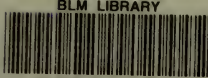


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1960 Annual Report

SECRETARY OF THE

INTERIOR

FRED A. SEATON

For the Fiscal Year Ended June 30, 1960



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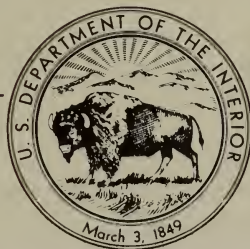
1960 Annual Report

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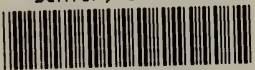
INTERIOR

FRED A. SEATON

For the Fiscal Year Ended June 30, 1960



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THE SECRETARY OF THE INTERIOR
WASHINGTON

DEAR MR. PRESIDENT: It is a pleasure to transmit to you the annual report of the Department of the Interior for the fiscal year 1960.

This summary of departmental activities has been prepared in the hope that it will bring to public attention the cause of sound conservation and development of our natural resources by increasing public knowledge and understanding of this important area of the Nation's responsibilities.

Great strides have been made and I am certain that they will be continued in the years to come because the groundwork has been carefully laid.

Sincerely,

FRED A. SEATON,
Secretary of the Interior.

THE PRESIDENT,
The White House.

United States
Department of the Interior



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Office of the Assistant Secretary

Water and Power Development

Fred G. Aandahl, *Assistant Secretary*



THE ASSISTANT SECRETARY for Water and Power Development discharges the duties of the Secretary with respect to the Department's program in the field of water and power development. Secretarial direction and supervision is exercised by the Assistant Secretary over the Bureau of Reclamation, Bonneville Power Administration, Southeastern Power Administration, Southwestern Power Administration, and Office of Saline Water.

▲ *The Bureau of Reclamation constructs water-use projects whose primary purpose is the reclamation of arid and semiarid lands in the West, markets electric power produced at water resource projects of the Corps of Engineers in the 17 Western States, except for the Pacific Northwest area, and operates several high-voltage transmission systems in the West.*

▲ *Bonneville Power Administration markets power produced at projects of the Corps of Engineers and Bureau of Reclamation in the Pacific Northwest and it also operates an extensive high-voltage transmission system.*

▲ *Southeastern Power Administration and Southwestern Power Administration market power from Corps of Engineers projects in the Southeastern and the central Southwest areas, respectively. The latter operates a high-voltage transmission system. Southeastern markets power at the projects or uses wheeling arrangements.*

▲ *The Office of Saline Water develops low-cost processes for the conversion of salt water to fresh water and constructs and operates facilities to test these processes.*

The following table, prepared on a consolidated basis for fiscal year 1960, summarizes the marketing of hydroelectric power by Department of the Interior agencies.

Power production and marketing data, fiscal year ended June 30, 1960

Marketing agency	Installed capacity, as of June 30, 1960 (kilowatts)	Net energy generated (million kilowatt-hours)	Energy marketed (million kilowatt-hours)	Gross revenue (thousands of dollars)
Bureau of Reclamation.....	¹ 5,928,085	27,418	⁴ 13,984	⁵ \$51,776
Bonneville Power Administration.....	² ³ 3,781,000	18,304	29,683	70,998
Southeastern Power Administration.....	² 1,283,600	4,087	⁶ 4,048	20,651
Southwestern Power Administration.....	² 601,000	1,672	⁶ 2,061	15,015
Total.....	11,593,685	51,481	49,776	158,440

¹ Includes 745,035 kilowatts in Corps of Engineers, 31,500 kilowatts in International Boundary and Water Commission, and 5,151,550 kilowatts in Bureau of Reclamation projects.

² Capacity in Corps of Engineers projects.

³ Bonneville Power Administration also markets power from Bureau of Reclamation's Grand Coulee, Hungry Horse, Chandler and Roza powerplants with a capacity of 2,252,250 kilowatts.

⁴ Excludes 12,857 million kilowatt-hours delivered at Grand Coulee, Hungry Horse, Chandler, and Roza powerplants by Bureau of Reclamation to Bonneville Power Administration (this amount included in Bonneville Power Administration energy marketed).

⁵ Excludes \$16,978,000 revenue received by Bureau of Reclamation from Bonneville Power Administration (this amount included in Bonneville Power Administration revenue).

⁶ Includes purchased energy.

The Assistant Secretary is responsible for the defense functions with respect to electric power which have been delegated to the Secretary by the Office of Civil and Defense Mobilization. To carry out this program, a field organization has been established to handle certain postattack power problems. Some 40 directors and assistants have been appointed to head the 16 power areas in this organization and approximately 2,000 power liaison officers to Office of Civil and Defense Mobilization regional offices and to State and local governments have been designated.

Personnel of electric utilities were trained in radiological defense. A survey of normal inventories and uses of electric survival items has been completed, and data with respect to generating plants and substations is nearing completion.

Coordination Activities

The Assistant Secretary served as Departmental representative on the Inter-Agency Committee on Water Resources and on the President's Advisory Committee on Public Works Planning, State Department Advisory Committee and as chairman, Engineering Group for

Canadian Columbia River Storage, an international study; participated in interagency conferences on the coordination of watershed, flood-control, and reclamation programs. He conducted conferences in the field and in Washington on power marketing and irrigation development, attended by water and power users, congressional delegations, and representatives of local interests and industry, and testified before congressional committees.

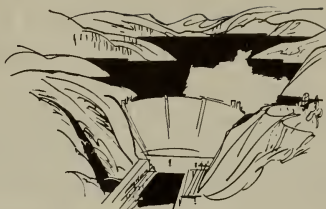
Specialized power studies by the Technical Inter-Agency Power Group for National Defense were made in southern California, the Pacific Northwest and Alaska. Outstanding among these accomplishments was a program for implementing firm power supply through 1963 in the Missouri River Basin, developing a marketing plan in the Colorado storage project service area, and studies for marketing of surplus Pacific Northwest power in the northern California area.

During the year, the office of the Assistant Secretary reviewed 73 reports of the Corps of Engineers, Department of the Army, primarily for flood control and navigation improvements; 35 Federal Power Commission applications for permits and licenses for hydroelectric developments; and 39 Department of Agriculture watershed work plans.

Staff of the Office served as Departmental representatives on interagency committees concerned with radio frequency allocation, procurement of heavy electrical equipment, international water developments, the International St. Croix River Engineering Board, public works planning, financial practices for water and power projects, economic analyses, atomic energy, and national technical society committees.

Bureau of Reclamation

Floyd E. Dominy, *Commissioner*



INCREASED WATER SUPPLIES for homes, farms, and industry in the semiarid West, and other major multiple-purpose benefits of regional and national importance were provided by the extensive planning and construction program of the Bureau of Reclamation of the Department of the Interior during fiscal year 1960.

During the year, the Bureau's project development program involved preparation of comprehensive plans for development of river basin resources and investigation and planning of potential projects to meet the requirements of the fast growing population of the West which is dependent on limited water resources.

Under its construction program for the fiscal year, the Bureau continued to develop water and land resources. An investment of about \$200 million was added to the Bureau's \$3.3 billion plant investment in western projects through completion of dams, powerplants, irrigation canals, pumping plants, electrical transmission lines, and other wealth-creating facilities.

Construction completed during the year added more than 219,000 acre-feet of storage capacity in new Reclamation project reservoirs, 16,000 kilowatts of hydroelectric generating capacity, 159 miles of canals and related water conveyance and distribution structures, and more than 200 miles of high voltage backbone transmission lines.

The 155 Reclamation reservoirs capable of storing 87.7 million acre-feet of water in 1960 provided full or supplemental water supplies not only for the irrigation of arid lands and for generation of hydroelectric power, but also for use by rapidly growing municipalities and expanding industries, and for public recreation, fish and wildlife conservation, as well as storage space for flood control and salinity control.

Four new projects—Little Wood River, Idaho; Solano, Calif.; Santa Maria, Calif.; and Ventura River, Calif.—were in operational

status. Another—Michaud Flats, Idaho—was substantially completed.

The irrigable area for service on the 83 operating irrigation projects in 1959 totaled 8,094,383 acres, comprising 129,000 farms. The acreage actually irrigated was 6,798,751 acres.

Municipal and industrial water deliveries reached a total of 290 billion gallons, an increase of 13 percent over the previous year. More than 200 municipalities and other nonfarm entities, with a population of 8.1 million persons, benefited from this service. Recreational usage of storage reservoirs and other water areas amounted to an estimated 22.7 million visitor-days, an increase of 16 percent in 1 year.

The 129,000 farms on Reclamation projects in 1959 produced crops valued at more than \$1 billion. This 54th harvest, \$129 million greater than the previous year, was an all-time record and brings the cumulative value of crops grown on Reclamation projects since 1906 to more than \$15 billion.

The Bureau's activities in planning, developing, and operating Federal irrigation projects have been greatly facilitated through cooperation with other agencies or organizations. The special skills, experience and equipment of these public agencies have been fully utilized whenever it was to the advantage of the Government.

Recognizing that the development of water resources in other countries is often a prerequisite to economic progress in those countries, the Bureau—at the request of the Department of State—entered into an agreement with the International Cooperation Administration to assist the Government of Afghanistan in bringing its Helmand Valley project to a more satisfactory level of operating efficiency.

The Bureau also continued its established program of investigations in the Blue Nile River Basin of Ethiopia, and extensive "good neighbor" activities in support of the U.S. Government's technical aid program consisting of providing on-the-job training for foreign engineers and technicians at Bureau facilities. Reclamation specialists also were assigned for short details to various countries on specific problems. Funds to cover costs of such programs are provided by the agency requesting the service.

The Bureau participated in publication of two books of major interest to the West during the fiscal year. They were *Design of Small Dams*, a 611-page technical reference book published by the Bureau, and *Irrigation on Western Farms*, written and published jointly by the Bureau and the Soil Conservation Service, Department of Agriculture. A special Bureau report, "Future Needs for Reclamation in the Western States," was published by the Select Senate Committee on National Water Resources as its Committee Print 14, and attracted widespread attention.

Construction Increases Western Water Supply

More than 400 separate contracts for construction and equipment, materials, and supplies were awarded in fiscal year 1960 with a total value of about \$89 million. Of this total amount, construction contracts accounted for about \$73 million, or about 85 percent.

A total of 203 construction contracts having a value of more than \$49 million were completed during the year. The 160 construction contracts in force at the end of the year had a total value of about \$371 million.

In addition to contracts awarded for construction purposes, procurement of miscellaneous equipment, supplies, and services totaled approximately \$19 million, for a total procurement program for the year of about \$108 million.

Notable events during the fiscal year included the placing of the first bucket of concrete in Glen Canyon Dam on the Colorado River Storage project in Arizona, and the diversion of the Green River at the Flaming Gorge Dam, also on the Colorado River Storage project, in Utah, thus clearing the damsite for foundation and keyway excavation. More than 24 million cubic yards of the 33-million cubic yard earthfill Trinity Dam, on the Central Valley project in California, were in place by year's end. By the end of the fiscal year, about one-half of the 26-million cubic yard earthfill Navajo Dam, feature of the Colorado River Storage project in New Mexico, had been placed.

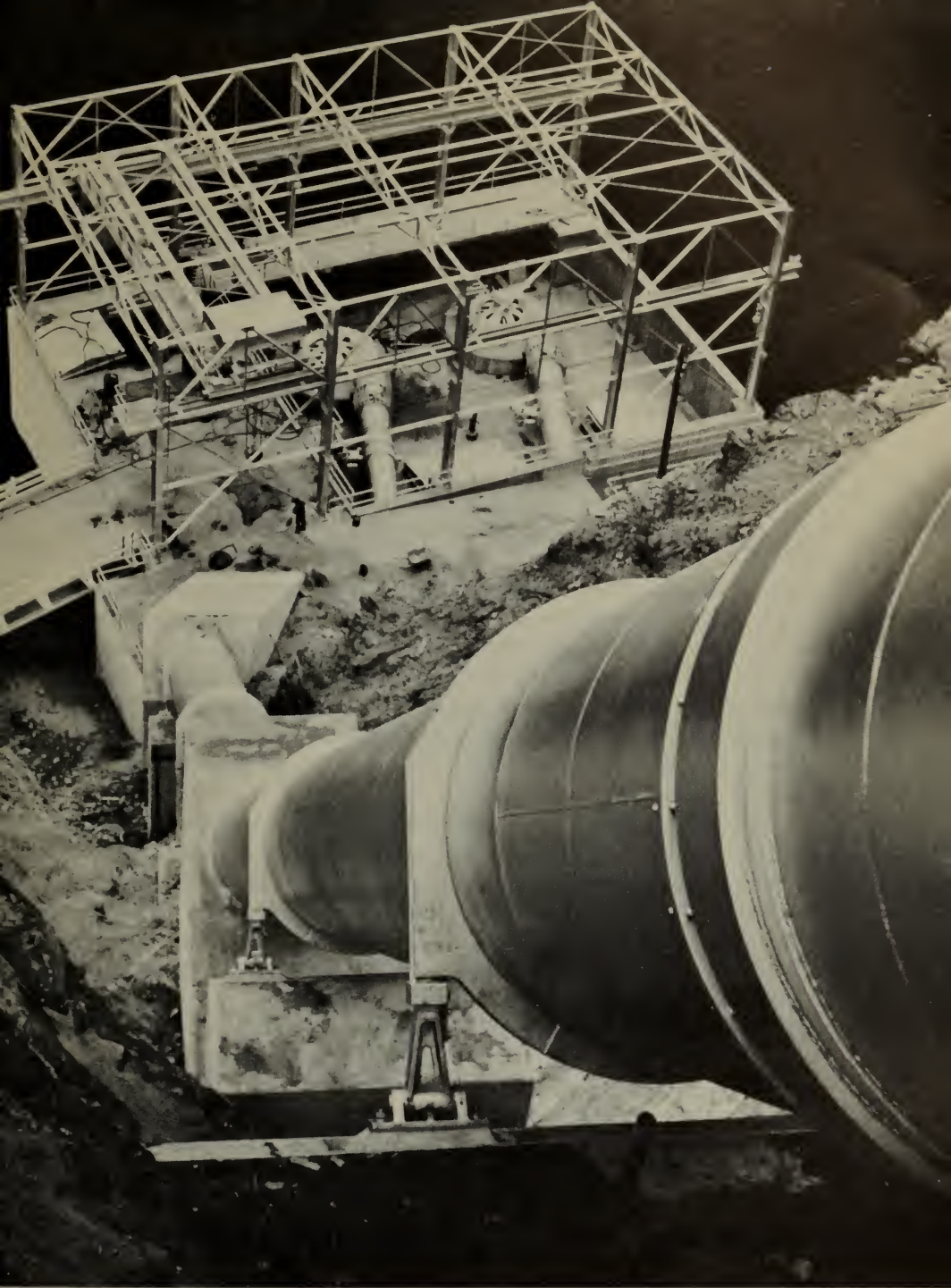
Other major events of the fiscal year included the placing in operation of the 16,000-kilowatt Green Springs powerplant on the Rogue River Basin project in Oregon and the completion of Vega Dam on the Collbran project in western Colorado and the Fort Cobb Dam in western Oklahoma.

A highlight of the year was the dedication in October 1959 of the Power System Operations Office Building at Watertown, S. Dak., a feature of the Transmission Division of the Missouri River Basin project. The operations office is the "nerve center" of the entire eastern division of the Federal power system in the Missouri River Basin. The office controls the transmission of the power from 5 powerplants over 3,700 miles of transmission lines, through more than 80 Federal substations, to 125 wholesale customers in an area of more than 270,000 square miles in Montana, North and South Dakota, Nebraska, Minnesota, and Iowa.

The year will also be remembered for the celebration of the Golden Jubilee of the Lower Yellowstone project in Montana and North Dakota—50 years of progress on the project since the first water for irrigation was made available in 1909.



Workmen on the 230-kilovolt bus structure in the substation yard at the Watertown substation, South Dakota.



The Helena Valley pumping plant, located about 500 feet downstream from Canyon Ferry dam on the left bank of the Missouri River, is the throbbing pulse that will provide irrigation water for the Helena Valley Unit and the supplemental supply of municipal water for the city of Helena.

Other important events included the completion of Keene Creek Dam on the Rogue River Basin project in Oregon, the enlargement of the Little Wood River Dam on the Little Wood River project in Idaho, and the Southside Tunnel on the Collbran project in Colorado.

Start of construction on four major earthfill dams was made during the year—Prosser Creek Dam on the Washoe project, California-Nevada; Twin Buttes Dam on the San Angelo project in Texas, Gray Reef Dam on the Glendo Unit of the Missouri River Basin project in Wyoming, and Sherman Dam on the Farwell Unit of the Missouri River Basin project in Nebraska. A major contract was awarded for construction of the Red Willow Dam, an earthfill feature of the Frenchman-Cambridge Division of the Missouri River Basin project in Nebraska.

Columbia River Basin

Irrigation facilities on the Columbia Basin project in Washington were completed to serve an additional 25,000 acres, bringing the total to 411,000 acres. Also completed were the enlargement of two reaches of the Potholes East Canal, the Sand Hollow Pumping Plant for the Royal Branch Canal lateral system in Block 83, the Royal Branch Canal lateral system in Block 82, the second section of the Wahluke Branch Canal, the Block 201 lateral system, and the White Bluffs Pumping Plant No. 2.

In Oregon, in addition to completion of the 16,000-kilowatt Green Springs Powerplant, construction progress was noted by completion of the earthfill Keene Creek Dam, Green Springs Power Conduit, and the Ashland Lateral and Phoenix Canal Diversion Dams. Also completed on the project were the second section of the Howard Prairie Delivery Canal, the Green Springs and Cascade Divide Tunnels, and a part of the South Fork Collection Canal system. Another section of the South Fork Collection Canal system was about two-thirds completed. Enlargement of Emigrant Dam was about two-thirds completed by the end of June 1960.

Construction of the earthfill Wasco Dam on the Wapinitia project in Oregon was completed. Construction of the earthfill Prineville Dam on the Crooked River project was virtually completed by the end of the fiscal year. Also completed was the enlargement of the Little Wood River Dam, an earthfill structure on the Little Wood River project in Idaho.

Central Valley of California, Labontan Basin, and Coastal Areas

More than 24 million cubic yards of the 33-million cubic-yard embankment for Trinity Dam were placed. The dam, the world's high-

est earthfill dam, on the Trinity River Division of the Central Valley project in California, is to be 537 feet high. The contract for construction of the dam was 87 percent completed, well ahead of schedule, by year's end. Clearing of 9,800 acres of the reservoir was essentially completed, and clearing of another 5,600 acres was about 50 percent completed. The contract for excavation and concrete lining of the 10.8-mile, 17.5-foot-diameter Clear Creek Tunnel, was about 78 percent completed at the end of June 1960, in 70 percent of the contract time. On June 30, less than 1,000 feet separated the headings in the tunnel, second largest tunnel on a Reclamation project; hole-through was achieved early in August 1960.

Other construction on the Central Valley project included construction of pumping plants and pipeline lateral system for the Tea Pot Dome Water District of the Friant-Kern Canal distribution system, which was started in January 1960, and was about 35 percent completed by the end of the fiscal year. Construction of the Corning Canal Pumping Plant was about 80 percent completed. Installation of new armature windings for two generating units of the Shasta Powerplant was completed in April 1960, and the units were returned to service.

Also on the Central Valley project, near the end of the fiscal year, contracts were awarded for the 2½-mile-long Spring Creek Tunnel and siphon and for Trinity and Clear Creek powerplants. Initial power generation is scheduled for February 1963. Specifications for Whiskeytown Dam were issued.

Solano and Ventura River projects are virtually complete and both have been transferred to operation and maintenance status. A part of the Solano project and all of Ventura River project are being operated by the water users.

Construction of the San Luis unit as an integral part of the Central Valley project was authorized by Public Law 86-488. This addition will ultimately serve an additional 458,460 acres with irrigation water. A joint-use agreement with respect to construction and operation is being developed with the State of California.

A new start of the fiscal year was the beginning of construction of the Prosser Creek Dam on the Washoe project, near the California-Nevada State line. The earthfill dam will be 157 feet high and have a volume of 1,738,600 cubic yards.

Lower Colorado River Basin

Hoover Dam passed its 25th anniversary. Authorized on December 21, 1928, and completed on May 29, 1935, when the last concrete was placed, this pioneer reclamation multipurpose river control project has captured and stored about 300 million acre-feet of Colorado



Cantaloupes grown on the Yuma Project—oldest Reclamation development on the lower Colorado River—are a favorite delicacy on dinner tables throughout the Nation, and project farmers in 1959 produced cantaloupes on nearly 13,000 acres of land valued at over \$6 million.

River flood waters. This storage has irrigated up to three-fourths million acres of farmland in California and Arizona each year—producing a cumulative crop value of \$2.25 billion. Since the first generator went on the line in 1936, Hoover hydroelectric units have delivered 98 billion kilowatt-hours of energy with a gross revenue of \$182.5 million.

Installation of the 17th and final generating unit—N-8—for the State of Nevada in the Hoover powerplant got underway following earlier awarding of major contracts for its manufacture. Rated at 95,000 kilowatts and raising the Hoover powerplant's rated capacity to 1,344,800 kilowatts, N-8 is scheduled to go on the line in the Fall of 1961—approximately 25 years after the first Hoover generator began operation.

The total fiscal year 1960 output by Hoover, Davis, and Parker Dams on the Lower Colorado River of 5.25 billion kilowatt-hours represented 12 $\frac{2}{3}$ percent of all electrical energy consumed in the Pacific Southwest.



Highscalers drill on the canyon wall just above the rushing water as it pours from the right diversion tunnel.



Aerial view looking downstream at Glen Canyon Dam site as excavation work has been almost completed. The upstream cofferdam is 160 feet high.

Reclamation's hydraulic cutter dredge completed a 19.2-mile stretch of new channel on the Colorado River between Needles, Calif., and Big Bend, below Davis Dam. The dredge cut about 5 miles of new channel and removed about 5.25 million cubic yards of riverbed material during the year. Some 31.5 miles of new channel have been completed in the Needles stretch of the river since the dredge began operations there early in 1949.

Sheep Creek barrier dam in the Paria River basin was completed. The structure will reduce silt inflow to the Colorado River below Glen Canyon Dam.

Major contracts were awarded for 61 $\frac{2}{3}$ miles of main conveyance channel and the 10-mile Snyder Ranch conveyance channel on the Wellton-Mohawk division of the Gila project, Arizona. This work is part of the drainage program for the Wellton-Mohawk Irrigation and Drainage District under a \$14-million amendatory repayment contract, which is the largest single drainage contract in reclamation's history.



Secretary of the Interior Fred A. Seaton pulls the lanyard tripping the bucket and releasing the first 12 yards of concrete onto the floor of Glen Canyon.

Rehabilitation and betterment work on the Salt River project in central Arizona continued at the rate of \$1 million per year. The Bureau has contracted with the Salt River Valley Water Users' Association for \$16 million of this work. Approximately \$9.5 million has been expended as of June 30, 1960.

The city of Yuma, Ariz., was assured an annual water supply from the Colorado River of 50,000 acre-feet under a contract executed with the Department of the Interior.

Upper Colorado River and Bonneville Basins

A major highlight of the year was the placement on June 17, 1960, of the first bucket of concrete in the Glen Canyon Dam, principal feature of the Colorado River storage project on the Colorado River in northern Arizona. Although the 6-months' strike from June 6 to

December 22, 1959, halted all construction at Glen Canyon damsite, the prime contractor was able to complete keyway and foundation excavation and construction of the aggregate, refrigeration, and batch plants so that regular concrete placement could begin in June 1960.

When completed, the 710-foot high concrete arch structure will have a volume of about 5 million cubic yards. Work under the contract for the dam and the 900,000-kilowatt Glen Canyon powerplant was about 35 percent completed.

Construction of the storage project's 490-foot high concrete arch Flaming Gorge Dam on the Green River in northeastern Utah, was about 30 percent completed by the end of the fiscal year. The flow of the Green River at the damsite was diverted through the diversion tunnel in November 1959, thus clearing the damsite for foundation and keyway excavation. By June 1960, foundation excavation in the river channel neared completion. The contractor continued erection of his concrete batch plant, aggregate plant, and overhead cableways for start of concrete placement in fiscal year 1961.

Construction of the earthfill Stanaker Dam on the Central Utah project, a participating project of the Colorado River storage project in Utah, was about 50 percent completed. All concrete work was essentially completed and approximately half of the 1,945,000-cubic-yard embankment was in place. On the Weber Basin project, also in Utah, construction of 3 trunklines and 4 pumping plants to distribute water from the Davis Aqueduct was completed, as was also construction of the Bountiful Subdistrict Lateral System. The Ricks Creek Lateral System and part 1 of the Woods Cross lateral system were virtually completed. Construction of the first stage of the earthfill Willard Dam was completed, and work on the second stage was about one-third completed.

In western Colorado, on the Collbran project, the 150-foot high, 926,000-cubic-yard earthfill Vega Dam was completed. Also completed was the half-mile long Southside Tunnel. Construction of the first 21-mile section of the Southside Canal and the remaining 11.6-mile section of the canal was about 30 percent completed. Construction continued on the 8,640-kilowatt Upper Molina powerplant and on the 4,860-kilowatt Lower Molina powerplant, as well as on the 5.6-mile long Bonham pipeline and the 5.5-mile long Cottonwood pipeline. Late in the fiscal year, construction began on the Leon and Park Creek Feeder Canal System.

At Paonia Dam, on the Paonia project, also in western Colorado, work during the year proceeded on the completion of the highway relocation, excavation for the spillway, placing concrete lining in the outlet works tunnel, and construction of the stilling basin preparatory to diverting Muddy Creek. The flow of Muddy Creek was

diverted through the completed tunnel and stilling basin during May 1960. Following diversion, excavation for the dam foundation was completed. Placement of the 210-foot high, 1,266,000-cubic yard earthfill embankment was scheduled to begin early in fiscal year 1961.

At Navajo Dam in northwestern New Mexico, the flow of the San Juan River was diverted through the outlet works in January 1960. By the end of the fiscal year, approximately one-half of the 26-million cubic yard earthfill embankment had been placed. The entire work on construction of the 408-foot-high dam, principal feature of the Navajo unit of the Colorado River storage project, was approximately 60 percent completed in 42 percent of the contract time.

The first construction contract on the Hammond project (New Mexico) was awarded in June 1960. The start of actual construction on the Seedska-dee project (Wyoming) was delayed by the problems associated with the discovery of valuable trona deposits underlying a large portion of the project area.

Construction of the Eden project (Wyoming) was completed. On the Weber Basin project (Utah), the second phase of Willard Dam was started, and work was continued and/or completed on a number of lateral systems to distribute water from the Davis and Weber aqueducts. Particularly significant was the payment of the first construction installment of \$198,873 on the Weber Basin project under the terms of the repayment contract with the Weber Basin Water Conservancy District.

Rio Grande and Arkansas River Basins

The most significant construction activity was the award of the prime contract for Twin Buttes Dam and the beginning of construction of the San Angelo project. The principal use of the 134-foot-high, earthfill dam and reservoir will be for a municipal and industrial water supply for the city of San Angelo, Tex. Ground-breaking ceremonies were held at the damsite on June 22.

Fort Cobb Dam on the Washita Basin project, Okla., was completed and the aqueduct system for municipal and industrial water for several Oklahoma cities was nearing completion. Construction of the Foss Dam, a 10,567,000-cubic-yard earthfill dam, was ahead of schedule and contract was awarded for construction of a 50-mile aqueduct system for municipal and industrial water supplies for several Oklahoma cities.

Planned recreational facilities around Fort Cobb dam and reservoir were practically completed.

Rehabilitation of existing irrigation and drainage work was begun on one of the Bureau's oldest projects—Rio Grande project,



Enough hydroelectric energy to supply five cities the size of Minneapolis, Minn., routed over 3,700 miles of transmission line for distribution over a 270,000 square mile area—that is the weekly, daily, hourly job of the dispatchers pictured at the console of the instrument board in the main system dispatchers office, Watertown, S. Dak.

Texas-New Mexico—and continued satisfactorily on several divisions of the Lower Rio Grande project, Tex.

A joint program with the Corps of Engineers and the Bureau of Reclamation for channelizing of the Rio Grande above the Elephant Butte Reservoir continued during the year. This work involves straightening the channel, providing floodways, and placement of protective features, all of which are designed to improve control of the river, protect irrigation project features and lands through which the river flows.

Construction of the Norman project, Okla., was authorized by Public Law 86-529. This project when constructed will provide needed domestic water for three Oklahoma communities and an important air base and will contribute substantial flood control and fish and wild-life benefits.

Missouri River Basin

In Wyoming, construction of the structure for the 48,000-kilowatt Fremont Canyon powerplant was completed, and lining of the 3-mile



Aerial view of the Kirwin Development Farm. The Kirwin Main Canal is at left and the farmstead at upper right.

long, 18-foot diameter power conduit was completed. Also in Wyoming, more than 60,000 cubic yards of the concrete was placed in the 203-foot high, 66,000-cubic yard Anchor Dam, Owl Creek unit, Missouri River Basin project. By the end of June 1960, the concrete was only about 17 feet below the final crest height. All mass concrete is expected to be in place early in fiscal year 1961.

On the Glendo unit of the Missouri River basin project, construction of Gray Reef Dam was started. This will be an earthfill structure on the North Platte River, and will be 36 feet high and have a volume of 49,000 cubic yards.

A new irrigation start was the 50,000-acre East Bench unit in Montana. Laterals, drains, and canal lining on the Helena Valley unit, and rehabilitation of Sherburne Lake Dam of the Milk River project, Mont.; modification of the outlet works for Shadehill Dam, on the Grand River, S. Dak.; and construction of the left abutment outlet works and rehabilitation of the penstock intakes, Buffalo Bill Dam, Shoshone project, Wyo., were also among the major construction activities during the fiscal year.

Another new start was Sherman Dam on the Farwell unit of the Missouri River basin project in Nebraska. The earthfill dam will be 97 feet high and have a volume of 1,700,000 cubic yards. About 300,000 cubic yards of embankment was placed by the end of the fiscal year.

On the Frenchman-Cambridge division of the Missouri River basin project in Nebraska, reconstruction of the old Culbertson Canal was continued; reconstruction of the last section of the old canal was about 90 percent completed when work was halted, until after the close of the 1960 irrigation season. Construction of the new Culbertson Extension Canal under two contracts was in progress during the year.

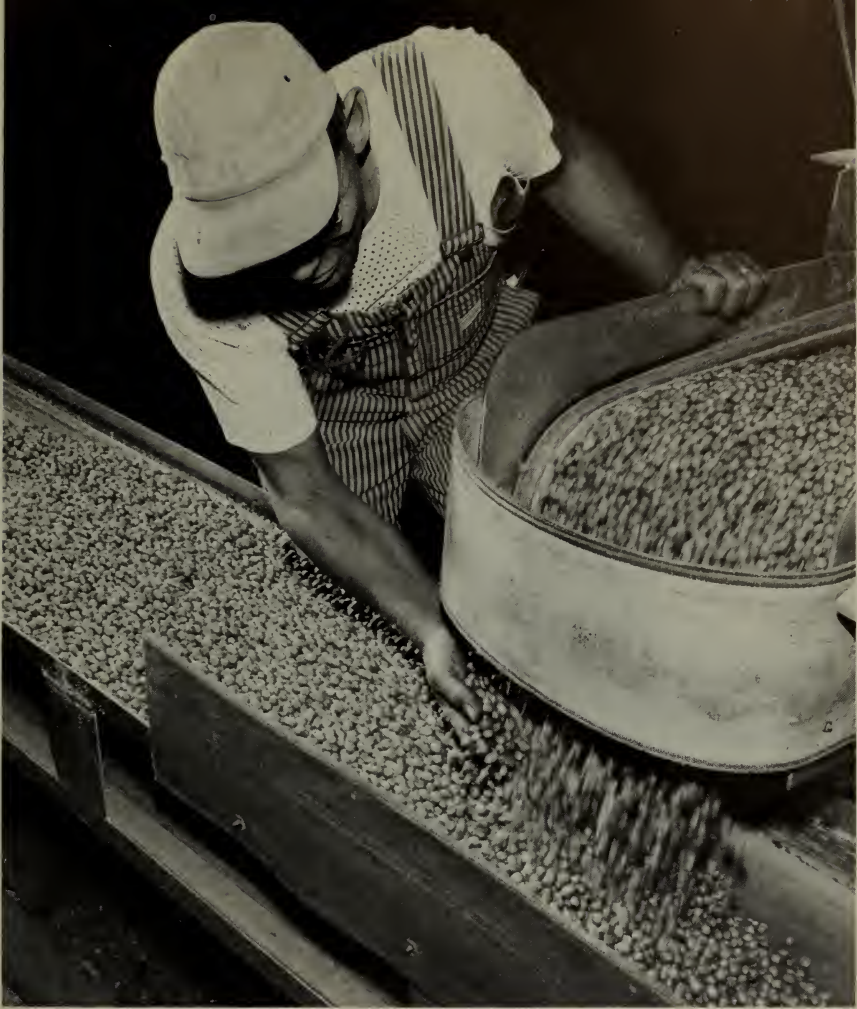
Work on the Bostwick division of the basin project in Kansas was noted by the completion of the 5.5-mile-long White Rock Canal. Work was started on the 8.6-mile-long White Rock Extension Canal and 6.9 miles of laterals. Also in Kansas, on the Kirwin unit, the 13.9-mile-long third section of the Osborne Canal and 17 miles of laterals were completed, and work was started on the 10.5-mile-long fourth section of the canal and 12.8 miles of laterals and drains.

Safety in Heavy Construction

The Bureau continued to maintain its safety program for the prevention of accidents associated with the hazards of heavy construction work. Efforts were directed toward prevention of injuries and loss of life by eliminating the physical and personal causes of accidents. The overall accident frequency rate was 10 percent below the national average for heavy construction, despite the fact that hazardous tunnel work on Reclamation projects accounted for 11 percent of the total man-hours worked.

Bidding Is World-Wide

Competition from European manufacturers under invitations for equipment issued by the Bureau of Reclamation increased over that of the past 2 years. Twenty-three contracts were awarded to companies offering foreign-manufactured equipment, including 9 Italian, 4 West German, 4 Swiss, 3 Austrian, 2 English, and 1 French. Sixteen of these contracts were for electrical equipment. The remaining seven contracts were for gates, valves, pumping units, a crane, and a hoist, indicating increasing interest in such equipment by foreign manufacturers.



As the farmlands develop on the project, a great many processing plants are built to handle the produce from irrigated lands. These peas have just been shelled and will be packaged and frozen.

The following tabulation shows a comparison of contracts awarded for foreign equipment during the past 5 fiscal years.

Fiscal year	Total contracts	Total value
1956.....	41	\$2,256,057
1957.....	26	1,387,693
1958.....	21	965,867
1959.....	18	899,076
1960.....	23	2,234,972

Bids were received for the first time from companies offering equipment manufactured in Japan. Bids were received from Japanese manufacturers for the Glen Canyon, Flaming Gorge, and Trinity powerplant turbines. The contract for channelization of the Rio



Citrus, a Reclamation health food crop. Nearly 300,000 acres of reclamation project lands are utilized for production of apples, peaches, grapes, citrus and other fruits. Citrus acreage has tripled in 30 years.

Grande, Belen Area unit 2, Middle Rio Grande project, N. Mex., was awarded on the basis that foreign steel would be used in the jetty units. In accordance with regulations, a differential was added to foreign bids for comparison with domestic bids.

Construction Costs Decline

Construction costs on Bureau of Reclamation projects decreased about 2 percent during fiscal year 1960. For the same period, construction wage rates increased about 5 percent, while most construction material costs remained fairly stable.

Bidding interest in reclamation construction work remained high; an average of 7.4 bids was received on each construction schedule advertised. The average low bid was 16 percent below the engineers' estimate.

Table 1 of the appendix lists major construction and supply contracts (more than \$1,00,000 each) awarded by the Bureau of Reclamation in fiscal year 1960.



West's livestock winters and fattens in irrigated stream valleys. More than 70 percent of reclamation project lands are utilized for grain and forage for livestock operations.

Principal features completed on Bureau of Reclamation projects in fiscal year 1960 are shown in table 2 of the appendix. The list includes 5 storage dams, 2 diversion dams and 159 miles of canals, pipelines, laterals, and drains, as well as 202 miles of transmission lines.

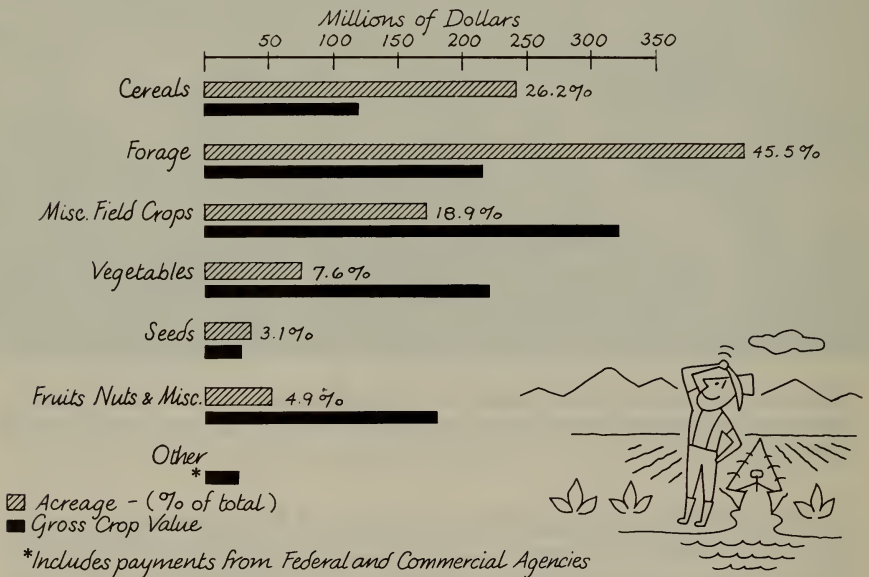
Dependable Water Means Diversified Crops

The value of all crops on all Bureau of Reclamation projects averaged \$164 per acre in 1959. The highest project average was \$819. Celery topped all crops with an average per-acre value of \$1,928. Details of this agricultural production are provided in tables 3 and 4.

The utilization of over 70 percent of the irrigated lands for the production of 18.4 million tons of forage and grain is indicative of the importance of livestock operations on reclamation farms.

Favorable trends are evident in the productivity and utilization of the reclamation areas. Crop yields progressively push ahead. Intensification is evident in increasing proportions of vegetables and fruit acreages.

Reclamation complements the Nation's agricultural plant in producing the fruits, vegetables, livestock, and livestock products—the protective, body-building foods rich in protein, vitamin A and the three B vitamins, needed for adequate diets of many of our people. Nearly 10 billion pounds of vegetable crops were produced by reclamation farmers in 1959. Vegetable cropping used only 8 percent of the irrigated land but produced one-fifth of the crop value. Much of this production is for the fresh vegetable market of late fall, winter, and early spring when only limited production is available from nonirrigated areas. The market value of these crops does not fully represent their true value in terms of benefits of balanced and attractive year-round diets.



Converting Water Into Power

In order to utilize to the greatest advantage the water supplies made available by multipurpose reservoirs, the Bureau of Reclamation in its program of aiding in the developing of America's water resources has constructed and, as of June 30, 1960, is operating 41 powerplants with an installed nameplate capacity of 5,151,550 kilowatts. In addition, the Bureau is responsible for marketing the power generated at four powerplants constructed by the Corps of Engineers with a total installed nameplate capacity of 745,035 kilowatts and one powerplant installed by the International Boundary and Water Commission, with a total nameplate capacity of 31,500 kilowatts.

Sale of electric power by the Bureau during the year aggregated 26,840,676,301 kilowatt-hours, with revenues from sales totaling \$68,754,385.

During the fiscal year ending June 30, 1960, the installed nameplate capacity of hydroelectric powerplants at Bureau of Reclamation multipurpose projects and at projects for which the Bureau is responsible for marketing the power was increased 16,000 kilowatts. Also the Old Eklutna hydroelectric powerplant in Alaska with a nameplate capacity of 2,000 kilowatts was sold during this period. This resulted in a net increase of 14,000 kilowatts in installed nameplate capacity over the fiscal year 1959 figures.

Additional Power on Way

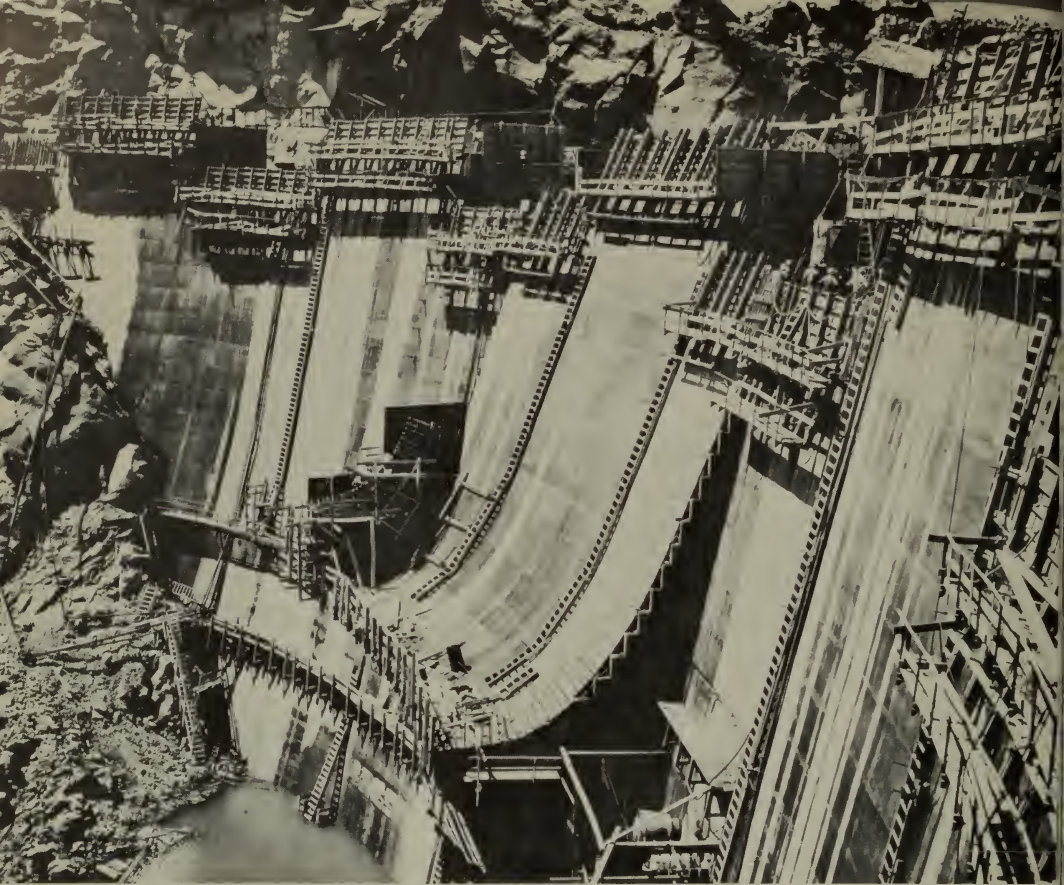
At the end of fiscal year 1960, the Bureau of Reclamation had under construction 8 powerplants, which will have an ultimate installed nameplate capacity of 1,453,500 kilowatts. They are listed below:

Plant	Project	River	State	Nameplate capacity (KW)
Clear Creek.....	Central Valley.....	Trinity.....	California.....	134,000
Spring Creek.....	do.....	do.....	do.....	150,000
Trinity.....	do.....	do.....	do.....	100,000
Upper Molina.....	Collbran.....	Colorado.....	Colorado.....	8,640
Lower Molina.....	do.....	do.....	do.....	4,860
Glen Canyon.....	Colorado River storage.....	do.....	Arizona.....	900,000
Flaming Gorge.....	do.....	Green.....	Utah.....	108,000
Fremont Canyon.....	Missouri River Basin.....	North Platte.....	Wyoming.....	48,000

The United States Army Corps of Engineers is proceeding with the construction of its Big Bend and Oahe plants in the Missouri River basin project. The ultimate installed nameplate capacity of the Big Bend and Oahe powerplants in South Dakota will be 468,000 kilowatts and 595,000 kilowatts, respectively. The Corps is also installing 2 additional generating units each in its Fort Peck and Garrison powerplants, thereby increasing the capacities of these plants by 80,000 kilowatts and 160,000 kilowatts, respectively. The Bureau of Reclamation will be the marketing agent for energy generated from these plants as in the case for other plants constructed by the Corps on the Missouri River basin project.

Transmission System

To provide the electrical energy for the Bureau's projects and to market the power which is surplus to the Bureau's needs, a transmission system including powerplant substations, switchyards, and transmission lines, has been constructed. During the fiscal year end-



New storage dam for Wyoming's Bighorn basin. Concrete emplacement goes forward on downstream face of Anchor Dam, a 208-foot-high, thin arch structure.

ing June 30, 1960, approximately 202 circuit miles of transmission lines were completed resulting in a total system of 10,151 circuit miles of line. As of June 30, 1960, the installed transformer capacity of the individual substations operated by the Bureau was 11,535,218 kva.

Important progress was made on the backbone transmission system for the Colorado River storage project. Extensive discussions with both the private power utilities and the preference power-user groups, regarding plans for transmission lines to interconnect the storage unit dams and to serve the anticipated market area, culminated in the announcement of the proposed Colorado River storage project power marketing area and criteria by the Secretary of the Interior on May 18, 1960.

Erection of steel towers for the 105-mile-long steel tower Fort Peck-Dawson County section of the 310-mile-long, 230-kilovolt transmission line, which extends from Fort Peck powerplant in Montana to Bismarck, N. Dak., was completed. Construction of footings and erection of steel towers for the 205-mile-long Dawson County-Bismarck section were essentially completed by June 1960. Stringing of

conductors and overhead ground wire for the 310-mile line was to begin early in fiscal year 1961. The line, which includes both the Fort Peck project and the transmission division of the Missouri River basin project, is expected to be ready for service in January 1961. Also completed was the 165-mile, 230-kilovolt steel tower transmission line between Fargo, N. Dak., and Granite Falls, Minn. In Wyoming, the 37-mile-long, 115-kilovolt Boysen-Pilot Butte transmission line was completed. Under construction during the year was the 100-mile-long, 230-kilovolt Bismarck-Jamestown transmission line No. 2 and the 84-mile-long, 230-kilovolt Jamestown-Fargo transmission line No. 2, both in North Dakota. In Wyoming, construction of the 140-mile-long, 115-kilovolt Kortess-Cheyenne transmission line was about 75 percent completed.

Sale of Power

During fiscal year 1960 there were 144 contracts executed for the sale of power, for transmission service or for other purposes.

Included in these 144 contracts were various types as follows:

<i>Number of Contracts:</i>	<i>Types of Customer</i>
32-----	Private utilities
43-----	REA cooperatives
37-----	Municipalities
8-----	Federal agencies
10-----	State agencies
7-----	Irrigation districts
7-----	Miscellaneous type contracts

A number of the contracts executed were renewals of operating contracts or revisions of existing contracts resulting from a change in operating conditions.

The Bureau continued its policy of contracting whenever possible with private utilities, public bodies and cooperatives for wheeling power and energy over existing facilities. The Bureau also entered into several interchange agreements with its customers.

The Bureau at the end of fiscal year 1960 had 43 contracts under active negotiation. In this number are included 12 contracts with private utilities, 11 with REA cooperatives, 11 with municipalities, 3 with Federal agencies, 5 with State agencies, and 1 with an irrigation district. A number of these are to renew the existing contracts or to revise contracts in existence due to changes in operating conditions.

The recently approved allocations for the Central Valley project and the eastern division of the Missouri River basin project will require the preparation of new contracts or supplements to existing contracts with the allottees.



Missouri River basin project—Kansas. Aerial view of the Kansas-Bostwick Irrigation Development Farm.

A Forward Look at Water Project Development

During the year the Bureau, in cooperation with other agencies, was engaged in comprehensive surveys in 14 river basins throughout the West, including three subbasins of the Missouri River basin. Miscellaneous general studies were essentially completed in several of these basins and subbasins such as the Kootenai River basin in Montana, the Lower Klamath River and adjacent basins in California and Oregon, and the Pecos River basin in New Mexico and Texas. Studies were also essentially completed on the Bighorn basin division in Wyoming and the South Platte River basin in Colorado, Wyoming and Nebraska—subbasins of the Missouri River basin.

Project Planning Reports

By the end of the year project planning reports had been submitted to Congress on the Mann Creek project in Idaho; the San Juan-Chama project in New Mexico and Colorado; the western division of

The Dalles project in Oregon; the Garrison diversion unit, Missouri River basin project in North Dakota; the Pine River project extension in Colorado; and Ruedi dam and reservoir, Fryingpan-Arkansas project in Colorado.

Planning reports on Agate dam and reservoir, Rouge River basin project, Oreg., and Savery-Pot Hook project, Colo. and Wyo., were transmitted to States and Federal agencies, and were under review at the end of the fiscal year, prior to submission to the Bureau of the Budget.

In addition, the planning report on the Oroville-Tonasket unit, Chief Joseph Dam project, Wash., was transmitted to and was under review at the end of the year by the Bureau of the Budget, to determine its position in relation to the President's program prior to submission to the Congress.

During the fiscal year definite plans for authorized projects were completed on the Florida project, Colo., a participating project of the Colorado River storage project; the Greater Wenatchee division of the Chief Joseph Dam project, Wash.; and the Kanopolis unit, Missouri River basin project, Kans.

The Central Utah Projects Office was established at Provo, Utah, to handle the accelerated planning program for the Central Utah project—the largest participating project of the Colorado River Storage project.

Review has been completed by interested Federal agencies and Alaska on the planning report for the Crater-Long Lakes division of the Snettisham project.

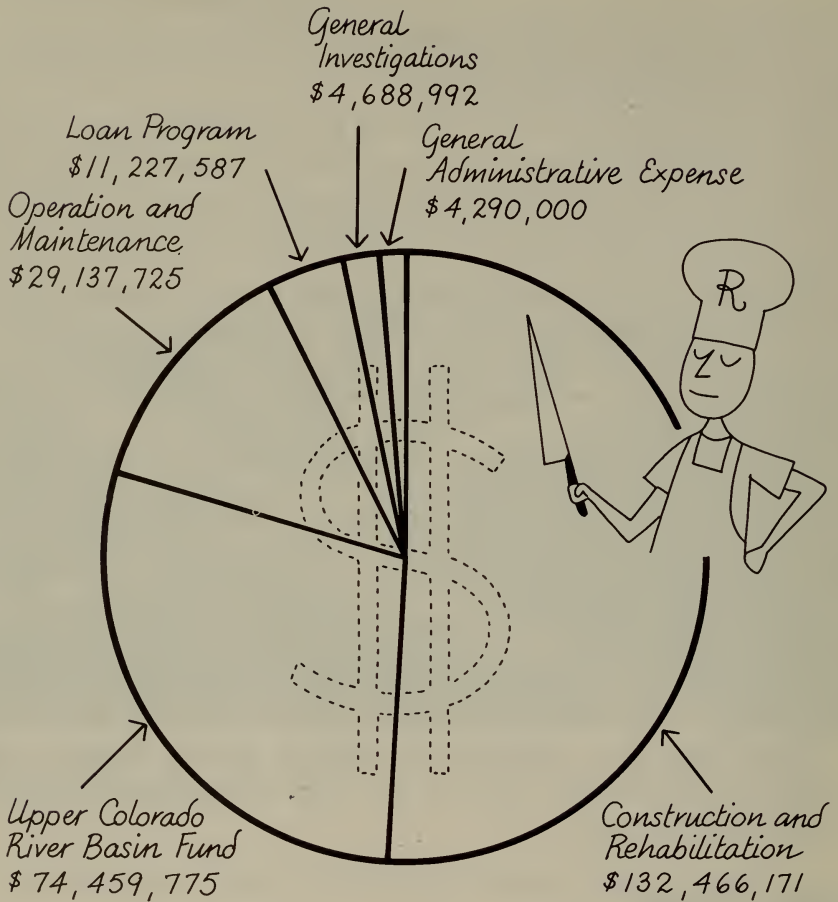
River Compacts

When called upon, the Bureau has continued to provide technical assistance with respect to negotiations on the following unperfected inter-State compacts:

- Arkansas River (Arkansas and Oklahoma).
- Arkansas River (Kansas and Oklahoma).
- Cheyenne River (Wyoming and South Dakota).
- Columbia River (Idaho-Montana-Nevada-Oregon-Utah-Washington-Wyoming).
- Little Missouri River (Wyoming-Montana-North Dakota).
- Niobrara River (Wyoming-South Dakota-Nebraska).
- Red River (Arkansas-Louisiana-Oklahoma-Texas).
- Truckee-Carson-Walker Rivers and Lake Tahoe (California-Nevada).

International Streams Investigations

The Bureau of Reclamation is represented on two International Engineering Boards of the International Joint Commission. Under



the reference of January 12, 1948, the Souris-Red Rivers Engineering Board through interested Federal agencies continued the systematic collection and study of hydrologic data and related flood control and irrigation investigations in the Souris, Red, and Missouri River basins.

Financing Western Water Projects

Appropriations made available to the Bureau of Reclamation for fiscal year 1960, exclusive of permanent appropriations, totaled \$256,271,250. This amount includes \$5,903,000 appropriated in two supplemental appropriation acts. Appropriations for 1960 were \$9,543,285 less than was made available for fiscal year 1959. This reduction was due primarily to the substantial completion in 1959 of the Ventura and Solano projects.

Water Users Repay

Contracts for repayment of an appropriate share of the reimbursable costs of a reclamation project are normally prerequisite to the initiation of construction. During fiscal year 1960, more than 40 contracts were executed for repayment, under reclamation law, of Federal costs associated with water resource projects.

The repayment contracts for the Black Butte and New Hogan projects in California achieved two significant firsts. The contracts, executed March 2, 1960, were the first to be negotiated by the Department of the Interior for repayment, under reclamation law, of irrigation costs of a project to be constructed and operated by the Corps of Engineers. They were negotiated at the request of the Department of the Army following an opinion by the Attorney General that Federal reclamation law applied.

