv. transmission lines.	Lindberg Construction Co., Jamestown, N. Dak.	112,950
604C-73	Missouri River Basin, Mont.	Sept. 19	Furnishing and applying 2.8 miles of buried asphaltic membrane lining for East Bench canal, station 411+00 511+47 and station 2350+75 to 2410+67.5.	N. L. Garrick Construction Co., Missoula, Mont.	160,928

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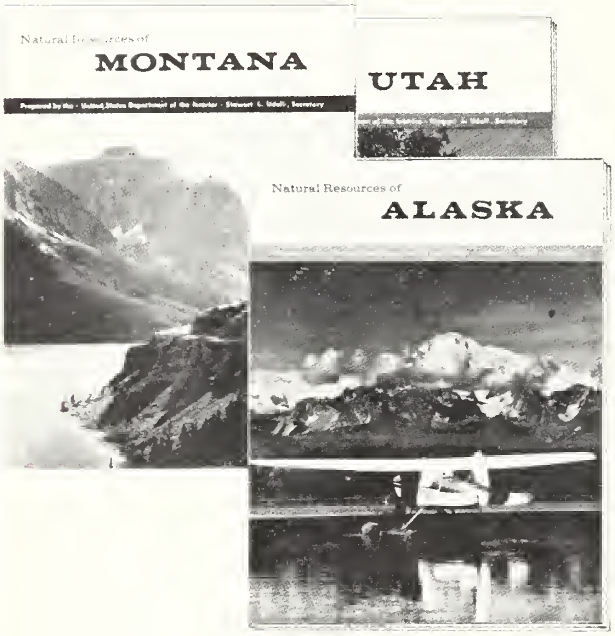

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