The New Hogan and Black Butte contracts are also unusual in that the State of California has assumed the responsibility for the repayment of reimbursable project costs.

This unique Federal-State contract arrangement is without precedent and was possible because the State legislature had previously appropriated \$13,740,000 for these purposes. The State serves as a guarantor while the United States is negotiating contracts with water user organizations. As these contracts are negotiated, the State's obligation will be correspondingly reduced. Beginning with the eighth full calendar year after a project is available for the storage or delivery of water, the State has the right to market the remaining project water supplies. The cost of the Black Butte project is estimated at \$18 million, of which 39.9 percent is assigned to irrigation. New Hogan project is estimated to cost \$17,600,000, with 36.2 percent assigned to irrigation.

The total value of all repayment contracts on June 30, 1960, amounted to \$954,674,498. Of this amount, a total of \$147,926,002 has been repaid and delinquencies were insignificant. In addition, over \$125 million will be returned to the Government in water service payments under contracts now in force.

Small Loans Assist Local Development

There was considerable contract activity in the loan programs during the fiscal year.

Congress appropriated \$4,062,575 for the first year requirements on five projects under the Small Reclamation Projects Act of 1956 having loans totaling \$11,045,000. Construction was initiated on four of these during the year and on one that received funds in the previous

year. Seven other small project applications were approved and forwarded to the Congress. One more was approved by the Secretary but had not yet been forwarded to Congress by June 30. These last eight approved applications represent loans totaling \$25,569,000. Good progress is being made by the four local organizations that started construction in fiscal year 1959 and two of the projects are nearing completion. At the end of the year all applications received had been acted upon within the Department.

Congress appropriated \$7,017,000 for two distribution system loans under Public Law 130, 83d Congress. Both local organizations started construction activities before the end of the year. One of the two distribution systems started earlier was completed and fairly good progress is being made on construction of the other.

Conservation Requires Teamwork

Cooperative work is implemented by means of agreements between the Bureau and the other organizations involved in conservation which now include several agencies within the Department of Agriculture and the State colleges and extension services of the 17 western States and the State of Alaska, as well as many other Federal, State, and local organizations.

During fiscal year 1960 there were 346 such cooperative agreements in effect. They include studies and investigations conducted on development farms, conservation, and efficient use of soil and water, crop and cropping problems, assistance to county agricultural agents, and weed-control studies. They cover also the development and management of reservoir recreational and wildlife areas, and assistance in solving many other problems pertaining to the development and operation of irrigation projects.

Cooperative work also included participation by Bureau representatives on the Interdepartmental Committee on Pest Control, and on the special work group to develop interagency coordination of plans for emergency water resource management for civil defense and defense mobilization.

Soil and Moisture Conservation

One of the principal functions of the Bureau of Reclamation is the efficient application of water to land without waste or erosion. The Bureau encourages agricultural agencies and cooperates with them in research and conducts research directed toward water-saving methods of irrigation, evaporation control, transpiration losses, and seepage control including canal linings.

The Bureau is interested also in soil and moisture conservation on the lands under its jurisdiction such as those surrounding reservoirs or other areas withdrawn or acquired for reclamation purposes.

These operations are directed toward the protection of reclamation-built structures and works from the adverse effects of soil erosion. The work undertaken includes reseeding watershed areas, structural installations, and other means of erosion control stabilization; vegetation control and pest control measures; sand dune control; and installations for the protection of irrigation facilities.

The program objectives are accomplished in cooperation with other Federal agencies, as well as State and local agencies. Water users' organizations also assist in planning the work and in many cases furnish a part of the labor, materials, and funds.

Water and Science Benefit Settlers

Development farms have proved to be an important part of the settlement program on new areas being developed for irrigation. The Bureau's field scale demonstrations and the research conducted by cooperating agricultural agencies on these farms furnish much valuable information for the use of the new settlers, and remove many of the factors which caused hardships and often failures of settlers on earlier developed projects. They also aid in the conservation of soil and water through promoting more efficient use of these important natural resources. This phase of conservation is especially important in view of our increasing population and the decreasing areas suitable for irrigation development.

Development farms are established as far as possible in advance of settlement, usually 2 to 5 years, in order that much of the necessary experience and information will have been obtained when the new settlers arrive. The farms are located in areas which best represent the soils and other conditions of the new project. The sites are chosen and the plans for the development and operation of each farm are formulated in cooperation with agricultural and other interested agencies.

The major portion of each farm is devoted to field scale demonstrations of approved farm irrigation systems, irrigation methods, kinds and varieties of adapted crops, cultural practices, weed control, farm drainage, and solutions to other problems with which new irrigation farmers are faced. From 10 to 25 percent of the area of most of the farms is set aside for research, which is conducted by State college experiment stations and cooperating agricultural agencies such as the Agricultural Research Administration and the Soil Conservation Service. The research may include investigations regarding ferti-

lizer requirements, handling of problem soils, water requirements, plant diseases, insect pests, and other problems peculiar to a particular area. After methods have been developed from the research and thoroughly tested they also are demonstrated on the farms.

Some of the farms have served the additional purpose of aiding in determining the feasibility of projects. The farms which are not operated by the owners are leased to carefully selected experienced farmers as soon as the land is cleared and leveled and the necessary buildings have been constructed. This method of operation has resulted in the farms becoming self-supporting.

There were 10 development farms in operation during fiscal year 1960 and 18 farms previously operated have been discontinued because they have served their purpose. The existing farms are located in the Wellton-Mohawk division of the Gila project, Ariz., and in several units of the Missouri River basin project in regions 6 and 7. Additional farms are proposed for new areas scheduled for development.

The Bureau of Reclamation and other agencies responsible for the development farms work closely with the State college extension services to be certain that the information from research findings and demonstrations is properly disseminated to the new settlers. Hundreds of farmers attend the annual field days and tours at which representatives of the Bureau and the cooperating agencies explain the work in detail. The settlers are encouraged to visit the farms at any time during the year to obtain information. Pamphlets are prepared and distributed which supply data on the crops raised, yields, and other pertinent information. In addition to project farmers the development farms benefit college and high school students who visit the farms with their instructors.

Land Settlement

The Bureau conducted two land openings on the Columbia basin project, Washington State, making available for settlement a total of 39 farm units.

Since the close of World War II, a total of 2,816 farm units, consisting of 271,108 irrigable acres, have been made available for settlement, either by homesteading or by purchase.

Settlers do not pay for the public land which is opened to homesteading. Government-acquired lands are sold to settlers as farm units. In either case, settlers pay to the Federal Government, through an irrigation district, or other recognized water-users' organization, the pro rata share of the construction costs of irrigation facilities built to supply the land with water. They also pay an annual charge for

operation and maintenance of the irrigation works. The construction costs are paid without interest over a long period, usually 40 or 50 years.

Towns Are Born at Reclamation Projects

The Boulder City Act of 1958 established conditions for local self-government by the people of Boulder City, Nev., a town developed in construction of Hoover Dam. The Federal Government transferred to a municipal corporation established under the act, its interest in municipal properties, utilities, and associated facilities. Concurrently residential and commercial properties, owned by the Federal Government, were sold into private ownership, thus creating a basis for complete assumption of the responsibilities of self-government by the newly created corporate municipality.

Ownership of slightly over 21,600 acres of land valued at \$2,393,900 was transferred from the United States to the municipality. Through the sale of federally owned residences in the city, properties having a total appraised value of \$1,224,800 were added to the tax rolls. Municipal electric, water, and sewerage systems, municipal buildings, streets and associated public use areas, together with related equipment and property representing a value of approximately \$2,500,000 were also turned over to the municipality. School buildings in Boulder City, representing a total investment of \$1,552,554 were transferred to the Clark County School District. The Bureau is completing the subdivision of that portion of Boulder City known as Lakeview Addition, pursuant to provisions of the Boulder City Act of 1958. On completion of this work, this last remaining area will be transferred to the municipality.

In connection with construction of the Colorado River storage project, Glen Canyon unit, Ariz., it was deemed necessary to establish a townsite at Glen Canyon damsite in order to provide necessary housing, municipal services and attendant benefits for the construction force employed there. The resultant town of Page, Ariz., is well on its way toward becoming a full fledged municipality. Subdivision has been accomplished, streets have been paved, and public utilities made available throughout the central area. Permanent commercial establishments are now being constructed by a variety of private operators who have taken advantage of the sale of commercial and residential lots to acquire the property necessary for such purposes.

It is currently anticipated that the community will continue to grow during the remainder of the construction period and reach a population of approximately 3,500 inhabitants. Although municipal administration and management is still retained by the United States,

all plans are being made with the objective of facilitating transfer of these functions to an appropriate municipal corporation at the earliest moment. It is thus hoped that with the conclusion of construction, Page, Ariz., will have become established to a degree that will permit its successful continuation as a tourist and recreational center in association with the nearby major project feature and other scenic attractions of the Southwest.

Land-Use Management

During the fiscal year, legal action was initiated by the Department of Justice to evict a number of trespassers on reclamation-withdrawn land along the lower Colorado River in Arizona and California. It was estimated that this illegal use of Federal lands may extend to as much as 27,000 acres. At the time the legal action was taken the Department announced that a land-use program for the lower river area was under consideration.

Water and Money Saved by Maintenance and Research

The review of maintenance program, initiated in 1948 to protect the Government's investment in constructed irrigation works, now provides for the periodic examination of 677 individual structures or irrigation systems on 101 projects. Regularly scheduled field reviews of the maintenance programs for major structures and facilities were made during the year. Also, special examinations were made of specific problems. The periodic examinations provide assurance of the structural safety of individual features and improved operating efficiency of the systems as a whole.

The 677 structures and facilities now subject to examination under the program include 187 storage dams; 117 diversion dams and headworks; 95 major and important pumping plants; 90 features of special importance to particular projects, such as desilting works, siphons, and tunnels; and 188 carriage, distribution and drainage systems. Of the 57 additional structures covered under the review of maintenance program for the first time during the past year, 17 storage and 16 diversion dams and several of the more important pumping plants were included.

Improved maintenance and repair of project works can be judged from the fact that the backlog of urgently recommended actions in the early years of the program has been drastically reduced. There also has been a reduction in the less urgent recommendations. Some of the reduction can be attributed to several project rehabilitation programs now under way on several of the older projects, such as

repair and rehabilitation of Sherburne Lake Dam on the Milk River project, the Buffalo Bill Dam on the Shoshone project, replacement of canal linings on the Salt River and North Platte projects, and the enclosing of many laterals in pipe. Most encouraging, however, is the major repair and rehabilitation being accomplished by the water users as a part of their general maintenance programs. It is generally recognized that the Review of Maintenance Program has been a major factor in this general improvement.

To Build A Better Project

To provide for expanding use of our essentially nonexpandable water resources, the Bureau is engaged in programs to make conservation structures more efficient and to develop ways to cut down on water waste that occurs through evaporation, nonbeneficial use by water weeds, and seepage.

A significant achievement during the fiscal year was the development of standard designs for noncylinder prestressed concrete pressure pipe. The design is expected to be used in the conveyance of water under moderately high pressure and should, under certain hydraulic conditions where this pipe is competitive, produce lower costs for pipelines and conduits for irrigation distribution systems.

A comprehensive review and evaluation of designs of large canals to develop improved methods of determining flow resistance in such canals was initiated during the year. The work was undertaken as a result of findings on the Central Valley project in California, which indicated that the design procedures which had been used satisfactorily to calculate the capacity of small and medium-sized canals may not be adequate for large canals on flat slopes.

Lower-cost Canal Linings

Loss of water through seepage in canals has for many years been of increasing concern to the Bureau of Reclamation and other irrigation interests, especially in the western United States.

Under the Bureau's lower-cost canal lining program, studies were continued to reduce seepage losses from canals and laterals and to prevent the waterlogging of irrigable lands. New developments under the program included experimental installation of plastics as canal linings, methods of detecting seepage, improvement of water measurement, and evaluation of linings installed. The studies showed that plastic materials which were formerly too costly can now be obtained at a cost competitive with other materials for use as buried membranes in lining waterways and reservoirs. Three trial canal

lining installations of plastic materials, each about 500 feet in length, were made during the year.

An electrical logging device, containing some features not usually found on electrical well-logging equipment and better adapted to canal logging, was tested and showed considerable promise as a means of detecting seepage from canals and laterals. The device included self-potential measuring equipment which was used to study water-flow through canal soils by picking up the electrical currents generated by the flow. A field test was also completed in which seepage losses were traced by tritium, an isotope of hydrogen.

Electronic Aids to Reclamation

During the fiscal year an electronic computer was installed in the engineering offices of the Bureau at Denver. The equipment was used to solve a diversity of complex problems requiring high speed computation. Extensive computations were made to speed determinations of canal and roadway earthwork quantities on many projects. Considerable savings in time and effort resulted from the use of the computer equipment for this work. Through the use of the computing equipment, engineers were relieved of making many routine calculations and were able to devote more of their time to professional design work.

Electrical designs were prepared for the Trinity, Clear Creek, and Spring Creek powerplants, to be constructed on the Trinity River division of the Central Valley project. These powerplants are to be supervisory controlled from the project's existing Keswick powerplant. The new plants will be attended only for purposes of maintenance, inspection, or for conditions requiring manual operation. The plants will have pushbutton automatic controls so that the generating units may be automatically started and stopped remotely by supervisory control. Designs were also prepared for the Glen Canyon powerplant main control board. This will be a circular board, the first control board of this type to be used by the Bureau.

In structural design, progress was made in the design of the Trinity, Clear Creek, and Spring Creek powerplants, to achieve maximum economy by duplication and similarity insofar as possible, such as equal crane span and crane capacity, equal column spacing, similar arrangement of transformers, similar superstructures having grouted masonry and steel siding, and other similarities in general arrangement. During the year a program was begun to establish design criteria on the amplitude, frequency, and acceleration of vibrational forces in hydroelectric powerplants.

To supply additional information on the ability of various metals to perform satisfactorily under high-pressure sliding contact, tests

were initiated to determine the friction coefficients and bearing values for various combinations of bronze, monel metal, and stainless steel used in high-pressure slide gates. The data thus obtained were used in specifying improved seating metal for the slide gates at Glen Canyon and Navajo Dams.

Research Reduces Water Waste

Laboratory and field investigations of a monomolecular layer (an invisible chemical film one molecule thick) for reservoir evaporation reduction were continued. Screening tests were made on various fatty alcohols and other film forming materials. Monomolecular layer behavior tests were performed at Boulder Basin of Lake Mead at Hoover Dam, and at Lake Sahuaro at Stewart Mountain Dam in Arizona.

The tests indicated that the persistence of a film on large lakes and reservoirs under reasonable wind conditions may be greater than previously anticipated. A new method by scientists of the Bureau of Reclamation's engineering laboratories at Denver, by which melted material is sprayed from automatic dispensers, was developed for use in reservoir evaporation reduction tests. The method of film formation and maintenance of the film promises to be much more efficient and economical than methods previously used.

Research investigations in the control of aquatic weeds, being performed in cooperation with the Agricultural Research Service of the Department of Agriculture, included the study of copper-bearing antifouling paints (originally developed to prevent marine organisms from adhering to ship bottoms) for the control of algae growth that tends to reduce the capacity of concrete canals and flumes. The results of field and laboratory tests indicated that a number of the paints had excellent algaecidal properties. Increased attention was given to the studies of aquatic weed problems in large canals of the far western States. Solvent type aquatic herbicides were evaluated for their performance in bioassay tests.

A War on Weeds

The comprehensive weed control program conducted by the Bureau of Reclamation is continuing to prove very effective in reducing the problems caused by undesirable vegetation and in decreasing operation and maintenance costs. It also is aiding materially in reducing water losses resulting from transpiration, evaporation, and seepage due to weed growths.

The research program conducted in cooperation with the Bureau by the Department of Agriculture is resulting in the development of more efficient and economical methods of controlling weeds infesting

banks and channels of irrigation and drainage systems. This phase of the program is being accomplished at four field stations in the West, and in the Assistant Commissioner and Chief Engineer's weed control laboratory in Denver. The cooperative research program in the laboratory has been enlarged and now two Bureau of Reclamation and two Department of Agriculture scientists are devoting full time to this work.

The ditchbank seeding program to prevent and control weed growths and erosion was continued with excellent results. The educational program which has been so successful in advising project personnel on new and more economical methods for controlling weeds also was continued through the distribution of motion pictures, slide lectures, manuals, special releases on new equipment, and articles in the Reclamation Era.

Work was continued for developing more effective methods for controlling salt cedar (tamarisk) in the Southwest. Progress was made also in controlling other woody phreatophytes where these plants have invaded irrigation systems, natural water courses, reservoirs, and other areas. These growths not only usurp millions of acre-feet of water so greatly needed for irrigation, municipal, and industrial purposes, but increase flood hazards and take over lands which should be used for grazing and agriculture. It is estimated that in the 17 contiguous western States, undesirable phreatophytes infest over 15 million acres and transpire at least 25 million acre-feet of water. Committees composed of representatives of the Departments of Agriculture and Interior, including the Bureau of Reclamation, are working on this and other weed control problems common to Government agencies.

Much progress has been made in reducing costs and water losses due to weeds on irrigation systems in a comparatively short time through the Bureau's weed control program. It is estimated that in fiscal 1960 the losses due to weeds on irrigation systems were reduced several million dollars annually as compared to 1948. However, all weed problems have not been solved as economically as desired. Therefore, research is being continued as planned to aid in solving this major problem of irrigation systems.

A halogeton control program has been developed in cooperation with other agencies under the provisions of the Halogeton Glomeratus Act (Public Law 529, July 14, 1952) in the interest of increasing the land use value of the lands under the jurisdiction of the Bureau and of protecting the livestock. It is known that this poisonous weed infests Bureau lands in Utah, Nevada, Colorado, Wyoming, and Idaho. Surveys to locate halogeton infestations were continued as were the cooperative investigations to determine the most effective and economical control methods. The actual control programs including

chemical spraying and grass seedings were continued primarily through agreements with the Department's Bureau of Land Management.

Laboratory Studies

Increased emphasis was given to better instrumentation in hydraulic laboratory studies. New equipment utilized included a six-channel direct-writing recorder to measure simultaneously, flow, velocity, pressure, acceleration, vibration, temperature, strain, and other physical phenomena at different points on laboratory and field structures and test facilities.

Epoxy resin compounds for bonding fresh mortar to aged mortar and for making epoxy mortars for use in patching spalled concrete, received considerable attention in laboratory studies. Several compounds were selected for field application. Epoxy resins were also evaluated in other construction materials, such as protective coatings and joint fillers. In laboratory tests, certain epoxy compounds were found to be effective in resisting the damage caused by the erosive force of flowing water.

Laboratory studies on the improvement of quality of aggregates for concrete through the method of separating the unsound material were initiated to find additional ways of improving marginal aggregates for use in Bureau concrete structures. The method involves elastic properties, that is, the rebound characteristics of an aggregate to separate sound, dense particles from less sound particles by the distance of its bounce when it is dropped on a massive, inclined steel plate.

A nuclear instrument for rapidly determining the in-place density and moisture content of soil was evaluated in the laboratories. The instrument utilized radioisotopes in probes which can be placed on or in the soil. After study in the laboratories, the instrument was given field trials on two earth dams. The field test data will be analyzed to determine the accuracy of the instrument and its potential for future use in earthwork control.

Protection of Metalwork

A new device was developed to measure the corrosiveness of soils and waters to iron and steel. The instrument, an electric resistance corrosion meter, was also used to estimate corrosiveness of various other materials and alloys considered for use in highly saline and acidic ground water.

Indicative of increased emphasis on research in protective coatings for metal work was the comprehensive test program initiated during

the year in the 6-foot-diameter siphon piping of the Southside Canal on the Collbran project on the Colorado River. Among the new coatings placed under test in the siphon piping were the "accelerated" or chemically set materials and metalized zinc and zinc-pigmented coatings. Comparison of the new coatings side by side with currently specified coatings is designed to indicate which offer significantly greater durability and economy in preventing corrosion of ferrous materials.

Laboratory and field tests during the year disclosed that a sand-filled vinyl resin paint system is an economical and durable replacement for eroded vinyl paint linings in the invert section of steel pipes carrying sand-laden water. The paint system proved to be one of the best of many evaluated in the laboratory and is suited to new pipe installations as well as to old installations.

During the year an improved vane-type soil testing apparatus was patented by a Bureau research engineer. The invention is used to determine the in-place shearing resistance of soils. A patent application for a Bureau invention covering a method for large-scale application of monomolecular layers of fatty alcohols to water surfaces to reduce evaporation from the surfaces was filed in the Patent Office.

The Behavior of Water

The Bureau's Hydrology Branch continued to study the source of, occurrence of, and use of surface and underground waters where they affect the planning and operation of reclamation projects. For proposed projects, studies are made to determine the amount and usability of the available water supply, to determine the amounts and distribution of sediment transport loads and depositions, and to determine the design flood conditions. Studies also were continued to improve the reservoir operational criteria so as to attain optimum benefits from the standpoint of irrigation, flood control, hydropower, recreation, fish and wildlife resources, and sediment control.

Studies were made to analyze changes in channel regime caused by the installation of structures in streams and by the extraction or addition of water to the natural flow pattern of streams.

Cooperative work with the Department's Geological Survey was continued on the measurement of water consumption by salt cedars in the Salt River Valley of Arizona. Six large lysimeters are being used to measure the water consumption of both beneficial crops and non-beneficial phreatophytes.

The basinwide hydrometeorological study of probable storms for aid in spillway design for the eastern slopes of the Sierra Nevadas

and for the Rogue River basin was continued. Six detailed unit hydrograph studies were prepared for exchange through the Inter-agency Committee on Water Resources.

Cooperative investigations of the effects of land treatment and conservation practices on yield of streamflow were continued with the Agricultural Research Service and Soil Conservation Service of the Department of Agriculture.

Coordination continued with the Corps of Engineers, Department of the Army, in the preparation of flood control operating rules for several Bureau reservoirs. Study was initiated on emergency operating rules for use in spillway design.

Preliminary analyses were completed to evaluate the complex relationships of precipitation and temperature to snowmelt and glacier melt runoff in several Alaskan streams.

Water Research Is a Literate Undertaking

A major publication issued during the year was the comprehensive book, *Design of Small Dams*. The book presents instructions, standards, and procedures for use in the design of small dams. It is intended to serve primarily as a guide to safe practices for those concerned with the design of small dams in public works programs in the United States.

A pamphlet, *Irrigation on Western Farms*, written and published jointly by the Bureau of Reclamation and the Soil Conservation Service, Department of Agriculture, summarizes the technological advances that have been made in irrigation practices within the past 15 years. It retails for 40 cents. *Design of Small Dams* sells for \$6.50. Both books are available at the office of the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., or the Bureau of Reclamation, Attention Code 841, Denver Federal Center, Building 53, Denver 25, Colo.

Also published were technical records on the design and construction of Tecolote Tunnel, Delta-Mendota Canal, Glen Canyon bridge, Cachuma Dam, Folsom powerplant and switchyard, and Kortes Dam and powerplant. An engineering monograph on a rapid method of construction control for embankments of cohesive soil was issued during the year.

The Bureau's research accomplishments during the past 10 years were described in a publication entitled "Research—Engineering Methods and Materials," issued in fiscal year 1960. In addition to summarizing accomplishments, the publication described research in progress and that planned for the future.



One of 22.7 million recreational visits to reclamation reservoirs. Annual recreational use increased 17 percent over 1958 and 139 percent over 1955.

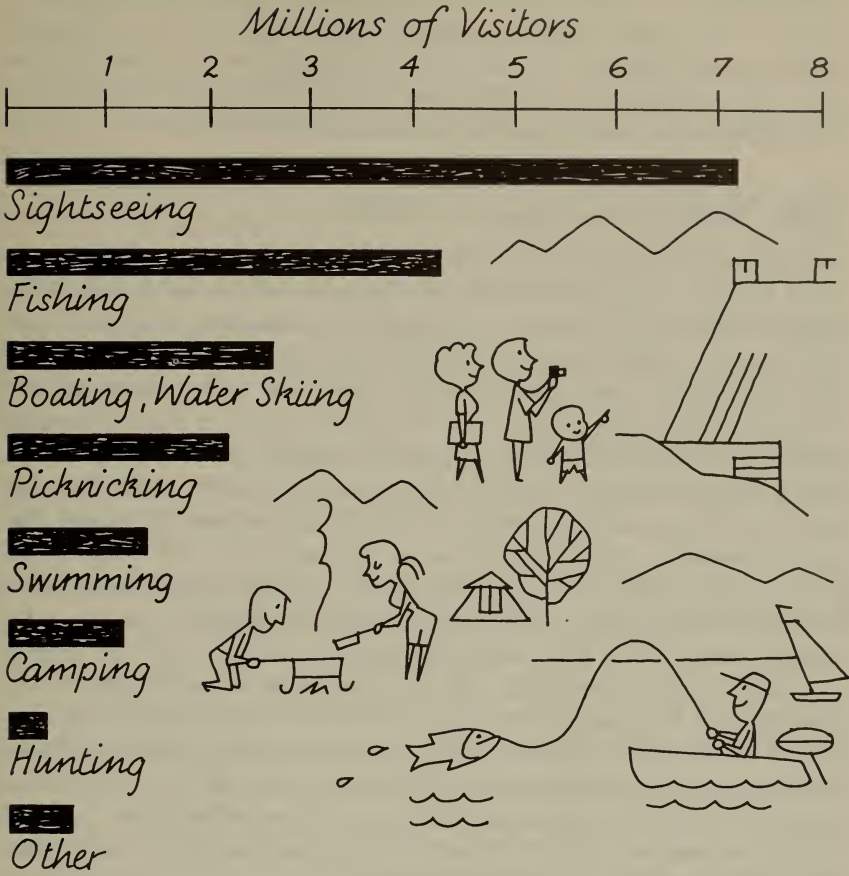
Issued during the year were 139 laboratory reports covering research and testing in concrete and concrete materials, earth materials, hydraulics, bituminous construction, protective coatings, corrosion of metals, structural problems, seepage control, and weed control.

The Public Enjoys Reclamation Reservoirs

Recreation Use Reaches New High

The impressive upsurge in public use of reclamation projects that has been apparent for the past several years continues unabated. In calendar year 1959 recreational use on the 174 reservoirs and other public use areas in the 17 contiguous western States totaled 22.7 million visitor days. The following tabulation shows the principal activities comprising this use:

Activity:	<i>Number of visitor days</i>
Sightseeing-----	8, 608, 348
Fishing-----	4, 797, 574
Boating & Waterskiing-----	3, 438, 909
Picnicking-----	2, 740, 829
Swimming-----	1, 579, 273
Camping-----	1, 061, 670
Hunting-----	346, 766
Other-----	145, 951
Total-----	22, 719, 320



Recreational use during 1959 represents an increase of 3.2 million visitor days over the 19.4 million reported for calendar year 1958, and more than double the use reported in 1955.

The absence of general authority to construct recreational facilities with Federal funds on older projects poses many problems for organizations having responsibility for public use administration of reclamation reservoir areas. These organizations (mostly States and counties or their administrative subdivisions) to which authority for public use administration has been transferred, often find that available funds do not keep pace with increases in public use. These problems generally are not characteristic of nationally significant recreation areas administered by the Department's National Park Service, or reservoir areas within national forests administered by the U.S. Forest Service of the Department of Agriculture. Inequities of the present situation are being recognized on many new projects where nonreimbursable Federal funds have been and are being provided in project

authorizations. An example of this latter situation, where recreation has been recognized in the project authorization, is the Colorado River storage project. If the problem of adequate financing can be overcome reclamation reservoirs will undoubtedly prove to be even more effective in meeting public use demands for recreation.

Better Habitat for Fish and Wildlife

The value of reclamation development for fish and wildlife purposes has been recognized since the beginning of the reclamation program in 1902. The resource potentials of reclamation reservoirs and other project works has been only partially utilized, however, because of limitations in general authority to carry out appropriate fish and wildlife development programs. In specific instances authorizing legislation has provided such authority in connection with certain specific project features. In other instances fish and wildlife developments have been carried forward under State programs through formal agreements with the Bureau of Reclamation. Obviously, programs of this kind have been only partially adequate in utilizing project resources that were appropriate for fish and wildlife.

Enactment of the Fish and Wildlife Coordination Act on August 12, 1958 (Public Law 624, 85th Congress, 2d sess., 72 Stat. 563), strengthened Federal responsibility for fish and wildlife development on new reclamation projects. This act provides that equal consideration be given, in the project development process, to fish and wildlife along with other reclamation functions. New reclamation projects include evaluation of fish and wildlife in the development of project plans and in the allocation of project costs.

A specific fishery enhancement project under this program was the redesign of outlets for the Whiskeytown Dam, on California's Trinity River division, to provide for water releases from two levels in the dam to improve temperature control for the conservation of fish.

Good Neighbor Help for Arid Lands Overseas

At the request of the Department of State, the Bureau of Reclamation entered into an agreement with the International Cooperation Administration to assist the Helmand Valley Authority of the Government of Afghanistan in bringing the Helmand Valley project to a more satisfactory level of operating efficiency. An initial team was assigned to this project to lay the groundwork for an expanded operation for the next 3 to 5 years. This group will provide the Afghans with technical advice and on-the-job training in the operation and maintenance of an irrigation system.

The previously established project undertaking the reconnaissance of the Blue Nile River basin in Ethiopia, as part of the ICA program for that country, was expanded by the end of the fiscal year. Visual reconnaissance of the basin was completed by helicopter, the basic hydrologic net established, and extensive geologic, and preliminary soil classification investigations accomplished.

Continuing activities in support of the U.S. Government's technical aid program consisted of providing on-the-job training of foreign engineers and technicians at Bureau of Reclamation facilities, and the provision of reclamation specialists for short details to various countries on specific problems. The training program has seen 369 people from 35 countries spend from a few days up to a full year in various Bureau offices. The following special groups were included in this program:

1. *FAO Watershed Study Group*.—This group composed of 32 participants from 19 different countries made a 2-month coast-to-coast tour including visits to the Riverton, Central Valley, and Salt River projects.

2. *Japanese Agriculture Productivity Team*.—This group of six Japanese agricultural officials was escorted on a 3-month tour of Bureau projects and other agricultural areas by three Bureau representatives, each accompanying the group for 1 month.

The detailing of Bureau specialists to assist various countries with specific problems involved visits to 12 countries and provided advice on problems of design, construction, operations, farm settlement, geology, and project planning. In addition, extended personnel assignments were continued, providing advisory services on design and construction problems of the Snowy Mountains project in Australia and to completion of the Wu Sheh project in Formosa. All these activities were undertaken at the request of the International Cooperation Administration, the United Nations, or the government of the foreign country involved through the International Educational Exchange Service of the Department of State. Funds to cover all costs of this program are provided by the agency requesting the services.

TABLE 1.—*Major Bureau of Reclamation contracts awarded in fiscal year 1960*

Feature	Project	Amount of award
Twin Buttes Dam.....	San Angelo.....	\$11,836,428
0.2 mile of inlet channel for Spring Creek power conduit, 2.4 miles of tunnels, 2.6 miles of Rock Creek concrete siphon, Trinity River division.	Central Valley.....	11,617,104
Eight 155,500-horsepower hydraulic turbines for Glen Canyon powerplant.	Colorado River storage.....	6,392,000
50.8 miles of pipeline for Foss aqueduct and Clinton, Bessie, and Cordell laterals, Foss division.	Washita Basin.....	3,826,245
Stringing conductors and overhead ground wires for 310 miles of Ft. Peck-Dawson County-Bismarek 230-kv transmission line.	Fort Peck and Missouri River basin.	3,080,053
Red Willow Dam, Frenchman-Cambridge division.....	Missouri River basin.....	3,045,606

TABLE 1.—Major Bureau of Reclamation contracts awarded in fiscal year 1960—Continued

Feature	Project	Amount of award
Clear Creek powerplant, Trinity River division.....	Central Valley.....	\$2, 712, 275
21.6 miles of Wellton-Mohawk main conveyance channel.....	Gila.....	2, 183, 554
Frosser Creek Dam.....	Washoe.....	2, 181, 323
Sherman Dam, Farwell unit.....	Missouri River basin.....	2, 149, 379
Penstocks for Clear Creek and Trinity powerplants, Trinity River division.....	Central Valley.....	1, 667, 464
10.9 miles of Culbertson Extension Canal and 19.6 miles of laterals, wasteways, and drains, Frenchman-Cambridge division.....	Missouri River basin.....	1, 593, 106
22.6 miles of Wellton-Mohawk main conveyance channel.....	Gila.....	1, 422, 720
Constructing foundations and furnishing and erecting steel towers for 57 miles of Oahe-Ft. Thompson 230-kv. transmission line.....	Missouri River basin.....	1, 405, 097
16.1 miles of Culbertson Extension Canal, 19.5 miles of laterals and wasteways, and 1.5 miles of drains, Frenchman-Cambridge division.....	do.....	1, 356, 515
Constructing foundations and furnishing and erecting steel towers for 84 miles of Jamestown-Fargo 230-kv. Transmission Line No. 2.....	do.....	1, 329, 905
48.7 miles of Block 80 laterals and wasteways, West Canal.....	Columbia Basin.....	1, 213, 629
16.5 miles of pipelines for lateral and sublaterals, Tea Pot Dome Water District.....	Central Valley.....	1, 208, 662
Trinity Powerplant, Trinity River division.....	do.....	1, 047, 867

TABLE 2.—Principal features completed on Bureau of Reclamation projects in fiscal year 1960

Feature	Project	State
Potholes East Canal Enlargement.....	Columbia Basin.....	Washington.
4 miles Wahluke Branch Canal.....	do.....	Do.
56 miles Royal Branch Laterals, Block 82.....	do.....	Do.
Sand Hollow Pumping Plant.....	do.....	Do.
Enlargement of Little Wood River Dam.....	Little Wood River.....	Idaho.
Green Springs Powerplant.....	Rogue River basin.....	Oregon.
9 miles Howard Prairie Delivery Canal.....	do.....	Do.
Keene Creek Dam.....	do.....	Do.
Green Springs Power Conduit.....	do.....	Do.
Ashland Lateral Diversion Dam.....	do.....	Do.
Phoenix Canal Diversion Dam.....	do.....	Do.
Wasco Dam.....	Wapinitla.....	Do.
Armature Windings for Shasta powerplant units U-1 and U-2.....	Central Valley.....	California.
Five pumping plants.....	Ventura.....	California.
South Gila Drain No. 2.....	Colorado River front work and levee system.....	Arizona.
Bypass lines for Wellton-Mohawk pumping plants No. 1, 2, and 3.....	Gila.....	Do.
Sheep Creek Barrier Dam.....	Paria River basin.....	Utah.
Vega Dam.....	Collbran.....	Colorado.
Southside Tunnel.....	do.....	Do.
Parking area and utilities for block 17, Page, Ariz.....	Colorado River storage.....	Arizona.
Rehabilitation of Little Sandy diversion works.....	Eden.....	Wyoming.
1st stage earthwork for Willard Dam.....	Weber Basin.....	Utah.
2 trunklines with 4 miles of pipeline and 4 pumping plants on Davis aqueduct.....	do.....	Do.
8 small reservoirs and Bountiful subdistrict laterals, 0.6-mile pipeline.....	do.....	Do.
Channelization of Rio Grande in Albuquerque area unit 3.....	Middle Rio Grande.....	New Mexico.
Channelization of Rio Grande in Belen area and construction of 5 miles of San Juan feeder canal.....	do.....	Do.
Fort Cobb Dam.....	Washita Basin.....	Oklahoma.
11.5 miles Spokane Bench laterals for Helena Valley canal.....	Missouri River basin.....	Montana.
165 miles Fargo-Granite Falls 230-kv transmission line.....	do.....	North Dakota.
37 miles Boysen-Pilot Butte 115-kv transmission line.....	do.....	Wyoming.
Left abutment outlet works for Buffalo Bill Dam.....	Shoshone.....	Do.
17 miles final section Courtland Canal and laterals.....	Missouri River basin.....	Kansas.
5.5 miles White Rock Canal and laterals.....	do.....	Do.
Fremont Canyon powerplant structure and power conduit.....	do.....	Wyoming.
31 miles 3rd section Osborne Canal and laterals.....	do.....	Kansas.
Reconductoring 29 miles of Flatiron-Greeley 115-kv transmission line.....	do.....	Colorado.

TABLE 3.—Irrigation and gross crop value data, by projects, for each State, 1959

State and project	Irrigable area for service				Irrigated area	Gross crop value	
	Full	Supplemental	Temporary	Total		Amount	Per irrigated acre
Arizona:							
Gila	103,488	0	0	103,488	78,071	\$13,738,680	\$175.98
Salt River	238,787	95,730	0	334,517	228,833	67,577,067	295.31
Yuma (see also California)	51,956	0	0	51,956	44,915	19,160,950	426.60
Yuma Auxiliary	3,406	0	0	3,406	2,932	711,150	242.55
Subtotals	397,617	95,730	0	493,347	354,751	101,187,847	285.24
California:							
Boulder Canyon	608,530	0	0	608,530	494,100	146,777,141	297.06
Cachuma	500	26,610	0	27,110	11,982	7,154,986	597.14
Central Valley	33,855	816,196	32,323	882,374	722,369	224,452,703	310.72
Klamath (see also Oregon)	80,913	0	0	80,913	77,100	10,373,978	134.55
Oroville	19,811	0	0	19,811	17,499	1,466,308	83.79
Santa Maria	0	39,215	0	39,215	33,058	27,071,107	818.90
Solano	0	6,409	0	6,409	2,569	565,835	220.25
Ventura River	530	6,475	0	7,005	2,566	265,688	469.41
Yuma (see also Arizona)	14,620	0	0	14,620	10,608	2,533,064	238.79
Subtotals	758,759	888,905	32,323	1,679,987	1,369,851	420,660,810	307.09
Colorado:							
Colorado-Big Thompson	0	720,000	0	720,000	720,000	82,887,626	115.12
Fruitgrowers Dam	0	2,662	0	2,662	1,811	238,486	131.69
Grand Valley	34,686	7,995	0	42,681	34,789	5,751,790	165.33
Manitou	0	8,650	0	8,650	7,232	290,033	40.10
Panama	0	13,070	0	13,070	8,581	992,061	115.61
Pine River (see also New Mexico)	0	40,198	0	40,198	34,626	1,461,221	42.20
Pine River Indian Irrigation	0	13,000	0	13,000	9,392	393,731	41.92
Uncompahgre	76,439	0	0	76,439	63,564	5,423,660	85.36
Subtotals	111,125	805,575	0	916,700	879,995	97,440,608	110.73
Idaho:							
Avondale	873	0	0	873	511	30,597	59.88
Boise (see also Oregon)	223,065	136,115	0	359,180	325,388	40,299,778	123.86
Dalton Gardens	944	0	0	944	536	42,606	79.49
Lewiston Orchards	3,590	0	0	3,590	2,002	501,892	250.60
Little Wood River	0	5,191	0	5,191	1,056,242	68,633	68.63
Michaud Flats	0	0	0	0	7,270	1,056,584	145.33
Minidoka	9,532	0	0	9,532	1,077,012	119,182,317	110.66
Owyhee (see also Oregon)	214,642	932,361	473	1,147,476	1,182,317	119,182,317	132.45
Preston Bench	33,360	4,500	0	33,360	31,319	4,148,190	106.65
Rathdrum Prairie	5,010	0	0	5,010	4,111	412,095	92.25
Subtotals	491,016	1,078,167	473	1,569,656	1,457,184	166,409,327	114.20

TABLE 3.—Irrigation and gross crop value data, by projects, for each State, 1959—Continued

State and project	Irrigable area for service			Irrigated area	Gross crop value		
	Full	Supplemental	Temporary		Total	Amount	Per irrigated acre
Kansas:							
Missouri River basin:							
Bostwick division:	Acres 31,566	Acres 0	Acres 0	Acres 31,566	\$1,056,668	\$65.07	
Courtland unit:	11,500	0	0	11,500	461,344	71.31	
Solomon division:							
Kirwin unit:	43,066	0	0	43,066	1,518,012	66.84	
Subtotals:							
	16,665	0	0	16,665	633,756	39.00	
Montana:	22,938	0	0	22,938	1,493,599	71.14	
Bitter Root:	4,810	0	0	4,810	251,314	66.08	
Buffalo Rapids:	32,447	0	0	32,447	1,758,620	74.21	
Frenchtown:							
Hundley:	881	0	0	881	30,916	42.29	
Intake:	36,832	0	0	36,832	2,094,899	69.46	
Lower Yellowstone (see also N.Dak.):	134,170	0	0	134,170	3,653,266	41.77	
Milk River:	977	0	0	977	39,766	86.45	
Missoula Valley:							
Missouri River basin:							
Three Forks division:							
Crow Creek pump unit:	4,545	0	0	4,545	240,982	70.90	
Yellowstone division:	2,215	0	0	2,215	77,650	40.21	
Savage unit:	91,823	0	0	91,823	2,525,788	37.04	
Sun River:							
Subtotals:	348,303	0	0	348,303	12,800,556	49.79	
	11,662	0	0	11,662	1,304,324	116.01	
Nebraska:							
Mirage Flats:							
Missouri River basin:							
Bostwick division:							
Superior-Courtland unit:	23,110	0	0	23,110	1,368,191	68.47	
Frenchman-Cambridge division:	37,578	0	0	37,578	2,322,063	83.02	
Middle Loup division:							
Sargent unit:	12,900	0	0	12,900	570,514	83.37	
Oregon Trail division:							
Glendo unit (see also Wyoming):	0	22,524	0	22,524	2,068,711	97.45	
North Platte (see also Wyoming):	171,571	92,398	0	263,969	24,126,429	97.50	
Subtotals:	256,821	114,922	0	371,743	31,740,232	94.90	

TABLE 3.—Irrigation and gross crop value data, by projects, for each State, 1959—Continued

State and project	Irrigable area for service				Irrigated area	Gross crop value	
	Full	Supplemental	Temporary	Total		Amount	Per irrigated acre
South Dakota:							
Belle Fourche.....	57,183	0	0	57,183	\$3,418,742	\$61.80	
Missouri River basin:							
Cheyenne Division:	12,135	0	0	12,135	849,772	74.66	
Angostura unit.....	0	8,900	0	8,900	257,458	40.32	
Rapid Valley.....	69,318	8,900	0	78,218	4,525,972	61.92	
Subtotals.....	0	10,608	0	10,608	1,194,152	214.95	
Texas:	76,114	118,330	0	194,444	18,168,844	275.22	
Balmorhea.....	76,114	118,330	0	194,444	18,168,844	275.22	
Rio Grande (see also New Mexico)	76,114	118,330	0	194,444	18,168,844	275.22	
Subtotals.....	0	6,800	0	6,800	371,205	63.57	
Utah:	0	75,256	0	75,256	1,548,516	20.68	
Hyrum.....	0	2,807	0	2,807	139,814	63.97	
Moon Lake.....	0	22,807	0	22,807	2,332,965	148.27	
Newton.....	0	46,609	0	46,609	4,304,565	114.64	
Ogden River.....	0	13,663	0	13,663	974,802	37.94	
Provo River.....	0	3,609	0	3,609	674,807	70.24	
Sanpede.....	0	21,340	4,945	26,285	2,794,610	68.74	
Scotfield.....	17,269	108,978	0	126,247	10,613,029	116.07	
Strawberry Valley.....	0	313,722	4,945	318,667	23,528,002	84.87	
Weber River.....	0	0	0	0	0	0	
Subtotals.....	17,269	313,722	4,945	335,936	277,221	23,528,002	84.87
Washington:							
Chief Joseph Dam.....	2,860	0	0	2,860	242,433	195.20	
Columbia basin.....	41,163	0	0	41,163	32,437,434	121.80	
Okanogan.....	5,038	0	0	5,038	800,090	198.02	
Yakima.....	279,922	181,844	100	461,926	85,887,453	218.13	
Subtotals.....	698,985	181,844	100	880,989	119,427,430	179.41	

Wyoming	17,131	0	17,131	12,964	409,754	31.61
Eden	23,957	0	23,957	18,641	637,347	34.19
Kendrick						
Missouri River basin:						
Big Horn basin division:						
Hanover-Buff unit	6,527	0	6,527	5,568	478,083	86.86
Owl Creek unit	0	11,338	11,338	10,009	506,872	50.64
Oregon Trall division:						
Glendo unit (see also Nebraska)	0	8,732	8,732	6,322	477,870	76.59
North Platte (see also Nebraska)	54,752	16,317	71,069	66,765	5,988,275	29.69
Riverton	53,857	0	53,857	50,064	2,173,112	43.41
Shoshone	93,369	0	93,369	76,355	4,977,723	65.19
Subtotals	249,593	36,387	285,980	246,688	15,649,046	63.44
Total—All States	4,311,724	3,743,290	8,094,383	6,798,751	1,116,547,902	164.23

1 Area for which service is available under Warren Act contract.
 2 Includes 18,330 acres for which service is available under Warren Act contract.

TABLE 4.—Acreage, production, and gross crop value by crops and types of crops—1959

Crops	Irrigated lands		Tonnage		Gross crop value	
	Total	Percent of total	Total	Percent of total	Total	Percent of total ¹
Cereals:	<i>Acres</i>	<i>Percent</i>	<i>Tons</i>	<i>Percent</i>		<i>Percent</i>
Barley.....	545,498	8.02	724,304	2.151	\$29,609,616	2.65
Corn.....	369,372	5.43	772,938	2.295	31,370,842	2.81
Oats.....	177,970	2.62	164,707	.489	7,219,820	.65
Rice.....	7,395	.11	14,771	.044	1,217,610	.11
Rye.....	1,946	.03	1,379	.004	54,180	-----
Sorghums (sorgo, kaffir, etc.).....	115,410	1.70	171,149	.508	7,475,822	.67
Wheat.....	462,992	6.81	691,335	2.053	37,251,971	3.34
Other cereals.....	103,538	1.52	161,607	.480	6,699,171	.60
Subtotals.....	1,784,121	26.24	2,702,190	8.024	120,899,032	10.83
Forage:						
Alfalfa hay.....	1,629,301	23.96	6,288,533	18.673	148,936,745	13.34
Other hay.....	189,131	2.78	350,875	1.042	6,836,562	.61
Irrigated pasture.....	1,014,333	14.92	2,562,929	7.610	33,217,785	2.98
Corn fodder.....	12,675	.19	63,778	.189	527,298	.05
Silage or Ensilage.....	204,002	3.00	3,413,614	10.136	22,020,870	1.97
Crop residue: Beet tops.....			2,469,700	7.333	1,507,164	.13
Stubble, stalks, etc.....			153,399	.456	1,272,163	.11
Straw (all kinds).....			267,945	.796	2,030,061	.18
Root crops (carrots, etc.).....	820	.01	16,890	.050	85,970	.01
Other forage.....	44,308	.65	108,082	.321	508,037	.05
Subtotals.....	3,094,570	45.51	15,695,745	46.606	216,942,655	19.43
Miscellaneous field crops:						
Beans, castor.....	1,531	.02	1,280	.004	153,519	.01
Beans, dry and edible.....	366,915	5.40	326,837	.970	41,305,809	3.70
Broomcorn.....	3,366	.05	950	.003	135,247	.01
Cotton, lint (Upland).....	469,351	6.90	236,338	.702	155,565,676	13.93
Cotton, seed (Upland).....			372,316	1.106	16,217,646	1.45
Cotton, lint (American-Egyptian).....	34,889	.51	9,766	.029	10,278,797	.92
Cotton, seed (American-Egyptian).....			17,089	.051	779,197	.07
Hops.....	20,105	.30	17,975	.053	15,914,880	1.43
Peppermint.....	14,719	.22	522	.001	3,287,261	.29
Spearmint.....	5,255	.08	219	.001	1,581,440	.14
Sugar beets.....	370,638	5.45	7,147,454	21.223	76,670,105	6.87
Other miscellaneous field crops.....	2,059	.03	2,806	.008	276,307	.03
Subtotals.....	1,288,828	18.96	8,133,552	24.151	322,165,834	28.85
Vegetables:						
Asparagus.....	16,486	.24	21,996	.065	4,623,889	.41
Beans (processing).....	9,258	.14	17,564	.052	2,173,344	.20
Beans (fresh market).....	923	.01	2,370	.007	805,250	.07
Broccoli.....	11,329	.17	32,336	.096	4,922,552	.44
Cabbage.....	6,165	.09	81,973	.243	4,922,894	.44
Carrots.....	13,147	.19	165,114	.490	11,287,912	1.01
Cauliflower.....	2,201	.03	17,009	.051	1,709,901	.15
Celery.....	2,088	.03	55,838	.166	4,025,806	.36
Corn, sweet (processing).....	21,687	.32	119,830	.356	2,479,188	.22
Corn, sweet (fresh market).....	8,419	.12	29,132	.087	2,759,223	.25
Cucumbers.....	2,376	.03	25,725	.076	3,043,078	.27
242.....			1,454	.004	226,208	.02
Lettuce.....	63,279	.93	447,024	1.327	37,135,890	3.33
Melons: Cantaloupes, etc.....	31,749	.47	229,926	.683	14,266,956	1.28
Honey Ball, honeydew, etc.....	3,801	.06	42,959	.128	2,607,828	.23
Watermelons.....	11,668	.17	98,026	.291	3,852,504	.35
Onions, dry.....	16,758	.25	259,183	.770	10,100,303	.91
Onions, green.....	123	-----	914	.003	90,301	.01
Peas, green (processing).....	11,898	.18	22,142	.066	1,817,051	.16
Peas, green (fresh market).....	1,041	.02	1,819	.005	330,416	.03
Peppers (all kinds).....	3,955	.06	58,267	.173	3,304,029	.30
Potatoes, early.....	45,467	.67	610,217	1.812	20,121,007	1.80
Potatoes, late.....	201,479	2.96	2,139,042	6.352	58,374,846	5.23
Squash.....	2,763	.04	15,619	.046	1,917,035	.17
Sweet Potatoes.....	551	.01	2,667	.008	283,610	.03
Tomatoes (canning).....	14,218	.21	208,655	.620	5,073,292	.45
Tomatoes (fresh market).....	11,257	.17	95,360	.283	15,341,926	1.37
Other vegetables.....	6,125	.09	41,821	.124	3,588,015	.32
Subtotals.....	520,543	7.66	4,843,982	14.384	221,184,254	19.81
Total Nursery.....	3,718	.05	-----	-----	8,874,220	.80

TABLE 4.—Acreage, production, and gross crop value by crops and types of crops—1959—Continued

Crops	Irrigated lands		Tonnage		Gross crop value	
	Total	Percent of total	Total	Percent of total	Total	Percent of total ¹
Seeds:	<i>Acres</i>	<i>Percent</i>	<i>Tons</i>	<i>Percent</i>		<i>Percent</i>
Alfalfa.....	65,931	.97	14,525	.043	\$8,099,912	.73
Clover (all kinds).....	38,050	.56	7,574	.023	4,040,480	.36
Corn.....	7,510	.11	8,900	.027	1,027,256	.09
Flaxseed.....	35,891	.53	37,787	.112	3,894,448	.35
Grass (all kinds).....	16,646	.24	4,542	.014	3,522,289	.32
Lettuce.....	908	.01	150	-----	260,885	.02
Onion.....	1,319	.02	262	.001	509,877	.05
Pea.....	32,493	.48	39,527	.117	3,272,951	.29
Potato (all kinds).....	912	.01	9,496	.028	432,854	.04
Sugarbeet.....	3,170	.05	4,447	.013	1,289,070	.11
Other seed.....	13,484	.20	8,716	.026	1,834,245	.16
Subtotals.....	216,314	3.18	135,926	.404	28,184,267	2.52
Fruits:						
Apples.....	44,180	.65	441,966	1.312	31,058,336	2.78
Apricots.....	8,012	.12	55,173	.164	5,026,694	.45
Berries (all kinds).....	2,386	.04	9,817	.029	3,993,160	.36
Cherries.....	6,076	.09	14,672	.043	4,275,365	.38
Citrus:						
Grapefruit.....	18,006	.26	96,861	.288	4,606,916	.41
Lemons and limes.....	13,006	.19	125,485	.373	5,357,421	.48
Oranges and tangerines.....	30,527	.45	326,429	.969	28,367,788	2.54
Dates.....	4,026	.06	19,129	.057	5,219,551	.47
Grapes, table.....	56,078	.82	348,630	1.035	28,438,294	2.55
Grapes, other.....	35,042	.52	287,902	.855	14,460,415	1.29
Olives.....	8,156	.12	8,266	.025	2,023,508	.18
Peaches.....	25,783	.38	178,134	.529	10,954,024	.98
Pears.....	24,771	.36	165,169	.490	11,004,498	.99
Prunes and plums.....	11,062	.16	67,128	.199	4,448,610	.40
Other fruits.....	3,248	.05	8,983	.027	1,228,403	.11
Subtotals.....	290,359	4.27	2,153,744	6.395	160,462,974	14.37
Nuts:						
Almonds.....	7,338	.11	5,502	.016	2,536,440	.23
Pecans.....	5,284	.08	2,575	.008	1,815,583	.16
Walnuts.....	5,992	.09	4,081	.012	1,802,708	.16
Other nuts.....	189	-----	64	-----	34,350	-----
Subtotals.....	18,803	.28	12,222	.036	6,189,081	.55
Family gardens and orchards.....	22,186	.33	-----	-----	5,299,463	.48
Total, all crops.....	7,239,442	106.48	33,677,361	100.000	1,090,201,780	97.64
Less multiple cropped.....	583,407	8.58	-----	-----	-----	-----
Total harvested cropland and pasture.....	6,656,035	97.90	-----	-----	-----	-----
Cropland not harvested.....	124,812	1.84	-----	-----	-----	-----
Soil building.....	17,904	.26	-----	-----	-----	-----
Acres irrigated.....	6,798,751	100.00	-----	-----	-----	-----
Additional revenues ²	-----	-----	-----	-----	26,346,122	2.36
Total gross crop value.....	-----	-----	-----	-----	1,116,547,902	100.00
Full irrigation service.....	3,436,305	50.54	-----	-----	551,340,439	49.38
Supplemental irrigation service.....	3,327,273	48.94	-----	-----	557,044,684	49.89
Temporary irrigation service.....	35,173	.52	-----	-----	8,162,779	.73

¹ Additional revenues are included in computing percentages.

² Includes payments received from Federal and commercial agencies.

Bonneville Power Administration

William A. Pearl, *Administrator*



BONNEVILLE POWER ADMINISTRATION, authorized by the Bonneville Project Act of 1937, is the designated marketing agency of the Department of the Interior for 17 hydroelectric generating plants of the U.S. Columbia River Power System currently completed or under construction.

Federal Projects

Power was marketed during fiscal year 1960 from nine U.S. Corps of Engineers plants and four of the Department's Bureau of Reclamation plants with an installed generating capacity of 6,033,250 kilowatts. These include existing projects and projects under construction where initial generators have been installed.

With completion of the projects under construction the nameplate rating will be 7,594, 250 kilowatts, and with completion of the authorized projects nameplate rating will be nearly 8,900,000 kilowatts. Projects existing, under construction and authorized for construction by the Corps of Engineers and Bureau of Reclamation are shown in table 1.

Generation Added

Additions to the U.S. Columbia River Power System in fiscal year 1960 have a nameplate rating of 312,000 kilowatts. Four units of 78,000 kilowatts each were added at the Corps of Engineers project, The Dalles, leaving two units to be installed for the completed project.

Existing storage capacity usable for power in Federal reservoirs is 9,868,500 acre-feet. An additional 414,000 acre-feet will be provided by Cougar and Hills Creek on which construction is underway, and 5,343,000 acre-feet will be provided by Libby and Green Peter projects which are authorized for construction.

TABLE 1.—U.S. Columbia river power system—General specifications, projects existing, under construction and authorized, June 30, 1960

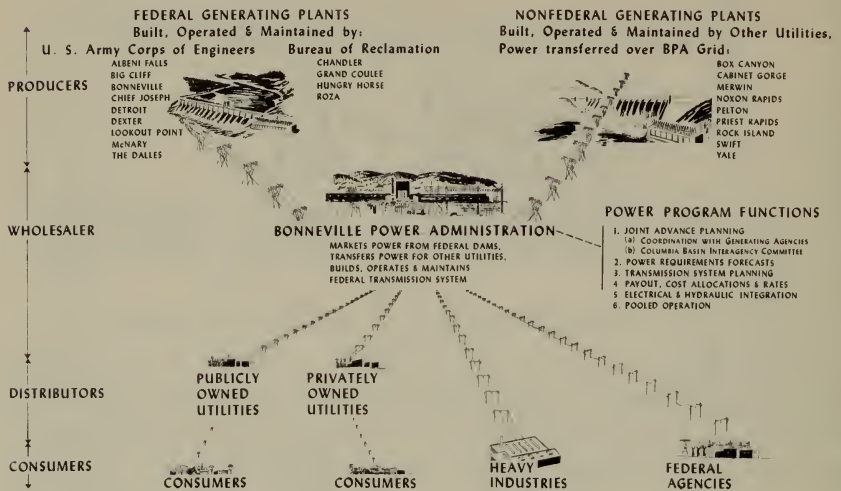
Project	Operating agency ¹	Location	Stream	Plant installations		Date in service ² (initial unit)	Generation fiscal year 1960 ³
				Number of units	Total capacity kilowatts ²		
Existing:							
Bonneville	CE	Washington-Oregon	Columbia	10	518, 400	June 1938	3, 420
Grand Coulee	BR	Washington	Columbia	18	1, 944, 000	September 1941	11, 924
Hungry Horse	BR	Montana	South Fork Flathead	4	285, 000	October 1952	930
DeWitt	CE	Oregon	North Santiam	2	100, 000	July 1953	387
McNary	CE	Washington-Oregon	Columbia	14	980, 000	November 1953	5, 347
Big Cliff	CE	Oregon	North Santiam	1	18, 000	June 1954	101
Lookout Point	CE	Oregon	Middle Fork Willamette	3	120, 000	December 1954	301
Alben Falls	CE	Idaho	Pend Oreille	3	42, 600	March 1955	252
Dexter	CE	Washington	Middle Fork Willamette	1	15, 000	May 1955	73
Chief Joseph	CE	Washington	Columbia	16	1, 024, 000	August 1955	4, 346
Chandler	BR	Washington	Yakima	2	12, 000	February 1956	44
The Dalles	CE	Washington-Oregon	Columbia	14	963, 000	May 1957	4, 074
Roza	BR	Washington	Yakima	1	11, 250	August 1958	80
Subtotal					6, 033, 250		31, 282
Under construction:							
The Dalles (Add.)	CE	Washington-Oregon	Columbia	2	158, 000	July 1960	
Hills Creek	CE	Oregon	Middle Fork Willamette	2	30, 000	December 1961	
Ice Harbor	CE	Washington	Snake	2	274, 000	December 1961	
Cougar	CE	Oregon	South Fork McKenzie	2	23, 000	November 1962	
John Day	CE	Washington-Oregon	Columbia	8	1, 080, 000	June 1967	
Subtotal					1, 561, 000		
Authorized:							
Libby	CE	Montana	Kootenai	4	344, 000		
Lower Monumental	CE	Washington	Snake	3	270, 000		
Little Goose	CE	Washington	Snake	3	300, 000		
Lower Granite	CE	Washington	Snake	2	90, 000		
Green Peter	CE	Oregon	Middle Santiam	2	30, 000		
Foster	CE	Oregon	South Santiam	2	30, 000		
Subtotal					1, 304, 000		
Total, 23 projects					8, 898, 250		

¹ CE—Corps of Engineers; BR—Bureau of Reclamation.

² Nameplate rating.

³ Millions of kilowatt-hours.

Functions of Bonneville Power Administration



All generation and storage capacity under Federal construction will be in service by June 1968 under the present schedule. Service dates for the other authorized projects are not yet scheduled.

Non-Federal Projects

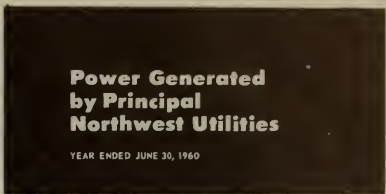
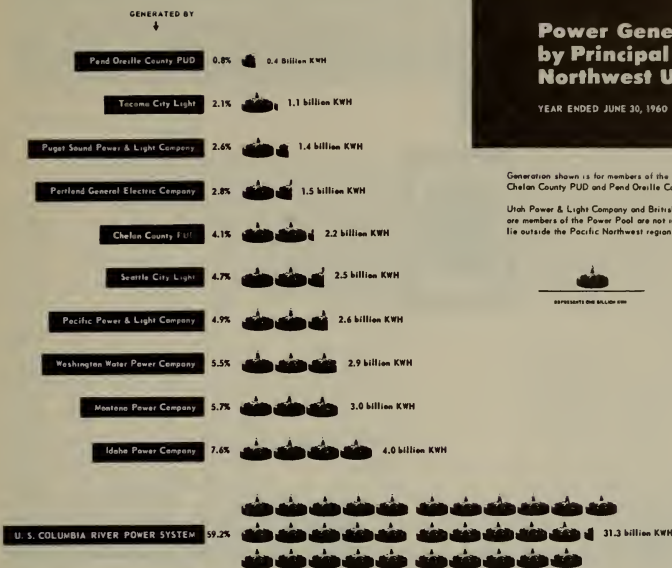
Addition of 825,250 kilowatts of nameplate rating by non-Federal utilities increased the generating capacity of non-Federal resources in the area served by the Bonneville Power Administration to a total of 3,644,580 kilowatts.

Future additions under construction or licensed for construction by non-Federal utilities would add 2,464,600 kilowatts to the area's resources.

Northwest Power Pool

Generation by the principal electric utility systems of the Pacific Northwest during the fiscal year 1960 is shown in the accompanying chart.

With the exception of Chelan County and Pend Oreille County Public Utility Districts, all utilities listed are members of the Northwest Power Pool. These two are included because they provide substantial amounts of generation to the pool. The Utah Power and Light Co. and the British Columbia Electric Co. are members of the pool but are not included as their major service areas are outside the region.



Generation shown is for members of the NORTHWEST POWER POOL plus Chelan County PUD and Pend Oreille County PUD. Utah Power & Light Company and British Columbia Electric Company who are members of the Power Pool are not included because their service areas lie outside the Pacific Northwest region.



SOURCE: WEEKLY OPERATING REPORTS OF NW POWER POOL

A total of 59.2 percent of the energy generated by the major utilities of the region was provided by the U.S. Columbia River Power System. In addition to its other load, Bonneville Power Administration provided 8.4 billion kilowatt-hours of energy to meet the net requirements of eight other pool utilities.

Bonneville Power Administration's electric energy account for fiscal year 1960 is shown in table 2.

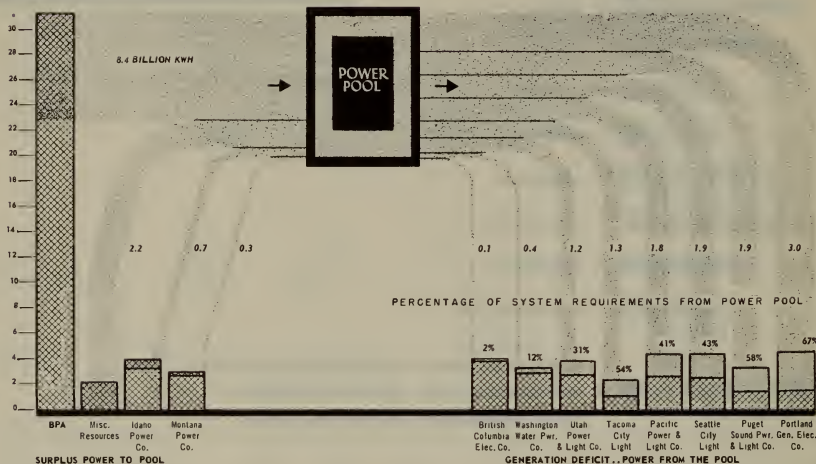
Transmission Network

Bonneville Power Administration, as part of its marketing function is responsible for construction, operation, and maintenance of transmission facilities to transmit the power to the region's load centers. The administration's transmission grid at the end of the fiscal year consisted of 8,028 circuit miles of high voltage transmission lines and 201 substations.

Electrical Coordination and Integration

Bonneville Power Administration's high voltage transmission grid serves as the "backbone" for all interconnected utilities of the Pacific Northwest. The administration's transmission network had 424 points of connection as of June 30, 1960, almost double the 256 connections of 10 years ago. These include interconnections with all the principal utilities having generating facilities in the region.

NET OPERATIONS ENDING JUNE 30, 1960
Northwest Power Pool
 BPA SUPPLIED 72% OF NET ENERGY REQUIREMENTS



An expanded "wheeling" program instituted in 1954 has made possible integration and coordination of Columbia River basin generating and transmission facilities. The program makes possible not only integration of all plants contributing to the Northwest Power Pool, but effects substantial economies in power transmission and in many cases makes feasible construction of non-Federal projects far distant from load centers.

TABLE 2.—Electric energy account for fiscal year 1960

Energy received (millions of kilowatt-hours) :

Energy generated for BPA :

Bureau of Reclamation	12,978
Corps of Engineers	18,303
Power interchanged in	6,158

Total received

37,439

Energy delivered (millions of kilowatt-hours) :

Sales	29,683
Power interchanged out	6,087
Used by Administration	34

Total delivered

35,804

Energy losses in transmission and transformation

1,635

Losses in percent of total received—percent

4.4

Maximum demand on Federal plants (kilowatts) March 3, 1960,

5-6 p.m. PST

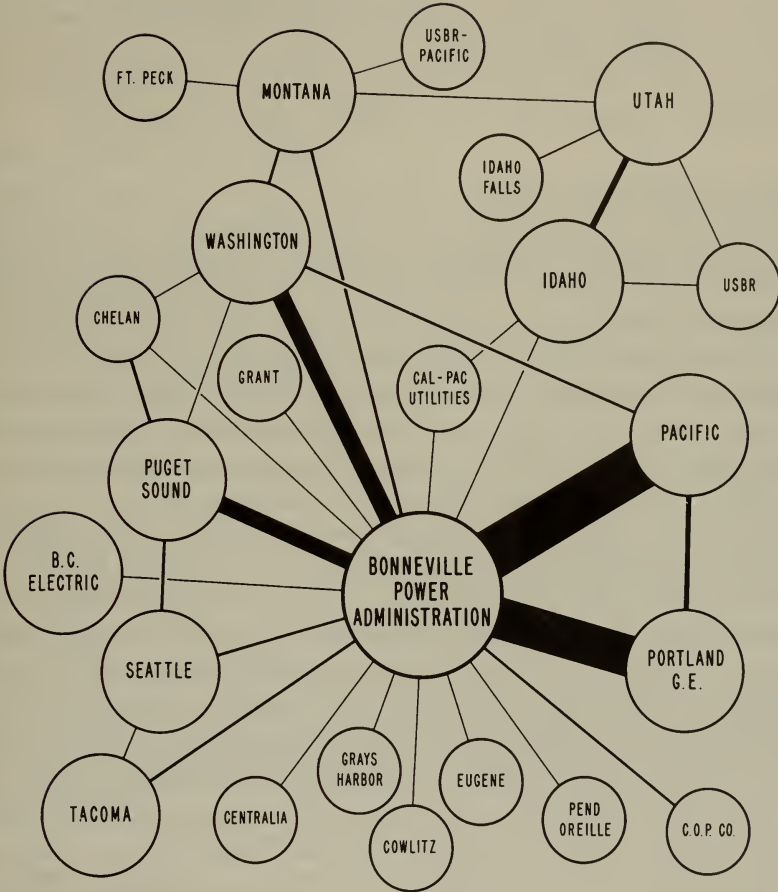
4,928,000

Load factor, total generated for BPA, percent

72.3

Interconnected Utilities of the Northwest Power Pool

LARGE CIRCLES - MAIN SYSTEMS IN POOL
 SMALL CIRCLES - OTHER INTERCONNECTED SYSTEMS
 LINE WIDTH - NUMBER OF INTERCONNECTIONS



Growth of Wheeling Program

The wheeling program under which the Federal transmission grid is made available for transmission of non-Federal power generation to area load centers increased by 40.3 percent in fiscal year 1960 over the previous year. The Bonneville Power Administration wheeled or transferred for other utilities 6.7 billion kilowatt-hours of energy as compared to 4.8 billion kilowatt-hours the previous year. During the

same period other utilities wheeled or transferred 2.1 billion kilowatt-hours of energy for the Government.

Power is being delivered under long-term firm capacity contracts from the Pelton project of the Portland General Electric Co., the Box Canyon project of the Pend Oreille Public Utility District and the Priest Rapids project of the Grant County Public Utility District. Excess capacity contracts cover power from the Swift project of the Pacific Power and Light Co., the Rock Island project of the Chelan County Public Utility District, the Priest Rapids project of the Grant County Public Utility District, and into the region from the California Oregon Power Co. and the Idaho Power Co.

Construction Program

Major transmission additions completed during the year in Oregon included a 230,000-volt line between Albany and Toledo, to supply additional industrial power for the Toledo area and a 115,000-volt line between Finn Rock and Leaburg near Eugene, to serve the lumbering and resort area of the upper McKenzie Valley. In the Columbia Basin Reclamation area in Washington, a 115,000-volt line was added between Sand Dunes and Larson, near Moses Lake and a 33,000-kilovolt-ampere substation at Larson.

Construction under way at the close of the fiscal year included a 345,000-volt, 128-mile line from Chelan County Public Utility District's Rocky Reach hydroelectric project to Maple Valley, near Seattle, Wash., to bring the output of the project to western Washington; a 23-mile, 230,000-volt line from Rocky Reach hydroelectric project to Columbia, near Wenatchee, Wash.; a 125-mile, 287,000-volt line between Tacoma, Wash., and Columbia; an 81-mile, 345,000-volt line with initial 230,000-volt operation, between Big Eddy substation, The Dalles Dam, and McLoughlin substation, near Oregon City, Oreg., owned by Portland General Electric Co.; a 130-mile, 115,000-volt line between Redmond and Burns, Oreg.; and a 40-mile, 115,000-volt line between DeMoss and Fossil, Oreg.

Energy Sales of 29.7 Billion Kwh

During fiscal year 1960, BPA sold 29.7 billion kilowatt-hours of electric energy for about \$69,000,000, an average of 2.32 mills per kilowatt-hour. Energy sales increased 3.6 percent over the previous year.

Percentage distribution of energy sales by classes of customers for fiscal year 1960 follows:

	Number of customers June 1960	Energy sale by percent of total
Publicly owned utilities.....	79	35.7
Privately owned utilities.....	9	18.8
Aluminum industry.....	9	30.1
Other industries and Federal agencies.....	19	15.4
Total.....	116	100.0

Public Utility Sales Increase

Sales to publicly owned utilities continued to increase at a higher rate than sales to other classes of customers. Between 1950 and 1960, sales to publicly owned utilities increased 273 percent, while total sales increased 128 percent.

Increased non-Federal generation, most of which was transferred over the Bonneville Power Administration transmission system, resulted in reduction in BPA sales to privately owned utilities, and to cities of Seattle and Tacoma, Wash.

The aluminum companies increased their purchases of firm power during 1960 by about 60,000 kilowatts, which is a 10 percent increase over 1959. Sale of interruptible power to aluminum plants decreased by 7 percent from the previous year, with most of the decrease shown by those plants increasing their purchase of firm power. Sales of interruptible power to the aluminum industry have decreased by 270,000 kilowatts since 1956.

An increase in energy deliveries to other industries and Federal agencies results from their increased operations during the 1959 fiscal year. The energy consumption level in June, 1960 was about equal to June, 1959.

Unused Capacity

Bonneville's industrial customers have, in the aggregate, an estimated capacity to use power at the rate of approximately 1,800,000 kilowatts. As of June 30, 1960, their power purchases from the Government and from other sources totaled 1,417,000 kilowatts; leaving idle plant capacity of about 400,000 kilowatts. Firm deliveries from the Government were 1,102,000, interruptible deliveries were 180,000 kilowatts, and 135,000 kilowatts were purchased from non-Federal sources.

Detail of energy deliveries by classes of customers for 1960 compared with 1959 are shown in table 3.

TABLE 3.—Sales of electric energy by classes of customers

	Fiscal year 1960		Fiscal year 1959		
	Millions of kilowatt-hours	Mills per kilowatt-hour	Millions of kilowatt-hours	Mills per kilowatt-hour	Percent Increase
Publicly owned utilities: ¹					
Firm.....	10,455	2.71	9,186	2.75	13.8
Nonfirm.....	134	2.50	299	2.50	-55.2
Total.....	10,589	2.70	9,485	2.74	11.6
Privately owned utilities:					
Firm.....	4,522	2.15	5,657	2.13	-20.1
Nonfirm.....	1,068	2.50	897	2.50	19.1
Total.....	5,590	2.22	6,554	2.18	-14.7
Aluminum plants:					
Firm.....	7,761	1.98	7,039	2.02	10.2
Nonfirm.....	1,167	1.82	1,256	1.92	-7.1
Total.....	8,928	1.96	8,295	2.00	7.6
Other industries: ²					
Firm.....	4,053	2.25	3,847	2.27	5.4
Nonfirm.....	523	2.21	483	2.24	8.2
Total.....	4,576	2.24	4,330	2.27	5.7
Total energy:					
Firm.....	26,791	2.33	25,729	2.34	4.1
Nonfirm.....	2,892	2.17	2,935	2.21	-1.5
Total.....	29,683	2.32	28,664	2.33	3.6

¹ Data for city of Richland billed to the Atomic Energy Commission. July 1959–October 1960 has been shifted from Federal agencies to publicly owned utilities for comparative data.

² Including Federal agencies.

Power for Industrial Expansion

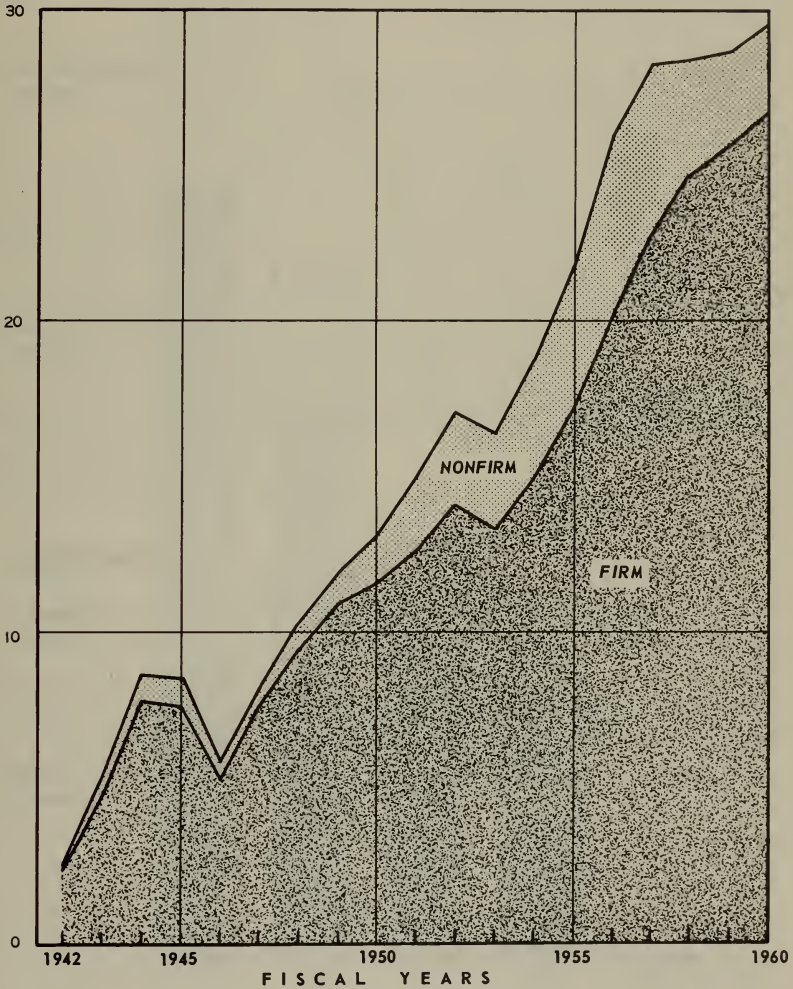
As a result of the favorable power situation and unprecedented expansion of hydroelectric generation in the Pacific Northwest, Bonneville Power Administration was able to offer for sale last May a block of 150,000 kilowatts of firm power for industrial expansion. Concurrently, a new category of high priority secondary power called "industrial power," limited to 400,000 kilowatts was offered.

Contract negotiations in progress at the end of the fiscal year indicate the new power offer will result in the establishment of two new electroprocess industries in the region and plant expansion of two existing industries with an estimated private investment of about \$140 million in new plant equipment. Peak requirements of the four plants are expected to total 177,000 kilowatts of firm and 222,000 kilowatts of secondary power.

The new industrial sales are expected to increase Bonneville Power Administration revenues by about \$6,500,000 a year.

Firm and Nonfirm Sales of Electric Energy

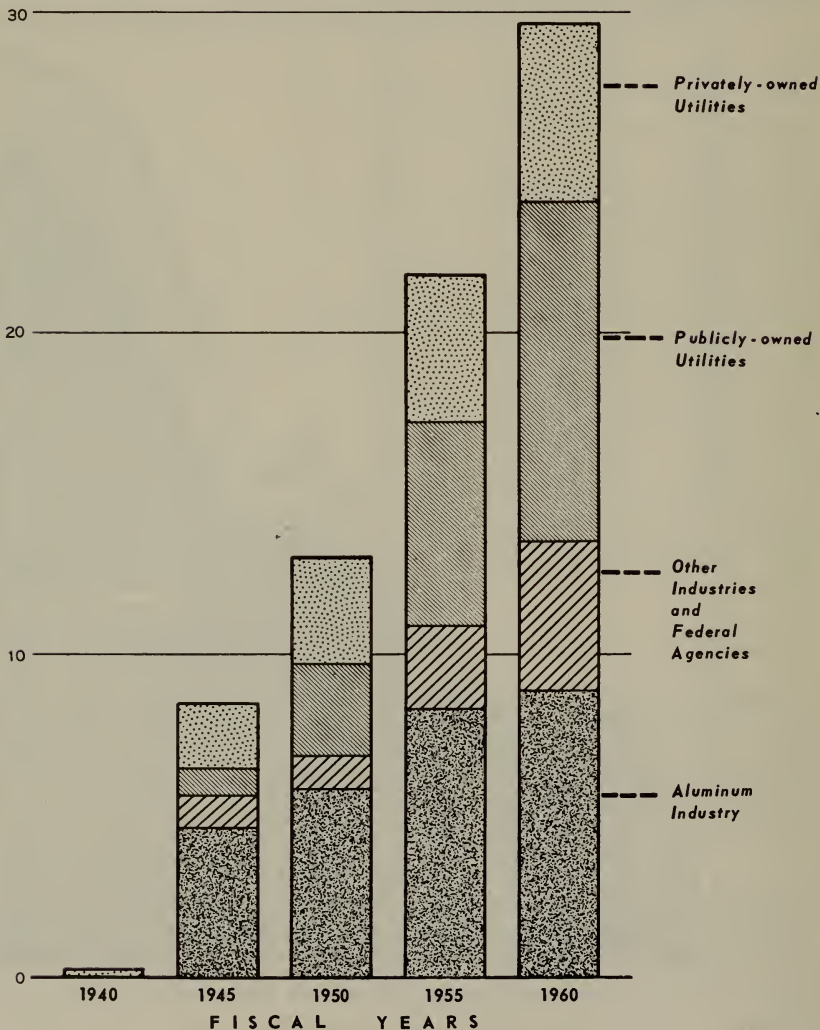
BILLIONS OF
KILOWATT HOURS



Sales of Electric Energy by Class of Customer

BILLIONS OF
KILOWATT HOURS

SALES TO



Power Rates

Bonneville Power Administration delivered about 69 percent of its energy sales at an average cost of 2.15 mills per kilowatt-hour to industries, and to utilities having substantial generating facilities.

A summary of energy sales for fiscal year 1960, classified by rate schedules is shown in table 4.

TABLE 4.—Sales of electric energy by rate schedules fiscal year 1960

Rate schedule	Energy			Mills per kilowatt hour
	Millions of kilowatt hours	Percent of total	Percent change from 1959	
C-4 ¹	20,519	69.1	-0.3	2.15
F-4.....	56	0.2	-8.3	4.54
A-4 ¹	2,157	7.3	21.6	1.68
E-4.....	5,641	19.0	14.0	3.10
H-3.....	1,296	4.4	-0.1	2.50
Space heating.....	14	(²)	(³)	1.00
	29,683	100.0	3.6	2.32

Major features of rate schedules:

C-4.....	Kilowatt-year for transmission system firm power.
F-4.....	Demand-energy rate for firm power.
A-4.....	Kilowatt-year rate for at-site firm power.
E-4.....	Demand-energy rate for firm power for resale to ultimate consumers.
H-3.....	Energy rate for dump, emergency, breakdown or experimental service.
Space heating.....	Special space heating rate applicable in vicinity of Grand Coulee plant.

¹ Includes interruptible industrial sales.

² Less than 0.05 percent.

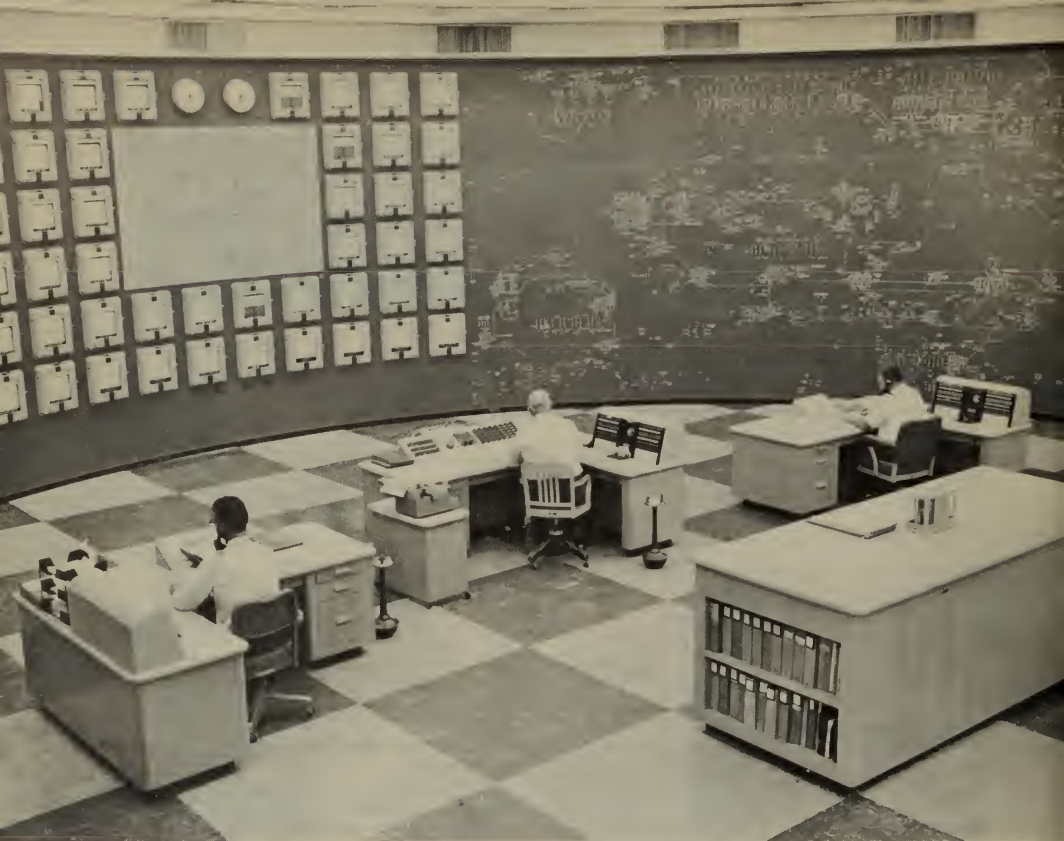
³ Initial service under this rate in September 1959.

Basic Rate Unchanged

Special studies of the Bonneville Power Administration's wholesale rate structure and payout schedules resulted in continuance of the present basic wholesale rate of \$17.50 per kilowatt-year for another 5-year period effective December 20, 1959, with approval by the Federal Power Commission. Bonneville Power Administration has maintained the same basic rate level since beginning of operations in 1938.

Financial Results

Financial results of operations for the Bonneville Power Administration for fiscal year 1960 compared with fiscal year 1959 are shown in summary form in tables 5, 6 and 7. These data are necessarily preliminary inasmuch as the annual audit by the General Accounting Office was not complete at the time of the preparation of these statements. However, it is anticipated that final figures will not differ materially from those now available.



Bonneville Power Administration's regional power dispatching center, Portland, provides almost instantaneous control over the generating and transmission facilities of the U.S. Columbia River Power System, including Oregon, Washington, northern Idaho and Montana west of the Continental Divide. Two dispatchers are on duty 24 hours a day with an outage dispatcher added during the daylight shift.

The financial information is presented on two bases: (1) an accrued cost accounting basis in accordance with the uniform system of accounts prescribed by the Federal Power Commission for electric utilities, and (2) a payout basis.

The principal differences between these methods are: (1) payout is based on cash receipts rather than accrued revenues but it does include accrued expenses with the exception of noncash exchange account items; (2) in lieu of depreciation expense payout substitutes amortization of the capital investment over periods of time shorter than the estimated service lives used in cost accounting for determining depreciation expense; and (3) payout provides for use of power revenue receipts to assist in the repayment of irrigation costs, whereas cost accounting does not include such payments as power costs.

It should be noted that the payout requirements govern the system rate level because cash receipts must be adequate to cover the



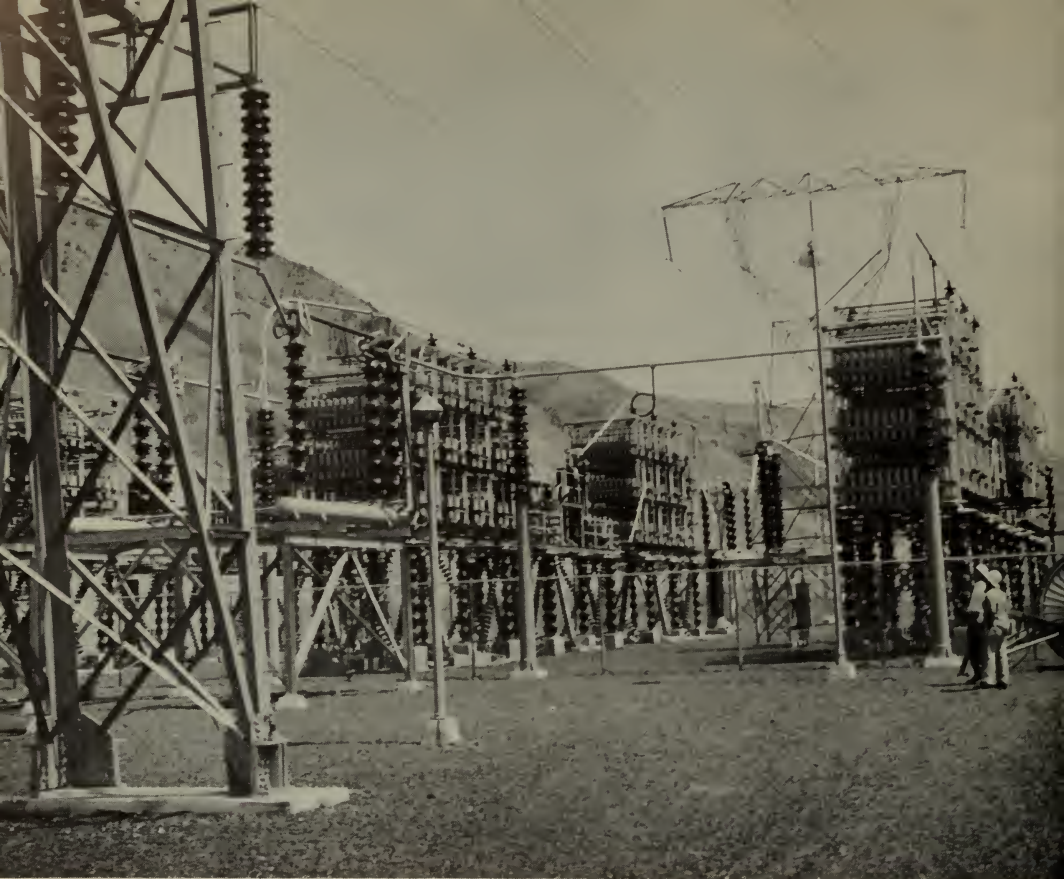
A Bonneville Power Administration helicopter patrols one of the double circuit steel transmission lines, bringing power down the Columbia gorge from the Mid-Columbia plants of the U.S. Columbia River Power System.

total payout requirements, which are assigned to be repaid from power operations, for all of the projects in the U.S. Columbia River Power System.

Statement of Revenues and Expenses

A comparative statement of the revenues and expenses of the Bonneville Power Administration on a cost accounting basis for fiscal years 1959 and 1960 is presented in table 5. Energy sales increased by \$2,084,506 or 3.12 percent during the year. Other electric revenue increased by \$439,622, or 27.23 percent, the large increase being due to the increase in wheeling energy from non-Federal projects to load centers. Total operating revenue reached \$70,998,219 in 1960, an increase for the year of \$2,524,128, or 3.69 percent.

After providing for all expenses of operation, maintenance and interest and the allocations of revenues to the generating projects, net revenues in fiscal year 1960 of \$3,447,792 were available for repayment of the capital investment in the transmission system. Such net rev-



Installation of the first 345,000-volt-series capacitor bank in the nation was completed during fiscal year 1960 on Bonneville Power Administration's McNary-J. D. Ross 345,000-volt transmission line at John Day substation near the site of John Day dam. The capacitor bank will assure optimum power transmission characteristics for the 175-mile line.

enues were \$1,115,616 less than the amount available in 1959. On a cumulative basis through June 30, 1960, net revenues available for repayment of the transmission system capital investment were \$125,276,474 and left a surplus of \$15,367,767 after providing for depreciation and amortization.

Revenues allocated to the Federal generating projects that supplied power to the Bonneville Power Administration totaled \$47,078,000 in 1960, an increase of \$2,336,000 over 1959. These allocations are independent of the amount of energy generated but are geared to the schedules necessary to repay the costs allocated to power. Such costs include operating expenses, interest on and amortization of the capital investment at all of the generating projects, plus financial assistance to irrigation repayment in the case of the Columbia basin and the Yakima projects.

TABLE 5.—Bonneville Power Administration: Comparative statement of revenues and expenses, fiscal years 1959 and 1960 (preliminary)

[Cost Accounting Basis]

	Fiscal year 1959 ¹	Fiscal year 1960	Increase or decrease	Total to June 30, 1960
Operating revenue:				
Sales of electric energy.....	\$66,859,544	\$68,944,050	\$2,084,506	\$718,242,443
Other electric revenue.....	1,614,547	2,054,169	439,622	16,307,651
Total operating revenue.....	68,474,091	70,998,219	2,524,128	734,550,094
Less revenues allocated to generating projects:				
Bonneville dam.....	2,300,000	2,100,000	(200,000)	65,825,430
Columbia basin project.....	12,800,000	12,800,000	-----	174,358,680
Hungry Horse.....	3,816,000	3,833,000	17,000	27,240,210
Albion Falls.....	1,400,000	1,400,000	-----	8,575,000
McNary.....	9,000,000	9,000,000	-----	63,910,000
Detroit-Big Cliff.....	1,900,000	1,700,000	(200,000)	12,840,000
Lookout Point-Dexter.....	1,800,000	1,700,000	(100,000)	10,000,000
Chief Joseph.....	6,700,000	6,500,000	(200,000)	24,150,000
Yakima, Kennewick and Roza.....	326,000	345,000	19,000	1,286,000
The Dalles.....	4,700,000	7,700,000	3,000,000	15,020,000
Total revenues allocated to generation.....	44,742,000	47,078,000	2,336,000	403,205,320
Operating revenues allocated to Bonneville Power Administration.....	23,732,091	23,920,219	188,128	331,344,774
Less operating expenses:				
Purchased power.....	597,557	652,314	54,757	9,507,857
Operation, maintenance, administration, etc.....	10,597,403	11,493,369	895,966	120,959,467
Total operating expenses.....	11,194,960	12,145,683	950,723	130,467,324
Less interest and other deductions:				
Interest on Federal investment.....	8,365,765	8,708,916	343,151	81,820,371
Less amount charged to construction.....	291,056	391,595	100,539	7,703,404
Miscellaneous income deductions, net.....	(100,986)	9,423	110,409	1,484,009
Total interest and other deductions.....	7,973,723	8,326,744	353,021	75,600,976
Net revenues available for depreciation and amortization of Federal investment.....	4,563,408	3,447,792	(1,115,616)	125,276,474
Less depreciation and amortization.....	11,934,218	12,067,262	133,044	109,908,707
Net revenues.....	(7,370,810)	(8,619,470)	(1,248,660)	15,367,767

¹ Data for fiscal year 1959 have been restated from the previously published figures to make the 1959 information comparable to the data shown for fiscal year 1960 as the result of the reclassification of interchange account credits adopted in fiscal year 1960. Formerly such transactions were included in the operating expense accounts, but beginning with 1960 the transactions are shown as revenue from the sales of electric energy. Hence, energy sales for 1959 have been increased by \$500,406 and operating expenses (purchased power) have been increased by a corresponding amount. The final net revenues are not affected. In fiscal year 1960 interchange credits of \$1,023,219 have been included in the energy sales figure.

Comparative Balance Sheet

Table 6 is a condensed statement of assets and liabilities on a cost accounting basis for the investment in Bonneville Power Administration as of June 30, 1959 and 1960. Electric transmission plant in service at the end of 1960 was nearly \$451,000,000, an increase of more than \$8,700,000 during the year. Construction work in progress at the end of the year was approximately \$27,700,000, an increase of more than \$9,300,000. The total investment in electric transmission plant increased approximately \$18,100,000.

The gross investment of the Federal Government in the Bonneville Power Administration transmission and marketing program increased approximately \$41 million. These gross amounts include, in addition

to transmission capital investment, the amounts necessary for operation, maintenance and interest expenses. Funds returned to the Treasury by BPA after deducting amounts allocated to the generating projects increased by more than \$22,400,000, with the result that the unpaid investment owing to the Federal Treasury increased only \$18,600,000. This increase is represented almost entirely by the increase in the investment in electric plant, with the remainder consisting of cash on hand and other miscellaneous assets.

TABLE 6.—*Bonneville Power Administration—condensed statement of assets and liabilities of June 30, 1959 and 1960 (Preliminary)*

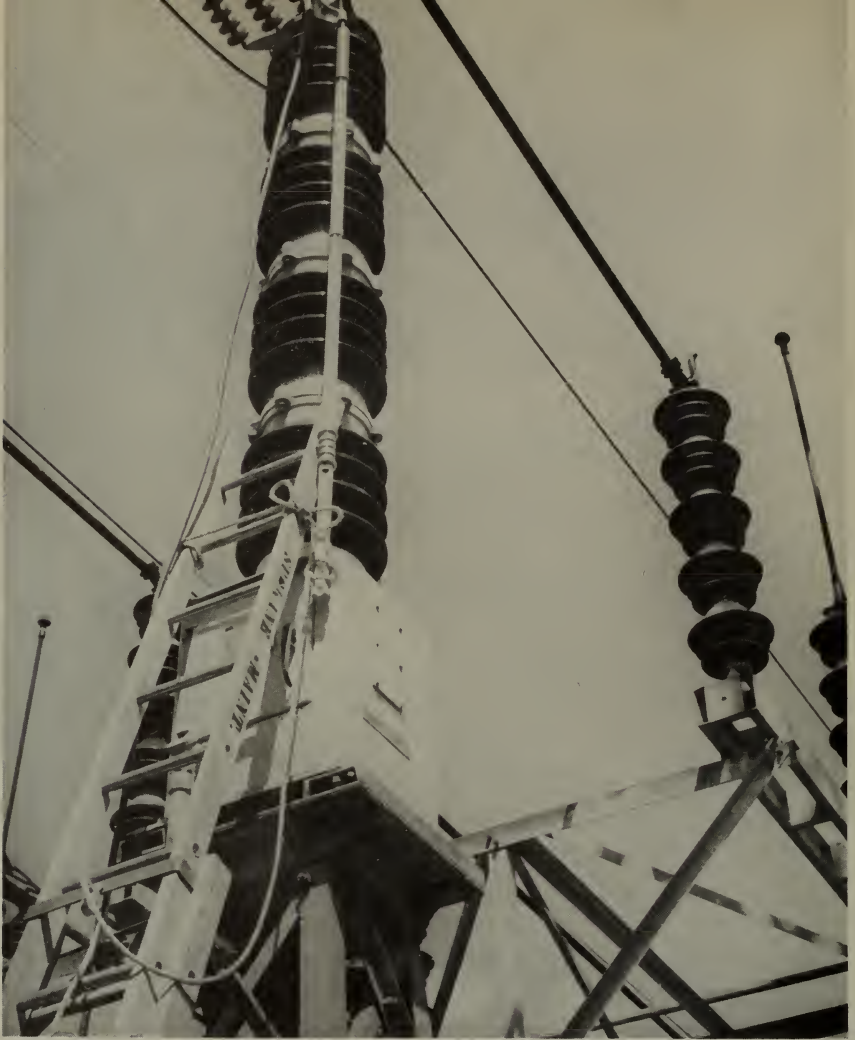
(Cost Accounting Basis)

	1959	1960	Increase or (decrease)
ASSETS			
Electric plant—original cost:			
Electric plant in service.....	\$442,212,176	\$450,929,591	\$8,717,415
Electric plant leased to others.....	462,571	445,307	(17,264)
Construction work in progress.....	18,343,373	27,668,725	9,325,352
Electric plant held for further use.....	775,691	869,741	94,050
Other physical property.....	73,569	42,771	(30,798)
Total electric plant.....	461,867,380	479,956,135	18,088,755
Less reserve for depreciation.....	86,321,176	96,992,049	10,670,873
Original cost less reserves.....	375,546,204	382,964,086	7,417,882
Current assets:			
Unexpended funds.....	16,146,758	20,396,529	4,249,771
Special deposits.....	617,472	692,210	74,738
Accounts receivable:			
Customers.....	9,995,078	10,390,953	395,875
Others.....	806,938	484,492	(322,446)
Materials and supplies.....	5,819,435	5,058,948	(760,487)
Total current assets.....	33,385,681	37,023,132	3,637,451
Other assets and deferred charges.....	3,457,494	1,881,808	(1,575,686)
Total assets.....	412,389,379	421,869,026	9,479,647
LIABILITIES			
Investment of U.S. Government:			
Congressional appropriations.....	574,903,234	606,464,620	31,561,386
Transfers ¹	17,391,902	18,114,858	722,956
Interest on Federal investment:			
Charged to operations.....	65,799,646	74,116,967	8,317,321
Charged to construction.....	7,311,809	7,701,768	389,959
Continuing fund.....	1,833,035	1,833,035	
Gross investment.....	667,239,626	708,231,248	40,991,622
Less: funds returned.....	287,512,126	309,865,070	22,352,944
Net investment.....	379,727,500	398,366,178	18,638,678
Accumulated net revenues:			
Balance June 30, 1958 and 1959.....	31,358,047	23,987,237	(7,370,810)
Net revenue for year.....	(7,370,810)	(8,619,470)	(1,248,660)
Balance June 30, 1959 and 1960.....	23,987,237	15,367,767	(8,619,470)
Total investment.....	403,714,737	413,733,945	10,019,208
Current and accrued liabilities:			
Accounts payable.....	5,203,768	5,404,337	200,569
Employees' accrued leave.....	2,275,195	2,261,177	(14,018)
Total.....	7,478,963	7,665,514	186,551
Deferred credits.....	1,195,679	469,567	(726,112)
Total liabilities.....	412,389,379	421,869,026	9,479,647

¹ Consists of goods and services furnished without charge by other Federal agencies less such items furnished to other Federal agencies by BPA.



A construction crew, with the aid of a giant crane, erects a single circuit steel tower for Bonneville Power Administration's Tacoma-Grand Coulee 287,000-volt transmission line in the rugged Stampede Pass section of the Cascade range.



A ground lead "hot stick" is connected to the line side of a wave trap on the Hot Springs terminal at Bell substation for the safety of workers on the new terminal facilities.

Repayment of Federal Investment

The amount of the Federal investment in the Bonneville Power Administration transmission system and the status of repayment on a payout basis as of June 30, 1960, are shown in table 7. From the inception of operations to June 30, 1960, the Bonneville Power Administration has returned cash receipts to the Treasury in the aggregate amount of \$713,070,391. Of this total, \$403,205,320 has been allocated to the generating projects and \$309,865,071 to the transmission system.

These receipts have reimbursed the Federal Treasury in full for Bonneville Power Administration's expenses of operation, maintenance, marketing, administration, etc., totaling \$110,826,179, and have



A Bonneville Power Administration testing crew checks out a fault locator and phase selector at one of BPA's large substations.

TABLE 7.—Bonneville Power Administration—summary of Federal investment in transmission system and repayment as of June 30, 1960 (preliminary)

[Payout basis]

	Gross investment	Repayments	Net investment
Investment in current expenses:			
Operation, maintenance, etc.....	\$110, 826, 179	\$110, 826, 179	-----
Interest.....	74, 116, 967	74, 116, 967	-----
Total current expenses.....	184, 943, 146	184, 943, 146	-----
Investment in capital assets:			
Electric plant investment and other capital assets.....	502, 773, 937	¹ 124, 921, 925	\$377, 852, 012
Unexpended appropriations.....	20, 379, 457	-----	20, 379, 457
Total capital investment.....	523, 153, 394	124, 921, 925	398, 231, 469
Total Federal investment.....	708, 096, 540	² 309, 865, 071	398, 231, 469

¹ Consists of \$89,068,000 scheduled amortization and \$35,853,925 repaid in excess of scheduled requirements. The total repayment, \$124,921,925 equals 24.8 percent of the invested capital of \$502,773,937.

² Total cash receipts covered into the U.S. Treasury by BPA to June 30, 1960..... \$713, 070, 391
 Less amounts allocated to generating projects..... 403, 205, 320

Cash receipts allocated to Bonneville Power Administration..... 309, 865, 071



Bonneville Power Administration's A-C network analyzer, largest west of the Rockies, is used to work out system problems of coordination and integration for both Bonneville and interconnected systems, as well as for planning transmission facilities that will be required in the next 10 to 25 years to meet the power needs of the region.

repaid in full interest on the transmission investment in the amount of \$74,116,967 with the balance of \$124,921,925 applied to repayment of the capital investment. This capital repayment exceeded scheduled amortization requirements by \$35,853,925 and represented repayments of 24.8 percent of the total capital investment of \$502,773,937.

Power Development Trends

There were several important developments in the power field during fiscal year 1960 that could have a tremendous impact on both the power resources and power operations of the U.S. Columbia River Power System.

One of these important events was an announcement by the International Joint Commission of a general policy statement as a guide for development of upper Columbia river storage projects. The recently established negotiating committee is currently proceeding with discussions between Canada and the United States. The U.S. negotiating team is made up of representatives of the Department of Interior, the Corps of Engineers and the State Department.

The potential hydroelectric generation resulting from downstream benefits of the proposed upper Columbia storage projects could make a substantial contribution to the generating capacity of the Columbia river power system. Completion during the next decade of one or more of these projects would affect many phases of Columbia river power operations and resource planning.

Atomic Energy

Another important event was start of construction on a dual purpose reactor at the Hanford Atomic Energy Works. This could be the forerunner of the first large scale generation of electric energy by atomic fission in the Pacific Northwest.

The Federal Power Commission, with the assistance of BPA, has completed its study of the feasibility of installing steam operated generation facilities in connection with the reactor. The most feasible reactor design under assumptions of the study would produce 654,000 kilowatts during the initial 10-year period of operations, and 756,000 kilowatts over the 25 years following.

California Intertie

Bonneville Power Administration in cooperation with the Department's Bureau of Reclamation and in consultation with interested utilities of the Pacific Northwest and California, completed a study of a proposed intertie between the U.S. Columbia River Power System and northern California.

The study was made in response to a resolution of the Senate Committee on Interior and Insular Affairs adopted May 19, 1959, and was submitted to the Committee on February 17, 1960. The purpose of the study was to determine the extent of a potential market for substantial blocks of secondary power currently surplus to the needs of the Pacific Northwest. The potential market for the power involves a displacement of steam generation in northern California, when such surplus power is available from the Pacific Northwest.

Negotiations relative to a proposed sale of surplus energy to the Pacific Gas and Electric Co. were suspended at the request of the Senate Committee pending conclusion of an independent study sponsored by the State of California of an extra high voltage "common carrier" type of interconnection. The committee desired to consider legislation insuring that the construction of an intertie would not deprive power consumers of the Pacific Northwest of power produced in the region.

Southwestern Power Administration

Douglas G. Wright, *Administrator*



GROSS REVENUES of the Department of the Interior's Southwestern Power Administration for fiscal year 1960 were \$15,012,588.74, representing an increase of \$479,538.86, or 3.3 percent over the gross revenue for fiscal year 1959.

Since fiscal year 1958, the year Southwestern Power Administration's adjusted rates became effective, the revenue has increased. During the same period operating expense has increased. A continuing effort is being made to obtain a more stable relationship between expense and revenue.

During fiscal year 1960, private utilities accounted for 32 percent of the revenue dollar, electric cooperatives 57 percent, municipalities 9 percent, and Public Authorities 2 percent, as compared to fiscal year 1951 when the private utilities accounted for 82 percent, electric cooperatives 16 percent, municipalities 2 percent, and Public Authorities 0 percent.

Table 1 presents a source and application of funds statement as of June 30, 1959, and 1960.

TABLE 1.—*Southwestern Power Administration, Source and Application of Funds*

Funds provided:	June 30, 1959	June 30, 1960
Congressional Appropriations (net) ..	\$37, 932, 662. 37	\$39, 910, 976. 35
Transfer of cost or property to or from other Government agencies (net) ..	497, 029. 70	624, 052. 27
Gross operating revenue and other income	70, 070, 270. 39	85, 083, 374. 29
Total funds provided	108, 499, 962. 46	125, 618, 402. 91



Southwestern Power Administration facilities, Springfield, Mo., the hub of Interior's Power Marketing System, graphically portray the continuing progress toward integration of all sources of power in the Southwest region. This substation, with associated switching yard, dispatching center, and communications equipment, interconnecting six 161-kilovolt and four 69-kilovolt lines providing electric service to customers of SPA, G&T cooperatives, municipalities, and private companies, will ultimately be the greatest point of power exchange in the area.

TABLE 1.—Southwestern Power Administration, Source and Application of Funds—Continued

Funds applied:		
Returned to U.S. Treasury ¹	\$26, 087, 682. 12	\$34, 106, 932. 77
Accumulated operating expenses.....	53, 236, 073. 35	66, 117, 878. 43
Less: Nonfund depreciation and amortization expense.....	(4, 655, 490. 79)	(5, 367, 079. 08)
Electric plant.....	25, 303, 960. 01	27, 107, 525. 85
Special and trust funds.....	8, 997, 948. 33	5, 746, 690. 86
Cash.....	3, 034, 067. 85	2, 469, 579. 73
Accounts receivable.....	1, 028, 949. 34	1, 114, 878. 86
Non-utility property.....	2, 056. 89	2, 474. 18
Other current and accrued assets.....	322, 370. 00	20. 00
Material and supplies.....	479, 759. 05	493, 987. 16
Prepayments and advances.....	1, 175. 00	1, 791. 65
Deferred debits.....	(4, 365. 34)	(3, 642. 84)
Less: accrued and other nonfund items—		
Accounts payable.....	(390, 637. 31)	(616, 766. 59)
Accrued payroll.....	(45, 213. 86)	(18, 512. 73)
Accrued leave.....	(102, 886. 77)	(112, 275. 01)
Contributions in aid of construction..	(57, 486. 96)	(55, 920. 04)
Accrued interest on invested capital..	(4, 737, 998. 45)	(5, 369, 160. 29)
<hr/>		
Total funds applied.....	108, 499, 962. 46	125, 618, 402. 91

¹ Total funds referred to U.S. Treasury. No allocation of revenue has been made to the Corps of Engineers to date.

The original cost investment in transmission facilities of Southwestern Power Administration amounted to \$27,107,525.85, as of June 30, 1960.

Marketing

During fiscal year 1960, the electric power utilized by Southwestern Power Administration was obtained as follows: 1,672.0 mil-



Southwestern Power Administration construction crew at work on new section constructed at SPA substation, Springfield, Mo., to provide for increased capacity resulting from the completion and interconnection of the department's Table Rock to Springfield 161-kilovolt transmission line placed in full commercial operation in fiscal year 1960.

lion kilowatt-hours generated at Federal multiple-purpose projects, operated by the Corps of Engineers, Department of the Army, 511.6 million kilowatt-hours obtained from thermal-electric generation of other, public and private utilities, making a total of 2,183.6 million kilowatt-hours. A total of 1,820.9 million kilowatt-hours (83.4 percent) was marketed as firm energy, 240 million kilowatt-hours (11.0 percent) was marketed as secondary and dump energy, 122.7 million kilowatt-hours (5.6 percent) were system losses.

Deliveries to preference customers amounted to 1,528.3 million kilowatt-hours, representing a 1.2-percent increase over the previous year.

Energy sales of Southwestern Power Administration for the fiscal year 1960 were 2,183.6 million kilowatt-hours, representing an in-

crease of 137.1 million kilowatt-hours or 7.1 percent over the energy sales for the previous year.

The following table demonstrates the comparison of sales, in millions of kilowatt-hours, for fiscal years 1959 and 1960 by rate schedules.

Rate schedules	Fiscal year 1959, mil- lions of kilowatt hours	Fiscal year 1960, mil- lions of kilowatt hours
P-1.....	0	20.9
F-1.....	1,442.8	1,409.5
EE.....	26.7	55.2
IC.....	2.4	.5
Special contracts:		
Firm.....	391.5	390.5
Secondary.....	60.4	184.3
Total sales.....	1,923.8	12,060.9

¹ Includes total secondary sales of 240 million kilowatt-hours, the sum of EE, IC, and special contracts secondary.

Transmission and Wheeling Arrangements

Southwestern Power Administration has constructed transmission facilities interconnecting six Federal multiple-purpose projects from which it markets electric power and energy. These facilities have been interconnected with the systems of other public and private utilities so that Federal transmission facilities are minimized.

In order to serve preference customers at their load centers without the duplication of transmission facilities, Southwestern Power Administration has contractual agreements with several private utility companies and with rural electric generation and transmission cooperatives to serve its customers from the transmission facilities of those electric companies and cooperatives. The principal arrangements embodied in these contractual agreements provide for service to customers of SPA from facilities of others.

Contracts

During the past 2 years, three new basic power contracts have been completed. Outstanding of these is a 25-year contract with Tex-La Electric Cooperative, Inc., composed of cooperatives and municipalities in east Texas and Louisiana, which establishes a contractual arrangement for the sale of the entire 17,000 kilowatt output of Narrows Dam, with an additional 45,000 kilowatts from Southwestern Power Administration's interconnected transmission system. The contract becomes effective October 1, 1960.

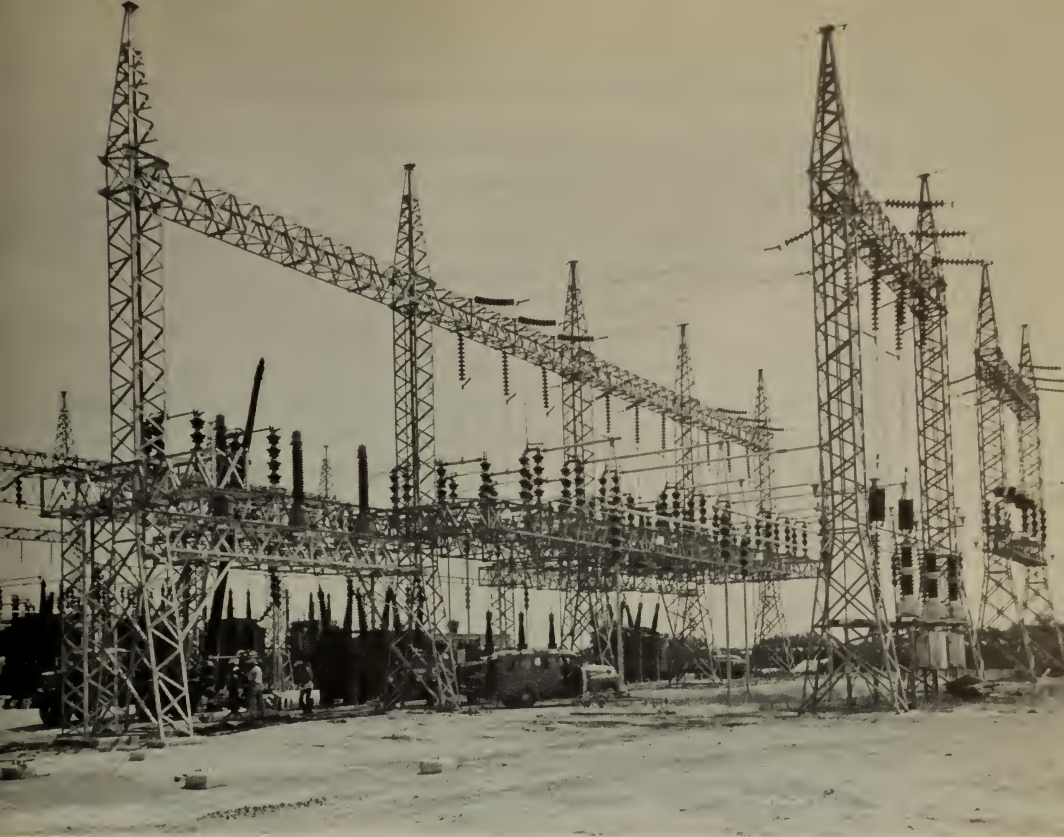


Breakers installed at Spa substation, Clinton, Mo. Extensive expansion of these installations was required to provide for interconnection of Kansas City Power and Light Co. and Missouri Public Service Co., Kansas City, Mo.

A contract, unanimously endorsed by preference customer groups, with the Kansas City Power and Light Co., also established an arrangement for the sale of hydroelectric peaking power. This new contract establishes greater integration and utilization of the Federal and non-Federal power in the Southwest area and has resulted in the development of a market for large blocks of hydroelectric peaking capacity on terms which will enable Southwestern Power Administration to make available by withdrawal any or all of such capacity as necessary to meet the requirements of preference type customers. Also, a contract of this type was signed with the Missouri Public Service Co., Kansas City, Mo.

A third contract was completed with the Oklahoma Gas and Electric Co. which provided for the sale of 1,200 hours of energy per kilowatt of peaking capacity annually rather than the 1,800 hours per kilowatt of earlier contracts. This contract provides for (a) reduction in the number of hours thus permitting Southwestern Power Administration to market additional peaking capacity; and (b) an increase of kilowatt hours to be delivered during summer months when the demand for energy is greater in the Oklahoma area.

These three new contractual arrangements will result in full utilization of hydroelectric power generated from the Federal multiple-purpose projects in the Southwest.



Construction crews at SPA substation, Weleetka, Okla., key point of interchange of power for Oklahoma and Texas customers of SPA. Extensive expansion of this substation with related facilities which will provide for doubling the power capacity—from 30,000 kilowatts to 60,000 kilowatts—is nearing completion.

A contract was completed and service was started in fiscal year 1960 to one new preference customer—the city of Walters, Okla.—to serve the entire load of the city.

Intensive studies are now under way for effecting improvements of present contractual arrangements with G&T cooperatives throughout the Southwest. Contracts with the Western Farmers Electric Cooperative, Anadarko, Okla., and with the N.W. Electric Power Cooperative, Cameron, Mo., have been amended to provide for conversion of part of the Government's commitments for firm power to peaking power, insofar as the loads will permit. This amendment will assure conservation of non-firm energy and make additional amounts of capacity useable as dependable peaking capacity from the Federal system. The same contractual changes are now being negotiated with the Central Electric Power Cooperative, Jefferson City, Mo., and with the Sho-Me Power Corporation, Marshfield, Mo.

Conforming with the pattern already set with other G&T cooperatives, Southwestern Power Administration's contract with the KAMO Electric Cooperative, Vinita, Okla., has been amended to change the

metering of the Government's power from the points of delivery to the points at which the Government interconnects with the KAMO system. The result is that KAMO is responsible for losses in its system. As compensation for these losses, KAMO receives the benefit of the diversity in load within its own system.

Power Resources

The installed capacity and capability in the hydroelectric and steam electric plants in Southwestern Power Administration's interconnected system are shown in table 2. The installed capacity of the interconnected Federal hydroelectric system was increased to 601,000 kilowatts when two units at the Table Rock project were placed in operation on June 1, 1959.

TABLE 2.—SPA total system capability

Project or plant	State	Installed capacity	Dependable capacity	Capability June 30, 1960
Hydroelectric interconnected system:				
Bull Shoals	Arkansas.....	160,000	100,000	184,000
Denison	Oklahoma-Texas.....	70,000	54,000	80,000
Fort Gibson.....	Oklahoma.....	45,000	45,000	48,000
Norfolk	Arkansas.....	70,000	56,000	80,000
Table Rock.....	Missouri.....	100,000	69,000	100,000
Tenkiller Ferry.....	Oklahoma.....	34,000	28,000	39,000
Subtotals		479,000	352,000	531,000
Isolated plants:				
Blakely Mountain.....	Arkansas.....	75,000	75,000	75,000
Narrows.....	Arkansas.....	17,000	14,000	19,000
Whitney.....	Texas.....	30,000	24,000	28,000
Subtotals		122,000	113,000	122,000
Total hydroelectric.....		601,000	465,000	653,000
Steam:				
Central Electric Power Coop.....	Missouri.....	15,000	16,000	16,000
N.W. Electric Power Coop.....	Missouri.....	40,000	42,000	42,000
Western Farmers Electric Coop.....	Oklahoma.....	30,000	31,000	31,000
Total steam.....		85,000	89,000	89,000
Grand total.....		686,000	554,000	742,000

Energy Production

Reservoir inflow for 9 months of the fiscal year 1960 was well above normal with average flow for the year being about equal to median. The reservoir system storage was approximately 90 percent full at the beginning of the fiscal year, and was 96 percent full on June 30, 1960. The net generation for all Federal projects currently in operation is shown in table 3.

The total net hydro generation for 1960 was 1,726.6 million kilowatt-hours, which is the highest annual generation in Southwestern

Power Administration since fiscal 1957. The net generation from the interconnected hydro system amounted to 1,471.2 million kilowatt-hours.

TABLE 3.—SPA total system net hydro generation, fiscal years

[Million kilowatt-hours]

Year	Bull Shoals	Denison	Fort Gibson	Norfolk	Tenkiller	Table Rock	Inter-connected system	Narrows	Blakely Mountain ¹	Whitney	Grand total
Total to June 30, 1950.....	-----	1,099.1	-----	1,066.7	-----	-----	2,165.8	3.1	-----	-----	2,168.9
1951.....	-----	254.6	-----	207.6	-----	-----	462.2	29.4	-----	-----	491.6
1952.....	-----	142.6	-----	338.9	-----	-----	481.5	42.5	-----	-----	524.0
1953.....	270.2	92.4	32.1	126.8	-----	-----	521.5	47.4	-----	0.4	569.3
1954.....	334.7	192.4	39.5	132.8	43.3	-----	742.7	17.8	-----	20.2	780.7
1955.....	241.1	140.2	70.7	23.7	54.6	-----	530.3	29.2	-----	30.1	589.6
1956.....	385.6	197.0	74.8	105.5	38.4	-----	802.3	21.2	-----	66.1	938.2
1957.....	651.5	144.5	72.6	204.3	61.9	-----	1,134.8	39.8	-----	219.3	1,465.1
1958.....	991.7	245.4	146.7	248.2	118.0	-----	1,750.0	45.8	-----	177.0	2,056.0
1959.....	488.1	109.4	161.3	208.8	106.7	10.2	1,084.5	25.2	-----	175.8	1,323.2
1960.....	418.6	266.9	271.8	174.4	126.7	212.8	1,471.2	30.4	-----	155.6	1,726.6
Total.....	3,782.5	2,884.5	869.5	2,837.7	549.6	223.0	11,146.8	331.8	793.8	360.8	12,633.2

¹ Generation delivered into Arkansas Power & Light Co. system. By contractual arrangements 136 million kilowatt-hours per year of firm energy is delivered into SPA system.

Steam Power

The amounts of energy generated by G&T steam electric plants for marketing by Southwestern Power Administration during fiscal year 1960 are as follows:

Central Electric Power Cooperative (Chamois, Mo.).....	96,752,000
N.W. Electric Power Cooperative (Missouri City, Mo.).....	159,149,000
Western Farmers Electric Cooperative (Anadarko, Okla.).....	130,350,300
Total steam.....	386,251,300

Construction

Construction during fiscal year 1960 saw (1) the completion of the 40-mile 161-kilovolt transmission line connecting Table Rock project to the Southwestern Power Administration's substation at Springfield, Mo.; and (2) extensive expansion of Southwestern Power Administration's substations and related facilities at Springfield and Clinton in Mo., and at Tupelo and Weleetka in Okla.

Southeastern Power Administration

Chas. W. Leavy, *Administrator*



DURING FISCAL YEAR 1960, Southeastern Power Administration marketed 1,213,000 kilowatts of capacity (with peak generation of 1,462,760 kilowatts) and 4,048,025,373 kilowatt-hours of energy. It was sold to 52 public bodies, 74 rural electric cooperatives, 1 Federal agency, and 6 privately owned utilities. Sales during the year earned \$20,650,668.97, as compared with \$14,863,863.87 for the previous year, bringing the revenue earned in all years to a total of \$111,269,108.64.

The output was generated at 11 Corps of Engineers projects. They were the Wolf Creek, Dale Hollow, Center Hill, Old Hickory, and Cheatham projects in Kentucky and Tennessee, the Allatoona and Buford projects in Georgia, the Clark Hill project in Georgia and South Carolina, the Jim Woodruff project in Florida, and the John H. Kerr and Philpott projects in Virginia.

The installed generating capacity of 1,283,600 kilowatts includes a 12,000-kilowatt unit installed but not in commercial operation at Cheatham project in Tennessee. Construction by the Corps continued on Cheatham as well as three other projects—Walter F. George in Georgia and Alabama, Hartwell in Georgia and South Carolina and Barkley in Kentucky. The construction under way will add 524,000 kilowatts of installed capacity.

The combined output of Wolf Creek, Center Hill, and Dale Hollow projects continued to be sold to the Tennessee Valley Authority under a long-term contract. The entire output of the Old Hickory project and the output of two units of Cheatham were sold under another long-term contract with the Authority.

All of the Philpott project output was sold to Appalachian Power Co. under temporary arrangements pending the conclusion of negotiations for long-term sale. Two-thirds of the Kerr project's output continued to be sold under long-term contracts to the Virginia Electric

and Power Co., and to 17 cooperatives in Virginia and North Carolina; and the remainder continued to be sold under long-term contracts to Carolina Power and Light Co., and to 16 public bodies and cooperatives in North Carolina.

Part of the Clark Hill project output was sold under long-term contracts to two public bodies in South Carolina. One-half of the output of the Clark Hill project and the entire output of the Allatoona and Buford projects were sold under long-term contracts to Georgia Power Co. and 86 public bodies and cooperatives in Georgia. The output of the Jim Woodruff project was sold under long-term contracts to Florida Power Corporation and 6 public bodies and cooperatives in Florida.

The Congress appropriated for the fiscal year \$261,000 for headquarters operation and maintenance, and \$455,625 for the purchase of firming energy and the payment of wheeling fees. Southeastern's working force numbered 33 employees at the beginning of the fiscal year and 34 employees when the year ended.

Office of Saline Water

Dr. Arthur L. Miller, *Director*



RESEARCH AND DEVELOPMENT activities of the Office of Saline Water and the program to construct and operate five saline water conversion demonstration plants is attracting worldwide attention. Lowering water tables and the increased competition for readily available surface supplies in this and other nations, especially those in the arid areas of the world, is quickening the interest in the future potential of low-cost converted sea or brackish water.

A sharp increase in the number of inquiries or visits from representatives of foreign countries seeking information on the latest developments in the state of the art was readily noted throughout the year. An increasing number of United States research or industrial firms began to invest research funds or divert technical personnel from other projects to develop solutions for the problems of low-cost saline water conversion.

Present Activities

The contracts awarded by the Office of Saline Water during fiscal year 1960 mark an all-time high both in size and number. Fifty-four contracts totaling \$2,854,468 were awarded by the Office for research, development, and demonstration plant construction. Many of the contracts awarded by the Office only partially covered the cost of the research and development projects. The balance of the cost was assumed by the research organization or industrial firm, giving concrete evidence of the stepped-up interest of private companies in the development of new or improved conversion processes.

Many formidable problems still must be solved before economically competitive fresh water can be obtained from the sea. The most efficient sea water conversion plant operating in the world today is

producing 2.8 million gallons of fresh water per day at a cost of about \$2 per thousand gallons. This is far too expensive to be considered as a source of supply for any area where natural fresh water is readily available. There are, however, areas where natural fresh water is not available in the quantities required. To meet the water demands in some of these areas, conversion plants with a combined capacity of about 20 million gallons of fresh water per day are now in operation.

There is necessarily a lag between the developments of the research phase of any program and their practical application. Substantial strides have been made in the search for new or improved saline water conversion processes. During the coming year, three plants will be under construction by the Office which will incorporate a number of the latest process developments. Utilizing this new technology these plants are expected to produce fresh water from the sea for the first time for less than \$1 per thousand gallons.

Future Prospects

Once we have accomplished that objective, how much lower can we reasonably expect to drive down in the foreseeable future, the cost of converting sea and brackish waters to fresh? The prospect is so exciting, and the possibility so recent, that we must answer that we do not know in absolute terms. But on the basis of what we do know, we can reasonably assume that we shall soon be close to producing a thousand gallons of potable water from salt or brackish sources for 50 cents.

That figure is lower than many people now pay and is within a dime of what most Americans pay for water from their taps. In community after community, the curves of cost—of converted water and water from rivers and wells—are beginning to cross. And when they do—and that day is not far distant—the widespread and practical use of converted water will be here.

Demonstration Plants

Public Law 85-883, approved by President Dwight D. Eisenhower on September 2, 1958, provided for the construction and operation of five saline water conversion plants to demonstrate the reliability, engineering, operating and economic potentials of the most promising of the presently known processes.

The Demonstration Plant Act designated the following general geographic regions for the location of the plants: East, west, and gulf coast for sea water conversion plants, and the northern Great

Plains and the arid areas of the Southwest for plants designed to convert brackish water to fresh.

The act further requires each plant to utilize a different process and each process was to be chosen at 3 month intervals beginning on March 2, 1959. The selection deadlines were met due to the diligent efforts of a special Process Selection Board representing science, industry, and Government. Members of the board are: Dr. Ralph Morgen, president, Rose Polytechnic Institute; Dudley F. Phelps, president, the J. G. White Engineering Corporation; and Captain Ivan Monk, Department of the Navy.

Acting on the recommendations of this board, Secretary Seaton selected three of the processes during the last quarter of fiscal year 1959 and two in fiscal year 1960. The selection of processes was completed ahead of the schedule set forth by the Congress in the authorizing legislation.

Nearly 200 communities, many offering more than one site, applied for one of the authorized plants. A Site Selection Board consisting of three engineers with vast experience in water supply problems was appointed to evaluate the proposed sites. Members of this board, Mr. S. T. Powell, of Sheppard T. Powell and Associates; Mr. Lewis S. Finch, vice president and chief engineer of the Indianapolis Water Co.; and Dr. W. C. Schroeder, University of Maryland, carefully studied information submitted by the interested cities and communities and personally inspected many of the proposed sites before submitting their findings to the Secretary of the Interior. By the end of fiscal year 1960 Secretary Seaton had selected four sites and proposed sites on the east coast were being processed for final selection.

Demonstration Plant Processes and Sites

The processes and sites for the demonstration plants are as follows:

- Long tube vertical multiple-effect distillation, Freeport, Tex.
- Multistage flash distillation, San Diego, Calif.
- Electrodialysis, Webster, S. Dak.
- Forced-circulation vapor compression, Roswell, N. Mex.
- Freeze demineralization, east coast (site to be selected)

The construction specifications for the first plant at Freeport, Tex., were issued on April 1, and bids were opened on May 24, 1960. The Chicago Bridge and Iron Co. submitted the successful low bid of \$1,246,250. The plant is scheduled to be completed and in operation by May 7, 1961.

The specifications for the second and third plants were completed by the end of the fiscal year and have been issued. The Freeport plant was designed by W. L. Badger Associates of Ann Arbor, Mich.



Model of 35,000 GPD freezing process pilot plant being built at St. Petersburg, Fla.

The Fluor Corporation of Los Angeles is designing the San Diego plant, and the Department's Bureau of Reclamation is preparing the specifications for the Webster plant.

Basic Research

In any dynamic research and development program, considerable emphasis must be placed on fundamental research, since new ideas or new processes can be developed only through such basic studies. The conversion processes already selected for demonstration certainly are not the best that can be developed, even though they are the most advanced of their type. Research can improve the efficiency of those methods, develop entirely new methods, and solve specific related problems such as heat transfer, corrosion, scale deposition, and others.

Current research includes laboratory and theoretical investigations on 6 or 7 new conversion processes, scale formation in distillation and electro dialysis equipment, membrane development (both ion selective and osmotic types), heat transfer, corrosion, use of radioisotopes, etc.

New Processes

One potentially promising new conversion process involves the use of gas hydrates such as light hydrocarbons and halogenated methanes and ethanes. These substances form solid hydrates containing many moles of water per mole of agent. Essentially, the process consists of contacting saline water with a liquid hydrating agent, separating the crystalline hydrate formed under the proper conditions, washing and decomposing the hydrate into pure water and hydrating agent. Fundamental research aimed at determining the various agents which form

hydrates at reasonable temperatures and pressures and the thermodynamic properties of those agents is in progress.

Another new system under study utilizes a combination of electro-dialysis and resin-bed treatment, made possible by new materials and techniques which may minimize the inherent difficulties of each process. The proposed method utilizes conductive ion exchange materials which can be regenerated by means of an electric current and ion selective membranes to reduce the tendency of mixing the two solutions.

Work on determining the practicality of the osmionic-conversion process has been continued. This method is somewhat similar to electro-dialysis except that no electrodes or outside electric current is required. The driving force causing demineralization is produced by the concentration difference between a brine and feed water. Three laboratory prototypes have been fabricated and successfully operated.

Among other potential processes under investigation are: (a) An electrolytic demineralization cycle using a pair of porous electrodes, one responsive to the cation and the other to the anion. The technical feasibility of the process has been demonstrated and efforts are being directed toward the preparation of more economical electrodes and electrodes with greater capacity; (b) capillary diffusion; and (c) use of radioisotopes (actually radiowastes) as a source of energy for a conversion process.

Research Investigations

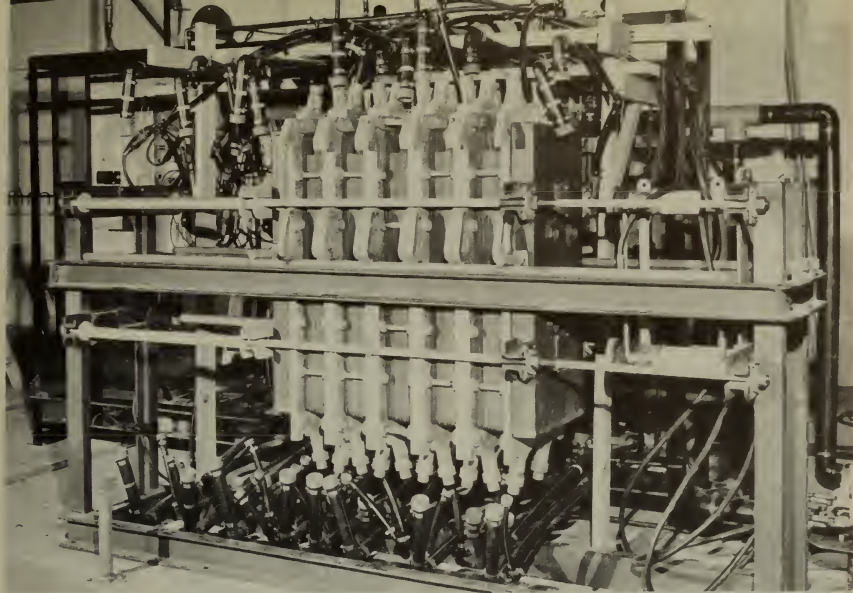
The deposition of salts in distillation and electro-dialysis equipment under certain conditions is a serious problem and it is essential that methods for eliminating or alleviating scale be developed. Two fundamental research investigations aimed at obtaining a better understanding of scale formation in both types of equipment and developing means of controlling it are being carried on.

Basic research investigations having as their primary objectives the development of improved or new ion selective and osmotic membranes are underway. If successful, such membranes will benefit the electro-dialysis, osmionic and reverse osmosis processes.

The use of acoustic vibrations to improve heat transfer rates in distillation units is under study and the first phase of a study on corrosion problems attendant with saline water conversion is nearing completion.

Processes Development

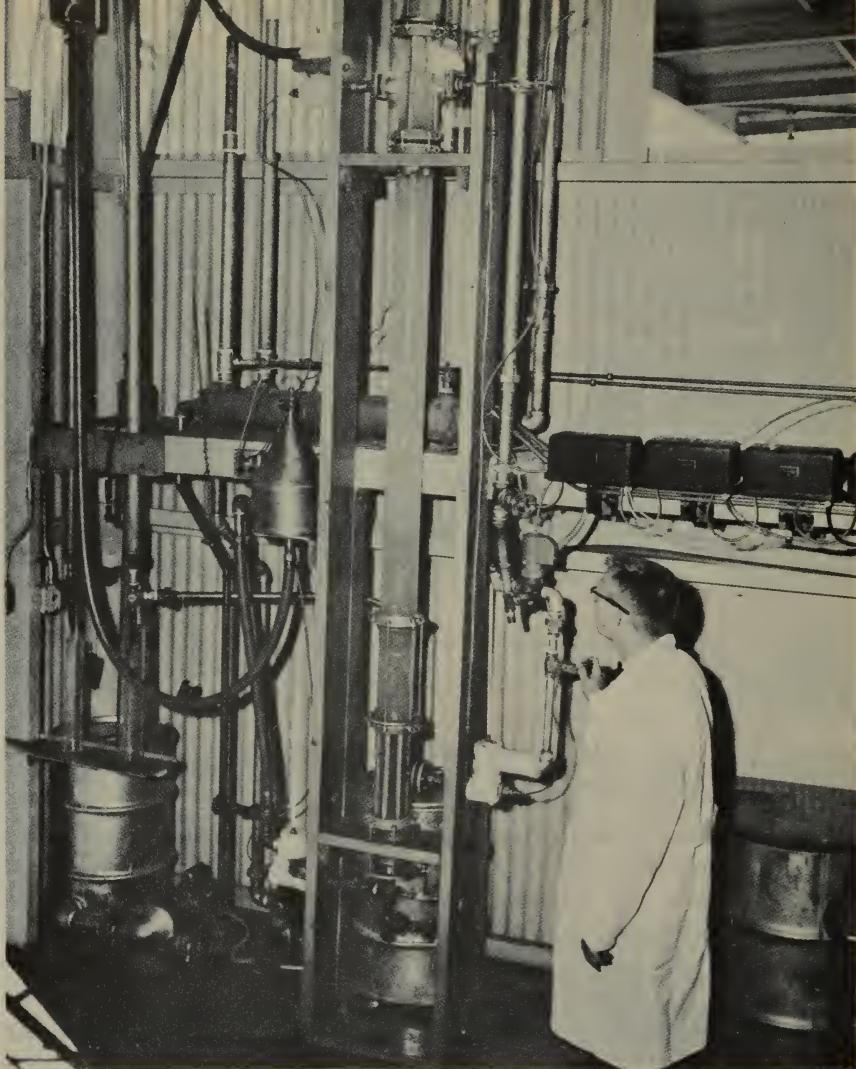
Successful operation was obtained on a 15,000-gallon per day pilot plant using a direct freezing process. This new process uses flash evaporation of precooled saline water to make ice, followed by washing



TNO type electro dialysis demineralizer—one of four types of equipment being evaluated for the Office of Saline Water by the Bureau of Reclamation laboratories in Denver, Colo.

of brine from the ice. At the close of the fiscal year, the pilot plant was being moved from Syracuse, N.Y., to Harbor Island, N.C., for additional operation on sea water. Increased activity in the development of freezing processes was reflected in the initiation of a project to build a 35,000 gallons per day pilot plant utilizing direct freezing with a secondary refrigerant and incorporating two ice crystal washing systems previously developed in the laboratory. Another promising approach in the development of freezing as a practicable means of salt water conversion was realized in the operation of a laboratory pilot unit wherein the size of the ice crystals was controlled so that washing procedures could be simplified. Economic projections of laboratory and pilot plant data indicate that freezing processes will compete favorably with developments in distillation.

The operation of the long-tube-vertical pilot equipment at Harbor Island has continued in an effort to control the calcium sulphate scale problem by the same type of sludge recirculation technique previously developed for calcium hydroxide. Also at Harbor Island, the testing of the large rotary vapor compression still was completed. However, additional research and development on rotor designs and water-spreading techniques and additional economic analyses were continued in the laboratories. Tests made on two types of small rotary vapor compression stills showed further development is necessary. Work was begun on a new distillation system based upon development of a wiped-film evaporator. Studies on the vapor reheat flash process in which there are no metallic heat transfer barriers continued with emphasis on the liquid-liquid heat exchange phases.



Experimental direct contact heat exchanger being operated at San Jose, Calif. This is part of the vapor reheat flash distillation system.

Cooperative Research

Membrane processes, particularly electro dialysis, have shown important application in the treatment of brackish waters; future development in both membrane and equipment may make these processes useful for the conversion of sea water. During the year, four types of commercial membranes have been evaluated and three different types of commercial equipment have been operated as a part of the experimental electro dialysis program underway at the Department's Bureau of Reclamation laboratories in Denver, Colo. Plans have been made for use of a brackish well water site near Denver for additional field testing programs. A means of practical use of ion exchange resins in



Dr. A. L. Miller, Director of the Office of Saline Water, signs the construction contract for the Nation's first saline water conversion demonstration plant at Freeport, Tex. With Dr. Miller are (l. to r.), Joseph L. Miller representing the successful low bidder, the Chicago Bridge and Iron Co., Russell Whitesell, representing the Dow Chemical Co., and Allen Cywin, Chief, Division of Demonstration Plants, Office of Saline Water.

sea water demineralization may result from a new project initiated for the pilot unit study of partial removal of scale components from sea water before conversion. The process depends upon using the concentrated effluent brine from a distillation conversion process to regenerate the resins.

Successful operation of both plastics and glass-cover basin types of solar stills has been obtained at the Daytona Beach, Fla., solar distillation research station. Ways to reduce cost of construction have been determined. Prototypes of tilted types of solar stills are being installed for evaluation. Research on plastic materials is underway at the station and at several laboratories.

During the year a series of four conferences were held on processes development. These were attended by representatives of contractors, cooperators, and proposers of research projects in the four major fields. One on distillation processes and one on membrane processes were held in Washington, D.C. One on freezing was held at Syracuse, N.Y., and one on solar distillation at Daytona Beach, Fla. The latest developments were discussed at these informal symposia and desirable future programs outlined.

Thirty-three processes development contracts were current during the year. Ten technical reports were published. Of particular interest is the new contract initiating the engineering study of a new chemical process based upon the use of hydrocarbon hydrates as a

means of desalting water. The contracts include a study being made jointly with the State of California on a solar heat application for multistage flash evaporation; research on means of scale prevention; investigation of secondary heat transfer media; compilation of technical data; development of infrared reflecting plastics; evaluation of external condensation with solar stills; and application of atomized suspension techniques for disposal of concentrated brines.

Cooperation and participation with the Department of Defense was effected on several development programs. The wiped-film evaporator development is jointly sponsored with the Navy. The Daytona facilities were made available for testing of an Army vapor-compression still and the Navy furnished evaporators for use in the ion exchange development.

No one process will ever be completely practical for all saline water conversion. Different processes are advantageous for either of the two major divisions of water to be treated—sea water and brackish water. In addition, other factors related to location, such as fuel costs, weather conditions, and waste disposal conditions, can determine which of several processes would be the most economical.

Office of the Assistant Secretary

Mineral Resources

Royce A. Hardy, *Assistant Secretary*



THE ASSISTANT SECRETARY for Mineral Resources discharges the responsibilities of the Secretary of the Interior with respect to the Department's programs in the field of the development and utilization of minerals and metals, including mineral fuels. He exercises supervision over: the Geological Survey, the Bureau of Mines, the Office of Minerals Exploration, the Office of Oil and Gas, the Office of Minerals Mobilization, and the Office of Geography.

The Assistant Secretary serves as the principal spokesman for the Department of the Interior in the field of mineral affairs at the policy-making level within the Federal Government. He participates in meetings of the Council on Foreign Economic Policy as the Department's liaison representative, and is the Department's representative on the National Export Expansion Committee.

This Office continued to coordinate and direct the Department's activities under the Export Control Act, administered by the Department of Commerce. During the past year the Department furnished technical and scientific information on a wide range of commodities, and advised on the need for export controls to protect the domestic economy.

In addition to the foregoing responsibilities, the Office of the Assistant Secretary, Mineral Resources, is the principal point of contact between the Federal Government and the mineral industries.

Staff Activity

Members of the staff of the Assistant Secretary, Mineral Resources, participated in the first meeting of the International Lead-Zinc Study

Group. The session, held in Geneva in January–February 1960, resulted in a continuation of voluntary curtailments of sales of lead on the part of several exporting nations. In light of the improved market situation, curtailments with respect to zinc, announced in the course of the inaugural meeting of the Study Group held in May 1960, were terminated.

Revised legislation to implement a long-range helium conservation program was submitted. At the close of the fiscal year the measure, which would contribute substantially to the conservation of this critical resource, had passed the House.

The Office of the Assistant Secretary, Mineral Resources, continued to supply information and advice to the Office of Civil and Defense Mobilization concerning administration of the Government's strategic stockpiling program and maintained a review of the overall stockpile situation. Additionally, the Office continued its active role in advising the Department of Agriculture with respect to acquisition of strategic and critical material for the supplemental stockpile through barter transactions.

Petroleum and Coal

The Office of the Assistant Secretary continued its extensive participation in interdepartmental discussions dealing with basic problems of petroleum supply and requirements from both national security and peacetime economic standpoints. The Assistant Secretary, Mineral Resources, served as chairman of the Oil Import Appeals Board, which was established to hear appeals arising from the program of mandatory import controls on crude petroleum and petroleum products.

By the close of the fiscal year, legislation creating an Office of Coal Research had received approval of the Congress and was later signed by the President. The measure establishes within the Department of the Interior a new agency to contract for research of immediate benefit to the domestic coal industry.

Geological Survey

Thomas B. Nolan, *Director*

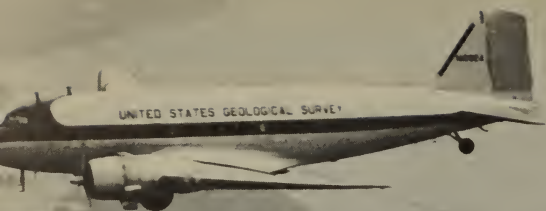


FOR MORE THAN 80 years the Geological Survey of the Department of the Interior has increasingly obtained information on the occurrence, distribution and quantity of the Nation's vast water and mineral wealth, at the same time gathering information concerning its land surface, and reducing this knowledge to reports and maps of widespread usefulness. Survey conducted mapping, investigations and reports have helped lay the strong foundation of America's economic well-being.

The need to supply more people with more things has placed heavier responsibilities upon those required to look ahead and to plan for the necessary raw materials and basic data. The immediate challenge is being met in the Geological Survey by the dedicated men and women who constitute our major asset. Upon their shoulders falls the burden of developing new techniques for achieving these objectives. The ability to use the products of intellectual curiosity for the resolution of practical problems in the national economy has been a most significant contribution.

During the past year, while accomplishing the scientific, engineering and administrative functions of the Survey, staff members participated in hundreds of individual projects, produced more than 1,200 reports, circulars, bulletins, geologic maps and professional papers; some 1,350 new topographic maps.

Although the Survey staff has remained about the same in numbers of people employed, the results to be reported this year mark a new high point in overall achievement.



Measuring the earth's magnetic field, a Geological Survey aircraft with trailing magnetometer traverses Chesapeake Bay.

Geologic Division

Fact-finding and research activities of the Geologic Division include a wide variety of investigations concerning the earth and man's attempts to understand and use its surface and resources. These activities can be broadly grouped into three main categories; economic geology, regional geology, and research on geologic processes and principles.

Economic geology is concerned with the study of known and potential deposits in mineral-bearing and mineral fuels-bearing districts, the application of geologic knowledge to the solution of engineering and land development problems, and the acquisition of geologic information to guide the search for new sources of needed mineral raw materials.

Regional geology includes studies of the structure, composition, history, and distribution of the rocks that underlie the United States, its Territories and possessions. Because the nature of this work is essentially exploratory, its underlying purpose also is, in large part,

economic, for it develops the information needed to appraise the potential resources and to plan for the best use of the land.

The research on geologic processes and principles includes observational and experimental studies in the field and in laboratories to develop and extend the usefulness of the geologic sciences.

A wide range of activities supplies information and services to other Federal agencies and is supported by them. These activities extend geographically over much of the earth and recently have extended into space. Long-established methods as well as intricate research on new methods are used to aid in the planning and accomplishment of some of the varied tasks of the Army, Navy, and Air Force, the Atomic Energy Commission, the National Science Foundation, the International Cooperation Administration, the National Cancer Institute, the Bureau of Public Roads, and the Department's Bureau of Mines.

In addition, geologic programs were carried on during the past year in cooperation with 18 States and Puerto Rico. These range from geologic studies aimed at small immediate economic objectives to broad geologic mapping programs contributing to the ultimate publication of modern State geologic maps.

During the past year the results of the Geologic Division's investigations were published in 26 professional papers, 74 bulletins, 111 maps, and 3 circulars. In addition, 79 reports were placed on open file, and more than 200 reports were published in scientific journals. A summary of the important results of the Geologic Division's current work was published as Geological Survey Professional Paper 400, entitled "Geologic Research, 1960." The first portion of this report is primarily a synopsis of important new findings, and the second part consisting of 232 short papers summarizes results of individual investigations.

Economic Geology

Detailed geologic mapping and other field studies primarily concerned with economic geology were in progress in many areas from coast to coast during the past year, and many significant results were achieved. A few of the highlights are cited below.

Base and ferrous metals.—Geologic investigations being carried on in several of the major mining districts have resulted in the discovery of new deposits or yielded important new geologic guides that will aid future exploration in all mining districts where geologic associations are similar. Included are discoveries of new deposits of low-grade sedimentary iron ore in the Christmas area, Arizona and a new iron-bearing formation about 200 feet thick in Iron and Dickinson

Counties, Mich.: and recognition of geologic guides useful to future exploration of the metalliferous veins in the Butte area, Mont., in the Michigan copper district, in the copper-bearing rocks near Pima, Ariz., and in the Coeur d'Alene lead-zinc-silver mining district, Idaho.

Light metals and industrial minerals.—A new mineral association of beryllium is being studied in the Mount Wheeler mine, Nev., where the beryllium-bearing minerals phenacite, bertrandite, and beryl have been found in association with scheelite and fluorite along vertical quartz veins. Because these beryllium-bearing minerals are similar in appearance to quartz and feldspar, they may have been overlooked in the past. Their recognition may lead to the discovery of new beryllium deposits in this area. In the tin districts of the Seward Peninsula of Alaska, beryllium has been identified in samples from bedrock sources at the Lost River mine, and at the Ear Mountain and Cape Mountain tin areas. Beryl and phenacite have been identified, and idocrase samples collected in the region also are consistently high in beryllium.

Studies of clay beds in Maryland indicate that extensive deposits are suitable for use as fire-clay and other deposits are suitable for use in the manufacture of lightweight concrete aggregate. Of special interest, these latter "bloating" clays underlie extensive areas that include many potential strip-mining sites. The distribution of valuable deposits of flint clays in northeastern Kentucky has been studied and mapped.

Geochemical exploration and minor elements.—Geochemical prospecting techniques require rapid analytical methods suitable for the determination of trace amounts of various metals. Methods suitable for more than 20 of the more diagnostic elements are in use. During the past year, a new technique was developed for concentrating ionic constituents of natural waters by resin collectors, and a method was devised for determining the molybdenum content of natural waters employing resin collectors. Trace amounts of the volatile elements antimony, mercury and arsenic in vegetation can now be analyzed. A fluorometric procedure for determination of beryllium in rocks has been developed that is sensitive in the range of 1 to 10 parts per million.

Organic fuels.—Investigations that furnish basic mapping and stratigraphic data on possible mineral fuel-bearing strata are in progress in many parts of the country. For example, a summary of the petroleum possibilities in Alaska delineated six possible petroleum provinces in southern Alaska; three potential petroleum provinces of pre-Cenozoic rocks and several potential petroliferous basins of Cenozoic rocks in central Alaska; and a large area north of the Brooks Range in



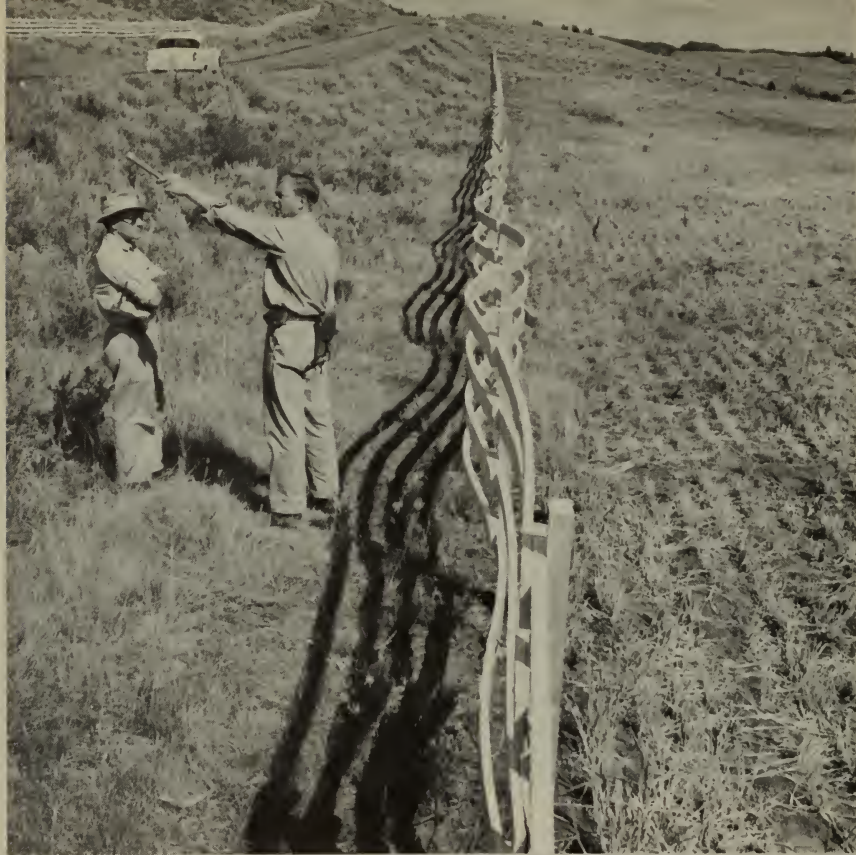
This is Red Canyon fault east of Blarneystone Ranch, a freshly made fault scarp caused by the Hebgen Lake, Mont., earthquake.

northern Alaska, where good possibilities exist for petroleum production.

A new estimate of coal reserves of the United States has been made. Based on latest available data, some 1,660 billion tons remain in the ground, of which about half is assumed to be recoverable. Studies of several coal fields are in progress, and recent estimates of coal resources have been prepared for the Trinidad field in Huerfano and Las Animas Counties, Colo., an important source of coking coal for the western United States; the Mesa Verde area, Colo.; the Square Buttes coal field of western North Dakota; the southern Kolob Terrace coal field of Utah; the Kenai coal field of Alaska; and the coal-bearing region of southwestern Washington.

Studies in the Uinta basin of Utah and Colorado and in the Piceance Creek basin of western Colorado indicate very large reserves of shale oil in beds 15 feet or more in thickness and yielding 15 gallons or more per ton.

Engineering geology.—Geologic data are being used with increasing frequency and success in planning construction and other land development projects, especially in areas of heavy population expansion, and in problems of public safety and public health. As an example of specific application, the geologic examination of a proposed damsite



Results of the Hebgen Lake earthquake are visibly recorded in this board fence, which was compressed by the strong down-hill movement during the quake.

at Devil Canyon, about 125 miles north of Anchorage, Alaska, indicated that shifting the site 100 feet upstream would avoid a large shear zone. Relocation of the spillway site was suggested to take advantage of lower excavation costs afforded by the recognition of a favorably located buried preglacial valley. Similarly, savings in cost, increased safety, and reduction of natural hazards have been achieved in such metropolitan areas as San Francisco, Los Angeles, and Seattle, where studies of landslides permit analysis of potential hazards and plans can be made to avoid or minimize building in areas of probable future slides.

The series of earthquakes at Hebgen Lake, Mont., in the late summer movement of debris and subsidence of a large area some 27 miles long and 14 miles wide. Geologic mapping was already in progress in this area, and an intensive study of the effects of the earthquake was accomplished promptly.

Selecting the sites for underground nuclear tests, and evaluation of the effects of underground nuclear explosions requires detailed knowledge of the rocks surrounding the point of explosion both before and after each test. These studies, carried on in behalf of the

U.S. Atomic Energy Commission, also indicate the behavior of the rocks during the explosion, that is, their response to seismic shock and extreme temperatures and pressures and the changes brought about by fusion.

Another program, also in behalf of the Atomic Energy Commission, concerns the safe disposal of radioactive wastes. It includes studies of deep basins containing sedimentary rocks that might be suitable for underground storage of liquid wastes, as well as studies of specific minerals such as vermiculite and montmorillonite that by ion exchange, sorption, or other processes, will retain caesium, strontium, or other high-level waste products with safety. As a precautionary measure, the natural background radioactivity has been determined for many areas being considered for installation of nuclear facilities. This information will be used to detect significant changes in radiation levels.

The relationship of human health and geology are receiving expanded study. Previously, medical research has related certain physiological effects to the presence or absence of such elements as iodine, selenium, and fluorine, but few geologic studies were specifically aimed at analyzing the available geologic data to compare with health studies. During the past year, a map was prepared to show the maximum reported fluorine content of ground water in each county in the United States. A joint study with the National Cancer Institute and the Washington County, Maryland, Health Department is appraising the geological environment of that county to provide detailed data on distribution of natural radioactivity and any unusual distribution of elements. An interesting byproduct of the development of an extrasensitive device to measure magnetic susceptibility of rocks has been the discovery of a measurable difference between cancerous and noncancerous tissue both from animals and humans, apparently due to a depletion of iron in the former.

The prolonged and intense volcanic activity at Kilauea from November through February was extensively studied and every phase carefully recorded by the Survey's Volcano Observatory staff. Effective use of newly developed portable tiltmeters and of seismographs permitted early warnings to be issued, so that no loss of life occurred. Better understanding of future volcanic activity is possible as a result of the thorough and continuing study of all phases of eruptivity.

Radioactive materials.—Detailed studies of uranium deposits at Ambrosia Lake, N. Mex.; Gila County, Ariz., in several basins in Wyoming, in the Southern Black Hills, S. Dak., and at Palangana salt dome in Texas, are developing specific information on the local conditions that prevailed during ore deposition and defining favorable areas for further exploration.



Department geochemists sampling hot volcanic gases at Kilauea Iki, during the development of a volcanic cone, November 22, 1959.

Studies of uranium occurrence in coal in the Cave Hills area and other areas of northwestern South Dakota and other coals in Montana, North Dakota, Wyoming, Idaho, and New Mexico indicate that the uranium-bearing coals are of low rank and contain more ash than nonuraniferous coals; that they occur with rocks containing volcanic materials and that the uranium content increases towards fractures, permeable layers, or other probable ground water conduits. These relations indicate that the uranium was leached from the volcanic materials and deposited in the coals by circulating ground waters. The application of this theory to known stratigraphic information has been successful in the discovery of several uranium-bearing lignites, and also in indicating additional areas for exploration.

Regional Geology

A large number of studies in progress in the United States during the past year were aimed at exploring the composition, structure, origin, and history of the rocks that form the earth's crust. Although not specifically designed to furnish immediate solutions to economic and social questions, these studies provide the basic facts that may develop clues to the location of new sources of useful minerals, or improved utilization of the surface of the earth.

Primarily, these studies result in the preparation of geologic maps, although geophysical, geochemical, stratigraphic, and paleontologic studies are used extensively to supplement, expand, or extend the work in many areas. This research results typically in maps of quadrangular areas bounded by lines of latitude and longitude, at scales ranging from 1:24,000 to 1:250,000, depending on amount of detail to be shown.



Wearing crampons and cold weather gear, a Geological Survey geologist and his companion are shown here climbing a glacier in the western part of Antarctica, to study and sample exposures of basaltic rock.

Other work includes the preparation of several kinds of geologic maps of the Nation as a whole. One example is a paleotectonic folio of the Triassic system, describing the sequence of development of physical features of our country during this ancient time. Work on a similar folio of the Permian system is nearly completed. Other nationwide maps that are being prepared include collaborative work with scientific societies in producing a new tectonic map and an absolute gravity map.

Examples of work aimed at improving our understanding of major features of the earth's crust are the studies of several major intrusive bodies including the Sierra Nevada batholith in California, the Idaho batholith, the Boulder batholith in Montana, and batholiths of the Colorado Front Range and Northern Cascade Mountains in Washington. To understand the history of major segments of the earth's crust requires detailed knowledge of its component parts, so studies are



Glaciological data were collected by a scientist of the Geological Survey in western Antarctica.

broadly dispersed. Currently, work is in progress from Maine to Hawaii, from northern Alaska to Puerto Rico, and in Antarctica.

Studies in the Antarctic suggest that much of Marie Byrd Land is a volcanic archipelago. In other parts of Antarctica, additional knowledge of the geologic character of that least-known continent is slowly accumulating.

As an example of the results that can be obtained by combining geological and geophysical studies, in the Los Angeles area a detailed analysis of the density of more than 2,000 samples was required to integrate the results of geologic mapping of the surface and sub-surface with gravity surveys. As a result, a compartmentalized lithodensity model was constructed that permitted calculation of the residual regional gravity gradient. The results of this study indicate that the crust of the earth thickens landwards.

Geophysical exploration techniques have been directed at studies of large regions to assist in determining geologic structure in areas of poor exposure and in determining the depth and configuration of basement rocks and deeply buried magnetic masses. These studies are providing information not previously attainable by older methods. High speed computers are routinely used to obtain quantitative interpretations of geologic mapping problems, especially in the application of aeromagnetic methods. Recent drilling and seismic surveys at three places in Indiana have confirmed predictions of depth to Precambrian basement rocks as published in 1958. Magnetic methods

have been used to a large extent in making a recently published map of the layered magnetic rocks in the Iron River-Crystal Falls district of Michigan. A graphical method has been developed for determining the dip of buried geologic structures when the depth to the top of the structure is known.

Aerial radioactivity surveys have proven to be helpful in geologic mapping in some areas of poor exposure and low relief. Small differences in content of radioactive minerals can be detected and correlated with specific rocks—for example, felsic igneous rocks and shales are generally more radioactive than mafic igneous rocks and carbonate rocks.

Electrical resistivity and induced polarization techniques have shown promising results in geologic mapping of nonconductive layers in the study of metamorphic rocks under alluvial or glacial cover. These techniques have been tried in small areas in upper Michigan, Maine, and Virginia. In addition, the value of induced electrical polarization studies is being demonstrated in the search for low grade metallic ores that are not sufficiently concentrated to cause other types of electrical or magnetic or gravity anomalies. In favorable circumstances, the measurements may be used not only to locate ore bodies but also to estimate their grade.

Geologic Processes and Principles

In addition to research stimulated by projects seeking specific economic objectives or by projects investigating specific areas, another type of research is undertaken to increase our knowledge of natural processes within the earth, and the related geologic principles. Such research is essential to develop better geologic techniques. These researches include studies in several fields such as paleontology, plant ecology, geomorphology, geophysics, geochemistry, mineralogy, petrology, and isotope and nuclear geology.

Studies in plant ecology and geomorphology are demonstrating systematic relationships between plant type, topographic form, soil composition and water availability. In addition to previously well-known associations of some plants with certain soils and parent rocks, these newer studies indicate that vegetation maps can be made to reveal origin and development of land forms. Field studies in the Potomac River basin based on this approach have indicated that the classical concept of the origin of peneplains through cycles of erosion may not be valid. The present landscape is considered to have formed by long-continued erosion under conditions similar to the present.

Topical studies of the physical properties of rocks, experiments on rock deformation, and studies of past changes in the earth's magnetic

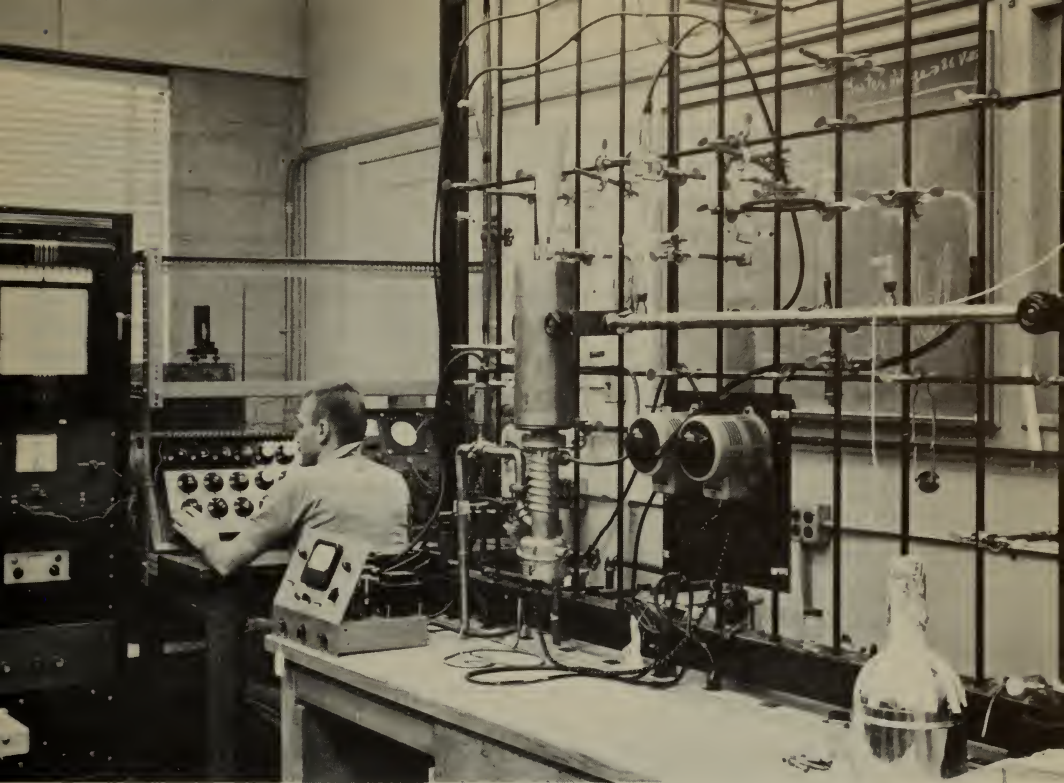


Photogeologist measuring the diameter of a crater on the spherical surface of the moon. Using stereoscopic photoviewer, the geologic features of the moon's surface are carefully diagrammed to produce detailed maps.

field are furnishing new geophysical information. New data on the mechanical, electrical, magnetic, optical, thermal, thermodynamic and mass properties of rocks and minerals are helping to explain many previous empirical observations.

Pioneering studies of earth mechanics and the geometry of faulting suggest that larger earth fractures and faults can be related to simple equations of plasticity. Studies of ballistic theory, impact phenomena and data from nuclear and conventional explosions have been integrated to develop a theory of how meteor craters developed. This has been verified in field studies at Meteor Crater, Ariz. Results of these studies have been extrapolated for use in interpreting craters in the moon.

In this regard, a program of broad current interest in behalf of the U.S. Army Corps of Engineers was directed at mapping the features of the moon. Detailed study using photogeologic techniques resulted in distinguishing the relative age of many terrain features. Comparison of lunar craters and some comparable earth features suggests



A low temperature calorimeter being used to determine the specific heat properties of rocks and minerals near absolute zero.

that all the large craters and most of the others were caused by meteorite impact. Rays extending from some of these are interpreted as the result of splashes of crushed rock ejected during crater formation.

Topical studies in mineralogy, petrology, and geochemistry include the description of new minerals, their chemical and physical properties, and how they were formed; the study and description of rocks; and the distribution and abundance of chemical elements and their isotopes in the earth's crust.

Studies of mineral composition and structure reveal conditions during natural formation of these minerals as well as suggesting ways of synthesizing them and, ultimately, how to use them. For example, studies of beta-spodumene, a lithium silicate mineral, have shown it shrinks on heating and swells on cooling, so that it can be mixed with normal ceramic materials to mold precisely dimensioned forms that retain their exact size after firing.

Studies of the distribution of isotopes of the elements are providing clues to ancient temperatures, to the establishment of a more exact geologic time scale, and they give data on the composition and origin of ore-forming fluids. Studies of isotopes of hydrogen have indicated usefulness in tracing oceanic currents. For example, the waters originating in Antarctica have about 1 percent less of the heavy hydrogen

isotope, deuterium, than other ocean waters contain. In studies of liquids obtained from minute bubbles in ore minerals from fluorite deposits in Illinois, the early minerals were found to contain fluids similar to waters normally present in rocks of that locality, but the fluids from later minerals are progressively depleted in deuterium.

Analytical methods and laboratory techniques are continually being improved and new equipment is devised to provide the new kinds of data required in modern research. New equipment developed includes an electron microprobe X-ray analyzer for use in identifying minute grains of minerals intergrown with other minerals; a heating stage for use with X-ray diffractometer; a cooling cell that extended the useful range of study of temperature effects in fluid inclusions in minerals under the microscope; a new device to convert seismic observations to numerical form for rapid coding and input into high speed computers; and the development of a low-cost instrument for beryllium exploration.

Foreign Geology

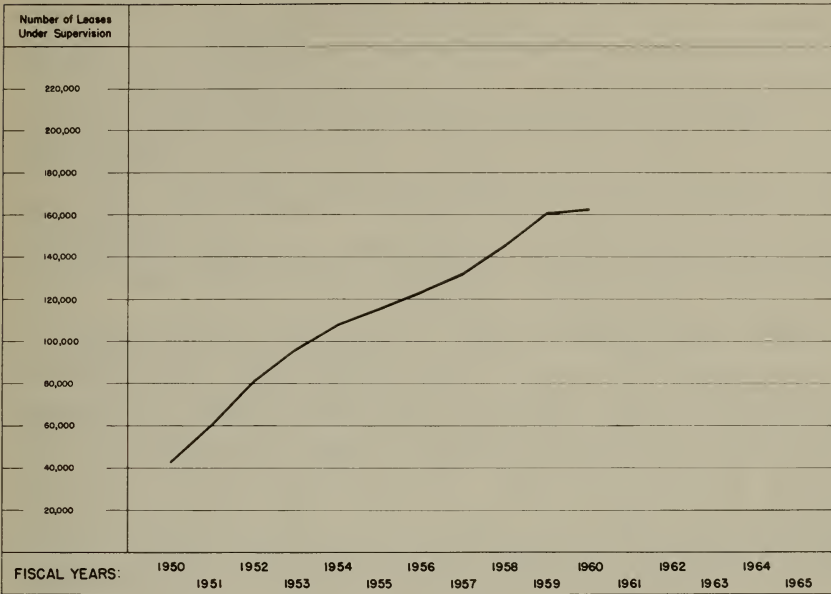
Technical assistance of the Geological Survey to foreign governments is primarily designed to aid the growth of their economies through development of their mineral resources. This program under auspices of the International Cooperation Administration includes the training, advisory, and service functions of 47 of the Department's geologists working in cooperation with their host country counterparts in 12 nations, sharing advances in methods and techniques of geologic research and investigations; and the training in this country of some 121 earth scientists and technicians from 30 countries.

Cooperative geologic mapping or other field studies were in progress in Chile, Brazil, Libya, Saudi Arabia, Taiwan, Mexico, India, Pakistan, Thailand, the Philippines, and Indonesia. Advisory services to central government mineral agencies were an integral part of the program in several of these countries and in Bolivia and Peru.

Conservation Division

This Division classifies Federal lands as to mineral and water resources and supervises mineral recovery under leases, permits, and licenses on Federal, Indian, and Naval petroleum reserve lands. A headquarters staff and a field staff of geologists and engineers make surveys, maps, and reports dealing with water power, fuels, minerals, and chemicals essential to the economy of the United States; supervise mining and drilling operations to assure safe and economical production by private enterprise of coal, oil, gas, and other minerals; and supervise operations of the Federal Petroleum Board.

OIL, GAS & MINERAL LEASES UNDER GEO. SURVEY SUPERVISION

*Mineral Classification*

During fiscal year 1960 a total of 30,724 cases were processed by the Survey including 7,040 cases involving the outright disposal of Federal lands either with no reservation of minerals or with the reservation of one or more specified minerals. In addition, 21,033 cases involving the exercise under Federal leasing laws of the Government's right to lease a mineral substance to private enterprise were handled.

Initial or revised definitions of 66 producing oil and gas fields were prepared concerning Federal lands and 358 unit-plan and participating area proposals were appraised geologically; 63 determinations were made of the productive limits of producing oil and gas deposits; the geologic significance of 248 new discoveries of oil or gas made on or affecting Federal leaseholds were reported for appropriate action; competitive sales of oil and gas leases on 29 parcels of public land were reviewed; 18 appeals from decisions of the Department's Bureau of Land Management affecting the disposal of Federal lands were reported; 198 miscellaneous reports were prepared on the mineral potentialities of specific lands for various agencies of the Federal Government.

Geologists from field offices throughout the West made investigations and produced geologic reports and maps of considerable assistance to engineers in planning development and administering Federal leases. These studies are also valuable to others concerned with

conservation, or with determining more efficient methods of recovery of leasable minerals.

Maps or reports were completed on the following fields or areas: Cumberland National Forest, Kentucky, preparatory to oil and gas leasing activity in the area; in the Florida phosphate reserve to obtain background information concerning proposed legislation for restoration of reserved mineral rights in patented lands; geologic structure map and report on the Soso oil and gas field, Miss.; map of the Gragg and Boonville gas field, Washburn anticline, Ark.; maps and a report on the Precambrian of southeastern New Mexico and its relation to structure; geologic maps and report on the structure and stratigraphy of the Delaware Basin.

Surface and subsurface studies of one section of the potash area in southeastern New Mexico; contour maps of San Juan Basin and Bisti fields, N. Mex.; revision of map showing areas of prospective value for oil and gas, map showing oil, gas, and exploratory wells, contour map and report on the Pinta Dome helium field, Ariz.; geologic reconnaissance of damsites on the Trask, Siletz, and Nehalem Rivers, Oreg.; geologic reconnaissance of the Surprise Creek, Lost Lake, and Nellie Juan damsites, Kenai Peninsula, a geologic map and report on the Baranof Lake and Carbon Lake powersites on Baranof Island, Alaska.

Stratigraphy of the Colorado Group of the Sweetgrass Arch and Disturbed Belt, geologic report on damsites on the Lower Flathead River, contour maps of Poplar, Bredette, Outlook, and west half of Sumatra Anticline fields, Mont.; contour map of the Sherwood area, Renville County, N. Dak.; geologic and structure map of the Glenrock area, geologic and structure maps and report of the East Thermopolis area, geologic investigation of damsite on Dinwoody Creek, Wyo.; geologic map and report on the Rifle Gap coal district, Colo.; preliminary stratigraphy and nomenclature of the Paradox member saline facies, Utah.

Waterpower

Investigations were conducted in Alaska, Colorado, Oregon, Washington, and Montana during the year to determine the waterpower and storage possibilities of streams and lakes on public lands.

Eighteen sets of maps were published covering 307 miles of stream channel and 26 damsites; six sets totaling 95 miles of stream channel and 8 damsites were ready to submit for publication, and eight sets covering about 200 miles of stream channel were in various stages of preparation.

A report on the waterpower potential of streams along the Alaska mainland between Thomas Bay near Petersburg and Juneau was submitted for publication as a water-supply paper. A report on Bradley Lake was completed and is being reviewed for publication. Reports on Nellie Juan Lake and Snow River on the Kenai Peninsula and on five lakes on Baranof Island, Alaska, and Trask River, Oreg., are in preparation.

A report on the Nehalem River, Oreg., was made available for public reference.

Work was continued on the program for making a systematic review of waterpower withdrawals.

Lands withdrawn in powersite reserves total 7,205,637 acres, and in reservoir site reserves 131,593 acres.

Two hundred and forty reports were prepared and submitted to the Department's Bureau of Land Management on the waterpower value of lands affected in applications for rights-of-way, and 7,300 reports on applications for land acquisition. Thirty reports were submitted on applications to the Federal Power Commission for permit or license, and 65 on applications for restoration of lands in powersite withdrawals.

Mining

Supervisory control is exercised by the Survey over mining activities concerned with prospecting, development and production of minerals under permits and leases on public, Indian, and acquired lands.

Permits and leases issued under applicable laws and regulations involve operations for coal, potassium, sodium, and phosphate on public lands and such metals and minerals as copper, iron, lead, manganese, nickel, tungsten, uranium, vanadium, zinc, asbestos, barite, bentonite, clay, coal, garnet, gypsum, feldspar, fluorspar, limestone, mica, peat, phosphate, pumice, quartzite, quartz crystal, sand and gravel, stone, and vermiculite on Indian and acquired lands.

Mining supervision includes responsibility for investigating and reporting on applications for leases and prospecting permits; recommending lease terms, enforcing compliance with lease terms and regulations governing the conduct of prospecting, mining, and milling operations; and determining royalty liability of lessees, maintaining accounts, preparing statements and receiving payment of royalties and rentals.

As of June 30, 1960, there were under supervision 3,857 properties involved in leases, permits, and licenses in 32 States, of which 2,738 were on public land, 319 on acquired land, and 800 on Indian land.



Survey petroleum engineer, accompanied by operator's representative, checking temperature and volume of butane going from lease to storage. On-site inspections assure resource conservation and protection of the Government's royalty interest.

Production from such lands during the fiscal year is estimated at 25,974,928 tons, valued at \$165,065,401 with royalties amounting to \$7,718,076.

In order of magnitude and value, potash ranked first with 13,041,547 tons at \$76,328,418 followed by coal, 5,433,342 tons at \$33,914,541; phosphate, 2,180,183 tons at \$5,281,675; and sodium, 1,012,694 tons at \$25,532,781. Other production in substantial quantity includes uranium, 1,371,757 tons at \$20,316,485 and sand and gravel, 2,057,986 tons at \$1,694,247.

Of particular interest during the year was the delineation of a mineable potash deposit on the Cane Creek Anticline southwest of Moab, Utah, and indicated southeast extension of that deposit into the nearby Lisbon Valley revealed by prospecting on permit land. Intensified prospecting in the Green River area, Wyoming, disclosed extension of known deposits of the sodium mineral, trona, resulting in extension of the defined leasable area.

Several of the major mining companies are continuing exploration activities in southeast Missouri which has resulted in valuable discoveries of lead and zinc in the sediments and prospectively valuable discoveries of copper and iron in the basement rocks. Further, a modern mill near Viburnum with an initial capacity of 3,000 tons per day and a potential capacity of 6,000 tons per day was put into operation to process the new production.

Oil and Gas Leasing

Supervision of oil and gas activities includes operations for the discovery, development, and production of crude oil, natural gas and products extracted from natural gas, on Federal, Indian, and certain Naval petroleum reserve lands.

Table showing supervised oil and gas activities

PROPERTIES AND WELLS UNDER SUPERVISION

Lands	Number of properties	Acres	Number of States	Wells spudded	Wells completed	Completions productive ¹	Number of wells— June 30	
							Pro- ductive ¹	Total
Public.....	139,389	113,633,091	24	1,982	2,091	1,341	18,238	31,172
OCS.....	527	2,141,049	off 3	404	540	427	1,696	2,421
Acquired.....	6,726	4,854,468	31	81	77	25	315	864
Indian.....	12,320	4,471,529	16	633	700	496	6,826	11,258
Naval petroleum reserve No. 2.....	17	9,226	1	13	12	12	469	729
Military and miscellaneous.....	20	9,969	5	22	9	9	147	182
Total.....	158,999	125,119,332	-----	3,135	3,429	2,310	27,691	46,626

PRODUCTION, VALUE, AND ROYALTY LANDS UNDER SUPERVISION

Lands	Oil, barrels	Gas, 1,000 cubic feet	Gas liquids, gallons	Value	Royalty
Public.....	148,495,000	499,334,000	338,462,000	\$471,861,000	\$58,260,000
OCS.....	40,765,000	234,328,000	0	170,668,000	29,787,000
Acquired.....	5,621,000	26,647,000	434,000	23,812,000	2,961,000
Indian.....	60,424,000	93,850,000	98,597,000	177,774,000	21,730,000
Naval petroleum reserve No. 2.....	4,771,000	4,871,000	13,386,000	16,598,000	2,272,000
Military and miscellaneous.....	1,200,000	39,282,000	450,000	8,874,000	1,246,000
Total.....	261,276,000	898,312,000	451,329,000	869,587,000	116,256,000

¹ Multiple completions (2 or more separately productive zones) are counted as separate wells.

Note.—Production and royalty figures include some estimates. Royalty figures do not include revenues from rentals and bonuses.

Unitization activities of oil and gas operations involving public and acquired land were reflected in the approval of 94 new unit plans during the year and the termination of 49 previously approved unit plans, leaving 420 approved plans covering 7,923,103 acres outstanding.

On the outer Continental Shelf 4 such plans were approved and 1 was terminated. The total now stands at 15, embracing 375,800 acres. About 60 percent of the petroleum, 40 percent of the natural gas, and 71 percent of the gasoline and liquified petroleum gases obtained from Federal lands during the year was produced under approved plans of unit operation.

On Indian lands 11 new units were approved and 1 was terminated, the total number of plans in effect at the end of the year being 60, involving 121,887 acres.

There were 147 drilling units, or communitization agreements approved during the year and 2 terminated making a total of 1,021 outstanding as of June 30. There were three development contracts approved during the year and none terminated. The total number of such approved contracts outstanding on June 30 was 14 involving 4,644,830 acres.

Connally Act Administration

The Connally Act of February 22, 1935, supports conservation activities of oil-producing States by prohibiting interstate shipment of oil produced in violation of certain State oil and gas conservation laws.

The act is administered by the Federal Petroleum Board under supervision and direction of the Geological Survey.

While the Connally Act is applicable wherever State laws limit the rate of production and prescribe conditions for producing and handling oil, its chief application is in 106 counties of Texas, Lea and Eddy Counties in New Mexico, and all of Louisiana. The Board also enforces provisions of the act in Mississippi, Oklahoma, Arkansas, Kansas, and other oil-producing States.

Unless exempted by the Board in writing and by notice, producers within the above designated areas are required to maintain daily production records and file monthly production reports of operations on each lease in the oilfield. Transporters and refiners are also required to file monthly reports. Leases inspected number 4,645, those visited 1,185, and 50 pipelines were checked, involving the visiting of 411 oilfields and the conducting of 1,551 interviews. Twelve violations of the Connally Act were detected.

There were 17 cases of alleged violation of the act on the docket of the Board when the fiscal year began and three new investigations were started. Seven cases were closed by court action, resulting in fines of \$52,900.

Water Resources Division

Another primary responsibility of the Geological Survey is to provide basic facts on the occurrence of water, its quantity and quality, and the manner of its use. Such data are needed to aid in solving the Nation's mounting water difficulties. Increasing requirements for water have created many new problems and intensified some of those that have plagued the Nation in the past. Some of the paramount problems related to responsibilities of the Water Resources Division of the Geological Survey include:

1. Impact of a growing and shifting population on water supplies, accompanied by an accelerated increase in water requirements for industry and agriculture.

2. Limitations on water development and use brought about by radioactive and chemical waste disposal from municipalities, industries, and agriculture.

3. Effects of land use practices and urban development upon existing water supplies.

4. Water losses through evaporation and inability to capture surplus runoff for later use.

5. Contamination of fresh water supplies by salt water intrusion in adjacent coastal and inland areas.

6. The need to determine sources, character, and potential of water of marginal purity that might be suitable for upgrading through saline water conversion methods.

7. Legal questions arising out of laws on water rights, flood zoning and insurance, or compacts between States.

8. Floods and the need for adequate design and operation of flood-control structures, forecasting flood stages and volumes, and enactment of flood zoning and insurance regulations.

The Survey's water-resources investigations include systematic collection, analysis, interpretation, and publication of hydrologic and related data; appraisal of water resources of specific areas; study of water requirements for industrial, domestic, and agricultural uses; and research and development to improve the scientific basis and techniques of investigations. The results appear as scientific or technical reports and papers.

Recognizing that the usefulness of water-resources investigations depends largely on availability of reports that meet the variety of needs for water information, the timely production of reports is being emphasized.

During fiscal year 1960, the Survey published 89 water supply papers, 21 circulars, 14 professional papers, and 6 bulletins concerning water. In addition, 51 reports on water were made available for public reference, and 334 manuscripts were approved for publication as cooperative State reports and as abstracts and articles in scientific journals. Six water reports were prepared for the Senate Select Committee on National Water Resources, a committee established in 1959 to study the development and coordination of water resources.

In recent years, emphasis has been placed on interpretive studies to give more meaning to basic data. Added attention is being placed on research activities as a source of new knowledge and an improved understanding of processes in the hydrologic cycle is being sought. These efforts are resulting in increased usefulness of the vast quantity

of basic data on water that have been systematically collected for many years.

The program of water-resources investigations is a coordinated effort between Federal, State, and local agencies. Federal-State cooperative investigations began in 1895 and this kind of work has grown steadily, now constituting about 60 percent of the total program. Funds made available by States and municipalities in 1960 for cooperative investigations include:

State and municipal offering for cooperative water resources investigations

State	1960	State	1960
Alabama.....	\$173,293	Nebraska.....	\$119,665
Alaska.....	8,690	Nevada.....	62,082
Arizona.....	249,762	New Hampshire.....	14,734
Arkansas.....	76,283	New Jersey.....	208,340
California.....	714,106	New Mexico.....	250,379
Colorado.....	200,307	New York.....	388,427
Connecticut.....	47,609	North Carolina.....	184,584
Delaware.....	50,543	North Dakota.....	83,701
Florida.....	337,991	Ohio.....	186,267
Georgia.....	174,312	Oklahoma.....	109,887
Guam.....	16,000	Oregon.....	111,969
Hawaii.....	177,961	Pennsylvania.....	232,911
Idaho.....	77,750	Puerto Rico.....	63,841
Illinois.....	90,137	Rhode Island.....	37,452
Indiana.....	203,776	Samoa.....	4,500
Iowa.....	107,657	South Carolina.....	43,032
Kansas.....	148,762	South Dakota.....	63,976
Kentucky.....	165,685	Tennessee.....	106,773
Louisiana.....	221,665	Texas.....	432,442
Maine.....	26,111	Utah.....	227,147
Maryland.....	71,375	Vermont.....	10,700
Massachusetts.....	72,243	Virginia.....	52,284
Michigan.....	139,677	Washington.....	242,066
Minnesota.....	103,112	West Virginia.....	32,908
Mississippi.....	93,539	Wisconsin.....	88,729
Missouri.....	48,226	Wyoming.....	103,987
Montana.....	83,003		
		Total.....	7,342,408

Surface-Water Investigations

Streamflow and other surface-water data were obtained at 7,200 sites distributed throughout the 50 States, Guam, Samoa, and Puerto Rico. A special summary of all streamflow records for the period 1888-1950 is essentially complete. Reports were published for Hudson Bay and Upper Mississippi River basins, Missouri River basin above Sioux City, the Central Valley, and Pacific slope basins in California.

Flood-frequency analyses, parts of a nationwide study, were completed for Pacific slope basins in Washington and upper Columbia River basin, Snake River basin, and Pacific slope basins in Oregon and lower Columbia River basin. Pending completion of this project preliminary statewide analyses are being conducted in cooperation with several State agencies. Reports were made available in 1960 covering the States of Washington and Maryland.

Five flood reports were published as water-supply papers or circulars:



Sampling the sediment load of the Solomon River at Beloit, Kansas during a flood.

Floods of April–June 1953 in Louisiana and Adjacent States.

Floods of January 1953 in Western Oregon and Northwestern California.

Summary of Floods in the United States During 1953.

Summary of Floods in the United States During 1954.

Floods of January–February 1959 in Ohio.

Work is in progress on several other flood reports including floods of January–February 1959 in Ohio and Indiana. As part of a continuing program for mapping flood-inundated areas, the Survey has completed manuscripts for publication covering 12 cities in Ohio subjected to floods of January–February 1959; Calumet City, Ill., and vicinity floods of 1954 and 1957; Des Moines, Iowa, and vicinity floods of 1903, 1947, 1954, and 1960; and Boulder, Colo., and vicinity.

Runoff studies of maximum annual floods were made for 2,443 drainage areas of less than 400 square miles, at the request of the

Soil Conservation Service. Hydraulic data for 78 drainage-structure sites were furnished to highway departments in 14 States.

Considerable progress was made on a new manual of hydrology, which was started during the 1959 fiscal year.

Compacts for the apportionment of interstate waters usually include provision for measurement of streamflow, commonly by the Geological Survey. Nineteen such agreements are in effect and five others are under negotiation. Water-resources investigations were continued along the Canadian boundary, as required by the Boundary Water Treaty of January 11, 1909, between the United States and Canada, or by order of the International Joint Commission.

Ground Water Investigations

This program places a major emphasis on area investigations and appraisal studies supported by research and training directed toward providing a thorough knowledge of future water problems and methods by which they can be solved.

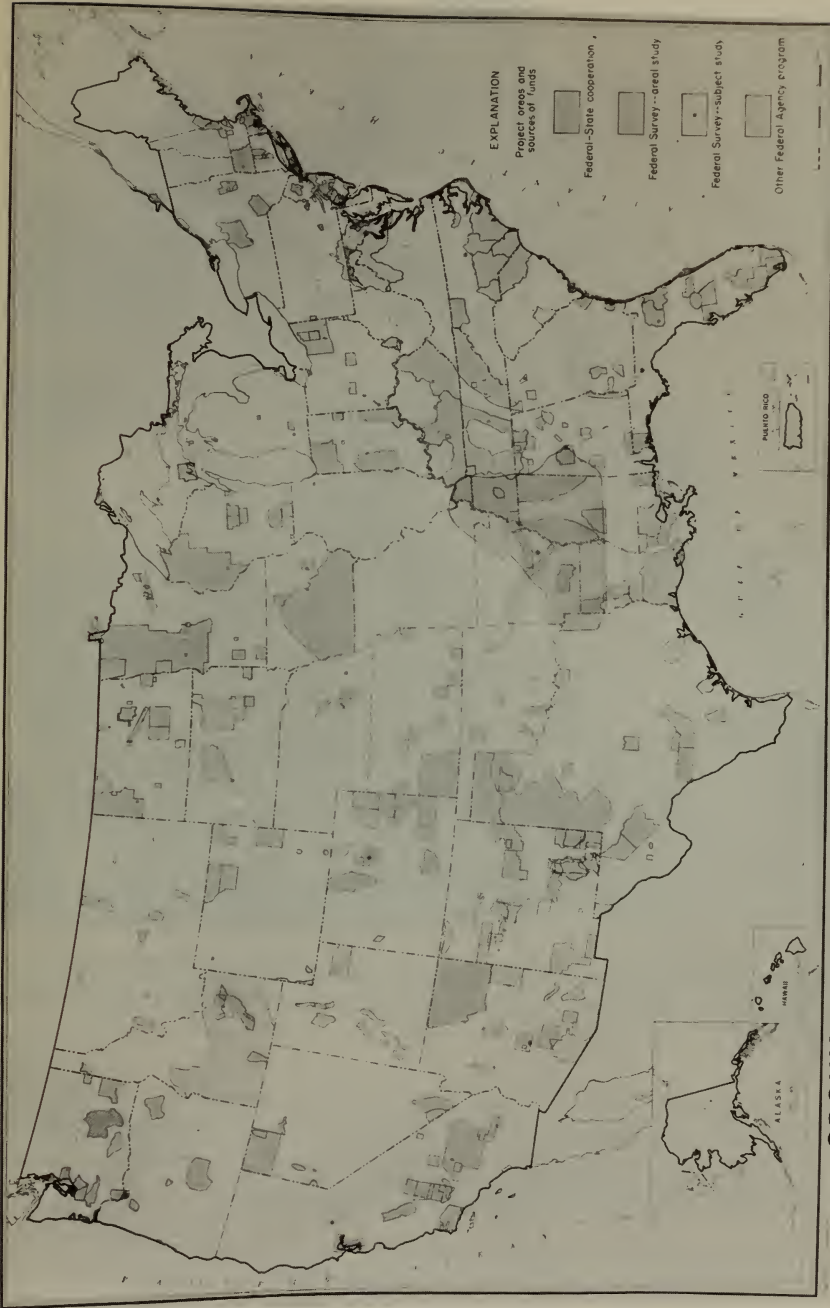
In addition to the more formal published reports released, 9,000 replies to requests for ground-water information were made by field and Washington offices. The requests covered a wide range of needs, as follows: Industrial 21 percent, municipal 14 percent, irrigation 18 percent, private 25 percent, and other interests 22 percent.

In research, many projects are in progress which will lead to a better understanding of the ground-water environment, particularly the flow of fluids through porous media. It is imperative that these new concepts and principles be developed to enable more accurate prediction of future ground-water trends, particularly in areas where limited supplies are being "mined".

Studies are in progress to determine the factors and processes involved in the strain, deformation, and compaction of water-bearing rocks resulting chiefly from changes produced by withdrawal of ground water. The studies are designed to provide knowledge concerning the storage capacity of aquifers, particularly as related to long periods of ground-water withdrawal. The San Joaquin Valley in California, which is an area of active subsidence, is being used as a field laboratory.

As a result of widespread interest in the possible application of radioactive isotopes in hydrologic studies, a project concerned with the use of tritium in hydrologic studies was started in 1957. The objectives are to test the value of tritium as a hydrologic tool in studies of ground-water recharge, movement, and discharge, and in quantitative evaluation through water-budget studies.

Type-area studies are directed toward developing geologic and hydrologic principles and techniques that will aid in the evaluation



GROUND WATER INVESTIGATIONS IN PROGRESS, 1959 - 60



A Geological Survey ground water engineer measuring flow of water from pump discharge pipe as part of a nationwide inventory of the country's ground-water resources.

and development of water supplies in various terranes. A study of volcanic terranes is now in its third year in the Pacific Northwest on the Columbia River Basalt. A study of limestone terrane was begun in the central and southeastern United States in 1960.

Chemical Quality of Water Investigations

Water-quality data were obtained at 907 sites in 1960. About one-third of these river observation stations are east of the Mississippi River. In addition to this national quality-of-water measuring network, special investigations were continued in the basins of the Colorado, Columbia, Snake, Mississippi, and other rivers. The quality

of the Nation's ground water was evaluated as part of the Survey's investigations of underground supplies.

Several other special studies also contributed to the fund of knowledge about water quality. Some examples include: Factors controlling the solution and deposition of iron and manganese; absorption of radioactive elements by water-sediment mixtures; spectrographic methods for analysis of minor elements; use of tritium in hydrologic studies; occurrence of radiostrontium in water; and criteria for distinguishing waters of deep origin.

Subjects of reports issued in 1960 on water quality included: The occurrence of iron in ground water; occurrence of strontium in natural water; quality of surface waters for irrigation; worldwide runoff of dissolved solids; detergents in ground water; and some chemical factors relating to artificial recharge.

Sediment Investigations

Comprehensive studies of the movement of sediment in streams were continued in the Missouri, Colorado, and Middle Rio Grande basins. Work included measurement and analysis of sediment loads and related factors.

Other sediment studies included the mineralogy of river sediments, techniques for the use of sediment reconnaissance data, effect of variable roughness and other factors on bed-load transport, and methods for measurement and analysis of sediment loads in streams. Investigations of sediment yields and trap efficiency of reservoirs in small watersheds were continued in collaboration with the Soil Conservation Service.

Reports made public during the year discussed flume studies using medium sand, dispersion and concentration of radioactive wastes by stream sediments, sediment transport in alluvial channels, ultrasonic measurement of size distribution and suspended sediment concentration, effect of fine sediment on the mechanics of flow, and related subjects.

Special Investigations

A comprehensive study of the hydrology of the Colorado River basin above Lees Ferry, Ariz., neared completion in 1960. All aspects of the occurrence, use, and availability of water are being covered with special emphasis on chemical quality and the interrelationships between surface water and ground water supplies. Planning was underway for a comparable study of the Lower Colorado River basin (below Davis Dam), scheduled to begin in July 1960.

A report on water requirements of the copper industry is in press. Similar studies on the petroleum industry, steel, and synthetic mate-

rials producers are in progress. Reports on the water resources of metropolitan areas of Boston, Mass., Flint, Mich., Hartford, Conn., and Syracuse, N.Y., are completed or nearing completion and will be published during fiscal 1961. A similar study is in progress for the Waterbury-New Britain, Conn., area, and new investigations have been started for Green Bay, Wis., and Wichita, Kans.

Work continued on a series of publications which will summarize knowledge about the water resources of each State. Drafts of reports are complete or have been started for Alabama, Arizona, Delaware, Georgia, Idaho, Oklahoma, Oregon, and Rhode Island.

In the interest of conserving water and to reduce flood hazards in sections of the arid West, scientists are studying the problems of phreatophytes (water-loving plants) that grow in many stream valleys. In addition to wasting large quantities of water through evapotranspiration, these plants develop a junglelike growth that invades and chokes the normal overflow channels of streams. Projects are now underway in the Salt River Valley, near Phoenix, Ariz., and in the Humboldt River Valley, near Winnemucca, Nev. To determine the effect and economic feasibility of eradicating large areas of these weeds evapotranspiration studies are made in tanks up to 30 x 30 x 15 feet, planted in conformity with surrounding vegetation and providing controlled systems for measuring water use.

Soil and Moisture Conservation

Continuing activities included investigations of hydrologic and geologic conditions on public lands to provide data needed by other bureaus of the Department of the Interior for the management of those lands. Investigations were made in support of the development of water supplies in grazing areas in Arizona, Utah, Nevada, Idaho, Oregon, and California. Data on runoff and sediment yields were collected for reservoirs constructed as part of the conservation program on public lands in Montana, Wyoming, Colorado, Utah, New Mexico, and Arizona. Studies in stream morphology, aggradation and degradation were made in Arizona, Nebraska, and Wyoming.

Technical Assistance Program

Activities under the auspices of the International Cooperation Administration's Technical Assistance Program increased somewhat during 1960. Long-term projects were being carried on in Afghanistan, Chile, Iran, Libya, Pakistan, Philippines, Saudi Arabia, Tunisia, and Turkey at the close of the year. Five administrative reports and four scientific reports on water were reproduced and distributed, and per-



GROUND-WATER REPORTS OF THE GEOLOGICAL SURVEY
PREPARED LARGELY IN COOPERATION WITH STATE AND LOCAL AGENCIES

sonnel were assigned for short periods to Argentina, Brazil, Egypt, Haiti, and southern Rhodesia to assist in modernizing or expanding surface or ground water investigations.

Technical assistance given continued to emphasize the establishment or strengthening of foreign governmental organizations engaged in water-resource investigations. On-the-job training in investigational methods and techniques, and advisory help in organizational problems are the principal avenues for this assistance.

Survey personnel were giving training to nationals of countries in which long-term projects are being conducted. Additionally, during 1960, visitors from Argentina, Brazil, Colombia, Chile, Egypt, Ethiopia, Ghana, India, Iran, Israel, Kenya, Libya, Pakistan, Peru, the Philippines, Sudan, Turkey, and Uruguay received training in the United States.

Topographic Division

This Division prepares and maintains the National Topographic Map Series covering the United States. Operations include four major mapping phases: Aerial photography, geodetic control, photogrammetric and field surveys, and cartographic work.

Related activities include research and development of instruments, methods, and procedures, the preparation of special maps, and supplying Federal agencies and the general public with published maps, advance map materials, aerial photography, geodetic control lists, and map information.

By the end of August, 1959, the Pacific area headquarters had been moved from Sacramento, Calif., to a new building at Menlo Park, Calif. This building, a model for modern topographic mapmaking facilities, is the first Survey-owned building ever designed and constructed for this specific use. It was dedicated by Secretary of the Interior Fred A. Seaton on November 24, 1959.

Through the International Cooperation Administration, the Geological Survey extends technical assistance to accredited representatives of many nations. During fiscal year 1960, extended periods of technical training were provided by the Topographic Division to visitors from Argentina, Nicaragua, Pakistan, Brazil, Ceylon, and Ethiopia. On two occasions, needed information was obtained in Libya for preparation of a base map of that country at 1:2,000,000 scale. A 6-month training course was conducted in Ceylon to train photographic laboratory personnel and advice was furnished to Brazil concerning the cartographic work of that nation and the training of technicians in modern cartographic techniques.

The Division also assisted in a Geological Survey photogeology training program for foreign participants, by providing a brief period of instruction in photogrammetry. Tours of Division mapping facilities or discussion of its activities and techniques were arranged for visitors from abroad. Preparation of the 1:500,000 scale maps of Arabia and revision of foreign maps for the Army Map Service continued.

Staff work for the domestic names activity of the Board on Geographic Names continued and resulted in the publication of four lists containing decisions on 2,009 names. A fifth list containing 515 additional names was printed on July 1.

Surveying and Map Preparation

As a result of the surveying and cartographic operations of the Topographic Division, 96,000 square miles of new standard topographic quadrangle mapping were completed during the year, at scales of 1:24,000 and 1:62,500 (1:63,360 in Alaska). In the revision program, 6,800 square miles were completed. The Division also completed 11,000 square miles of new quadrangle mapping, and 3,000 square miles of revised mapping, using topographic survey data of other civil agencies and the Department of Defense.

In addition, numerous miscellaneous maps were published on a special format, some of them intended for research, administrative, or information purposes. Included in the miscellaneous maps were 1:62,500 scale maps of the Hawaiian Islands of Oahu and Molokai, a new 1:2,500,000 scale map of the United States in two sheets, and a new 1:500,000 scale State map of Utah. Cartographic compilation is in progress for new State maps of Kansas, Maine, Montana, Nebraska, Nevada, North Dakota, South Dakota, and Washington. Urban area maps were published for Washington, D.C., Chattanooga, Tenn., and San Juan, P.R. Now in progress are maps for the cities of Shreveport, La., Albuquerque, N.Mex., Madison, Wis., New York, N.Y., and Indianapolis, Ind.

Quadrangle mapping projects were under way in most States, the Virgin Islands, and Puerto Rico. Nearly 365 permanently marked triangulation stations were established to provide control for areas totaling more than 26,675 square miles. About 3,010 linear miles of transit traverse, 5,970 miles of electronic traverse, and about 13,400 linear miles of leveling were run, with permanent marks established at intervals of 2 to 3 miles. The computed results of these surveys are made available, on request, to other Government agencies and to the public.



Erecting portable observing tower for triangulation mapping observations.

Field and office work concerned with Antarctica, was conducted with the support of the National Science Foundation. Survey engineers were members of both the Marie Byrd Land and Victoria Land traverse parties, serving as navigators and determining the geographic positions of mountain features. Another engineer on the icebreaker U.S.S. *Glacier* determined geographic positions on Thurston Peninsula when, for the first time in history, a ship penetrated the ice pack to reach the Bellingshausen Sea coast.

Antarctic photogrammetric and cartographic activity in Washington was concerned primarily with the preparation of three 1:500,000 scale maps in the vicinity of Knox Coast and with the start of map compilation in the McMurdo Sound area. A library of Antarctic maps and aerial photography is being maintained.

Several special mapping assignments were undertaken for other divisions of the Geological Survey and for other agencies. In this category were topographic maps for the Department's Bureau of Mines studies of land subsidence in Arizona, location maps for electric powerplants for the Office of the Secretary, base maps for the U.S. Study Commission—Southeast River Basins, and continuation of the 1:1,000,000-scale series of North America for the Army Map Service.

During fiscal year 1960, cooperative programs were in effect with 32 States and Puerto Rico. Total cooperative offerings during the

year amounted to about \$2,700,000. The large increase over the previous year was chiefly due to expansion of the Ohio program aimed at completing the 1:24,000 scale mapping of the State in 1962. Ohio's current offering is \$1 million annually.

A detailed summary of map production is shown in the following table:

Areas (in square miles) mapped or revised during fiscal year 1960 for publication at standard scales

[Contour intervals, 5 to 100 feet]

State	Area mapped, scale		Area revised	Total
	1:24,000	1:62,500		
Alabama.....	644			644
Alaska.....		¹ 18,344		18,344
Arizona.....	3,124			3,124
Arkansas.....	262	490		752
California.....	3,104	449	96	3,649
Colorado.....	2,200	2,083	756	5,039
Connecticut.....			290	290
Delaware.....				
District of Columbia.....				
Florida.....	559			559
Georgia.....	62			62
Hawaii.....	176		323	499
Idaho.....	355	818	55	1,228
Illinois.....	224		86	310
Indiana.....	3,873		1,482	5,355
Iowa.....	218			218
Kansas.....	2,768			2,768
Kentucky.....			735	735
Louisiana.....	258	1,104	380	1,742
Maine.....		383		383
Maryland.....				
Massachusetts.....			377	377
Michigan.....	928	1,922		2,850
Minnesota.....	1,344			1,344
Mississippi.....	785			785
Missouri.....	1,022		176	1,198
Montana.....	1,524	2,066		3,590
Nebraska.....	474			474
Nevada.....	3,094	788		3,882
New Hampshire.....				
New Jersey.....	1,113	884	244	2,241
New Mexico.....	698		199	897
New York.....	191			191
North Carolina.....	1,935			1,935
North Dakota.....	7,220			7,220
Ohio.....	1,978			1,978
Oklahoma.....	834	1,878		2,712
Oregon.....	1,631		667	2,298
Pennsylvania.....				
Rhode Island.....			16	166
South Carolina.....	150			709
South Dakota.....	709			709
Tennessee.....	703			703
Texas.....	7,870	2,143	258	10,271
Utah.....	1,206	872		2,078
Vermont.....	210			210
Virginia.....	343			343
Washington.....	86			86
West Virginia.....	1,334			1,334
Wisconsin.....	1,786	206		1,992
Wyoming.....	2,985	1,566	310	4,861
Total.....	59,980	35,996	6,450	102,426
Puerto Rico.....			334	334
Virgin Islands.....				
Total.....	59,980	35,996	6,784	102,760

¹ 1:63,360.

Research and Development

Research and development to improve the efficiency of instrumentation for mapping operations was continued during the year. A large part of the research in methods, techniques, and procedures was concentrated on maintaining and improving the accuracy of topographic maps. In the interest of improving horizontal map accuracy, a project was initiated for empirical determination and analysis of representative horizontal errors in all component phases of the mapping process. The information will provide a more logical selection of the operations in which technical improvements may be sought.

The manual of Topographic Instructions, formerly issued in a loose-leaf multilith format, has been reorganized and is being revised and prepared for publication in a sales edition. The complete series of 41 volumes will constitute a comprehensive manual of topographic surveying and mapping.

Major items of research and development in field-survey operations included development of a lightweight portable surveying tower which can be erected by two men in about 1 hour and which can be transported without disassembly. It is intended particularly for theodolite observations and electronic distance measurements over obstructions. Tubular aluminum construction with welded one-piece horizontal triangular sections contributes toward light weight, rigidity, and simplicity. This provides a standard 50-foot, 500-pound tower which can be erected to greater or lesser heights by the addition or omission of 12-foot standardized sections. Its light weight will permit transportation by helicopter with the unit fully assembled.

Collimator equipment has been installed to enable faster and better testing of theodolites and levels. The collimators will be of particular value in evaluating competitive instruments. The considerable number of new instruments now available requires an increased amount of testing, both in the laboratory and in the field. The collimator system, by permitting more accurate and complete laboratory testing, reduces the amount of field testing required.

Research in the field of photogrammetry included studies of a new type of aerial film using a polyester base. This has been found to possess greater dimensional stability than the film currently used. It is quite possible that this film may be used in obtaining all aerial photography in the future, providing the film becomes commercially available in sufficient quantity. Its use should increase both the horizontal and vertical accuracy of photogrammetrically compiled maps.

A limited study of visual factors in stereoplotting was completed.



Survey topographic engineers measuring angles with a theodolite atop portable tower.

This included the effects of applying refractive correction to a number of stereo operators and of varying room illumination. The results were sufficiently encouraging to warrant an expanded investigation along similar lines to give the findings a broader base for statistical evaluation.

Two new super-wide-angle (120-degree) cameras were obtained for testing and evaluation. Consideration has been given to design factors for super-wide-angle projection equipment and a system has been devised for modifying the Geological Survey camera calibrator to accommodate the wider angle of coverage.

Fabrication and assembly of the first Universal orthophotoscope were completed. The new device is more complex and automatic than previous instruments of this type, and is expected to produce better orthophotographs with a maximum of operator comfort. Either Kelsh or ER-55 projectors may be used.

Research and development in cartographic instrumentation was concentrated on the improvement of instruments and techniques used in scribing operations. Several map revision techniques designed for use with the scribing process have been worked out and are now being evaluated. Experiments are continuing in an endeavor to devise techniques and procedures that will satisfactorily permit both 7½- and 15-minute maps to be processed from the same color-separation material.

Map Information

Facilities for supplying information on maps, aerial photography, and geodetic control surveys to Federal, State, and local government agencies, and to the public are maintained at the Map Information Office in Washington and at the Division's field offices. Services include over-the-counter map sales for the convenience of the public, commercial firms, and Government agencies; sale of prints of advance materials from current topographic mapping; graphic or tabular assemblies of map, photographic, and geodetic-control information.

The ninth edition of the index map, *Status of Topographic Mapping in the United States*, was prepared for publication. It will be issued in two sheets on the National Atlas format. One sheet will show the coverage for the 48 continental States; the other will show the coverage in Alaska, Hawaii, Puerto Rico and the Virgin Islands. The new edition will show by color and pattern the scale and quality of topographic maps available.

The tenth edition of the *Status of Aerial Photography in the United States*, another index map, was also published on the National Atlas format. For the first time, it shows that there is complete aerial photographic coverage of all 50 States, Puerto Rico and the Virgin Islands.

The Map Information Office continued to serve as the central depository for maps which make up the National Atlas of the United States, and provide economic, physical, and cultural information.

Publications Division

During the fiscal year 1,042 reports were submitted for publication. Of these 319 were for publication by the Geological Survey; 52 as professional papers, 62 as bulletins, 77 as water supply papers, 23 as circulars and 105 geologic maps in the Map Series. The remaining 723 were for publication by cooperating agencies for use in scientific journals.

The following is a summary of map reproduction work completed during the year.

	New	Reprinted
Topographic Division maps:		
Standard topographic.....	1,349	¹ 445
Standard topographic (engraved).....		191
Standard topographic (revisions).....	231	
1:250,000 scale.....	43	18
Scale conversions.....		55
Planimetric.....	4	9
State base.....	6	13
State topographic indexes.....		88
Miscellaneous.....	24	3
Geologic Division maps:		
Geologic quadrangles.....	6	3
Mineral investigations.....	28	
Geologic indexes.....	3	3
Coal.....	2	
Oil and gas maps.....	2	1
Oil and gas charts.....	3	
State geologic.....		1
Geophysical investigations.....	42	1
Miscellaneous investigations.....	42	4
Conversion Division maps:		
River surveys.....	35	4
Water Resources Division:		
Miscellaneous.....	2	
Total.....	1,822	839

¹ Includes 19 maps totaling 24,100 copies printed by other Government agencies.

These 2,661 new and reprinted map editions comprise 7,771,926 copies ranging in size from 13 by 18 inches to 50 by 72 inches.

In addition to the foregoing production, 1,080 jobs comprising miscellaneous maps and other preliminary map services were completed. This printing includes 238 maps totaling 728,353 copies of which 145 were illustrations comprising 484,981 copies for the Government Printing Office for use in the Survey's book reports. The rest of the miscellaneous printing and service was done for other units of the Government, including branches of the Survey and various States.

The total cost of all production was \$1,464,594.99. Of this amount \$70,079 was received from other agencies for map sales and \$14,155 was paid by other agencies and miscellaneous organizations for printing or service work.

Distribution

In addition to more than 40 million items on hand at the beginning of the year 400,321 copies of 200 separate reports in book and pamphlet form printed by the Government Printing Office and the Interior Duplicating Section and 7,490,015 copies of 2,661 new and reprinted maps were received. The distribution of 4,579,090 maps, including approximately 450,000 map indexes, constituted a substantial increase

of 266,483 copies over the corresponding total for the preceding fiscal year. There were approximately 274,774 book reports and pamphlets distributed by the Survey this year.

The total number of maps, map indexes and reports distributed by the Geological Survey this year as compared with last is shown in the following table:

	Fiscal year 1959 Maps, map indexes and book reports	Fiscal year 1960 Maps, map indexes and book reports	Percent of increase or decrease
Washington.....	2,787,158	2,786,218	-----
Denver.....	1,452,989	1,701,381	+17
Fairbanks.....	38,957	46,006	+18
Other field offices.....	285,447	320,259	+12
Total.....	4,564,551	4,853,864	+11

Funds

During the fiscal year 1960, obligations were incurred under the direction of the Geological Survey totaling \$65,328,255. Of this amount 64 percent was appropriated directly to the Geological Survey, 19 percent was made available by other Federal agencies, and 17 percent by States or their political subdivisions, and miscellaneous non-Federal entities.

Source and use of funds in fiscal year 1960

Topographic surveys and mapping:		
Appropriation.....		\$14,715,122
Reimbursements from non-Federal sources:		
States, counties, and municipalities.....	\$2,724,713	
Sales to the public of aerial photographs and copies of records.....	118,829	
Miscellaneous.....	53,250	
		2,896,792
Reimbursements from other Federal agencies:		
Bureau of Reclamation.....	908,231	
Department of the Army.....	785,255	
Atomic Energy Commission.....	130,000	
National Science Foundation.....	160,213	
Miscellaneous.....	208,182	
		2,191,881
Total appropriation and reimbursements.....		19,803,795
Direct State payments.....		6,750
		19,810,545

Source and use of funds in fiscal year 1960—Continued

Geologic and mineral resource surveys and mapping:	
Appropriation.....	\$11, 417, 473
Reimbursements from non-Federal sources:	
States, counties, and municipalities.....	\$354, 149
Miscellaneous.....	8, 965
	363, 114
Reimbursements from other Federal agencies:	
Department of the Air Force.....	154, 625
Department of the Army.....	1, 290, 449
Atomic Energy Commission.....	1, 746, 294
Government Printing Office—map repro- duction.....	100, 123
International Cooperation Administration..	1, 144, 503
National Science Foundation.....	57, 511
Miscellaneous.....	345, 934
	4, 839, 439
Total, geologic and mineral resource surveys and mapping.....	16, 620, 026
Water resources investigations:	
Appropriation.....	11, 675, 431
Reimbursements from non-Federal sources:	
States, counties, and municipalities.....	\$6, 170, 589
Permittees and licensees of the Federal Power Commission.....	230, 478
Miscellaneous.....	71, 967
	6, 473, 034
Reimbursements from other Federal agencies:	
Bureau of Reclamation.....	879, 438
Department of Agriculture.....	226, 978
Department of the Air Force.....	131, 000
Department of the Army.....	1, 836, 684
Department of Health, Education, and Wel- fare.....	155, 177
Department of State.....	114, 689
Atomic Energy Commission.....	598, 964
International Cooperation Administration...	462, 963
Tennessee Valley Authority.....	96, 948
Miscellaneous.....	309, 434
	4, 812, 275
Total appropriation and reimbursements.....	22, 960, 740
Direct State Payments.....	1, 171, 819
Total, water resources investigations.....	24, 132, 559
Soil and moisture conservation:	
Appropriation.....	174, 825

Source and use of funds in fiscal year 1960—Continued

Conservation of lands and minerals:	
Appropriation.....	\$2, 748, 716
Reimbursements from non-Federal sources:	
Miscellaneous.....	1, 822
Reimbursements from other Federal agencies:	
Miscellaneous.....	46, 426
Total, conservation of lands and minerals.....	<u>2, 796, 964</u>
General Administration:	
Appropriation.....	1, 305, 721
Reimbursements from non-Federal sources:	
Miscellaneous.....	14, 300
Reimbursements from other Federal Agencies:	
Department of the Army.....	\$142, 394
Miscellaneous.....	330, 921
Total, General Administration.....	<u>473, 315</u>
Total, General Administration.....	<u>1, 793, 336</u>
Summary:	
Appropriation.....	42, 037, 288
Reimbursements from non-Federal sources:	
States, counties and municipalities.....	\$9, 249, 451
Miscellaneous.....	499, 610
Total, non-Federal sources.....	<u>9, 749, 061</u>
Reimbursements from other Federal agencies.....	<u>12, 363, 337</u>
Total, appropriation and reimbursements.....	64, 149, 686
Direct State payments.....	1, 178, 569
Grand total.....	<u>65, 328, 255</u>

Bureau of Mines

Marling J. Ankeny, *Director*



THE BUREAU OF MINES of the Department of the Interior completed a half century of service to the Nation with the close of the 1960 fiscal year. Throughout the five decades that have passed since its creation by Congress in July 1910, the Bureau's major objectives have remained constant—to promote the wise and efficient use of the Nation's mineral resources, and to advance in every way possible the safety and health of those who mine and process metals, nonmetals, and fuels.

Significant progress in many different approaches to these primary goals was recorded by the Bureau during its 50th year. For example, Bureau metallurgists developed new techniques for making special shapes of high-purity tungsten—most promising of the “missile metals”—and found a way of using uranium to impart new strength to steel. New applications of solvent-extraction and electrolytic processes proved successful in experimental production of such metals as nickel, cobalt, vanadium, tungsten, molybdenum, columbium, tantalum, and chromium.

Mining research advanced with favorable results in experiments with precast concrete to solve ground-support problems at an Idaho metal mine and with improvement of a Bureau technique that promises increased output at a copper operation in Michigan. In petroleum studies, Bureau engineers helped enhance the efficiency of waterflood projects aimed at secondary recovery of oil in California and Montana, while other Bureau scientists undertook new research on properties of missile fuels. Coal studies moved ahead with successful experiments in hydraulic mining of bituminous coal and preliminary research on hydraulic transportation of anthracite.

In the health and safety field, cooperative research by the Bureau and industry reached the field-testing stage in a program to develop a continuous methane-monitoring system for use with electrically powered mining equipment. A pocket-sized methane detector devised by the Bureau for miners was found suitable for coal-mine use. Research was completed on controlling mine fires with high-expansion foams, and mine operators were given practical advice on employing the method. The Bureau also stepped up its permissibility testing services and health and safety educational programs.

The Bureau continued to gather and to publish facts on production, consumption, distribution, and other aspects of mineral trade at home and abroad, and contributed the experience of its engineers and technologists, who served under governmental technical-assistance programs in many friendly foreign countries. It also participated in projects to develop the varied resources of the Nation's several great river basins, and performed many special economic and statistical studies to develop essential information for defense planning and international trade negotiations. Meanwhile, output of technical and scientific publications in the Bureau's series of research reports continued at a high level.

To achieve greater efficiency in planning, programing, and coordinating research and development work at Bureau installations throughout the Nation, responsibility for these functions was centralized, during the year, in headquarters Divisions of Minerals, Coal, and Petroleum. At the same-time, steps were taken to free research personnel in the field from many operating-management type duties.

These activities, and many others in which the Bureau of Mines engaged during fiscal 1960, are described in the following pages.

Minerals Development

The Bureau completed a planned realignment of its mineral-research activities toward the end of the fiscal year. As a result, administrative lines were shortened to permit more effective technical direction and supervision of metallurgical and mining-research establishments in the field. This streamlining was accomplished without impairing the Division's factfinding or programing functions.

Ferrous Metals

The Bureau's new Minneapolis Metallurgy Research Center at Fort Snelling, Minn., was occupied during the year with equipment and personnel transferred from other locations. The new facilities will enable the Bureau to expand studies in mining, minerals beneficiation,



This modern laboratory and administration building at Fort Snelling, Minn., near Minneapolis and St. Paul, was occupied by the Bureau of Mines during the year to speed research in the north-central States.

and extractive metallurgy, especially those concerning iron and manganese, two of the Lake Superior region's major resources.

The Bureau's research program for ferrous metals was directed principally toward finding better ways to extract, prepare, and use high-temperature alloys of tungsten, molybdenum, and vanadium. The program included research on techniques for recovering iron, manganese, cobalt, and nickel from domestic resources and studies aimed at conserving these resources. In addition, Bureau engineers investigated ferrous-metal mineral deposits and Bureau scientists developed fundamental data on the physical and chemical properties of several ferrous metals and alloys.

A comprehensive report was published on the thermodynamic properties of manganese and its compounds, bringing scientific literature on this subject up to date for the first time since 1934. A report was completed on the distribution of iron minerals in the taconite area surrounding the Mesabi Range of Minnesota, and another was published, describing a promising method developed by the Bureau for producing intricate shapes of high-purity tungsten industrially by fluoride reduction. The technique also may provide a means of applying a protective tungsten coating on less durable material. Development of this process to commercial scale would be an outstanding contribution to the Nation's space and missile program.

In conservation studies, the Bureau continued research on use of large tonnages of so-called "depleted" uranium—material from which most of the fissionable isotope, U-235, has been removed in producing atomic fuel.

Uranium-bearing steels produced in Bureau laboratories exhibited tensile strengths higher than 300,000 pounds per square inch. A Bureau survey of the steel industry indicated that there is a large



Mineralogists and petrologists use this ultraphoto microscope for examining mineral specimens at the Bureau of Mines' new research station, Fort Snelling, Minn.

market for such high-strength steels. Therefore, some of the surplus depleted uranium that is accumulating might help supply this market, if the Bureau's laboratory work can be duplicated on a commercial scale.

The Bureau also conducted a nationwide survey of the vacuum-melting industry. Another study was made of the iron and steel scrap industries in California and Nevada to determine areas where research problems exist in using scrap.

Bureau researchers sought methods to conserve domestic coking-coal resources and to improve efficiency of iron-ore reduction processes. As a result, five private companies, adopting techniques developed in the Bureau's experimental blast furnace, installed equipment at their commercial furnaces to enrich the air blast with natural gas. First reports on these operations indicate savings of about 10 percent in coke requirements with increases of as much as 20 percent in furnace efficiency.

Bureau scientists applying a melt-quench-leach process to Colorado rhodonite and siliceous manganese-bearing ores of Aroostook County, Maine, on a laboratory scale succeeded in extracting over 90 percent of the manganese in these refractory materials.

An electrolytic solvent-extraction process developed in Bureau laboratories was successfully scaled up to produce nickel and cobalt of better than commercial purity from Nicaro nickel-oxide sinter in a continuous circuit.

Experiments in production of high-temperature alloys showed marked success with electrowinning and electrorefining of vanadium,

tungsten, and molybdenum on a laboratory scale. Also discovered was a fused-salt electrolytic process for extracting chromium directly from low-grade domestic chromite-bearing materials.

Bureau scientists greatly improved a process developed earlier for electrowinning tungsten from scheelite in a fused-salt bath and discovered that molybdenum can be separated from the tungsten metal product in the process. This led to invention of an open-cell fused-salt method for electrowinning high-purity molybdenum from the trioxide.

Extremely ductile vanadium metal—probably the softest ever produced—was made by electrorefining an impure vanadium feed material in a Bureau of Mines laboratory.

Nonferrous Metals

Results of Bureau research on recovering copper from oxide and mixed oxide-sulfide copper ores by a segregation process were used to design a commercial plant that began operating in Arizona during the year. Conditions were established for concentrating mercury from the concentrate by leaching. Progress was made in recovering antimony, lead, zinc, and tin from primary materials by chloridization and leaching. Other metallurgical research included the vacuum casting of copper to form an air-cooled mold, studies of the thermoelectric properties of selected minerals, and the application of ultrasonic techniques to chemical and metallurgical processes.

In Bureau research on recovering and refining secondary nonferrous metals, the yield of tin from hardhead by amalgam electrolysis averaged about 90 percent with a purity above 99.9 percent. Work continued in other phases of this program which included experiments in recovering lead and zinc from scrap, refining secondary cadmium, and developing instrumental methods for analyzing metallurgical reactions.

Favorable results were obtained in mining research on the use of precast concrete supports for mine openings to overcome ground-support problems at a deep base-metal mine in Idaho. Progress was made also in applied physics research at open-pit and underground base-metal mines. Additional data were compiled for improving a Bureau-developed mining method that promises to double ore recovery at a large underground copper mine in Michigan. Basic information was obtained for use in developing methods to control noise in mining operations, to aid in rock-drilling and fragmentation research, and to help solve mine-drainage and water-control problems.

Antimony, copper, mercury, and tin occurrences in Alaska were examined and evaluated and Bureau reports were issued describing

the lode and placer tin deposits. A Bureau study of mercury resources in the United States was completed and a bulletin reporting the results was begun. In addition, a Materials Survey on mercury was published, and the Bureau reported on mining methods and cost studies at base-metal mines in Arizona, California, Colorado, Missouri, Nevada, and Oklahoma.

Progress was made in the Bureau's program to recover alumina from domestic low-grade bauxite or nonbauxite materials. Bauxitic laterite from Oregon, Hawaii, and Arkansas, and anorthosite from Wyoming and California were tested. Cost calculations were prepared for a number of proposed processes.

Research on the direct smelting of clays, or similar aluminum-silicate materials to produce crude aluminum-silicon alloys, was described in a Bureau publication, and studies were undertaken to determine whether these alloys can be upgraded to commercially pure aluminum or silicon.

Tests were begun on samples of various waste materials from primary aluminum plants. Preliminary results showed that with some samples simple flotation techniques will yield high aluminum and fluorine recoveries with correspondingly high carbon rejection.

Two Bureau reports were published describing examinations of titanium resources in Oklahoma and Maryland. Five other publications discussed Bureau research on the physical metallurgy of titanium, chlorination processes, and a technique for reducing titanium tetrachloride with high-surface sodium metal. The Bureau completed tests on a 10,000-ampere electrolytic cell to evaluate the commercial possibility of its electrolytic process for recovering titanium from titanium scrap and other materials.

Experimental operation of this cell, in cooperation with the General Services Administration, resulted in improved techniques and significant cost reductions. Studies to develop suitable mold materials for casting titanium and new electrorefining processes also progressed satisfactorily.

The Bureau conducted tests of single crystals of pure magnesium combined with small additions of other elements, to measure accurately their specific damping capacity under various stresses.

A Nationwide search for beryllium continued, and the Bureau prepared to use two mobile laboratories—one equipped with a spectroscope and the other with a special "nuclear" detector—for quick testing of rock samples. The Bureau also published a description of a field test it developed for detecting as little as 0.013 percent beryllium in rock samples.

A beryl-flotation test plant was operated next to the Foote Mineral Co.'s installation at Kings Mountain, N.C., to test a Bureau improved



As part of its metallurgical research, the Bureau of Mines operates this experimental retort for producing tantalum or columbium by the Kroll process.

method for recovering beryl and to determine the feasibility of extracting this mineral from low-grade southeastern pegmatite deposits. These deposits represent one of the largest known potential resources of beryllium in the United States. Results thus far have been encouraging, and samples of the low-grade concentrate obtained are being used in research to develop processes for extracting beryllium metal.

The Bureau persisted in its search for new commercial sources of tellurium and intensified its development of improved methods for tellurium detection and analysis. This element, once little used, has become an important material in thermoelectric applications.

Ductile columbium metal was prepared in a Bureau laboratory, using the Kroll process. Purified columbium sponge was arc melted, and the resulting material machined, press forged, and cold rolled into thin, pliant sheets. After annealing in a helium atmosphere, the sheet could be bent easily with the fingers.

Cooperative research by the Bureau demonstrated the feasibility of separating a columbium-tantalum product from other metal impurities in euxenite by direct chlorination. Hafnium of a purity higher than heretofore attained was prepared by treating hafnium tetrachloride with free chlorine. By this means the oxygen content was cut nearly in half, with a corresponding reduction in metal hardness. Research on producing ductile yttrium continued. Cast buttons of high-purity yttrium were hammer forged, vacuum annealed, and rolled into foil-thin sheets that were successfully arc-welded under an inert atmosphere. A Bureau publication described the preparation of high-purity yttrium by metallic reduction of yttrium trichloride.

Results of 4 years' intensive research on rare earth metals were presented in a series of 14 Bureau reports published during the year. Two of these described methods for analytical control in processing, five gave details of thermodynamic studies on various rare earth compounds, and seven described solvent-extraction and ion-exchange methods for extracting rare earth metals and compounds from euxenite, bastnasite, and an euxenite-carbonate residue. A method was developed for analyzing rare earth oxide mixtures and a simple and efficient technique was devised for extracting rare earth compounds from bastnasite, a mineral rich in cerium and lanthanum. High-purity electrolytic cerium produced by the Bureau was tested and used in experiments by other research organizations.

Three Bureau publications on uranium exploration and mining methods and costs complemented six earlier reports in this series and were enthusiastically received by the industry. An important step towards eliminating radioactive uranium mill wastes was made through Bureau research on recycling of mill effluents.

Nonmetallic Minerals

Research on recovering fluorine from low-grade siliceous fluor spar ores included pioneering studies of the reactions involved in the molten defluorination of fluor spar. The relationship between feed rate and defluorination of aluminum fluoride in a pilot plant rotary kiln also was investigated, and research was conducted on separating the fluor spar and barite in complex ores by flotation. Mining methods and costs at a large fluor spar mine were studied.

Asbestiform minerals were synthesized and information was obtained on the fibrosity, occurrences, and anomalies of natural asbestos minerals. Advanced X-ray techniques were used to study the crystal structure of fluor amphiboles. Mining-methods-and-costs data were compiled on Arizona asbestos mines.

The Bureau conducted sulfur-utilization surveys in the midwestern and northeastern States, during the year. Research on recovering sulfur through the decomposition of gypsum included test runs using a 10-inch fluidized-bed reactor. Various absorbents, including metallic oxides and molecular sieves, were investigated as possible agents for recovering sulfur gases from the reactor off-gas stream.

Bureau researchers prepared elemental boron in the laboratory by reducing boron trichloride with zinc, sodium, and lithium, and basic studies of boron's crystal structure continued.

Information was obtained on mining methods and costs at stone quarries and mineral-aggregate mines. Fundamental research in blasting included correlation of strain pulses produced in blasted rock with the properties of the explosives used. Other studies aimed at determining the effect of explosive charges with varying diameters when placed in shot holes of fixed diameters.

Vibrations generated by blasts at Wilson Dam in Alabama were recorded at various distances to determine the order of magnitude of particle motion and to compare the performance of commercial seismographs with that of the Bureau's transducer mobile laboratory system. This is the first step in new research to determine effects of blasting vibrations on buildings and other structures near quarries.

Results of laboratory tests on samples from nine silica deposits were given in a publication entitled "Industrial Silica Deposits of the Pacific Northwest."

Research on water requirements of metallurgical industries emphasized the role of common water impurities in flotation. Addition of sodium and potassium to distilled water resulted in the flotation of more limestone and quartz than when these salts were absent.

In cooperation with industry, the Bureau continued research on methods of recovering commercial lithium-mineral concentrate from pegmatite ores.

Fundamental studies of various synthetic micas furnished accurate data on their melting points, an evaluation of properties affecting their preparation and uses, and basic information on crystal growth and structure. One family of synthetic micas and related synthetic minerals was found to have ion-exchange properties with potential commercial applications. Research in cooperation with the General Services Administration developed a method for processing certain water-swelling synthetic micas into strong, flexible sheets with high dielectric strengths.

An important phase of research on super refractories was the development and study of the operating characteristics of furnaces for X-ray diffractometers. The effects of design of windings, thermocouple locations, lead positions, and other related factors were studied

to improve the accuracy of thermal measurements. These investigations permitted the measurement of thermal expansion in a number of pure rare earth oxides to a temperature of 1,300° C. Enough information was obtained to extend the research to 1,500° C.

New chisels designed for the Bureau's phosphate-rock planer were field tested and found to have improved cutting characteristics. The search for new or more efficient processes for upgrading phosphate rock and for handling phosphatic slime continued. A study was begun to determine the feasibility of using statistical analysis on data obtained from phosphate-rock samples. Cavitation forces were investigated for use in possible techniques for fragmenting phosphate rock and other materials.

Pioneering work by the Bureau resulted in the acceptance of bentonite from a deposit near Yakima, Wash., for use in constructing the Wapamum Dam on the Columbia River. Several hundred thousand dollars will be saved over the cost of a suitable material from a more distant source.

Under cooperative agreements with State agencies, clay, nepheline syenite, and other ceramic mineral occurrences in Washington and Oregon were examined and sampled.

Work continued on the complex problem of removing alkalis from submarginal Missouri fire clays. Reports were published on refractory-clay deposits of Colorado and on sources of refractory raw materials and refractories markets in the South Central United States. The Bureau-developed wet-attribution grinding process proved more efficient than any of the commercial methods now used.

Research on abrasive and hard materials included the synthesis of borides and carbides by fused salt electrolysis, and flame plating of ceramic and metal surfaces with carbides, borides, and silicides.

Several deposits of kyanite and related minerals in the Pacific Northwest were examined, sampled, and evaluated, and some appeared to have commercial possibilities. Work on disaggregation of halloysitic clays continued with encouraging results. High-pressure liquid extrusion was the most promising method developed.

Foreign Activities

A study completed during fiscal year 1960 showed recent trends in world mineral production and revealed that the United States ranks first in output in 29 of 63 important commodities. The U.S.S.R. led in 8 and Canada in 3. However, the Communist world is scoring substantial gains.

Although the United States is still by far the world's leading energy consumer, Russia has displaced her as principal coal producer.



A Bureau of Mines engineer, representing the Department of the Interior, examines mineral specimens in Antarctica. Field trips arranged by the National Science Foundation resulted in investigation and sampling of coal deposits near Mount Gran.

A marble slab, quarried in Antarctica by a Bureau of Mines engineer, is lifted from its icy resting place by a Navy helicopter. The Department of Interior sent several representatives to the south polar region in cooperation with the National Science Foundation.



Temporarily, at least, the U.S.S.R. also is first in iron-ore production, but the United States still holds a substantial lead in steel output. However, in this area too, the Communists are gaining.

The portion of the world's total steel produced by Iron-Curtain countries has increased from 22 to 30 percent since 1953, while that supplied by free world nations has dropped from 78 to 70 percent. Growing mineral strength of the Communist powers was studied in the Bureau's foreign mineral program during the year and several papers on the subject were published.

The Bureau's foreign factfinding services helped in evaluating problems of domestic mineral industries arising from world surpluses of certain commodities and contributed to the formulation of corrective measures. Data supplied by the Bureau were used extensively by Government agencies administering domestic import controls on lead, zinc, and petroleum, also by domestic producers seeking to appraise their market positions. The Bureau of Mines evaluated all available sources of statistical information on supply-demand relationships for the International Lead-Zinc Study Group.

Another special service was a comprehensive survey made by the Bureau of potential mineral exports from foreign countries. The study was requested in connection with barter programs for disposing of surplus agricultural products.

The Bureau's major responsibility in the foreign field is to provide consistently accurate and up-to-date information on mineral developments abroad. During fiscal 1960, this included foreign statistical tabulation comprising over 10 percent of volumes I and II of the Bureau's Minerals Yearbook, review and distribution of over 50,000 mineral information dispatches from the United States Foreign Service, foreign governments and the United Nations; publication of 18 timely studies on foreign minerals of interest to domestic producers and consumers; and response to numerous inquiries from Government agencies and the public.

The Bureau also participated in an Antarctica field expedition sponsored by the National Science Foundation, sending an engineer for a 2-month study of the environmental problems facing mineral development in this region. Coal deposits near Mount Gran were investigated, and samples taken there were being studied in Bureau and other laboratories at the close of the year. The Bureau's engineer supervised what probably was the first venture of its kind in Antarctica. He directed the quarrying and transportation of three blocks of marble. The blocks, destined as cornerstones in three

chapels in Christchurch, New Zealand, were transported by helicopter to a waiting ship and were presented in appreciation for New Zealand's cooperation in the United States antarctic program.

Twelve Bureau technologists conducted technical-assistance projects in Afghanistan, Colombia, Indonesia, Israel, Korea, Laos, Mexico, Peru, and Taiwan. Three others completed short-term assignments in Panama and Mexico. Research on Philippine lateritic ores was completed in Bureau laboratories and the possibilities of commercial production were evaluated. Thirteen foreign technicians were in training at Bureau installations at year's end. Nineteen others had already completed their assignments and returned to their respective countries under a program sponsored and financed by the International Cooperation Administration.

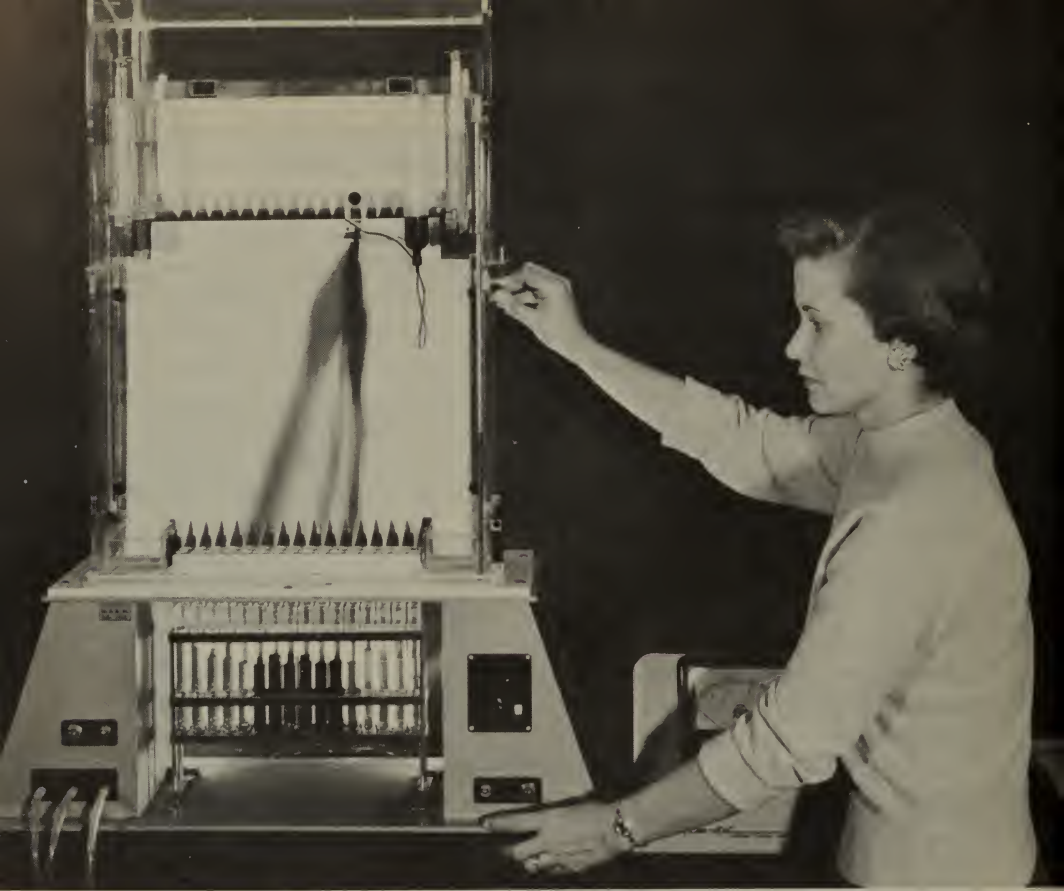
Petroleum and Natural Gas

Bureau of Mines research in petroleum and natural gas made important contributions to the conservation of these essential fuels during the 1960 fiscal year.

In Utah, the State Oil and Gas Commission established a policy of wide well spacing and ordered practices designed to promote efficient recovery of oil and gas in the Greater Aneth fields, which have developed recently in the Four Corners region. This decision was based substantially on Bureau studies of the properties of reservoir oils in this major producing area—properties that affect both the amount of oil that can be removed and the rate of production.

The Bureau's success in applying advanced mathematical theory to evaluations of petroleum reservoirs in California will help solve problems encountered in using water drives to increase oil recovery. The new technique employs electronic computers, as well as conventional procedures, in many of the calculations, and provides correlations of physical and chemical properties with other data to permit economic as well as scientific evaluations.

Bureau-developed relationships between the properties and the complex behavior of natural-gas condensate fields systems are being used to prepare digital computer programs that will give rapid solutions to difficult petroleum engineering problems encountered with high-pressure reservoirs. Such reservoirs are increasing in number as the industry drills to greater depths for oil and gas, and conventional approaches to production problems are difficult, lengthy and expensive. Digital computers facilitate this work and thus aid petroleum conservation.



This continuous electrophoresis apparatus has been installed by the Bureau of Mines for separating petroleum specimens in a high-voltage electrical field.

Data obtained by the Bureau in pioneering field tests during World War II were supplied to operators in a large southwestern gas field for use in connection with computer calculations of reserves. The information obtained will help the operators choose efficient production procedures and should substantially increase ultimate recovery of gas.

In the Appalachian region, the Bureau is investigating the flow of air-oil mixtures in vertical pipes. A model well has been constructed and studies were begun during the year to obtain information needed in designing lower-cost flowstrings and pipelines—which can mean important savings in an area where the bulk of production comes from small companies or individual operators.

Research on oilfield brines produced sensitive analytical methods capable of detecting several materials that are present only in minor or trace amounts. These methods are being used to determine sources of intrusive water, concentrations of recoverable metals, and also for correlating properties of reservoir rocks and crude petroleum.



The space age has brought increased attention to Bureau of Mines pioneering research in safer handling and storage of liquid fuels. Here a large-scale conflagration is studied in a Bureau laboratory.

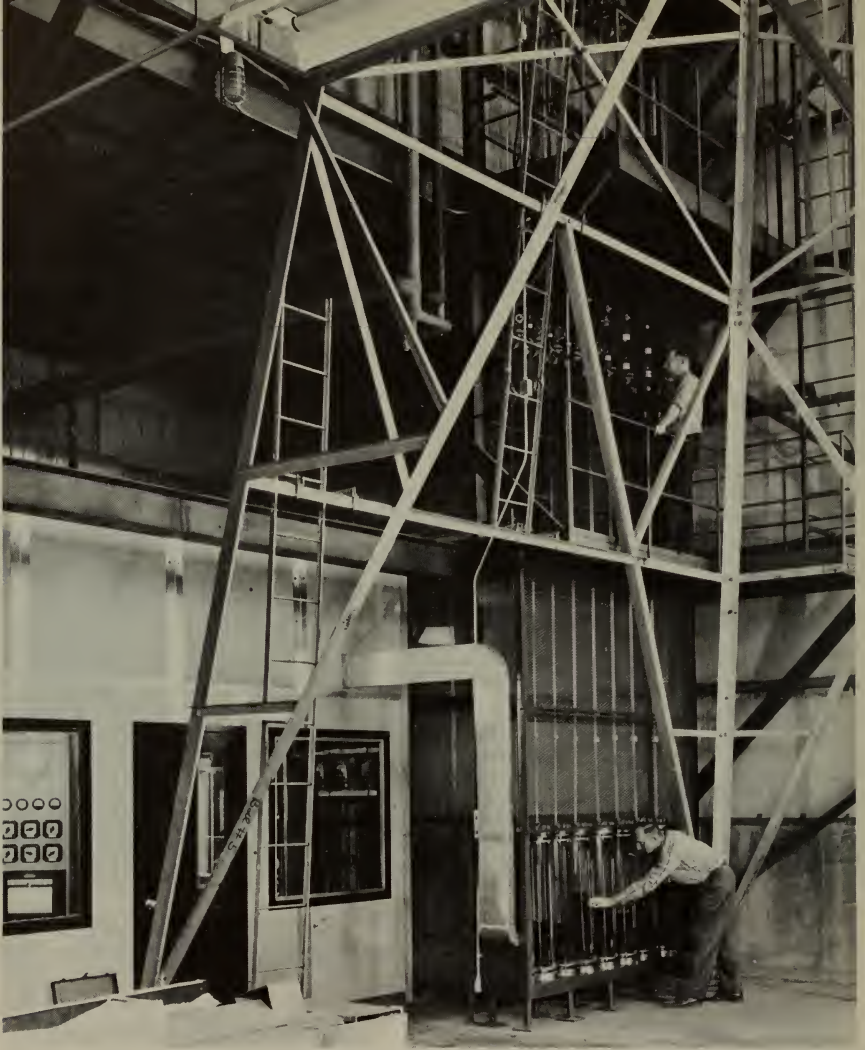
Secondary Recovery

In the nearly depleted Cutbank field of Montana, waterflooding to recover more oil shows greater promise as a result of Bureau research on certain characteristics of the oil-producing formations.

The Cutbank sand was found to have no swelling-type clay minerals, as supposed earlier, so fresh water can be injected for secondary recovery. In the Rocky Mountains fields, research on water-sensitive sands has helped prevent damage to oil-producing formations by fresh water drilling muds.

Results of Bureau field and laboratory tests showing that sodium tripolyphosphate increases water-injection rates in secondary recovery operations were used during the year in Northwestern Oklahoma, where this chemical now is being applied successfully on 17 waterflood projects. The methods employed were suggested by Bureau scientists.

Radioactive gases were used by Bureau scientists to trace flow paths through naturally fractured rocks in the Spraberry Trend petroleum



A two-story layout is used in a Bureau of Mines laboratory for studying the vertical-flow of air-oil mixtures in pipes.

reservoirs of west Texas. This tracing, to determine the direction of fractures before large-scale waterfloods, improves operations and recovery. It is a conservation measure that has applications with newer methods, such as passing heat or light hydro-carbon fluids into oil-bearing rocks to increase the flow of oil to wells.

Petroleum Chemistry, Refining, and Thermodynamics

As part of cooperative studies with the Public Health Service on air pollution, Bureau researchers burned various gasolines in an engine under simulated road conditions to determine how fuel composition and driving cycle affect the composition of exhaust gas.

The study showed that, during acceleration and cruising, the composition of gasoline has little effect on the composition of the exhaust gas; however, during deceleration and idling, the exhaust composition is close to that of the fuel.

A continuous flow paper-electrophoresis apparatus was adapted from medical science and was applied with good results in studies of crude oil systems. This apparatus and method open new research areas in fundamental studies of petroleum's composition. Another new method, employing X-ray fluorescence, was developed for analyzing hydrocarbons and hydrogen. It is now being extended to include sulfur and nitrogen.

Gasoline compounds were tagged radioactively to learn which formed gum. Studies showed that, of the various hydrocarbons in gasoline, aromatic types are the worst offenders. In addition, most nitrogen compounds and certain sulfur compounds are active gum formers.

New thermodynamic research was begun on missile fuels and reliable information was obtained on a spontaneously flammable liquid aluminum compound. Studies were undertaken on several organic silicon and fluorine compounds; important byproducts of this work are experimental techniques developed by the Bureau and now being adopted by scientists of the propellants industry. Comprehensive thermodynamic tables were completed for 100 petroleum sulfur compounds, and studies were conducted of minor constituents in Wilmington, Calif., crude oil.

Petroleum Economics

The Department of the Interior's Oil Import Administration makes extensive use of the Bureau of Mines petroleum statistics. In addition to the forecasts required to set allocation levels, the Bureau now compiles historical data for use by Government and industry. Import controls have emphasized the need for more detailed information on petroleum demand, and the Bureau's monthly Petroleum Statement was expanded during the year to accomplish this.

Oil Shale Research

The Bureau analyzed samples from a 620-foot section of 25-gallon-a-ton oil shale—about six times thicker than expected—which was found in western Rio Blanco County, Colo. Also discovered were thick sections of apparently rich shale in the south-central Green River basin and the west-central Washakie basin of Wyoming.

Bureau laboratory experiments indicated that uranium oxides are good catalysts for removing sulfur during the hydrogenation of shale

oil. The oxides employed were prepared from depleted uranium, a substance available in large quantities as a byproduct of atomic energy programs. The catalyst studies are among several being pursued by the Bureau to help develop markets for depleted uranium, which has only limited use at present.

Twelve technical publications on oil-shale research were issued by the Bureau during the year, including: analyses of foreign oil shales, composition of low temperature extracts, crushing oil shale, development and experimental operation of three gas-solid oil-shale retorts, analyses of in-situ (in place) combustion methods and problems, procedures on organic nitrogen compounds and their reactions, catalyst evaluation, and test results in hydrogenating shale oil, and catalytic cracking of shale oil stocks.

Health and Safety Activities

The year marked important progress in the Bureau's various health and safety programs. New knowledge was acquired concerning hazards associated with increasing mine mechanization, and an intensified educational program—including stepped-up use of visual aids and demonstrations—conveyed practical safety guidance to large segments of the mineral industries.

Research on primary hazards moved ahead with promising new techniques for evaluating and controlling mine roof, and experiments were completed on a novel and effective method for fighting mine fires.

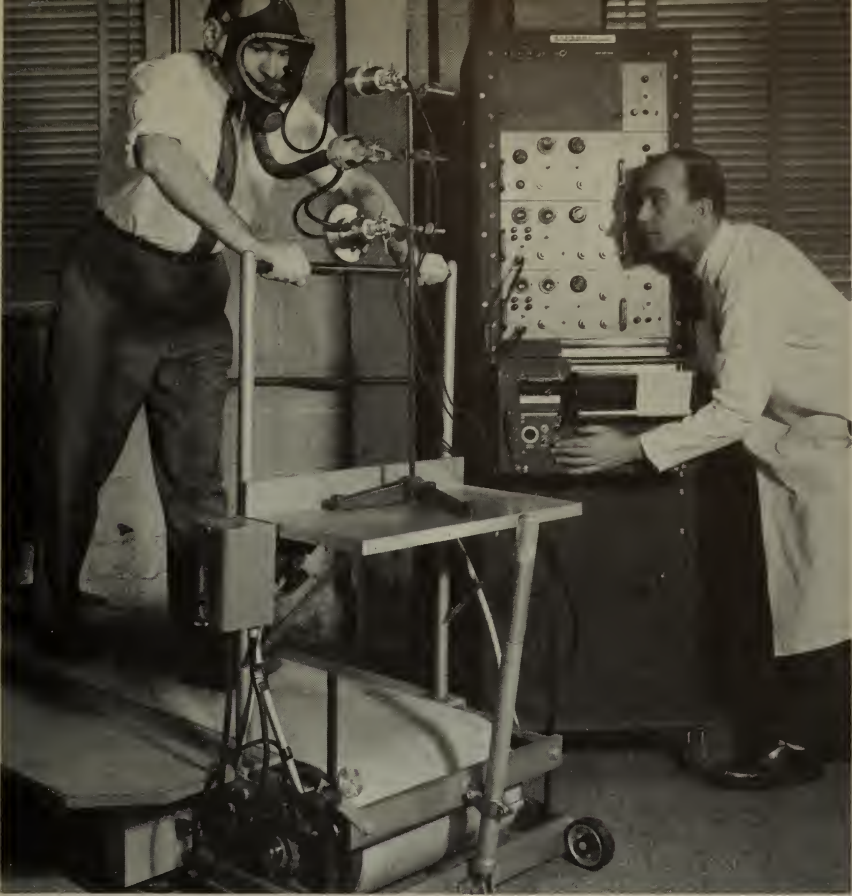
The entire mining industry recorded only one major disaster—in a West Virginia coal mine—during the fiscal year, compared with five such catastrophes in the preceding 12 months.

Work on Primary Hazards

Advances were made in research to reduce mine-roof hazards—traditionally the miner's most lethal enemy.

A commercial prototype of an articulated, self-propelled roof shield, designed by the Bureau, was built by a mine-equipment manufacturer and now is being tested in a Pennsylvania coal mine. Preliminary studies indicate that the shield should be an effective aid in reducing roof-fall accidents at working faces in mechanized coal mines.

The practicability of sonar techniques for exploring structural characteristics of mine-roof strata was demonstrated during the year. Bureau engineers and scientists are developing a smaller, more compact sonar device for general mine use.



Wearing a gas mask facepiece that is undergoing rigid tests by the Bureau of Mines, one experimenter walks a treadmill while a fellow researcher operates equipment to record characteristics of the device.

Roof-bonding experiments continued, with polyester resins being tested as substitutes for the more expensive epoxy resins. A new machine capable of accurately controlling the resin mix was developed by Bureau researchers and is being tested in coal mines in southern West Virginia.

Roof-bolting studies continued during the year with special emphasis on (1) standardizing pull tests; (2) determining operational characteristics of various types of headed mine roof bolts, embossed steel bearing plates, and newly developed shell-type roof anchors; (3) developing simple economic devices for making quick visual checks on roof-bolt tension; and (4) determining the effects of various bolting patterns and bolt loads on mine roof stability.

Cooperative research with industry—aimed at developing a continuous methane-monitoring system with automatic power shutoff for electrically powered mining equipment operated in face areas—

reached the stage of testing under simulated mining conditions. One system, developed cooperatively by two companies, was tested at the Bureau's Experimental Coal Mine near Bruceton, Pa. Results thus far are inconclusive, however, and further tests in commercial mines are planned.

The Bureau-designed, pocket-size methane detector was found suitable for coal mine use during the year. Principal advantages of this instrument are its compactness, long filament life, and readily available power supply (standard flashlight cell). A recording-type methane detector designed to give a continuing, instantaneous record of a mine atmosphere's methane content was developed by the Bureau in cooperation with industry and was tested successfully at the Experimental Coal Mine under conditions simulating operation of a continuous mining machine in a gassy atmosphere.

Research on ventilating continuous-type mining machines in thin coal beds was completed at the Experimental Coal Mine. Information obtained from these tests and data gathered from field observations led to design by the Bureau and industry of a centrifugal fan which, when mounted on a continuous miner, will be capable of dispersing methane liberated from the working face at the rate of 30 cubic feet a minute.

Testing Equipment

Improvements in mine mechanization continued to occur with remarkable frequency and again spurred demand for Bureau technical and testing services to determine permissibility of electric- and diesel-powered mining machinery and similar devices.

During the fiscal year, Bureau approvals were issued under 12 testing schedules for 17 continuous miners, 2 conventional mining machines, 13 conventional loading machines, 13 shuttle cars, 17 drilling machines, 2 power units, 1 utility truck, 2 rock-dust distributors, 6 distribution boxes, 3 air compressors, 2 mine pumps, 1 dust sampler, 1 fan, 7 diesel trucks, 1 diesel carrier, 2 flashlights, and 1 miniature methane-indicating detector.

The Bureau also issued 180 formal and 472 informal extensions of approval, explosion tested 80 compartments, conducted 2,572 explosion tests in natural gas-air mixtures, and flame tested 230 electric cables.

Five roof drills with integral dust-collecting systems were approved for use in coal mines, and 5 extensions of approval were granted. Also 3 new approvals and 120 extensions of approval were issued for respiratory-protective equipment.



A new device for detecting combustible gases, developed by the Bureau of Mines, is demonstrated here in an underground mine.

Health

The Bureau's efforts to promote healthful working environments in the mineral industries continued in analytical and investigative work on gases, dusts, and respiratory protection.

Approximately 19,000 atmospheric samples—most of them collected during Federal coal mine inspections—were analyzed during the year. Other samples analyzed came from tunnels under construction, inspection of uranium mines, tests of respiratory-protective devices, sealed fire areas in coal mines, coal crop fires, tests of diesel-powered equipment in underground use, metal and salt mines, and miscellaneous field and laboratory investigations.

About 900 samples of dust and dust-source material were examined by X-ray diffraction, emission spectrometry, microprojection, or chemical methods in connection with environmental surveys at western metal mines and with other field and laboratory studies to determine dust concentration, particle-size distribution, or composition. A high-

volume sampler was designed, built, and approved as permissible for collecting airborne dust.

A technique was devised and tested by the Bureau for using an unmodified 2-hour, self-contained, oxygen breathing apparatus in air pressures greater than atmospheric, such as those encountered in underwater tunnelling. Considerable progress also was made in developing equipment and procedures for evaluating respirators designed to protect against high-toxicity dusts.

Environmental surveys were coordinated with medical studies by the Public Health Service to evaluate the silicosis problem in metal mining. With more than 30 surveys carried out since April 1958, involving collection and examination of more than 9,000 airborne-dust samples, the first phase of this study neared completion.

Increased emphasis was placed on inspecting uranium mines to determine potential hazards from radon gas and its radioactive decay products, and to evaluate other health and safety hazards. More than 300 determinations of radiation levels were made during these studies. Bureau recommendations based on some 90 of these inspections contributed to markedly improved conditions in mines on Indian lands, the public domain, and lands controlled by the Atomic Energy Commission.

Explosion and Fire Prevention

Research was completed on controlling underground fires with high-expansion foams; fires in 6 to 12 tons of coal were controlled during experiments from distances up to 1,000 feet. Practical methods for using foam to fight fires in operating mines were demonstrated to industry.

By disseminating information and testing new and unusual materials the Bureau furthered industry efforts to control dust explosions. Specific data were obtained for powdered-fuel producers on the effect of an inert atmosphere in reducing explosion hazards of coal and lignite dusts. Explosibility of coal dust in an atmosphere containing low percentages of methane also was investigated.

Safety Education

Widespread interest in the Bureau's newest course on fundamentals of coal-mine accident prevention stimulated efforts to train instructors in this phase of mine safety education. During the year the Bureau's various accident-prevention courses were completed by more than 14,400 mineral-industry workmen and officials.

Approximately 34,300 workers completed first aid and mine rescue training. Emphasis continued on 100-percent participation in first



Large-scale excavations by private contractors often are involved in coal fire control projects directed by the Bureau of Mines. This big trench, being backfilled with incombustible material, was necessary in cutting off underground fire threatening school in background.

aid and accident-prevention training, because Bureau records show that improvement in safety is greatest at mines and plants where all employees receive instruction.

Two new motion picture films as well as slides, posters, and other visual aids to safety education were produced by the Bureau during fiscal year 1960. Films in the Bureau's safety series were viewed by more than 147,000 mineral-industry workers, and demonstrations of fire, explosion, and mine gas hazards were attended by 120,000.

Bureau employees participated in some 700 chapter and council meetings of the Holmes Safety Association, attended by more than 40,000 workers, mostly coal miners.

Accident Analysis

Reports from 30,000 operators in the mineral-extractive and related industries were used to compile the Bureau's injury frequency and severity rates, which help these industries evaluate their safety progress and improve their accident-prevention programs.

Approximately 1,200 mines, quarries, and plants participated in the 35th National Safety Competition sponsored by the Bureau.

Certificates of Accomplishment in Safety were presented to approximately 2,000 employees and officials of plants capturing top safety honors in the contest.

Control of Fires in Inactive Coal Deposits

With Bureau guidance and assistance, 80 fires in inactive coal deposits have been extinguished or controlled since 1949, when funds were first appropriated for this purpose. Forty-four of these fires were on the public domain and Indian lands, and 36 were on private property. An estimated 306 million tons of coal has been conserved thus far under this program which also has prevented extensive property damage and eliminated hazards to life in many areas.

During fiscal 1960, 12 fire-control projects were completed—4 on the public domain, 1 on Indian land, and 7 on private property.

Another 215 uncontrolled fires in inactive coal deposits are known to the Bureau. Of these, 103 already have been investigated and their control will be undertaken as appropriations permit and as private matching funds are made available where required. Maintenance work is done, as necessary, on completed projects so fires will not rekindle.

Coal-Mine Inspection

The eighth full year of Bureau coal-mine inspection work was completed under the Federal Coal Mine Safety Act, which calls for enforcement of certain provisions designed to prevent explosions, fires, inundation, and man-trip and man-hoist accidents in mines regularly employing 15 or more men underground.

The Nation had 10,618 active coal mines during the year. Of this total, 1,208 were so-called title II mines, to which the mandatory sections of the act apply. Smaller, title I mines, concerning which the Bureau is empowered only to make safety recommendations, totaled 7,600. Auger mines and strip mines, also exempt from mandatory sections of the act, totaled 251 and 1,559 respectively.

During the fiscal year, the Bureau's force of Federal coal-mine inspectors and safety engineers made 2,680 inspections of coal mines subject to title II. They observed 7,401 violations of mandatory provisions, many of which were corrected immediately and thus required no formal action. The inspectors issued 1,005 notices setting a reasonable time for abating dangers, 199 granting time extensions, and 969 certifying that dangers had been totally abated.

During the year, 101 orders were issued by the Bureau, requiring withdrawal of men from all or parts of 58 mines; 51 orders at 37 mines

were because of imminent danger, and 50 at 21 mines were due to failure to abate violations within a reasonable time. In comparison, 98 withdrawal orders were issued at 70 mines during the previous fiscal year.

Orders also were issued classing as gassy 14 mines previously considered nongassy. Three appeals were granted by the Federal Coal Mine Safety Board of Review, an independent agency, during fiscal 1960 for annulment of withdrawal orders issued for imminent danger in a State operating under a State-participation plan. The act does not permit an appeal to the Director where such a plan is in effect.

Federal inspectors and safety engineers also made 8,549 inspections of smaller title I mines (including 1,117 inspections at strip mines and 185 at auger mines) and many electrical, ventilation, dust, blasting, and related surveys. They also investigated fatal and serious nonfatal accidents, mine fires, gas and dust ignition, and other hazardous conditions.

Preliminary Bureau tabulations show 292 coal-mine fatalities in calendar year 1959, compared with 356 in 1958. The fatality frequency rate per million man-hours of exposure dropped from 1.13 in 1958 to 0.99 in 1959. However, the fatality frequency rate for the first 5 months of 1960 was again at 1.13.

One major disaster (a single accident causing 5 or more deaths) occurred during the fiscal year as a result of a fire in a West Virginia coal mine. Eighteen men were asphyxiated.

Helium

Further progress was made in 1960 to assure that helium would be available for the Nation's growth. Proposed legislation was resubmitted to Congress to make possible conservation of helium now going to fuel markets as a noncombustible component of certain natural gases in the southwestern part of the United States.

In May 1960, the House of Representatives passed H.R. 10548, and at year's end, a similar bill was reported favorably to the Senate by its Interior and Insular Affairs Committee.

The legislation would authorize the Government to purchase helium for conservation storage and future use from up to 12 new helium plants financed, built, and operated by industry. The plants, to be located on interstate pipelines carrying natural gas with a helium content above 0.4 percent, would recover helium that otherwise would be lost to the atmosphere when the gas is burned for fuel.

These proposed industrial plants and the five Bureau of Mines plants now operating could recover approximately 88 billion cubic feet of helium in the next 25 years. Total demand during this



Output of helium by the Department increased greatly during the year with completion of this new Bureau of Mines plant at Keyes, Okla.

period is expected to be 36 billion cubic feet. Thus, 52 billion cubic feet could be conserved and stored underground for use after 1985.

New Plant in Operation

The Government's own helium-production capacity was increased about 80 percent when the new Bureau of Mines helium plant at Keyes, Okla., began operations on schedule early in August 1959.

Operation of the \$11 million plant began 9 months after the contract for its construction was awarded. The technical staff of the Bureau of Mines Helium Activity did virtually all of the process engineering as well as some of the engineering design for the Keyes plant. The low-temperature process used for crude helium extraction is patterned after that employed in the Bureau's other four plants—but improved significantly.

During fiscal year 1960, the Bureau's plants at Amarillo and Exell, Tex., Otis, Kans., and Navajo, N. Mex., also were in operation. Reactivation of the Navajo plant, inoperative since the fall of 1958 for lack of helium-bearing natural gas, occurred early in the fiscal year when gas became available from a single well drilled in the area by a private company.

Helium was in abundant supply during the last half of the fiscal year, for the first time since 1954. Production and shipments reached new highs, exceeding 1959, the previous record year, by 76 percent and

17 percent, respectively. Production was 624.2 million cubic feet, shipments, 420.1 million cubic feet. Excess was stored in the Government-owned Cliffside field. At year's end 214.6 million cubic feet of helium was stored underground, about $2\frac{1}{2}$ times the maximum previously held in reserve.

Helium was used by the Air Force and Navy in rocket and missile programs, by the National Aeronautics and Space Administration for wind tunnel and shock tube tests, by the Atomic Energy Commission in nuclear reactor development, by the Weather Bureau to inflate meteorological balloons, by the National Institutes of Health in medical research and for many other purposes. Commercial users employed helium in shielded arc welding, leak detection, gas chromatography, low-temperature research, inert atmospheres for growing silicon and germanium crystals, and in medical and scientific studies.

Nearly 75 percent of the helium shipped went to Federal agencies and an estimated 80 percent of that delivered for commercial requirements was used on defense and atomic energy contract work. Consequently, almost 95 percent of the helium consumed was utilized in programs of the Federal Government. Most of the remaining 5 percent was used for medical purposes, by colleges and universities, and in research supported by private industry.

Crude helium separation units (right foreground) at the Department's new helium plant at Keyes, Okla., reflect improved techniques developed by the Bureau of Mines for capturing this valuable element from certain natural gases.



The Bureau's search for new sources of helium-bearing natural gas continued. Samples of gas from wells drilled by private operators in eastern Utah and western Colorado were found to contain about 1 percent helium. The parent gas is merchantable as fuel, and further development by the companies is expected. Extent of the discoveries has not been determined, and it is not known whether the new source is comparable to those already known.

Properties and characteristics of helium-bearing natural gas and helium-gas mixtures were studied by the Bureau to improve production, purification and transportation methods. Much of this research is expected to be useful to private companies that may ultimately be concerned with designing and building helium plants under the proposed Federal conservation program. New reports were added to an open file of information developed from research on extracting helium from natural gas by low-temperature processes. Information on building and operating the Exell and Keyes helium plants was placed on open file for consultation by firms interested in participating in the helium conservation program.

Bituminous Coal Activities

The Bureau's programs to improve methods for extracting, processing, and utilizing the Nation's vast reserves of coal continued, with significant developments on many fronts.

During the year, preliminary tests aimed at adapting hydraulic mining techniques to American conditions indicated that a coalbed can be cut effectively with high-pressure water. The Bureau also began research to develop an effective method for transporting coal hydraulically, and undertook a study of methane emission at gassy mines as a first step toward devising a method for degasifying coalbeds before mining. Water infusion and use of horizontal boreholes, through which the methane might be bled off in advance of mining, both offer promise as methods for removing this explosive gas.

Coal-preparation research included tests of a dense-medium cyclone washer in cleaning fine sized coal, with particular emphasis on washing an unsized feed without preliminary desliming. Other factors investigated were the flotation mechanism and use of reagents, reduction of sulfur by froth and kerosene flotation, and the performance of new equipment. Tests with a pilot-size vacuum filter indicated that it was possible to achieve significant reduction in filter-cake moisture without operational difficulty.

As part of a continuing evaluation of western coals, the possibility of making metallurgical briquets from lignite char was investigated. The carbonization assay was modified to provide for carbonization



Research in mining coal with jets of water progressed during the year. One setup was a hydraulic monitor (right) mounted on a regulation loading machine. As the water cut into the bituminous coal the loading machine removed the coal from the working area.

Tests in mining with powerful jets of water included those on anthracite. For this experiment, a block of anthracite was encased in concrete. Water jets cut deeply into the hard coal and even penetrated the surrounding concrete.



under pressure, a procedure that might be used in connection with the combined gas turbine-steam cycle for power generation.

In preliminary tests aimed at gasifying lignite with oxygen in a fixed bed under slagging conditions, runs were made with char, oxygen and air at atmospheric pressure and higher to develop operability and design data. This is the first time lignite char has been gasified in this country in a system of this type.

Research continued on the Fischer-Tropsch synthesis—one method of making synthetic liquid fuels or pipeline gas from coal. A variety of catalysts was prepared and tested, including the Bureau-developed carbon-expanded metal (CEM) catalyst. Work also progressed on establishing specifications for sulfur tolerance in synthesis gas. A hot-gas recycle system, one of several processes under development for the production of pipeline gas, was tested on a pilot scale.

In hydrogenation experiments, two promising developments for producing pipeline gas from coal at high temperatures were demonstrated in a Bureau laboratory. At 2,400° F., 50 to 60 percent of the coal was converted into pipeline gas at atmospheric pressure. Using lower temperature—about 1,500° F.—and higher pressure—6,000 pounds—a conversion of 70 percent was achieved.

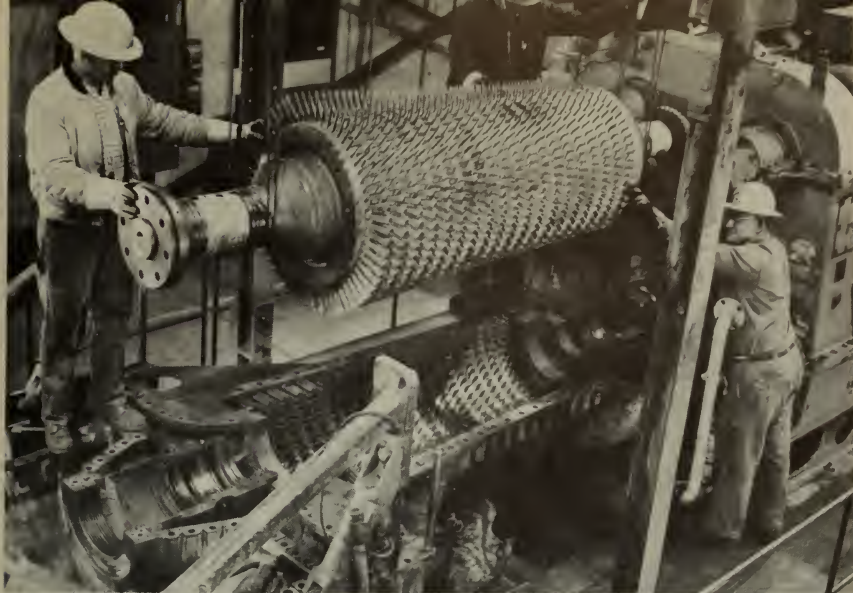
A Bureau-developed technique for overcoming lignite's tendency to freeze during winter transit by adding partly dried lignite to the mine product, began undergoing evaluation for industrial use.

In a study of how nuclear radiation affects the structure and properties of coal, selected bituminous coal samples were exposed to nuclear bombardment, then compared with unexposed samples. Although most of the tests indicated no significant change, there was in some instances, an increase in coal hardness, also an apparent minor change in the coal structure.

The Bureau continued studies on the correlation of furnace performance factors, external boiler tube deposits, the combustion of coal in suspension, fluid dynamics, and the incineration of combustible wastes.

Research on the use of ultrafine particles of coal as a possible fuel for coal-burning gas turbines led to the development of a feeder capable of supplying ultrafines to a burner uniformly at 1 to 5 pounds a minute. Work with the coal-fired gas turbine loaned to the Bureau by industry centered on design changes, repairs, and installation.

Investigations continued on the effects of coal properties and coke oven operating conditions on the properties of coke. In the Micum-ASTM correlation program, tests with samples of furnace, foundry, and other cokes from commercial organizations indicated high correlation between the properties of industrial cokes and those produced by the BM-AGA method.



Rotor for a coal-fired gas turbine, being studied by the Bureau of Mines, is removed for overhaul.

Bituminous Coal Economics and Statistics

Production of bituminous coal and lignite continued downward for the third successive fiscal year, hitting a yearend level about 2½ percent below fiscal year 1959. However, this was due largely to effects of the steel strike during the early part of the year. Output actually turned upward in the last half of fiscal 1960, notwithstanding a decline in coal exports.

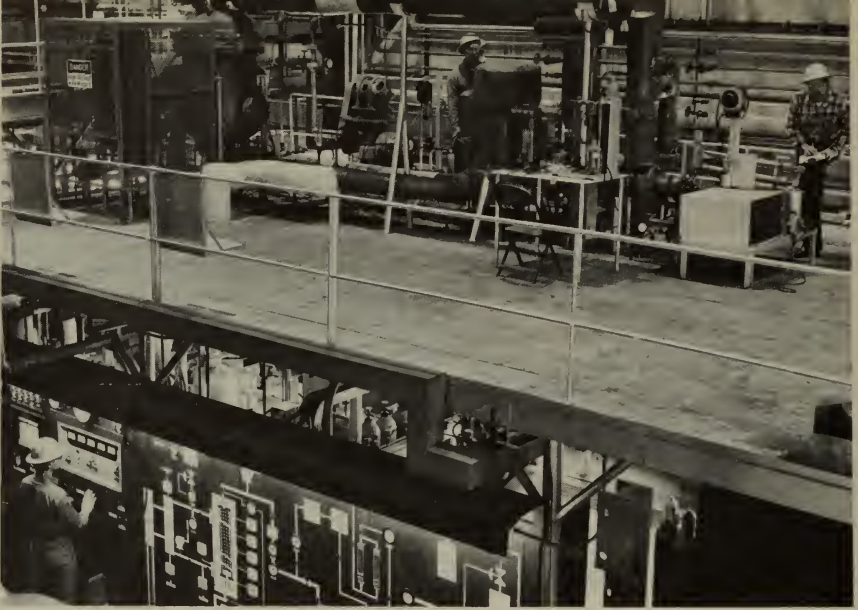
Coal consumption at electric power utilities continued its upward trend, increasing 6 percent during the year.

Comprehensive analyses of bituminous coal and lignite distribution and marketing were begun by the Bureau to delineate the extent of recent shifts in coal distribution patterns and to clarify coal's position in the competitive energy market.

Besides assembling and publishing information on the rapidly changing pattern of international coal trade, the Bureau informed other Departments on coal developments abroad. Detailed information also was supplied to defense agencies for use in planning solid fuels mobilization.

Explosives and Explosions

A statistical method developed by Bureau of Mines explosives researchers was used successfully during the year to study the effect of ammonium-nitrate particle size and type of carbonaceous component on incendivity. In addition, field and laboratory studies of toxic fume production and bullet sensitivity of ammonium nitrate-fuel oil



This simulated nuclear reactor for studying the gasification of coal has been built by the Bureau of Mines.

blasting agents provided a basis for further recommendations on the storage and underground use of this material. Fundamental research in cooperation with other Government agencies yielded new information on spherical detonation, also on electrical and magnetic effects accompanying detonation and deflagration to detonation transitions in propellants and explosives.

Investigations conducted for a Federal defense agency on fire and explosion phenomena associated with liquid hydrogen led the Bureau to prepare a table of recommended mass-isolation distances for this hazardous high-energy fuel. A study of air entrainment in commercial gas burners was undertaken in cooperation with the American Gas Association. Several disastrous fires, explosions, and potentially hazardous situations were investigated.

Air Pollution

Cooperative air-pollution research with the Public Health Service continued. Favorable preliminary cost estimates for a Bureau-developed method of removing sulfur dioxide from flue gases led to design and construction of a pilot plant for testing the process further. The Bureau's delineation of relationships between automobile fuels and exhaust compositions attracted interest from many concerned with air-pollution research. Bureau work on both catalytic and flame after-burning of exhaust gases assumed increased importance with more general acceptance of the automobile as a major factor in urban air pollution.

Anthracite Activities

The Bureau's anthracite research program was devoted primarily to developing new or improved methods to reduce mining costs, improving utilization and preparation practices, and carrying out the Federal Government's responsibilities under the joint Federal-Commonwealth of Pennsylvania Mine-Water Control Program.

Tests were conducted in cooperation with industry on a pitch mining project using a borer-trimmer type of continuous miner, a 2-foot underground auger equipped with a 4-foot reamer, and other auxiliary equipment. Continuing experiments in longwall mining, the Bureau installed an imported Eickhoff drum shearer-loader at a coal face and began testing. However, bad roof conditions developed and, after several roof falls, the project was stopped. Tests on eight samples of anthracite from the Bureau's hydraulic mining test site demonstrated the feasibility of breaking this hard coal with water jets. Plans are underway to investigate the techniques and economics of mining anthracite hydraulically.

Research was speeded on the vertical, hydraulic transportation of anthracite. A variable-speed pump was installed at the Anthracite Research Center, Schuylkill Haven, Pa. Limited tests already have shown that nut-sized anthracite can be moved vertically in a pipe column. An alternate method also has been designed in which the solids do not pass through the pump, but enter the high-pressure hydraulic system through a lock-hopper feeding mechanism. Construction of this mechanism for testing will begin soon.

In research on the chemical and physical properties of anthracite, an infrared spectrophotometer is now being used to permit a more fundamental examination of the nitric acid oxidation products of anthracite.

Investigations are underway to determine the effects of high-frequency induction and dielectric heating on anthracite.

Research was continued on producing an agglomerated anthracite metallurgical fuel. An experimental metallurgical stock column for pressure-drop studies was installed at the research center and, preliminary to large-scale tests, studies will be made in this apparatus to determine optimum shape and related properties of an anthracite metallurgical fuel.

Research on hydrogasification of anthracite was continued, with emphasis on the mechanism and kinetics of the hydrogen-anthracite reaction.

The breakthrough of the Susquehanna River into mine workings in January 1959 prompted reevaluation of a major part of the Federal State Anthracite Mine-Water Control Program. Three approved

pumping installations were cancelled and plans were begun to transfer the pumps to other locations. Four new projects, with a total estimated cost of nearly \$800,000, were approved.

Annual economic and statistical surveys were issued covering production, distribution, stocks, wholesale mine prices, hours and earnings, and other aspects of the anthracite industry.

River Basin Activities

Conservation and development of water resources are of increasing concern to mineral industries and to the Nation, and the Bureau of Mines cooperates with State, private, and other Federal agencies, to find solutions for mineral industry problems related to water supply.

Mineral engineering consulting services, investigations, and reviews of reports given other Federal agencies in connection with water resource development included 32 for the Federal Power Commission, 68 for the Corps of Engineers, 64 for the Department of Agriculture, and 9 for the Bureau of Reclamation.

The Bureau also served in an advisory capacity to departmental members of the Southeast and the Texas Study Commissions.

Mineral reconnaissance surveys were completed for the Bureau of Reclamation on seven proposed reservoir sites in the Colorado River basin and a special mineral appraisal was made on a coal deposit near a proposed dam in Utah. In addition, the Bureau of Mines furnished information for the Bureau of Reclamation for use in a condemnation proceeding concerning land acquisition and appraisal of a Utah clay deposit.

Professional engineering advice was given the Federal Power Commission counsel and the Department's counsel concerning applications by the city of Seattle and Public Utility District No. 1, Pend Oreille County, Wash., for hydroelectric projects in the Metaline Falls Mining District.

The Bureau cooperated with several agencies in analyzing information concerning a \$4-million damage suit resulting from percolating irrigation waters at a diatomite deposit.

Missouri Basin Project

Nine preliminary reports and one Bureau bulletin were completed in fiscal 1960 under the cooperative Missouri River basin project. Subjects included petroleum and natural gas development, recovery of water-borne mineral wastes, lignite storage techniques, and materials for the chemical industry and for canal lining materials. A comprehensive report was completed on 271 oil and gas fields of Wyoming.

Mineral reconnaissance surveys were completed for the Bureau of Reclamation on five proposed reservoir sites.

A Bureau inventory showed that nearly 19 million pounds of water-borne mineral wastes—about 75 percent ferrous and zinc sulfate and ferric phosphate—was lost in 1958 in the lower Missouri basin. Ways are being sought to salvage and use these valuable minerals.

Special Economic Studies

Mineral-supply problems were the subject of special economic studies during fiscal 1960. A major study of the petroleum industry was completed for the Office of Civil and Defense Mobilization, and papers were presented at professional meetings on problems of petroleum supply and demand. Problems of domestic mineral industries were kept under constant analysis to facilitate Department of the Interior evaluation of congressional proposals.

Preparations were made for large-scale multilateral tariff negotiations scheduled to begin in early 1961 and for negotiations on the new external tariff of the European Common Market, beginning in September, 1960. Detailed studies, conducted for these conferences, develop for many commodities the historical pattern of world trade, the structure of world prices, and the effects of changes in prices and national income upon consumption and imports.

An interrelated set of price indexes also was developed, measuring the annual changes since 1925 in (1) average at-mine value of mineral production; (2) average prices of refined primary mineral products; and (3) implicit price changes, relating the Index of Physical Volume to total value of mineral production. A lack of price indexes has hampered the economic study of the mineral industry, and these new indexes, to be published in the 1960 Minerals Yearbook, will give such studies a firmer foundation.

Public Reports

In fiscal year 1960, Bureau scientists and engineers wrote 754 public reports on research in metallurgy, mining methods, health and safety, explosives, and other subjects concerned with conservation and development of minerals and the saving of life. Of the publications issued, 136 were reports of Bureau investigations or original research, 71 were information circulars on new developments in industry, 7 were bulletins presenting results of completed programs or describing major phases of continuing research, 135 were preprint chapters of Bulletin 585, Mineral Facts and Problems. A new

edition of this popular "mineral encyclopedia" was issued during the year, giving an up-to-date analysis of minerals and their outlook, including information on technology, uses, reserves, production, consumption, foreign trade, prices and research. Bureau authors also prepared 319 articles for presentation at scientific meetings or for publication in scientific, trade, and technical journals.

National interest in the industry-sponsored sound motion pictures circulated by the Bureau remained high. Showings of these informational films, telling the story of America's mineral heritage, totaled 222,786, and they were seen by group audiences of 11,431,418. Approximately 5,500 prints were in circulation during fiscal 1960. Several older films were removed from circulation under a program for keeping Bureau films up to date.

Two new films—"California and Its Natural Resources" and "The Story of the Modern Storage Battery"—were added to the Bureau's library of educational motion pictures during the year. Both are entirely new versions of subjects that have long ranked high in popularity. At year's end, work was well along on a new film covering the resources of the Nation's 49th State—Alaska.

Office of Oil and Gas

Capt. Matthew V. Carson, Jr. (USN), *Director*



THE DEPARTMENT'S OFFICE of Oil and Gas is a focal point for petroleum information and provides staff services and technical guidance in carrying on petroleum and gas activities in the Government and in international petroleum programs in which the United States participates.

Long-Range National Policy

Background upon which Government can base long-range national security policy for petroleum has been developed for the Office of Civil and Defense Mobilization through the cooperation of the Department of the Interior and the work accomplished by its Office of Oil and Gas, Geological Survey, and the Bureau of Mines. In this connection, the Department has submitted to OCDM a report and conclusions, together with six technical papers which provide an evaluation of United States and free foreign petroleum resources, crude oil productive capacity, and oil requirements—under nonemergency conditions—through 1975.

Emergency Planning

Major strides have also been made in domestic planning to cope with possible oil and gas problems under emergency conditions of the nuclear era. Civil defense and defense mobilization oil and gas preparedness plans were approved this year by OCDM.

Based on Office of Oil and Gas staff work, these mobilization plans set forth the responsibilities and emergency actions required in management of petroleum and gas resources to meet essential emergency requirements. Among the items considered essential for survival are: Distillates, gasoline, kerosene, liquefied petroleum gas, lubricat-

ing oils, residual fuel oil, and natural and manufactured gas. During the year, supply and requirements data for these products as well as information regarding facilities for their production and handling were furnished the National Damage Assessment Center. Leaders in industry and Government are being briefed on national emergency oil and gas plans at OCDM-Interior conferences in the eight OCDM regions.

The Petroleum and Gas Unit of the Department of the Interior Executive Reserve has been established at the regional level. Subsequently, it will be enlarged to include a national headquarters. Since Reservists serve in Government in time of national crisis, they receive orientation and training in the responsibilities they would assume as members of an activated emergency petroleum and gas organization.

Assistance was requested and obtained from the National Petroleum Council in establishing a roster of competent personnel as candidates for the regional and national units of the Executive Reserve, in studying and reporting upon the use of radio and radar in the oil and gas industries, and in making a survey and furnishing data on the capacities and precise locations in the United States of petroleum storage in excess of 25,000 barrels.

Coordination of United States defense preparedness planning in oil matters with the North Atlantic Treaty Organization was carried on through participation of the Office of Oil and Gas in the work of the NATO Petroleum Planning Committee and its working group.

Because of the far-reaching effects of oil operations abroad on the peace and stability of the free world, the Secretary of the Interior has expanded the Foreign Petroleum Supply Committee so that a Readiness Subcommittee could be established to undertake worldwide petroleum studies as required by the Department of Defense in planning to cope with possible major emergencies. In the interim, certain surveys, covering production, refining, transportation, and petroleum products requirements in friendly foreign nations have been undertaken by the OOG for the Defense Department.

State and Industry Liaison

The Office of Oil and Gas has kept abreast of conditions and developments in the domestic petroleum and gas industries. The Director has represented the Department at meetings of the Interstate Oil Compact Commission where information on conservation programs of mutual concern to the States, the industry, and the Government were presented.

During the year, participation of the Director and technical staff at industry and government meetings has promoted better under-

standing of progress and problems in domestic and worldwide petroleum operations.

Technical assistance has been rendered on a day-by-day basis to governmental departments, agencies, and Congress. Proposed legislation has been reviewed for departmental use in reporting to committees of Congress. The technical staff has continually helped the public by providing petroleum and gas information in response to requests.

Office of Minerals Exploration

Frank E. Johnson, *Acting Director*



THE OFFICE OF MINERALS EXPLORATION was established by the Secretary of the Interior on September 11, 1958, to provide Federal financial assistance to exploration for domestic mineral reserves, excluding organic fuels, under Public Law 85-701.

OME also administers contracts in force and certified projects remaining from the exploration program conducted from mid-1950 to June 30, 1958, by the Department's former Defense Minerals Exploration Administration.

Program Functions

The Office of Minerals Exploration offers financial assistance to firms and individuals to explore their properties or claims for one or more of the 32 mineral commodities listed in the OME regulations. This help is offered to applicants who ordinarily would not undertake the exploration at their sole expense and who are unable to obtain funds from private sources on reasonable terms.

The Government will contract with an eligible applicant to pay up to one-half of the cost of approved exploration work as it progresses. The applicant pays the rest of the cost, but his time spent on the work and charges for the use of equipment which he owns may be applied toward his share of the cost.

Funds contributed by the Government are repaid by a royalty on production from the property. If nothing is produced, there is no obligation to repay. A 5-percent royalty is paid on any production during the period the contract is in effect; and if the Government certifies that production may be possible from the property, the royalty obligation continues until the Government's contribution is repaid.

with interest, or for the 10-year period usually specified in the contract. The royalty payment applies to both principal and interest, but it never exceeds 5 percent.

OME Operations

Interest in the program has continued at a high level as indicated by the more than 1,200 inquiries received during this fiscal year.

During this year, 38 applications were received requesting financial assistance for exploration work estimated to cost \$3,929,912. These bring the total for the OME program to 95 applications for explorations exceeding \$7,500,000 seeking deposits of 20 minerals in 22 States. Actions taken on these applications are shown in the following tabulation:

Disposition of OME applications

Action	Number	
	Fiscal year 1960	Total
Received.....	38	95
Denied.....	32	44
Withdrawn.....	8	15
Contracts executed.....	11	19
Pending on June 30, 1960.....	-----	17

The 11 contracts executed during fiscal 1960 brought the total of executed contracts to 19.

The 19 OME contracts in force are distributed over 11 States and cover operations valued at \$796,260. Under the contracts, exploration is planned or underway to develop additional reserves of mercury, lead, zinc, copper, fluorspar, and mica.

DMEA Operations

The recoverable mineral commodities found on the 391 certified DMEA projects are estimated to have a gross value of more than \$935 million based upon market prices in effect at the close of the fiscal year. Important additions to this estimate are anticipated as the 15 DMEA contracts remaining in force are completed.

Royalties collected incident to the sale of minerals found under the DMEA contracts continued at a relatively high rate during fiscal 1960. In this year \$444,083 was received bringing the total since the start of the program to \$3,571,146. Fifty-three projects have repaid in full the \$1,617,647 contributed by the Government.

Summary of DMEA contract data

Contracts	Fiscal 1960			Program through June 30, 1960			
	Number	Total value	Government participation	Number	Total estimated costs	Government participation	Government participation spent
Contract amounts as originally executed				1, 159	\$50, 547, 489	\$31, 056, 412	
Amendments which changed contract amounts	2	-\$31, 691	-\$17, 882	220	6, 223, 002	3, 748, 831	
Amounts as amended					56, 770, 491	34, 805, 243	\$23, 252, 970
Certified as discoveries	17	2, 460, 147	1, 365, 433	¹ 391	27, 904, 078	17, 389, 196	14, 154, 952
Terminated without certification	11	1, 376, 551	743, 454	672	23, 212, 363	14, 319, 586	8, 114, 779
Canceled without Government expenditures	2	75, 060	45, 680	82	2, 208, 613	1, 350, 070	
In force as of June 30, 1960, not certified				14	3, 445, 437	1, 746, 391	983, 239

¹ Includes one contract in force and two contracts certified though canceled.

Office of Minerals Mobilization

O. W. Bilharz, *Director*



THE OFFICE OF MINERALS MOBILIZATION has the responsibility of carrying out the Department of the Interior's functions relating to national defense preparedness in metals, minerals and solid fuels, and for procurement, transportation and distribution of solid fuels consistent with the national emergency fuel program, as delegated by the Office of Civil and Defense Mobilization.

During fiscal year 1960, the office continued to evaluate the extent to which production by the domestic minerals, metals and solid fuels industries and imports of minerals and Government stocks of metals and minerals would be able to meet essential civilian and military requirements under mobilization conditions.

During fiscal year 1960, supply evaluation studies were completed on chrysotile asbestos and celestite. A mobilization base-type study was completed on oxygen-free copper and a review was made of the iron ore mobilization base study and the antimony study. An asbestos disposal study was also completed.

Two revised evaluations were made of high temperature and special property materials. These reevaluations are made biannually at the request of the Office of Civil and Defense Mobilization.

Defense Stockpiling

The Office advised and assisted the Office of Civil and Defense Mobilization in matters pertaining to Government stockpiles, and disposals from Government inventories of minerals and metals in excess of defense requirements, and worked with that agency on the minerals, metals and solid fuels portion of the National Plan for Civil Defense and Defense Mobilization.

In fiscal year 1960, OMM assisted OCDM in the National Bomb Damage Assessment program by assembling, coding and keeping cur-

rent, input data on minerals, metals and solid fuels for use in computing machines for assessing probable bomb damage of these industrial facilities in the event of an enemy attack.

Executive Reserve

During the year the Office continued to recruit for industry officials to serve in the OMM unit of the National Executive Reserve. During this period eight additional reservists were designated by the Secretary to serve in this capacity. Fifty-seven reservists had been enrolled up to the close of the fiscal year.

The Office maintained a complete duplicate set of files and documents for use at the Relocation Center in the event of an emergency. It also participated in furnishing an Interior representative at the OCDM relocation site during various periods of the fiscal year.

The Office also participated in the Department's program for training key industry personnel as instructors in radiological defense by supplying a member of the teaching staff. During the period under review twenty industry technicians were trained.

Office of Geography

Meredith F. Burrill, *Director*



THE OFFICE OF GEOGRAPHY provides research and other staff services for the interdepartmental Board on Geographic Names and the Secretary of the Interior in the field of foreign nomenclature.

During the year over 200,000 names in several European and Asiatic countries were processed for standardization by the Board and gazetteers containing more than 250,000 entries for Turkey, Rumania, Ceylon, and the Federal Republic of Germany and East Berlin were prepared for publication. In addition, about 40,000 names were edited on maps or otherwise supplied to users as the result of inquiries.

Cooperation of the Permanent Committee on Geographical Names for British Official Use was obtained in the rendering of about 3,500 names in the Aden Protectorate by the BGN/PCGN system for the transliteration of Arabic.

Studies were made of nomenclature source materials and policy problems of 38 countries and comparable areas for use in name standardization for Federal agencies, and transliteration systems were analyzed for several nonroman-alphabet languages.

Further progress was made in studies of the type classification of geographic features, the meanings of generic parts of names, and the definitions of terms used to designate the features to which names are applied.

Board on Geographic Names

William G. Watt, *Chairman*

Meredith F. Burrill, *Executive Secretary*

The interdepartmental board on Geographic Names was established in 1947 to provide a central authority for standardizing geographic names for use by the Federal Government. It is composed of representatives of the Departments of Interior, State, Army, Navy, Post Office, Agriculture, Commerce, and Air Force; the Government Printing Office, the Library of Congress, and the Central Intelligence Agency.

The Department of the Interior provides staff facilities and maintains the records of the Board and its committees. Foreign names staff functions are performed by the Office of Geography, domestic names functions by the Department's Geological Survey.

During the year 1,444 domestic geographic names were considered, and 1,391 were approved for use on Federal documents. Three lists containing decisions on 1,130 names were published, and a fourth list containing 515 decisions was assembled for publication.

Office of the Assistant Secretary

Public Land Management

Roger Ernst, *Assistant Secretary*



THE ASSISTANT SECRETARY for Public Land Management, in discharging the Secretary's duties in that field, directs and supervises the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs, the Office of Territories, and the Alaska Railroad.

The last-named agency was designated as a separate bureau during the fiscal year, and removed from the jurisdiction of the Office of Territories. The Railroad's revenues for the year exceeded \$14.5 million, and it was not necessary to request Congress to appropriate any money for the line. After several years of negotiations, the Railroad sold its interest in a power plant in Anchorage for approximately \$2.3 million. The Alaska Railroad, a leader in the industry in containerization freight, continued to show gains in that field.

Revenue freight tonnage was down 1.89 percent from the preceding year, but still approximated 1.25 million tons. Revenue passengers totaled 76,991, a drop of 3 percent from the prior year.

More than \$371 million in revenues were received from the public domain managed by the Bureau of Land Management, the highest income in history for a single year. The 1960 revenues pushed the Bureau's total receipts past the \$2.2-billion mark; more than half of that has come in during the 1950's. The public lands yielded millions of board feet of timber, forage for millions of animals, wild and domestic, and enough oil to heat about 6 million homes. In the field of major land legislation, the Department requested introduction of H.R. 7042, or the "Public land Urban and Business Sites Act," would

authorize the sale of up to 1,280 acres to counties, municipalities, and individuals for urban or business purposes. Counties and municipal governments would have preference rights. Sales would be at the appraised fair market value. Individuals and nongovernmental entities could purchase only at public auction.

In areas administered by the Office of Territories, the past fiscal year climaxed a decade notable for advances in self-government. In 1950 Congress enacted organic legislation for Guam. And last year witnessed the appointment of Guam's first Governor of Guamanian ancestry. Another first in the Pacific was the granting of legislative authority to American Samoa through the secretarial approval of its first constitution. The Territory's native legislative leaders gained broader knowledge through participation in national conferences. Air and surface transportation improved in Samoa. The Territory's economic trends were encouraging. Samoan local revenues reached the million-dollar mark for the first time.

In the Trust Territory of the Pacific Islands, administered by the United States for the United Nations, gains were made in the task of preparing the 73,000 Micronesians for a larger role in the responsibilities of government, economic growth, and public welfare. Natives won promotions to higher jobs. Through a pilot fisheries project in Palau and a new fisheries cooperative in Ponape, the production, sale, and export of fish soared over any previous year. Cacao production was also pushed. Coconut rehabilitation continued. Educational gains were highlighted by the dedication of the new Pacific Islands Central School, with an enrollment of 140 students from all districts of the Trust Territory.

Revenues in the Virgin Islands were the highest in history. Local revenues increased 38 percent of fiscal 1959. The Territorial Department of Tourism and Trade estimated that more than 200,000 visitors came to the islands. The rapid tourist increase is straining electrical facilities, but by next year a combination saline distillation and electricity-generating plant is expected to be operating and meeting all demands.

The Bureau of Indian Affairs put new stress on its drive to provide American Indian citizens with adequate opportunities for personal development and growth so they can take whatever place they choose in the larger fabric of our national life. Record school construction projects provided nearly 2,000 additional pupil seats. In-service educational programs provided teachers, guidance personnel, and administrators with a deeper understanding of the needs of Indian education and better ways to meet these needs. Total income for Indians from oil and gas development of their lands exceeded \$47 million. Other mineral income was more than 2.6 million dollars. The volume

and value of timber sales hit a new high. Additional jobs were created by the timber development. The expanding tribal sawmill programs were evidence of awakening interest among Indians in the management of their forests. During the year the Bureau made its first loan to a tribal organization for the purpose of attracting industrial development. The tribe matched the loan with its own funds, built a factory, and leased it to a firm. The industry will furnish employment to about 150 persons, with Indians having a preference.

Nearly 66 million visitors came to the various areas administered by the National Park Service. It was the fourth year of the 10-year program known as Mission 66, a program designed to improve and protect the national park system culminating in 1966, the golden anniversary of the Service. Nine new visitor centers were opened during the year. Facilities were expanded to guide the visitors along roadsides and trailsides. Archeological, geological, and historical research continued. The national swing to family camping in park areas continued to mount. Visitor patterns also showed that more and more Americans are visiting these areas in what used to be considered "off" months, so that services in additional areas must be provided more on year-round rather than seasonal basis.

The Department also asked Congress to establish three national seashore areas, to preserve them for the public before they are lost forever to private or commercial development. The Department also took steps to protect scenic values from encroachment.

Bureau of Indian Affairs

Glenn L. Emmons, *Commissioner*



IN ADDITION to carrying out its trusteeship responsibilities embracing some 53 million acres of tribal and allotted Indian lands and its community service responsibilities involving some 350,000 Indians and Alaska natives, the Bureau of Indian Affairs of the Department of the Interior in fiscal 1960 gave increasing emphasis to the economic and social advancement of Indian tribal groups and individual Indians.

This was reflected in several ways—in a bigger-than-ever school construction program which provided over 2,000 additional seats for Indian pupils in Federal classrooms during the year and will provide new capacity for nearly 2,300 others as initiated projects are completed; in the technical help and guidance given to tribal groups in the planning and execution of economic growth programs; and in the broadening moves that were made to stimulate the development of job-providing industries on or near the reservations.

In a public speech in Washington, D.C., on March 31, 1960, Secretary Seaton declared that the “overriding objective” of the Department in administration of its Indian program is “to provide our Indian citizens with adequate opportunities for personal development and growth so they can take whatever place they choose in the larger fabric of our national life.” During the fiscal year which ended on June 30, 1960, the Bureau of Indian Affairs directed its resources and energies more sharply than ever before on a multifaceted program geared toward the ultimate attainment of this objective.

Tribal Programs

Under the heading of tribal programs there were many notable developments in fiscal 1960. On two of the larger reservations—Klamath of Oregon and Menominee of Wisconsin—further progress was made toward a termination of all Bureau of Indian Affairs activities and responsibilities in line with laws which were enacted in 1954.

Program development work of the terminal type also assumed considerable importance on the Colville Reservation in Washington, among the Catawbias of South Carolina and Choctaws of Oklahoma, and on a substantial number of rancherias in California. Programing for effective use of tribal funds was especially significant among the Standing Rock Sioux of North Dakota and South Dakota and the Jicarilla Apaches of New Mexico.

Klamath Indians of Oregon

Under the Klamath Termination act of August 13, 1954 (68 Stat. 718), as amended in 1958, nearly all of the so-called "fringe units", comprised primarily of farm or grazing lands, on the reservation in Oregon were sold during the year, mostly to Klamath Indians.

Of the seven major sustained-yield timber units advertised for sale within the year, only one was sold. This was the Antelope Desert unit, comprising 91,540.69 acres with an estimated 68,907,000 board feet of saw timber and 464,399 cords of lodgepole pine. It was sold to a large lumber company for \$1,642,182 or \$6,000 over the realization value. Three of the units put up for sale in the first advertisement were readvertised with bids to be opened December 1, 1960.

Because of the delay in the sales of the properties, extended by the amendment of August 23, 1958 (72 Stat. 816), the Klamath act was further amended by the act of September 9, 1959 (73 Stat. 477). This amendment changed the acquisition date of the Klamath marsh by the United States Government from April 1, 1961, to "the earliest date after September 30, 1959, when the Secretary of the Interior determines that funds for the payment of the purchase price are available from the sale of stamps under the Migratory Bird Hunting Stamp Act of March 16, 1934." Taking of title to the marsh and payment by the United States was consummated shortly after the end of the fiscal year. All terminal action is to be completed by 7 years from the date of the original act, or August 13, 1961.

Menominee Indians of Wisconsin

The act of June 17, 1954 (68 Stat. 250), as amended, required the Menominee tribe of Wisconsin to prepare and submit to the Secretary

of the Interior by February 1, 1959, a plan for taking over its property and affairs and managing them in an unrestricted status. Under the law the plan may be implemented any time up to, but not later than, December 31, 1960, when the Secretary must proclaim termination of the Federal trusteeship. On January 26, 1959, the Menominee tribe conditionally submitted a plan which was described in some detail in the Secretary's Annual Report for 1959.

By midsummer of 1959, the tribe's proposals for State legislation had undergone extensive examination and adjustment by the Wisconsin State Legislative Council and the State Legislature, and were signed into law by the Governor on July 30, 1959. The Secretary of the Interior responded on July 31 that he was approving the tribe's plan "in principle" but that a period after August 1 would be needed by the Department to analyze the plan thoroughly for its conformity to Federal and State laws and its equity. The tribe agreed to any changes consistent with the principles of the plan, such changes to be retroactive to August 1, 1959. At the close of fiscal 1960, the only legal issue yet unresolved was the specific language of a restrictive covenant on the forest lands of the new Menominee corporation, which the State asked to be examined again and possibly amended to meet the exigencies of Wisconsin law.

Four new Menominee bills were introduced in Congress in early 1960. The bills provided that the trust period should be extended beyond December 31, 1960, until such time as, in the discretion of the Secretary, it should be revoked; that a \$2,500,000 loan fund be made available for the Menominee tribe from Federal sources; that the tribe be reimbursed for all of the costs incidental to the termination process; and that the tribe be exempted from documentary stamp taxes on stock issuances under the Internal Revenue Code.

The Department recommended a short extension of the trust termination date, such as 6 months, would be an additional safeguard for the successful completion of the termination program; that the tribe be relieved from the payment of stamp taxes in connection with its initial organization under the termination plan; and that the Department should be authorized to take the final steps necessary to put the termination plan into operation if the tribe failed to take those steps as agreed upon before the trust termination date.

All of these provisions were accepted by the House of Representatives as it passed a combined bill in June. The House did not adopt the Department's recommendation that a loan program, under limited conditions, be authorized; and the House refused to approve 100 percent reimbursement of the tribe for the termination expenses as recommended by the Secretary. The Senate recessed in July without hearing the Menominee bills.

Standing Rock Rehabilitation Program

Like several other tribes living in the Missouri basin, the Standing Rock Sioux of North Dakota and South Dakota have had land taken from their reservation in recent years for the building of a multi-purpose dam and reservoir on the river. The tribe and its members were awarded a total of \$12,211,553 by the act of September 2 (72 Stat. 1762). This authorized the United States to acquire lands required for the reservoir to be created by the Oahe Dam and to pay compensation and rehabilitation funds to the Standing Rock Indians, numbering about 6,100.

Of the grand total, \$1,952,040 was appropriated to pay the Indians for lands and improvements actually taken, \$3,299,513 for indirect and intangible damages, and \$6,960,000 for rehabilitation of members of the tribe, regardless of place of residence. Half of the award for indirect and intangible damages was also to be used for rehabilitation, making a total of \$8,609,756.50 available "for the purpose of developing individual and family plans, relocating, reestablishing, and providing other assistance designed to improve the economic and social conditions of all recognized members of the Standing Rock Sioux Tribe."

During the past year, the tribe completed plans for a six-phase rehabilitation program and tentatively allocated funds for it as follows:

Family plan.....	\$3, 640, 000
Community development.....	770, 000
Farm livestock.....	770, 000
Land management.....	768, 000
Industrial development.....	770, 000
Education.....	1, 770, 000

The family-plan phase of the program was approved by the Secretary on December 1, 1959. This provides that each enrolled member will be allocated \$650 that can be expended only on the basis of a family schedule which has been approved by the Tribal Council and the Secretary's authorized representative. Of the other phases of the program, farm livestock, industrial development, and education have also been approved. By June 30, 1960, allocations had been started on the family plan and farm livestock phases, and \$560,000 had been advanced to the tribe.

Jicarilla Apaches' "Family Plan"

The Jicarilla Apache tribe of New Mexico, which now enjoys an annual income of more than \$1 million from oil and gas, timber and other resources, during the year developed a "family plan" for the

distribution of some of its accrued funds among its members. This plan is part of a short-range program designed to meet immediate, critical needs of the Jicarilla Apaches, like better housing, improved law enforcement, and wider educational opportunities. Its main feature is the establishment of "approval committees" by the tribe to see that the funds distributed under the "family plan" (\$1,600 to each member) are expended wisely and constructively. The Commissioner approved the plan just after the close of the fiscal year.

Since the beginning of its acquisition of substantial wealth in the 1940's, the human and physical resources of the Jicarilla Apache tribe have been studied by several nongovernmental groups. Using social and economic data uncovered by these surveys, the Representative Tribal Council, the tribe's governing body, has adopted several long-range programs to protect the tribe's resources and to increase job opportunities for its members.

These long-range programs include provisions for increasing the livestock carrying capacity of the reservation's grazing land, pure breed stock for improvement of its herds, and sustained yield management of its forests. The programs will benefit the members and their children in the years to come. In the preparation of both the short- and long-range programs, Bureau representatives have worked intimately with the Jicarilla leaders and people.

Colville Indians of Washington

In accord with the act of July 24, 1956 (70 Stat. 626), the Business Council of the Confederated Tribes of the Colville Reservation, Washington, in June 1960, submitted to the House Indian Affairs Subcommittee a report on the tribes' progress in preparing a plan by August, 1961, for termination of Federal trusteeship of the tribes' affairs within a reasonable time thereafter.

The Business Council informed Congress that the Bureau had since July, 1959, been delivering to the Colvilles a series of reports on the resources and social and economic conditions of the peoples of the reservation, and that the Bureau of Land Management was making progress in adjudicating old mineral leases. The Business Council also reported that it had appointed a planning committee to direct tribal activities in line with the obligations imposed by the 1956 act, and that it had contracted with a California research organization to make a study of the economic development of the reservation and future organizational possibilities. The research team's leader was to have arrived late in June, 1960, in the hope of completing the project within 5 months.

A conference held on the reservation in early 1960 disclosed that the Colvilles differed widely among themselves, with some favoring

complete liquidation of tribal assets and their distribution pro rata; others (apparently the majority of those living on the reservation) favoring maintaining a group entity of some sort and emphasizing the economic development of the reservation.

Final Disposition of Choctaw Affairs

The act of August 25, 1959 (73 Stat. 420) supplemented the 1906 act to provide final disposition of the affairs of the Choctaw tribe of Oklahoma. The Secretary delegated to the Commissioner authority to carry out the provisions of this act.

Preliminary steps leading to the disposition of Choctaw property were taken during the year, but a plan for the complete liquidation of Choctaw affairs has not been worked out. Disposition must be completed within 3 years of the date of the act.

Catawba Tribe of South Carolina

The Act of September 21, 1959 (73 Stat. 592) provided for distribution of the tribal assets of the Catawba Indian Tribe of South Carolina among the members and, in effect, provided for termination of the Catawba-Federal relationship.

The application of this law was contingent upon the acceptance of its terms by a majority of the adult Catawbas. A majority agreed to a division of the tribal assets under the act on February 2, 1960, and a plan to accomplish this was underway as the fiscal year ended. The distribution must be accomplished in 2 years from July 2, 1960 when notice of this majority agreement was published in the Federal Register.

California Rancherias

During the year 12 additional California rancherias submitted plans for distribution of their assets. This brought to 37 the number of plans submitted. The act of August 18, 1958 (72 Stat. 619) authorized 41 Indian groups in California to present plans to divide Government land among the members of the rancherias.

Six of the plans previously approved and accepted were completed during the year. A plan must be completed within 3 years of its final acceptance by the distributees.

Wyandotte Tribe of Oklahoma

The act of August 1, 1956 (70 Stat. 893) provided for termination of Federal trusteeship over affairs of the Wyandotte tribe of Okla-

homa on or before August 1, 1959. The Bureau of Land Management surveyed the tribe's major resource, a cemetery in downtown Kansas City, Kans. Thereafter an appraisal of the cemetery property established an evaluation of \$291,000 after the disinterment of the bodies.

A tribal referendum revealed that an overwhelming majority of the Wyandotte members are in favor of selling the cemetery and distributing the net proceeds after relocation of the graves. Pursuant to this tribal mandate, the Bureau's Area Director advertised the cemetery for sale in July 1959.

On July 10, 1959, two suits were filed in the District Court of the United States for the District of Kansas. These actions were entitled *George Zane, Jr., et al. v. United States, et al.*, Civil No. KC-1280; and the *City of Kansas City, Kansas, v. United States, et al.*, Civil No. KC-1279. These were actions by the city of Kansas City, Kans., and the "Absentee Wyandottes", filed against the Secretary of the Interior for the purpose of restraining him from disposing of the cemetery in Kansas City on the grounds that they had an interest in this property.

This litigation had the effect of depressing the amounts bid on the property, and the Department of Justice requested that no disposition of the property be made pending the outcome of the litigation. Trial was held on the controversy in Kansas City in May, 1960; but at the close of the fiscal year the court had not handed down its decision.

In the event the United States is successful in defending the interests of its beneficiaries, the Secretary will then have the responsibility of appointing a trustee under the 1956 act to liquidate the property and dispose of the proceeds to the enrolled members of the Wyandotte tribe of Oklahoma.

Peoria and Ottawa Tribes of Oklahoma

In 1956 Congress provided for ending the special trust relationship of the United States with the Peoria and Ottawa tribes of Oklahoma through the act of August 2, 1956 (70 Stat. 937) and the act of August 3, 1956 (70 Stat. 963), respectively. The function of the Bureau in administering these two statutes was largely that of determining the final roll of each of these tribes, thereby vesting in these individuals entitlement to any future income that might accrue to the tribes.

The Peoria trust termination act differs from any of the others enacted to date by the Congress in that it provides in section 4(b) that it shall become "Effective when all claims of the tribe that are now pending before the Indian Claims Commission or the Court of Claims have been finally adjudicated, all powers of the Secretary of the Interior or other officer of the United States to take, review, or approve

any action under the constitution and bylaws of the tribe are hereby terminated."

The Ottawa tribe of Oklahoma, too, has claims still pending before the Indian Claims Commission. In view of the fact that the United States may still have a ministerial service to perform for these two tribes in the event the Indian Claims Commission or the Court of Claims awards a judgment to them and the Congress then directs the Secretary of the Interior to distribute the awards appropriated for them, it was decided in fiscal 1960 to defer the proclamations of final termination of trust responsibility for these groups until the claims actions have been completed.

Rolls Prepared for Judgment Payments

The following rolls, prepared for use in the per capita distribution of judgment funds awarded certain tribes of Indians, were completed and the funds distributed during fiscal 1960:

Otoe-Missouria tribe of Oklahoma.—Rolls prepared and funds distributed pursuant to the act of May 9, 1958 (72 Stat. 106). A total of \$1,155,237.31 was paid to 1,987 enrollees.

Kiowa, Comanche and Apache tribes of Oklahoma.—A total of \$1,916,446.43 was paid to 9,942 persons listed on the roll. The funds were distributed pursuant to the act of September 21, 1959 (73 Stat. 598).

Western Oregon judgment funds.—The roll was prepared and funds distributed pursuant to the act of August 30, 1954 (68 Stat. 980). A total of \$3,092,096.63 was paid to 2,044 enrollees of five tribes and bands of western Oregon as follows:

Chetco.....	¹ \$417, 990. 01
Coquille.....	² 742, 880. 82
Tillamook.....	³ 1, 143, 401. 64
Too-too-to-ney.....	⁴ 381, 454. 26
Umpqua.....	⁵ 406, 369. 90

¹ Paid to 674 enrollees.

² Paid to 271 enrollees.

³ Paid to 185 enrollees.

⁴ Paid to 504 enrollees.

⁵ Paid to 410 enrollees.

Navajo-Hopi Rehabilitation

The Long Range Rehabilitation Program for the Navajo and Hopi tribes authorized by the act of April 9, 1950, entered its tenth and final year in fiscal 1960. Important progress was achieved especially in the expansion of school facilities, the improvement of irrigation

works, the construction of roads and bridges, and the application of soil and moisture conservation and range improvement practices.

Six projects involving the construction, expansion or rehabilitation of Federal school facilities for Navajo pupils were launched during the year. Included in the total were the Chinle boarding school construction, the Wingate boarding school rehabilitation, the Kinlichee boarding school expansion, the Low Mountain boarding school classroom addition, the Coal Mine Mesa trailer school and the Jeddito trailer school.

In addition to these Federal facilities, a new public school was completed at Chinle with a capacity of 450 students and new temporary classrooms to accommodate 1,710 pupils were added to public schools at Tuba City, Chinle, Kayenta and Window Rock.

Funds available under the Long Range Act for construction of irrigation facilities were used during the year on four major projects: (1) Extension of the Hogback Canal, including construction of a 3,600-foot syphon; (2) farm unit development on approximately 800 acres, including completion of the necessary drop and turnout structures on the lands developed in fiscal 1959; (3) replacement of old wooden structures by new concrete facilities on the Fruitland project; and (4) advance planning on the Hogback project.

In addition to the \$20 million authorized for construction of roads and bridges under the original act of 1950, another authorization of \$20 million for this purpose was provided by the more recent enactment of Public Law 85-740.

The work put under contract in fiscal 1960 included (1) construction of a 451-foot bridge across the San Juan River at Farmington, N. Mex.; (2) the paving of 15 miles of road from the Chinle road westward as far as Cottonwood school; (3) the construction of 8 miles of road between Many Farms and Chinle Wash; (4) the first 10 miles of road between Fort Defiance and Navajo to serve the new tribal sawmill enterprise; (5) two projects totaling 12 miles on the eastern portion of Route 1; (6) two projects on the western portion of Route 1 from Tonalea to Betatakin Ruin turnoff; and (7) replacement of an old timber bridge on Route 3 near Window Rock with a new concrete structure.

Education

Enrollment of Indian children of school age increased 1.1 percent in fiscal 1960 as compared to the preceding year. Of the 133,316 enrolled, 63.5 percent attended public schools, 28.0 percent were in Federal schools, and 8.5 percent in mission and other private schools. Public school enrollment increased by 3,552 students.



In fiscal 1960 the Bureau of Indian Affairs operated 277 schools with an enrollment of more than 40,000 Indian children. Housing facilities were provided by the Bureau for an additional 3,800 who attended local public schools.

The Bureau of Indian Affairs in fiscal 1960 operated 277 schools with an enrollment of 40,194 including those under 6 and over 18 years of age. In addition, dormitory facilities were provided at 19 locations for 3,814 students who attended public schools.

Quality in Education

With the goal of a seat for every Indian child almost reached, the Bureau's Branch of Education is able to devote more attention to improving the quality of education.

Increased staff for program direction, especially in technical supervision, has helped to raise the level of instruction in several areas. In-service educational programs in each area have provided teachers, guidance personnel, and administrators with a deeper understanding of the needs of Indian education and improved ways of meeting these needs. For example, each school is working diligently to raise the reading level of each child. Special reading programs have been initiated in several high schools and special reading teachers have been employed to work with cases of retardation.



In secondary schools operated by the Bureau of Indian Affairs students are given ample opportunity to develop their skills and interests in arts and crafts.

Dormitory staffs are better able to give individual attention to students in counseling and group living experiences. Emphasis on the development of work space and adequate planning for creative activities in dormitories is supported by techniques studied by school staffs with the help of specialists. Some schools report a reduction in drop-outs.

Summer programs have been planned for students remaining at boarding schools between school terms with emphasis on recreational and creative activities. A questionnaire survey on arts and crafts activities was made of all Bureau of Indian Affairs schools in which they reported creative activities in classroom and out. The range of activities was wide for the elementary school showing that a creative environment necessary to the discovery and development of artistic talents exists throughout each Area.

The elementary schools, which enroll 75 percent of the children, have time devoted to arts and art appreciation activities but few special classes. Two special art teachers have been assigned to work with elementary schools in the Southwest. In all schools combined, 556 adult Indians and 619 non-Indian staff members assist with instruction in creative activities.



Physical fitness is stressed in Federal Indian schools.

Reservation Adult Education

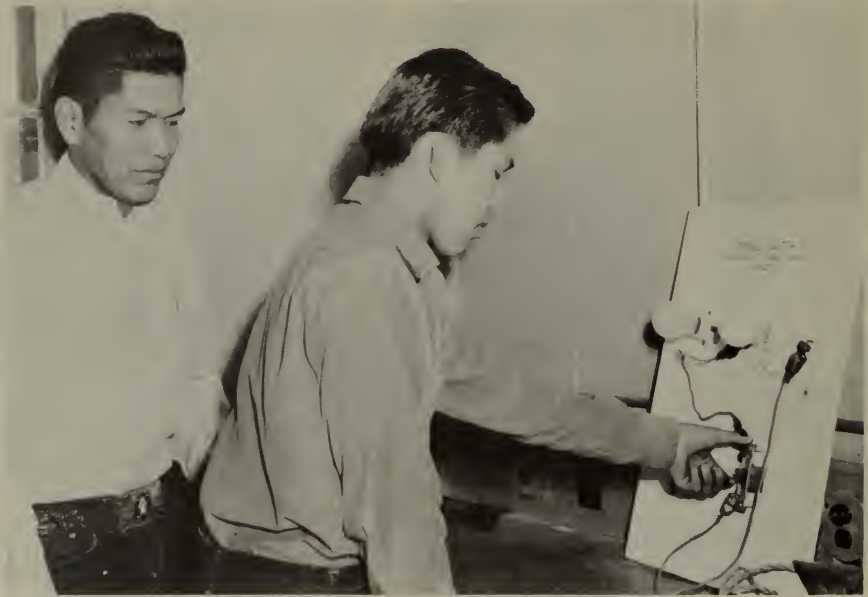
As a result of requests from Indian groups for educational opportunities for the adult members of their tribes, the Bureau initiated an on-reservation adult education program at five locations late in 1955 and early in 1956. Since that time, in response to requests from other Indian groups, the program has been expanded. At the close of fiscal year 1960, there were adult education units under 24 agencies of Area Field Offices serving 97 different reservation communities.

The objective of the adult education program is to raise the general educational level of Indian adults. According to the U.S. Bureau of the Census, Indian adults living on reservations in 1950 had attained only slightly more than half as many years of schooling as the general adult population of the Nation and are, therefore, seriously handicapped in our competitive society.

During the past year approximately 3,600 adult Indians have participated in formal or informal learning activities under this program. Of these, approximately 1,200 were engaged in formal learning activities, either group or individual, and 2,400 in informal activities.

Higher Education

During 1960, the Crow Creek tribe of South Dakota, the Fort Peck tribes of Montana, the Nez Perce tribe of Idaho, and the Standing



Two Navajo youngsters learn the mysteries of electrical circuits at the Riverside Indian School in Anadarko, Okla.

Rock Sioux tribe of North and South Dakota have established programs of scholarship assistance for their youth in education above the high school level.

The Federal grant and loan assistance made possible through the Bureau, the tribal scholarship funds, and the Indian scholarships donated by school organizations and individuals are being used to full advantage by the Indian students desiring higher education.

Welfare

In fiscal 1960 there was an increase in the need for financial assistance to indigent families on Indian reservations and additional funds were transferred from other Bureau activities to the welfare program to meet this need.

In addition to providing assistance, Bureau social workers were called upon increasingly to provide counsel, guidance, and social services to families and children with serious social problems where financial assistance was not involved. This latter function has become of major importance in the welfare program and the need for social services has been recognized officially by a number of tribal officials.

Procedures and guidelines for more effective administration of individual Indian money accounts were issued in manual form in January

1960 which should result in improved counseling service to Indians who need assistance in managing their affairs and making constructive use of their funds.

General Assistance

While the upward trend in general assistance needs during the past few years has continued, these needs were met more adequately in fiscal 1960 than in previous years. Chiefly because of increasing mechanization in agriculture, there has been a steady decrease in employment opportunities in unskilled seasonal work upon which many Indians depend. Meanwhile opportunities for other employment on or near reservations continued to be inadequate in many areas. A high proportion of those remaining on the reservations are not employable because they are children, or too old, or physically not qualified.

Assistance expenditures have increased also because of increased costs of living. These increased living costs are reflected in increases in the standards of assistance used by States for the State public assistance programs, and it is Bureau policy to follow State standards in each State where the Bureau administers a general assistance program.

The number of Indians receiving general assistance from Federal funds in fiscal 1960 ranged in the usual seasonal pattern from a low of 2,569 households, comprising 6,386 persons, in July to a high of 5,599 households, comprising 18,621 persons, in March. The average monthly grant per household was \$71.19 as compared with \$68.05 in fiscal 1959.

The average monthly caseload of 11,755 persons in fiscal 1960 was approximately 18 percent higher than the previous year, and the expenditures for such assistance were approximately 20 percent higher. On two reservations it was necessary to supplement the tribal assistance program with Federal funds because of exhaustion of tribal funds.

Child Welfare

Increased priority has been placed upon dealing with the problems of Indian children. The instability of many families on reservations remains a serious problem and the number of dependent and neglected children coming to the attention of Bureau social workers increases. As a result of better case finding, the number of physically and mentally handicapped children for whom the Bureau is providing care is also increasing. Contracts for foster care services with the States of Minnesota, South Dakota and Nevada were continued.

The Indian adoption project begun during the previous year as a pilot project under a contract with the Child Welfare League of America is progressing satisfactorily. Under this project Bureau social workers on selected reservations can refer homeless children for adoptive placement to qualified adoption agencies selected by the Child Welfare League.

Reports indicate that the 15 children who have been placed for adoption through the Child Welfare League under this painstakingly planned program are well placed in their new homes and their adoptive families are very happy with them.

A most promising result of the activity of Bureau social workers in the field of adoption has been the stimulation of both public and private agencies in States with Indian populations toward greater activity in planning for the adoption of Indian children. Another indirect result of the project has been to focus more attention on services which can be offered to young unmarried mothers.

Jurisdictional problems continue in many States to hinder or prevent the provisions of adequate protective services for dependent and neglected children on reservations. An important case entitled *The State of Washington v. The Superior Court of the State of Washington for the County of Yakima*, involving the jurisdiction of a State court over a dependent Indian child on the Yakima Reservation, was heard on appeal before the Washington State Supreme Court in May.

The principal issue involved was whether State courts have jurisdiction on Indian reservations to provide protective services to dependent and neglected children. This is the first such case to come to a legal test and the decision will provide an important precedent. The jurisdictional problem was briefly considered at one of the sessions of the 1960 White House Conference on Children and Youth, and the published recommendation of the conference includes the following recommendation: "That a study be made of the legal systems of the United States as they apply to and affect American Indians."

Law and Order

During fiscal 1960 no new legislation was enacted by any State pursuant to Public Law 280, 83d Congress, to assume civil and criminal jurisdiction over Indian reservations.

A suit by an individual Indian challenging the validity of State jurisdiction over the Quinaielt Reservation in Washington was instituted and was pending in the Washington Supreme Court at the end of the fiscal year. The challenge was predicated on an allegation that the tribal committee which had petitioned the Governor to proclaim State jurisdiction was not in fact empowered to act for the tribe. This

allegation is contrary to the position taken by the Bureau in the matter.

Matters involving Indian juvenile problems came into more prominence during the fiscal year. Several juvenile officer positions were established and programs for prevention of juvenile delinquency are being started on several reservations. Two cases were pending before the Supreme Court of Washington at the end of the fiscal year which involve the question of whether Indian juveniles residing on reservations are entitled to the same protective services from State and county agencies as non-Indian juveniles. The Senate Appropriations Committee, in its report on the Interior Appropriations Bill for 1961, directed the Bureau to make a survey of juvenile delinquency problems in the Pacific Northwest to determine the magnitude of the problem and the steps that are required to solve it.

The jurisdiction of State courts over criminal acts by Indians within reservations was further narrowed during the year by several decisions by the Washington State Supreme Court. These cases involved offenses committed by Indians within such organized cities as Toppenish and Wapato. No trust Indian land was involved but the cities are located within the boundaries of Indian reservations. In two of these cases, the State Supreme Court observed, significantly, that, "We are aware of the difficulty our conclusions cause in the field of law enforcement * * * and of the related problems they raise * * * but the solution in this State lies in corrective legislation * * *, not in unauthorized assumption of jurisdiction by our State court." It seems apparent that the State Supreme Court believes that the jurisdictional questions in Washington can be resolved by appropriate legislation pursuant to Public Law 280, 83d Congress.

The Congress enacted during the fiscal year a bill to make it unlawful to destroy, deface, or remove certain boundary markers on Indian reservations, and to trespass on Indian reservations to hunt, trap or fish. The bill was approved after the close of the fiscal year. It is designed to protect the wildlife resources of Indian tribes. It was deemed necessary after experience demonstrated that use of State laws against non-Indians was not practical. Indian tribes generally throughout the country joined in supporting the measure and urging the Congress to enact it.

Employment Assistance

Numerous steps were taken in fiscal 1960 to improve the quality of services to Indians in the field of employment assistance. The total number of Indian men, women and children benefiting directly from such services was 8,281 as compared with 7,200 in fiscal 1959.

Relocation Services

Relocation of Indian people for employment continued over the fiscal year as a whole on about the same level as in the previous year. Assistance was provided to 3,674 persons including 1,798 who relocated as single individuals or as the heads of family units.

The relocation services office at St. Louis, Mo., was closed during the year primarily because the city had proved to be a comparatively unpopular destination for Indians relocating from the reservations. This left eight city offices still in operation at the close of the period. Four of these were in California—at Los Angeles, San Francisco, Oakland and San Jose. The others were at Chicago, Cleveland, Denver, and Dallas.

Progress was made with relocatees in improving housing accommodations, training them for more effective money management, the upgrading of jobs, encouraging night school training for adults, and stimulating interest and participation in community activities.

Adult Vocational Training

Because of the increased interest of Indians in adult vocational training and the limited funds available to provide services, the Bureau in fiscal 1960 initiated a new program of relocation for employment prior to training. Through this operation, Indians who applied for vocational training and could not be accommodated immediately were given an opportunity to move to the city selected for training and be profitably occupied during the waiting period. About 200 Indians took advantage of these opportunities.

By the close of the year, the Bureau had approved 438 vocational training courses at 156 institutions for enrollment of Indians under the program. This was an increase of about 10 percent in the number of approved courses as compared with the previous year. The most popular courses were automobile, aircraft and diesel mechanics, metal work trades; and various types of commercial training.

Training was provided during the year to 1,771 Indian enrollees and services were made available under the program to 3,896 persons including family dependents. The number of new enrollments was limited because of the number carried over in training from the previous fiscal year.

Valuable help was given to the Bureau's field staffs by nearby universities and State employment services in determining the aptitudes of Indian applicants and in providing vocational guidance for marginal cases.

On-the-Job Training

Opportunities for on-the-job training in plants located on or near the reservations were made available to Indians through contracts with industrial companies. Training of this kind was given to 260 Indians during the period and guidance was furnished under the program to 260 family dependents of the trainees. At the end of the fiscal year, 10 contracts for on-the-job training were in effect and others were in process of negotiation.

Industrial Development

The purpose of the Industrial Development Program of the Bureau is to assist the Indian people in cooperating with their neighboring communities in the development of plans and programs which will attract industry to the areas surrounding the reservations and thus provide employment opportunities and improve economic and social conditions.

During fiscal year 1960, continued emphasis was placed on (1) working with tribal leaders to explain the basic concepts of industrial development and the need for cooperation with communities near the reservations to create the proper industrial climate; (2) assisting tribal and community groups in organizing industrial development foundations and similar entities in order that they will be in a better position to negotiate with industrialists interested in reservation area locations; (3) gathering necessary basic information on resources available and assisting in the preparation of fact sheets and brochures which clearly outline facilities available in the reservation areas; and (4) providing information and assistance to industries which have indicated interest in expansion or relocation of their present production facilities. This latter type of assistance was provided to 323 industrial concerns in fiscal 1960.

The growing interest of Indian tribes in industrial development is shown by the fact that the following tribal groups have taken action to earmark their own tribal funds indicated for industrial development purposes:

Eastern Band of Cherokee Indians, North Carolina.....	\$150, 000
Standing Rock Sioux tribe, North Dakota.....	770, 000
Three affiliated tribes of Fort Berthold Reservation, North Dakota....	50, 000
Navajo Tribe, Arizona.....	200, 000
Lac du Flambeau Band of Chippewa Indians, Wisconsin.....	40, 000
Lac Courte Oreilles Band of Lake Superior Chippewa Indians, Wisconsin.....	40, 000
Mescalero Apache tribe, New Mexico.....	51, 000
Santee-Sioux tribe, Nebraska.....	10, 000



This is the first plant ever built with Indian tribal funds specifically for leasing by a private industrial company. It is on the Cherokee Reservation in western North Carolina and provides year-round jobs for about 130 tribal members.

Nearly 600 meetings were held during the year with tribal groups and with civic organizations of communities near reservations to bring about a better understanding of industrial development goals and problems. As a result of the work done with the various tribes and communities, 58 industrial fact sheets and 9 brochures were prepared to cover communities on or near reservations.

The development of overall plans for proper utilization of Indian lands which have a high degree of industrial possibilities is essential for use in the selection of industrial sites. With this in mind, the Bureau contracted during the year for economic and engineering studies covering a portion of the Salt River and Gila River Reservations in Arizona and the Sandia Pueblo Reservation in New Mexico.

Complete inventories of reservation area resources are also essential to the promotion of industrial development. A beginning was made in this direction when arrangements were made for a study of clay deposits on the Pine Ridge Reservation in South Dakota. The technical work is to be done by the Department's Geological Survey and Bureau of Mines on a reimbursable basis. The Bureau of Mines also started a mineral resources economic study on two reservations in the Missouri River Basin. The inventory of resources on the Makah Reservation in Washington is scheduled for completion by the end of 1960 and plans for a forest products plant are progressing satisfactorily.

Individual State maps, showing locations of Indian reservations and related data, have been printed and a United States map for use in promotion and attraction of potential developments is in process of preparation.

In addition to these steps aimed at attracting industry, many opportunities have been developed for the employment of Indians in plants now operating in the vicinity of reservations.

One industrial company, engaged in the manufacture of quilted and other soft goods, opened a new plant with 77,000 square feet of floor space on the Cherokee Reservation, North Carolina, in October 1959, and dedicated the new building 2 months later. The plant was constructed by the Eastern Band of Cherokee Indians at a cost of \$300,000 and leased to the company for 25 years. At the close of the fiscal year, 130 Cherokee Indians—80 percent of them men and 20 percent women—were employed in the operation.

The approval of a 25-year lease on a 32-acre tract of tribal land concluded the final arrangements by a forest products company for the location of a \$300,000 wood treatment plant on the Yavapai Reservation at Prescott, Ariz. Wood products to be treated include railroad ties, fence posts, mine timbers, poles and cross-arms for utilities, poles for barns, and guard rails and mudsills for residential construction. A total of 28 men will comprise the work force of this plant, excluding the cutting and hauling of timber, and preference for employment will be given to qualified Indians.

Realty

The desire of a number of Indian tribes to acquire land being offered for sale by their members continued as a major concern of the Bureau. A moratorium on the sale of land by individual Indians, except to the tribe, was continued in effect on the Standing Rock Reservation in North Dakota, where the tribe is relocating and rehabilitating Indian families whose homes and farms lay in the area taken for the Oahe dam and reservoir project on the Missouri River.

At the Omaha Reservation in Nebraska, a land sale moratorium was extended pending the receipt by the tribe of a sizable judgment through the Indian Claims Commission and development of a tribal program for the use of a portion of the fund for purchase of land. Sales of land were temporarily suspended at Fort Belknap and Northern Cheyenne in Montana, at the request of the tribal councils, to enable them to work out details of lands purchase programs.

The act of September 21, 1959 (73 Stat. 602) provided the necessary authority for effecting the highest possible measure of equalization of values to the Indian allottees of the Agua Caliente (Palm Springs) Band of Mission Indians in California by removing the previously existing acreage limitation on allotments there and enabling the Bureau to proceed with the allotment of all of the remain-

ing tribal land holdings, except for a relatively small acreage in the scenic canyon areas and several other small tribal reserves.

Acquisition and Disposal

During the year 12,782 transactions involving land acquisitions and disposals, including 1,892 probate inventories, were processed by the Bureau. All told, 701,805.51 acres of trust or restricted land were disposed of by individual Indians and tribes, while during the same period, 329,676.04 acres were acquired through purchases and exchanges by individual Indians and tribes.

Land removed from Federal jurisdiction on the Uintah and Ouray (Utah) and Klamath (Oregon) Reservations and certain California rancherias in connection with their termination programs totalled 326,053.72 acres.

Sales to unrestricted status at the request of Indian owners accounted for 1,378 approved transactions; issuance of fee patents to Indian owners, removals of restrictions and certificates of competency for 759; exchanges and partitions for 410; purchases for 907; and other miscellaneous transactions for 1,215. The Bureau also processed an additional 6,221 realty applications which resulted in no transfer of property rights for the reason that the applications were either disapproved or withdrawn.

Minerals

Royalty on production was the principal factor in increasing the total income from oil and gas development on Indian lands from \$46,468,099 last year to \$47,696,957 for the current year, notwithstanding the drop in rental income for the same period from \$5,854,126 to \$4,801,446. The decrease in rents was due to the general oversupply of crude oil which brought about the termination of some leases on Indian lands and reduced the interest in the drilling of exploratory wells and the acquiring of new leases.

Sales of special interest brought bonuses in excess of \$10 million for the Ute Reservation leases in New Mexico and Colorado and in excess of \$1 million for leases on the Blackfeet Reservation, Montana. Leases were also sold on Navajo lands in Utah for a royalty rate bid with a fixed bonus of \$500 per acre. The royalty rate bids averaged 48.31 percent. Aside from these few sales of special interest, evaluation of oil and gas leases on which there has been no development to date was the outstanding feature during the current year.

By far the main source of Indian mineral income apart from oil and gas was the royalty from uranium production on Laguna Pueblo

lands in New Mexico. Due to restrictions on the purchase of uranium there was a drop in the overall income from this source. No new uranium leases were offered and a considerable number of leases were surrendered. The Fort Hall, Idaho, phosphate leases are producing over 1 million tons per year and the outlook is promising. Because of poor market conditions and the low grade of the ore, it was necessary to make a royalty reduction in the Quapaw lead and zinc mining leases. Due to the market conditions, operations on these leases have been shut down throughout the year.

The total royalty from all minerals other than oil and gas produced on Indian lands amounted to \$2,661,000 which is a drop of \$603,380 from the previous year.

Tenure and Management

In fiscal 1960 the Bureau of Indian Affairs closed 2,502 cases granting rights-of-way over Indian lands for various purposes. At the close of the year there were 32,136 surface leases or permits of all kinds in force on Indian lands, covering 3,478,249 acres and providing an annual rental of \$10,397,944 for the Indian owners. These leases and permits cover the use of Indian lands for farm, farm-pasture, grazing, and business purposes. They do not include lands embraced in range units.

A survey of the long-term leases made under authority of the act of August 9, 1955 (69 Stat. 539), was conducted during January 1960. It was found that 821 long-term leases had been approved at the time of the survey and that 593 proposed long-term leases were then pending. Of the approved leases, 167 are for agricultural purposes; 565 are for business, including residential and recreational purposes, and 89 are for other purposes. The latter category includes principally leases made at nominal rentals for religious, educational or other public purposes.

While the annual rental income from these long-term leases shows a net increase of only \$657,729, many of the business leases are on formerly undeveloped property, and their rental consideration is still on the minimum guaranteed rental basis or, in many cases, on the basis of a low rental during the construction period. The estimated cost of the improvements to be made to the land or structures that will remain on the land and become the property of the Indian lessor at the termination of the leases under the conditions of the approved contracts is over \$19,100,000.

In spite of this excellent showing, it has been found that the maximum lease term of 50 years, obtainable under the 1955 act, is not long enough to enable developers of large scale enterprises to obtain

institutional financing. During this fiscal year, statutes have been enacted authorizing leases for terms up to 99 years for the Agua Caliente (Palm Springs) Reservation, Calif., and for the Navajo Reservation. The Department has recommended that this longer authority be made generally applicable to all Indian lands.

Records

During fiscal 1960 an actual test of the previously proposed system for the modernization of the Bureau's land records was conducted covering the Lower Brule Reservation in South Dakota. Based upon the excellent results obtained therefrom, an approved land records improvement program, phased over a 5-year period, was developed. It provides for a land index, patterned on the Torrens method of recording land title transactions, the preparation of ownership status maps and a modernized title system.

In the construction of new indices, the greatest possible use will be made of modern electronic data processing equipment in sorting and chronologically listing the great mass of title data affecting Indian lands.

Forestry

Timberlands are the principal asset of many Indian tribes and individual Indians. In fiscal 1960 good additional progress was achieved in developing these lands for the benefit of the Indian owners. The volume and value of timber sales were at an all-time high. Jobs, created by the timber harvest were at an equally high level. Decisive action was taken to expand two tribal sawmill enterprises, and the program of timber inventories was continued as a first step in the revision of timber sale schedules.

In addition there was continued evidence of the Indians' growing interest in forest management.

To provide a sound foundation for future development, a project was begun during the year to review policies governing the use of tribal and allotted timberlands. On this foundation there will be prepared, by reservations, long-range plans for timberland management, in the Indian interest, and for the benefit of dependent communities. The need for this project has increased in recent years.

Timber Sales

The volume of timber cut under contract and used by tribal sawmills reached the record figure of 595 million board feet in the fiscal year 1960. Cash receipts were also at a record high of \$12.25 million.

Net income to the Indians, after the required deductions for administrative expense, was about \$11 million.¹

*Timber cut under contract and used by tribal sawmills
(exclusive of Klamath Reservation)*

	Volume cut, million feet, board measure	Cash receipts
Calendar years ¹ 1951.....	488,364	\$5,159,502
Calendar years 1952.....	486,299	6,356,863
Calendar years 1953.....	504,614	7,262,902
Calendar years 1954.....	476,075	7,254,012
Calendar years 1955.....	581,015	8,659,332
Calendar years 1956.....	507,548	9,759,034
Calendar years 1957.....	433,347	8,501,266
Fiscal years 1958.....	426,081	8,275,876
Fiscal years 1959.....	534,695	10,082,747
Fiscal years 1960.....	595,354	12,273,682

¹ Data by fiscal years not available prior to fiscal year ending June 30, 1958.

Timber sales benefit the Indian owners in at least three ways. They provide a direct cash income from the sales; they create employment opportunities; and, as a rule, they foster stabilized communities on or near the reservations.

On the average, the process of cutting 1,000 board feet of standing timber and converting it into lumber, requires two man-days of labor. By this rule of thumb, the 595 million board feet of timber cut on Indian lands in fiscal year 1960 created more than 1 million man-days of employment. With minor exceptions, all of this employment was on the reservations or at adjoining mills. All of it was in kinds of work for which the Indians have shown real aptitude. The contracts for sale of Indian timber provide for preferential consideration of Indians when they seek employment and are competent.

The job-creating aspect of forest management should be recognized. The 10-year record of sales, above, shows that the volume of sales in 1960 was about 20 million board feet greater than in 1959, and cash receipts were \$2.25 million greater. Equally important, but not shown in the tabulation, is the increase of about 40,000 man-days of employment resulting from the increased sales.

Navajo and Fort Apache Tribal Sawmills

During fiscal 1960 plans crystallized to expand the Navajo and Fort Apache sawmill enterprises. The former is located in Arizona and New Mexico; the latter in Arizona:

¹ All general statements and supporting data are exclusive of the Klamath Reservation in Oregon. Data for that reservation not included because of progress in terminating the Federal trust responsibility, pursuant to the Act of August 13, 1954, as amended.



Ground-breaking ceremonies for the new tribal sawmill on the Navajo Reservation in New Mexico. Recent inventories of the Navajo timber resources showed that the annual cut could be substantially increased under a sustained yield management program.

The Navajo Tribe had previously authorized the use of its funds for a forest inventory, which was needed in order to recalculate the allowable annual cut. It was found that the annual cut should be increased from an average of 15 million feet to more than 50 million feet. The tribe thereupon retained engineering consultants to advise on design and construction of a new sawmill capable of handling the increased production. A management board was appointed to direct the expanding enterprise, composed of four members of the tribe and five men of demonstrated ability in the business world, particularly in the wood-using industries. On May 19, 1960, ground-breaking ceremonies were held to mark the start of construction of the new mill. A modern town to house and service the mill employees will also be constructed.

This expanded Navajo Sawmill enterprise will begin operations in 1961. It will add substantially to the job opportunities available for members of the tribe. On-the-job training will be available to prepare tribal members for the higher skilled positions.

The White Mountain Apache Tribe of the Fort Apache Reservation also financed a forest inventory. It also retained an engineering consultant when it was found that annual production of the tribal enterprise should be increased, from about 10 million to 20 million board feet. A new mill will be erected at a place readily accessible to many tribal members in need of employment. It is expected that the new mill will be in operation in 1961.

Indian Interest in Forest Management

The expanding sawmill enterprises are evidence of awakening interest among some Indians in the management of their forests. Such interest is also reflected in tribal financing of forest management programs.

For many years, various tribes have authorized limited use of tribal funds in forest-fire suppression. But in fiscal year 1946 only four tribes contributed to the cost of other forest management activities. By fiscal year 1959, the number of these participating tribes had increased to 18. All important phases of forest management are now discussed with tribal representatives. The consultations increase in importance as the tribes gain experience in these matters. Individual Indian interest is also being stimulated through the media of personal contacts and newsletters.

Irrigation

The Indian people own approximately 53 million acres of land. This includes range and forest land, dry farm land and irrigated land. Of their irrigated land, they operated 391,000 acres themselves in fiscal 1960. This amount, which is 0.7 percent of the total Indian-owned land, produced \$10 million or 20 percent of the \$50 million income realized during the year from all agricultural uses, including agricultural leasing.

A total of 647,000 acres was irrigated under Indian irrigation projects in 1959. This includes the acreage farmed by Indians, Indian land leased by others and land owned by non-Indians within the Indian projects. Gross production from these lands totaled over \$60,491,000, an increase of more than 13 percent over the previous 5-year average.

In view of the relatively high production capacity of the irrigated lands, the Bureau is concentrating a particularly strict management effort on the Indian irrigation projects to improve and maintain this feature of the Indian economy. Continuing programs for betterment

of Indian irrigated land and expansion of irrigation facilities are being carried on.

Major accomplishments were as follows:

	New	Replaced or rehabilitated
Irrigation:		
Acreage brought under works.....	2,320	1,210
Structures (number).....	1,124	1,622
Wells and Pumping Plants (number).....	14	6
Lining canals and laterals (miles).....	9	34
Drain ditch (miles).....	19	22
Tile drains (miles).....	23	-----
Acreage drained.....	3,076	-----
Power:		
Customers.....	194	-----
Transmission Lines (miles).....	11.6	23
Distribution Lines (miles).....	31	14.6
Transformers (number).....	201	161

Operations Now Under Way

Major construction programs now under way include the 21,000-acre Michaud Irrigation Division on the Fort Hall Reservation, Idaho; the 15,000-acre Hogback Unit, Navajo Reservation, N. Mex.; and the 10,000-acre project for the Coachella Valley Indian lands in California.

The more important rehabilitation activities are concentrated on over 20,000 acres of Middle Rio Grande Pueblo lands, the 100,000-acre San Carlos project, Ariz.; the 40,000-acre Blackfeet project, Mont.; the 12,000-acre Duck Valley project, Nev.; and the 10,000-acre Pine River project, Colo. In addition, preliminary studies and planning as well as survey and design work are continuing on the proposed Navajo project, N. Mex., and the Animas LaPlata and Dolores projects, Colo., totaling approximately 133,000 acres.

Public Law 85-671 enacted in 1958 provided authority and the terms and conditions under which Federal responsibility for administering the affairs of 41 Indian rancherias in California might be concluded. Among the conditions outlined in the law was the construction, completion or rehabilitation of certain water supply facilities. Such work remains to be done on only 13 of the 41 rancherias. The drainage situation on the Colorado River irrigation project has been greatly improved. Of the acreage under project works, approximately 95 percent is now considered as having adequate drainage.

Agricultural Extension

Development of better agricultural extension procedures was a major objective of the Bureau during fiscal 1960. In this activity the



A group of Navajo and Pueblo sheep-owners participating in the New Mexico State Fair Range Sheep Show.

help of land grant college extension organizations was enlisted to assist Bureau technicians, as well as Indian groups, in program subject matter, personnel training, and specialist assistance.

Projects have been designed to enhance leadership development, community improvement, farm and home management, conservation of resources, housing, youth training, and health. The Arizona and New Mexico Extension Services have included more than 300 Indian men and women in their regularly held activities such as "wool grading and marketing school" and "homemakers college."

Events during past years revealed a growing awareness of the importance of the communications process between Bureau land operations technicians and the Indian people in promoting programs involving resources utilization. As a result of this realization and in the interest of presenting information to Indians in a more understandable and usable form, the Gallup area branch of land operations participated in the national project of agricultural information communications, which is sponsored by the American Association of Land Grant Colleges and the Kellogg Foundation. The project consisted of a series of workshops devoted to basic and oral, written, and audiovisual phases of personal communications.

Over the year as a whole, 10,132 meetings were held in Indian areas by Bureau technicians and land-grant college specialists with 243,552 Indians in attendance. The stress on improved methods of giving demonstrations and on the farm instructions has resulted in a noteworthy increase in Indian family interest, participation, and adaptation of improved farm and home practices.



A group of Pueblo Indian women departing for the New Mexico State Extension "Homemakers College."

Rural Development

The Bureau's extension program, which includes contractual services provided to Indians by the land grant colleges has recently involved cooperation in 15 States, with other Federal agencies in a broad program of rural development.

Indians residing on reservations in five of the western States, where "pilot" counties are established, have been encouraged to participate in the National Rural Development Program which is coordinated by the U.S. Department of Agriculture. One proposal of the program is to coordinate the services of Federal, State, and county as well as private business interests in low-income rural areas for development of broader opportunities to individuals in agriculture and industry, as well as for the acquisition of vocational skills.

Montana, for example, is one of the western States participating in this nationwide program, and it has designated Lake County as a "pilot" program county. Lake County includes considerable land owned by the Flathead Indians and has a heavy Indian population. A representative of the Flathead Reservation tribes is on the Lake County rural development planning committee.

4-H Program

The number of Indian young people in 4-H Clubs continues to increase. In fiscal 1960, there were approximately 10,000 Indian boys and girls throughout the country participating in 4-H Club activi-



Two Hopi Indian 4-H Club members giving their livestock conservation team demonstration which won them first place in Arizona and second place at Chicago in national competition.

ties on the same basis as non-Indian boys and girls. Many of these 4-H Club members have received county and statewide recognition for their achievements in project completions and in giving demonstrations in subjects relating to agriculture and home economics.

Soil and Moisture Conservation

The soil and moisture conservation program on Indian land continues to become more popular with the Indian people from year to year as their understanding of its benefits increases. Primarily for this reason, more emphasis has been placed on the educational phase of the program and in fiscal 1960 there were 3,292 conservation meetings held with Indians as compared with 2,180 in 1955. Accomplishments in the program shift from time to time as the need and understanding demand. The accompanying chart compares 1955 and 1960 accomplishments to show this shift by the percentage of change in some of the major conservation practices.

In 1960 the Bureau spent \$4,859,098 of appropriated money for soil and moisture work on Indian land. At the same time the co-operators or land users spent \$21,709,166 on the same phase of the program. Added emphasis is being put on soil surveys. In 1955 detailed soil surveys were made on 940,433 acres. In 1960 the same type of survey was made on 3,329,269 acres. Soil surveys furnish basic technical information that is essential to assure Indian people of the highest quality soil conservation program that will help them



These Pima Indian girls exhibited their sewing projects at the Pinal County, Ariz., 4-H Fair winning blue and red ribbons.

to obtain the maximum crop production and income from agricultural use of their lands.

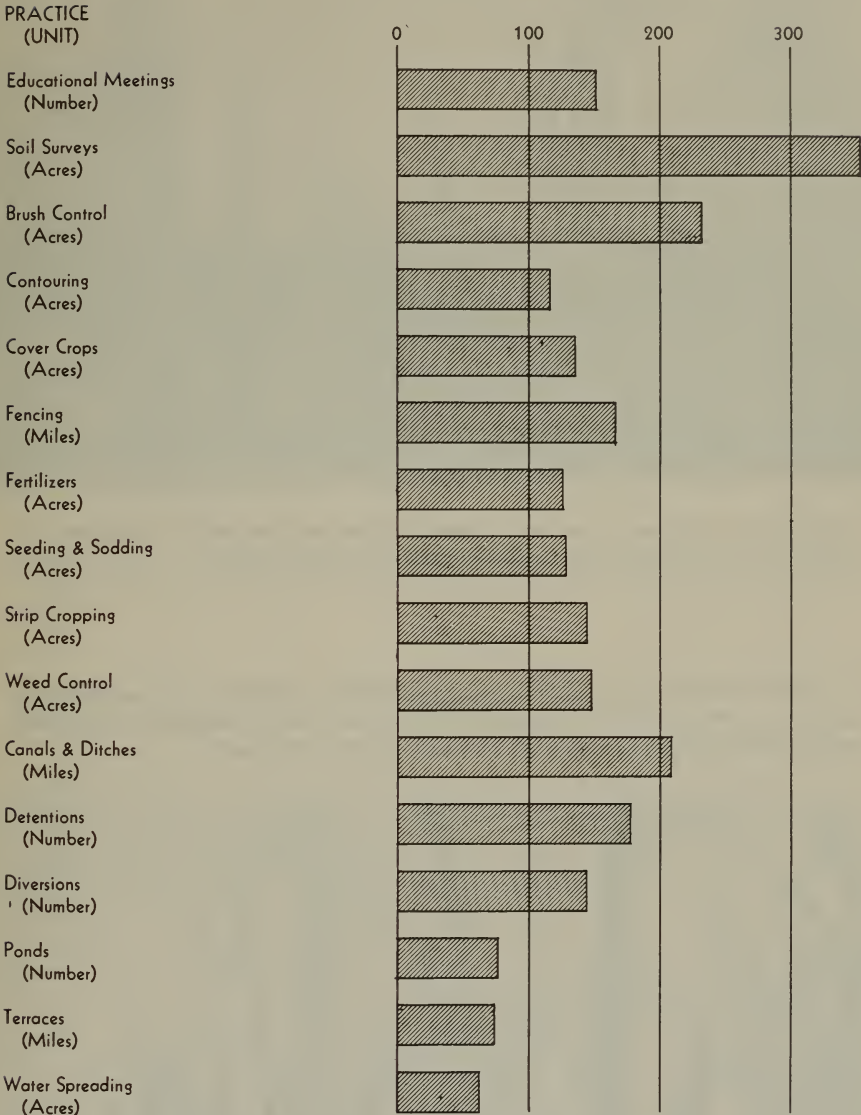
Another phase of the program that has received added attention during the past year is brush control. In 1960 brush control work was accomplished on 144,330 acres as compared to 65,065 acres in 1955. In some places where brush has been removed and the land has been seeded to adapted grasses, the grazing capacity has been increased up to 15 times. The best results on this type of work have been obtained in the higher rainfall areas. In some areas of lower rainfall approximately 8 to 10 years are required to return the investment in increased grazing capacities. In other projects the Bureau has found that the entire cost of the practice can be returned in less than 2 years.

Range, Wildlife and Recreational Resources

The year 1959 provided a major test of the range management program in effect on Indian reservations in North Dakota and South Dakota where drought conditions were especially severe. Fifty-four counties of these two States were designated as drought disaster areas for the purpose of emergency loans for livestock feed purchase. However, as a result of the Bureau's program of range management the livestock operators on Indian reservation lands in these two States came through almost unscathed apart from a few cases of reduced

SOIL AND MOISTURE ACCOMPLISHMENTS IN 1960
 COMPARED TO 1955

(1955=100%)





In 1954 this 14,000-acre tract on the Hualapai Indian Reservation in Arizona was virtually wasteland, capable of supporting only 66 head of cattle.

Five years later, after controlled burning and seeding, the same land had a grazing capacity of 990 head. Conservation practices not only controlled erosion but increased the annual value of forage production by \$2.13 per acre.





Many Indian tribes are now developing the recreation resources of their reservations as a new source of revenue. This is Hawley Lake on the Fort Apache Reservation in eastern Arizona developed and operated by the White Mountain Apache tribe.

livestock water supply. Supplemental feed was not required. In most instances prairie hay was available for harvesting.

More than 81 percent of the Indian range is used by Indian livestock operators. The grazing privileges temporarily in excess of the need of Indian livestock were sold through competitive bidding and often brought the highest price within a particular state.

Use of the Indian range resource for 1959 calendar year is as follows:

	Acres (thousands)	Percent of acreage used	Animal units grazed (thousands)	Use value (thousands)
Total range.....	41, 115			
Total use.....	40, 563	100	816	\$5, 783
Non-Indian use.....	6, 889	18	348	2, 028
Indian use.....	33, 674	81	468	3, 755
Not used.....	552	1		

In addition to the range resource, practically all Indian groups have their wildlife and recreation resources. Several Indian groups have developed these resources with the help of Indian Bureau technicians and with assistance provided by other bureaus of the Department. In recognition of the trend toward greater use of the Indian



Monument Valley on the Navajo Indian Reservation in Arizona. Indian Bureau asphalt road between Kayenta and the beginning of Utah asphalt road No. 47 at the Arizona-Utah State line.

recreation resource, the Bureau in 1959 revised its procedures for gathering statistical data bearing on these potentialities. The information will be available for analysis early in 1961 to further assist the tribes in their recreation programs.

Roads

The Bureau's 1960 road construction and road maintenance programs totaled \$17.4 million and were active on 71 Indian reservations in 20 States.

The \$2.8 million road maintenance program provided for upkeep on 16,807 miles of reservation roads and bridges. The work included surface repairs, blading, repairs to drainage, clearing of right of way, and snow removal.

The \$14.6 million road construction program consisted of 120 projects ranging in value from \$5,000 to \$680,000. Some of the smaller projects were completed with reservation maintenance equipment and government forces. Most of the projects were advertised for contract and some contracts covered two or more projects. Interest and competition among the contractors were very good; the average number of bidders per contract was 7; the number and value of contracts awarded during the year are as follows:

- Fifty-three contracts valued at \$5,000 to \$100,000
- Twenty-nine contracts valued at \$101,000 to \$500,000
- Six contracts valued at over \$500,000



Four Corners Oil Field. Bridge built by Bureau of Indian Affairs across San Juan River helps in development of resources on Navajo Indian Reservation.

Included in the construction program was \$5 million for Routes 1 and 3 on the Navajo and Hopi Indian Reservations. These two cross-reservation roads are being constructed to State highway secondary standards in accordance with Public Law 85-740; upon completion of agreed construction, the States of Arizona and New Mexico will designate each route as a State highway. Contracts have been awarded for 8 of the 19 projects on Route 1 and 7 of the 13 projects on Route 3.

The construction work accomplished during the year over the country as a whole included 394 miles of grading and draining; 253 miles of gravel surfacing; 209 miles of asphalt surfacing; 4,540 feet of bridges; and 586 miles of surveys and plans for future projects.

The Bureau's nationwide road system was reduced by 1,030 miles under the policy of building roads to an acceptable standard and transferring them to a local governmental unit for maintenance where possible.

Bureau road construction and maintenance activity was terminated at the Klamath Indian Reservation with the transfer of all roads and responsibility to Klamath County under the terms of a 1955 agreement. This agreement and the acceleration of the road program were part of the Bureau's termination program at Klamath under Public Law 587, 83d Congress.

The road program on the Menominee Indian Reservation was also accelerated under the termination program provided for in Public Law 399, 83d Congress. On August 11, 1959, the Bureau entered into



Actor Vincent Price, a member of the Indian Arts and Crafts Board, inspects the work of a Navajo rug weaver at the annual Inter-Tribal Indian Ceremonial in Gallup, N. Mex.

an agreement with the State of Wisconsin in which the State agreed to accept the transfer of all Federal public roads on the Menominee Reservation and to designate them as State, county, or township roads if the Bureau provided the rights-of-way and constructed certain roads. The estimated cost of construction was \$700,000. Funds were made available and the necessary work started and progressed on schedule for completion prior to termination of Bureau activities.

Arts and Crafts

The Indian Arts and Crafts Board continued to provide technical advice and assistance in production and marketing to Indian crafts groups and to individual Indian artists and craftsmen.

During the past year a significant change was made in the operation of the Seminole crafts program in Florida. The Seminole Crafts Guild, organized in 1940 on the Brighton Reservation with membership restricted to crafts workers of that reservation, has been purchased by the Seminole tribe and become a part of the tribal enterprise system. An Indian village and arts and crafts center was built at Dania, Fla., and opened for business early in March. Upon the request of the tribe, the Indian Arts and Crafts Board through its

arts and crafts specialist continues to give advice and assistance in the operation of the crafts program just as was done with the Seminole Crafts Guild.

Early in the spring of 1960 work was begun on a new \$50,000 highway sales center building for Qualla Arts and Crafts Mutual at Cherokee, N.C. The building was scheduled for completion in July, well before the end of the tourist season. This craft organization has for some time looked forward to having its own building where all its activities could be housed. Previously, the craft shop was in one building while the business offices were in another some distance away. Having both activities in one building will make for more efficient operation and, because of the strategic and desirable location of the new building, prospects are bright for an increase in business.

In other areas where there are active arts and crafts projects—South Dakota, Oklahoma, and Alaska—there has been progress, particularly in the strengthening of the craft organizations. There was also a slight increase in sales over the past year.

Plant Design and Construction

Primary consideration in the Bureau's construction program for fiscal 1960 was given to school facilities in order to provide classroom seats for those children not able to attend school because facilities did not exist. Additional work also involved alleviating the overcrowding at certain schools and the correction of some safety and sanitary hazards.

The Bureau architectural and engineering staff designed 46 individual projects and supervised the construction of 45 projects involving schools, dormitories, quarters, municipal centers, utilities, and other similar facilities.

Projects involving the construction of schools and related facilities providing for approximately 4,400 Indian pupils were under way during the year. Twenty-six of these projects were completed providing space for more than 2,000 pupils.

The Bureau assisted the United States Public Health Service in the Indian Health Program by completing 7 construction projects, including 3 hospitals and by supervising the continuing construction of 11 projects, which include 8 hospital facilities.





Credit Activities

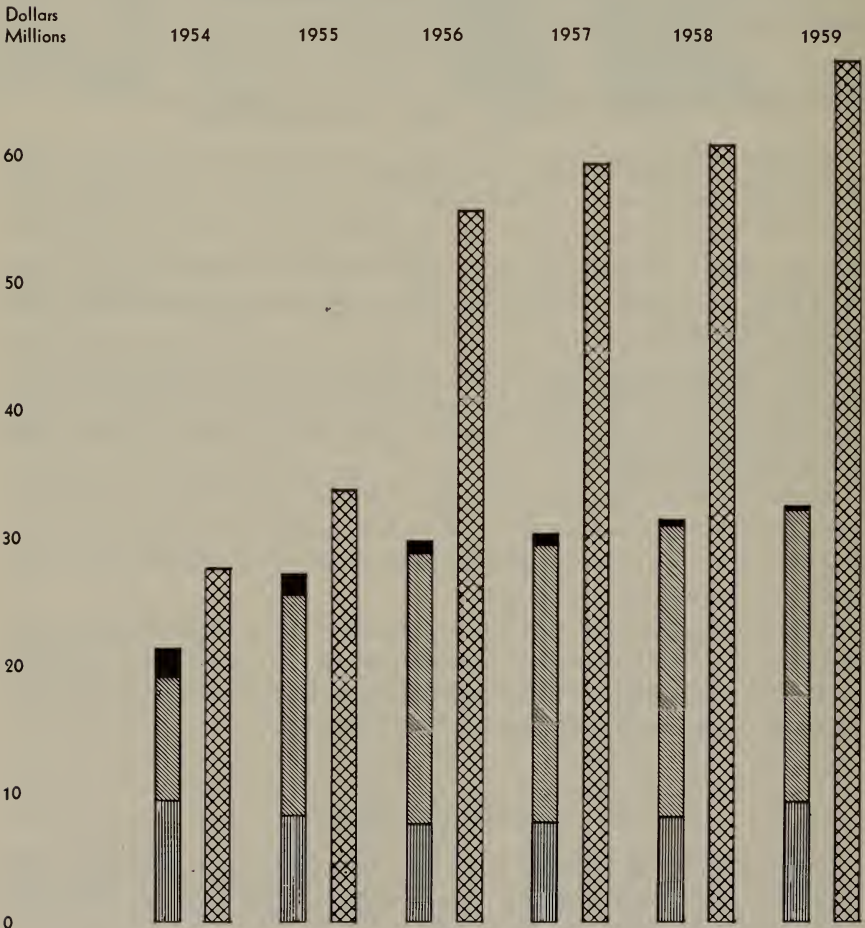
The activities of Indians have been financed more adequately the past few years than probably at any time in their history. The following table shows the progress made :

Report at June 30	Financing by customary institutions ¹	Financing through bureau	Total
1954.....	\$27,665,135	\$21,449,804	\$49,114,939
1955.....	33,959,558	27,149,696	61,109,254
1956.....	55,725,811	29,961,299	85,687,110
1957.....	59,424,956	30,344,983	89,769,939
1958.....	60,998,783	² 31,441,536	² 92,440,319
1959.....	67,670,018	32,690,234	100,360,252

¹ Figures are as of December 31 of preceding calendar year.
² Adjusted figures.

COMPARATIVE SUMMARY OF FINANCING RECEIVED BY INDIANS AND THEIR ORGANIZATIONS

Key:  Customary Credit Channels (Non-Bureau)
 Through Bureau Programs:
 Revolving Credit Fund
 Tribal Funds
 Programs in Process of Liquidation



Financing by Customary Financial Institutions

During 1959, the Bureau continued to place primary emphasis upon helping Indians and Indian organizations obtain needed financing from the same institutions that serve other citizens. Many Indians now deal with lenders on the same basis as other people. Consequently, complete information is not available on the amount of financing they receive. The estimated financing received by Indians from customary lenders during the current report year increased by more than \$6 million, or 11 percent over the amount received the preceding year.

The act of March 29, 1956 (25 U.S.C. 483a), authorizing the execution and approval of mortgages and deeds of trust on individually owned trust or restricted land, is proving of assistance to Indians in obtaining justified financing. They are now able to use their chief asset, land, as security. Thirty additional loans, amounting to \$256,363 were obtained by Indians during the current reporting year through the use of mortgages of their land as security.

An agreement was entered into during the year between the Valley National Bank of Phoenix, Ariz., and the Hualapai tribe under which the bank will make loans to members of the tribe on the basis of a guaranty fund furnished by the tribal organization. This should prove of value in encouraging these Indians to look to the same channels as other citizens for financing.

Financing Through Bureau

Financing through the Bureau receives secondary emphasis in the Bureau's program. At June 30, 1959, the following funds were involved:

Funds of Indian organizations.....	\$22, 972, 052
Loans, revolving fund.....	9, 515, 749
Reimbursable loans.....	123, 968
Livestock loans.....	78, 465
	<hr/>
Total.....	32, 690, 234

Tribes with funds of their own available are required to use their own moneys to make loans and finance tribal enterprises before applying for loans from the United States. At the close of 1959, a total of \$22,972,052 was in use, compared with \$22,778,045 at the close of 1958.

The United States makes loans to tribes, other Indian organizations, and individual Indians. Loans totaling \$9,515,749 were outstanding at the end of the year. A total of \$2,526,705 was loaned during 1959. This amount has been exceeded in only 3 years since establishment of the revolving fund was authorized in 1934.

Repayments totaled \$1,302,310 during 1959, compared with \$1,946,951 the prior year. Loan delinquencies were \$574,764, which is \$194,937 less than at the close of 1958. A reserve of \$1,437,847 was established for potential losses or slightly over 15 percent of the loans receivable. At the close of the year, there was a cash balance of \$3,115,005 available for general use. Against this sum were unadvanced commitments of \$3,724,510 including an estimated \$1,418,850 required to make loans to withdrawing members of the Klamath tribe during 1960, pursuant to the act of June 11, 1959 (73 Stat. 70). This cash balance is inadequate to take care of the credit needs of those Indians unable to receive financing elsewhere. A recommendation was made to the Congress that the revolving fund authorization be increased by \$15 million.

Use Made of Funds Loaned and Advances

Indian organizations use their own funds and moneys borrowed from the United States to make loans to members and associations of members, and to finance business enterprises. The total financing through the Bureau was being used as follows at the close of the year:

Loans to individuals:		
Cash	-----	\$7, 113, 651
Livestock	-----	771, 833
		\$7, 885, 484
Loans to Cooperatives	-----	191, 554
Loans to and invested in enterprises	-----	19, 442, 772
Loans to attract industries	-----	129, 830
Other:		
Reimbursable loans	-----	\$123, 968
Repayment in transit	-----	2, 179
Cash on hand:		
For relending	-----	2, 879, 433
For livestock operations	-----	268, 459
Other net assets	-----	1, 766, 555
		5, 040, 594
Total	-----	32, 690, 234

Loans to Individuals

A total of 1,853 loans for \$2,969,073 were made during 1959. This is the largest number of loans and amount in 6 years, and is an increase of 850 loans for \$425,797 over 1958.

Repayments on individual loans were \$1,899,971, which was \$739,781 less than in 1958. Of the loans receivable amounting to \$7,113,651, a

total of \$1,988,136 was owing on loans which were either delinquent or in process of liquidation. Interest payments of \$130,898 also were delinquent.

Loans to Cooperatives

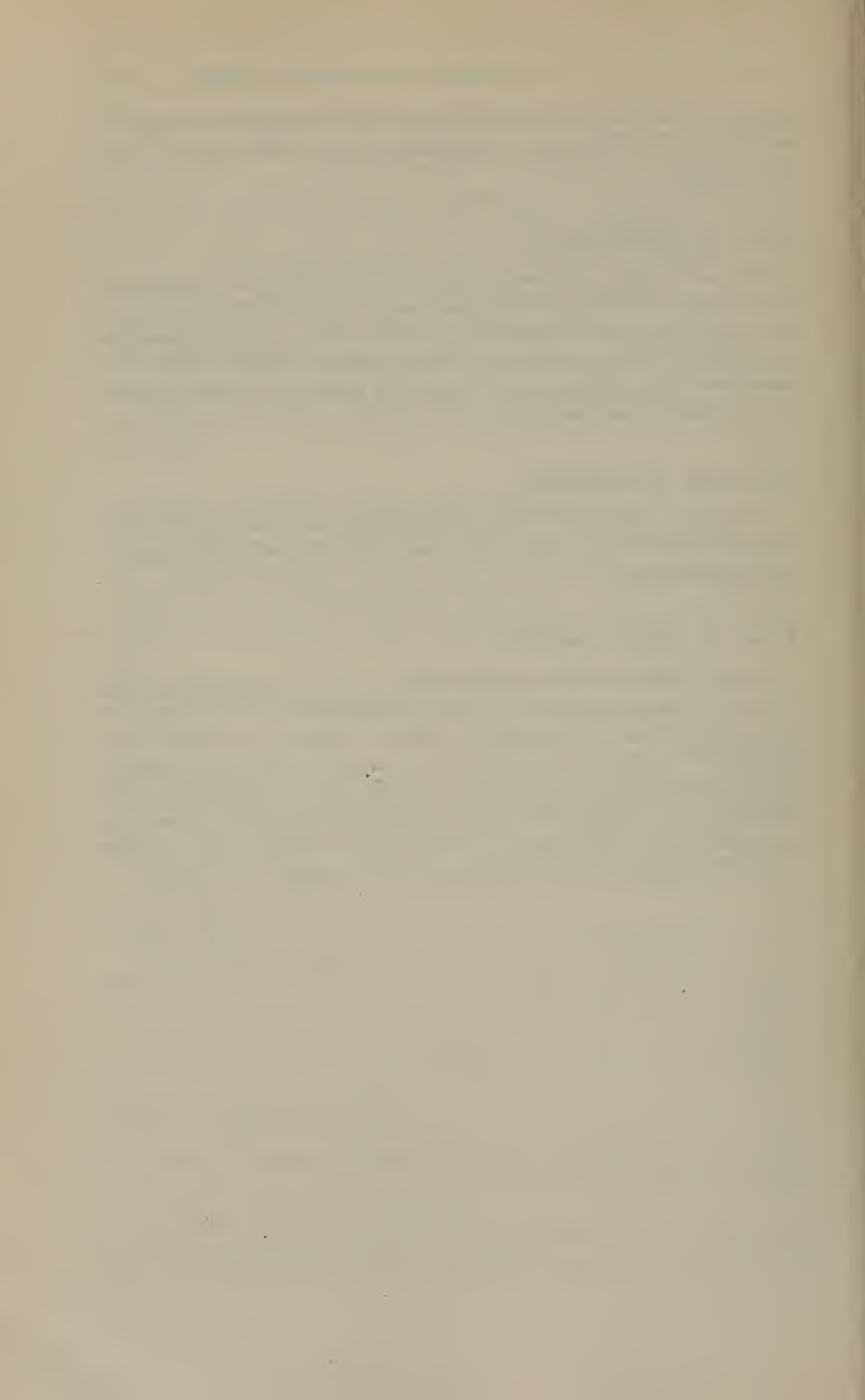
The outstanding balance includes \$44,386 owed by two cooperative associations in Oklahoma which has been uncollectible for a long time, but which there is no authority to write off or cancel. These two uncollectible debts originated in loans made in 1943 and 1950. Cooperatives were carrying cash on hand of \$623,071 to continue operations at the close of the year.

Financing of Enterprises

Payments of \$344,907 were delinquent. Enterprises were carrying as cash on hand at the close of the year \$2,586,323 with which to continue operations.

Loans to Attract Industries

In fiscal 1960 the Bureau made its first loan to a tribal organization for the purpose of attracting industrial development. This was to the Eastern Band of Cherokee in North Carolina and was in the amount of \$150,000. The tribe used the proceeds of the loan, together with a matching amount of tribal funds, for the construction of a building with 75,000 square feet of floor space which was leased to a manufacturing establishment. Initially, the industry will employ about 150 workers, with preference given to Indians.



Bureau of Land Management

Edward Woolzley, *Director*



FOR 175 YEARS America's public domain has been furnishing land and natural resources to help meet the needs of a Nation that has grown from less than 4 million people clustered on the eastern seaboard in 1785 to more than 180 million citizens across 50 States.

Out of the public domain that once included about 1.8 billion acres have been taken more than 1.1 billion acres to settle, develop, and use. No one can know or measure the real value of the public domain's contribution to the growth of the Nation.

Last year the public domain continued to fill its historic role, contributing enough timber to build a 50-foot boardwalk from New York to Los Angeles; enough oil to heat about 6 million American homes for a year; and forage for nearly 12 million livestock and big game.

In addition, the public domain managed by the Bureau of Land Management of the Department of the Interior produced revenues to the United States Treasury of more than \$371 million—an all-time record for any one year. Revenues during 1960 boosted total receipts by BLM to more than \$2.2 billion.

The following pages tell the story of BLM's important conservation activities during the fiscal year ended June 30, 1960. The report reflects the significant accomplishments of the last year and the great progress during the 1950's. It also portends much bigger jobs to be done in the future.

Lands

Americans are moving westward and to the suburbs. Industrial development is spreading to new areas. More and improved transportation is changing the Nation. These changes are also changing the role of the public domain as these lands and resources become more and more significant to the Nation's growth and development. The



Flash floods from the fire-scorched watershed swept through Boise on August 20. Tons of silt and muck were deposited on yards and streets.

management of these lands for all of the people of the United States is even more important and challenging than ever before.

The Bureau of Land Management has responsibility for determining the desirability of proposed changes in public land ownership and working out the changes. In accomplishing these tasks, the Bureau operates under authority of laws passed by Congress and regulations of the Department of the Interior.

Legislation

Legislative activities during the year yielded important progress. In Public Law 86-292, the Congress liberalized provisions of the Recreation and Public Purposes Act by (1) allowing States to acquire up to 6,400 acres each year for recreational purposes (with a temporary 3-year ceiling of 12,800 acres), and (2) confining the 640-acre limitation for other purposes to individual programs rather than to individual local governmental units. The reversionary clause previously limited to 25 years was made permanent.

Long-sought administrative improvements were achieved through enactment of Public Laws 86-509 and 86-649. The former act terminates overlapping responsibilities of the Department of Agriculture and the Department of the Interior for national forest exchanges and

several other national forest disposition laws. Except for mineral determinations, cadastral surveys, and issuance of land patents (deeds) responsibility for exchanges and other transactions now rests with the Department of Agriculture.

On July 14, 1960, the President signed Public Law 86-649, the Public Land Administration Act, which embodied a five-point program to improve the efficiency of public land administration.

The act authorized the Bureau of Land Management to conduct investigations, studies and experiments and to enter into cooperative agreements to carry out responsibilities with respect to the federally owned lands administered by the Secretary through the Bureau of Land Management.

It also authorized the Bureau to modernize fees required as service charges.

The law additionally authorized BLM to rehabilitate lands damaged by defaulting timber purchasers, and permitting the use of forfeited deposits or bonds for that purpose. It will permit BLM to accept donations of money, services, or property for the improvement or management of the public lands.

The act also authorized users of roads or trails under the jurisdiction of BLM to deposit sufficient money to enable the Bureau to keep them in satisfactory condition.

The legislation affected only those services which the Department performs on a fee basis and did not affect rentals for actual use of the public lands such as the grazing fees required by the Taylor Grazing Act.

The rapidly expanding economy of the West, sparked by large population increases, has made urgently necessary new legislation for the sale of lands for urban and business purposes.

Under terms of a bill proposed by the Department, BLM could sell up to 1,280 acres of unreserved public domain land to private firms or individuals or local government agencies.

The proposed Public Land Urban and Business Sites Act (H.R. 7042) would be the first major new concept relating to the acquisition of public lands since the Small Tract Act was passed in 1938. Land sold under this bill would not be sold for less than its fair market value. The bill would not apply to national forests, national parks, wildlife areas, or certain other lands in reserved status.

Two present gaps in the public land laws would be filled by H.R. 7042. At the present time, the Government usually may not sell more than 5 acres of public land to an individual purchaser for commercial or industrial development. Also, there is no means for making land available for urban and suburban residential development other than on a parcel-by-parcel basis.

The same influences that have led to increased needs for public lands have encouraged land speculators and promoters to take advantage of the desire of people to acquire lands for homesites, investment, or recreation. BLM and several States have taken a number of countermeasures which on the whole, have proved very effective. Activities of promoters were substantially reduced.

Another needed bill was H.R. 6290, a bill to consolidate and modernize the townsite laws, one of the Department's proposals for modernization of the public land laws.

The Department of the Interior has recommended repeal of the 1919 Pittman Act—originally designed to foster desert land reclamation in Nevada. The Department has asked repeal of this law because it has notably failed in its original intent, and is now being used principally for land speculation. Despite 40 years of operations under the act, only three economic farm units have been developed.

The Department has also asked for repeal of a law which allows nonresidents of Nevada to file applications under the Desert Land Act. In all other western States people must be residents of the State in order to file applications.

The nonresident provision appears to have had no appreciable influence on the development of Nevada agriculture. From the passage of the act of January 6, 1921, through 1958 only 17 patents were issued to nonresident entrymen. The nonresident provision has been employed by unscrupulous land locators in bilking the public.

As another part of the legislative attack on speculation, the Department has sponsored a bill by which land speculators would no longer be able to use an adjoining-owner preference right as a means of obtaining public lands put up for sale.

The bill is aimed at stopping speculative activities under the so-called Public Sale Act—a law which permits BLM to classify and sell tracts of isolated or disconnected public domain lands up to 1,520 acres. Such lands are appraised and sold by competitive bidding.

Under present law, the owner of land adjoining that which has been put up for sale has a preference right to purchase the tract at three times the appraised price or by matching the high bid, whichever is less.

In the past, some land speculators have been able to take advantage of this situation by buying a few acres adjoining the lands for sale (sometimes even after the sale has been advertised) and then claiming the preference right.

The proposed bill could clamp down on such speculative possibilities by limiting the preference right to adjoining land owners who own at least a legal subdivision and who have owned it for at least 1 year, or who have inherited the land.



Range seeding builds the productivity of the land, producing more feed for wildlife and livestock and vegetation to hold the soil.

Regulations

To facilitate processing State exchanges, regulations were issued that will close public lands to the filing of new applications when the lands have been applied for as part of a Federal-State land exchange.

The new rules will not permit the filing of additional applications approval of which are discretionary. State exchanges are essentially mandatory. The new rules will speed up processing of the States' applications by eliminating the need for processing applications which could not be approved.

Improved controls over billboards on Federal lands are provided in new regulations to protect scenic value of the public lands.

The new controls have as their minimum standards the highest standards set up by the Department of Commerce and by State governments. But the regulations permit the Department of the Interior to raise the safeguards in cases where the minimum controls would be inadequate.

Adjudication and Classification

Since almost all lands action involves adjudication, the number of unclosed cases and the cases closed per year give a general indication

of the status of the program. During the past 6 years, there has been a tremendous backlog of work, due primarily to the filing of thousands of applications.

During fiscal year 1960, an objective was established to reduce the backlog within 5 years. Progress exceeded expectations.

Several substantial improvements in classification operations were achieved during the year.

In certain areas where land locators have induced large-scale filings of agricultural applications for lands that are clearly nonagricultural in character, the Department has adopted a combined decision-classification to close the lands to further agricultural applications. In one such action, taken in connection with a large number of appeals actions, the Department classified more than 1 million acres in southern California for nonagricultural use. Applications under the agricultural land laws will no longer be accepted for the lands involved, all of which are not suitable for irrigated farm development.

Adjudication of lands cases, Bureau of Land Management, fiscal year 1960

Type of case	Unclosed cases, July 1, 1959	New cases during year	Reactivated cases during year	Cases closed during year	Unclosed cases, June 30, 1960
Title transfers:					
Homestead	2,977	2,625	4,423	6,579	3,446
Desert land	6,756	1,629	862	5,427	3,820
Public sales	3,761	2,084	141	2,043	3,943
Selections	1,244	903	214	755	1,606
Exchanges	948	280	33	362	899
Land title cases	3,245	3,242	1,731	5,363	2,855
Small tract (unclassified land)	21,230	3,567		7,516	17,281
Small tract application and drawing (classified land)	4,950	575	4,225	5,460	4,290
Small tract (auction)	342	1,464	86	1,731	161
Small tract (options)	5,259	16	4,903	7,207	2,991
Recreation and public purposes sales	454	232	95	228	553
Total title transfers	51,166	16,617	16,713	42,671	41,825
Leases and permits:					
Nonmineral leases	108	76	44	79	149
Rights-of-way	1,660	1,909	1,204	3,377	1,396
Nonmineral permits	598	780	490	1,452	416
Nonmineral material sales	13	124	89	179	47
Recreation and public purposes leases	99	97	25	92	129
Small tract leases	159	26	99	126	158
Total leases and permits	2,637	3,012	1,951	5,305	2,295
Investigations:					
Trespass	4	4	1	3	6
Other	131	199	4	236	98
Total investigations	135	203	5	239	104
Other tenure actions:					
Withdrawals and reservations	662	132	82	274	602
Revocations and restorations	330	261	84	169	506
Offers of excess land	3	24	2	24	5
Total other tenure actions	995	417	168	467	1,113
Total	54,933	20,249	18,837	48,682	45,337

In areas where continued retention of lands in Federal ownership for multiple use management, including management for public recreation, was indicated, the lands were classified under section 7 of the Taylor Grazing Act.

These two improvements in classification techniques represent constructive steps to make classification decisions in a more orderly and productive manner. This reduces the expenditure of public funds on nonproductive rejection of applications, thereby freeing manpower for constructive activities. In addition, it eliminates the public frustration which results from being allowed to file applications which must later be rejected.

Continued improvement was also made in the lands appraisal activity. Area and State reviewing appraiser positions were established in fiscal year 1960 to insure that all Bureau land-appraisal personnel receive the best possible advice on appraisal matters. Increased emphasis was placed on formal training and informational programs to keep all appraisal personnel up-to-date on the latest developments.

Public Recreation Land Use

Outdoor recreation is a resource of land which requires management. State and local governments are becoming more involved in recreation planning, and in many areas are looking to the public domain to help fill their recreation needs. During 1960, outstanding progress was made in the development of Bureau policies and programs for public recreation.

Under the Recreation and Public Purposes Act, vacant and unreserved land most suitable for public recreation has been classified by the Bureau for lease or purchase by State or local governments, and nonprofit organizations at reduced cost. Approximately 30,500 acres in 12 western States were classified for transfer or use under this act during 1960.

The Bureau's inventory of public domain lands having some special recreation value continued during the year. Preliminary estimates indicate that over 4,300 sites containing more than 19 million acres of public domain will be identified as having particular recreational value.

Practically all vacant unreserved public domain lands along the Pacific Coast have been classified for potential recreation use. Forty-five areas of high recreation potential have been identified in southern California, ranging from 40 to 300,000 acres.

Continued public use of more than 500,000 acres of public domain lands within an area of more than 1,200 square miles in the Steens Mountains of eastern Oregon has been provided for by a BLM classi-



Earth dams will hold the water and prevent the water from running off too fast. Many such dams have been built by BLM on western rangelands.

fication action which dedicates the area for retention in Federal ownership as a multiple purpose land management area. The classified area contains some of Oregon's finest deer-hunting lands.

Classification of the lands as a balanced multiple purpose land management area marks one step in the BLM program to work out long-term cooperative plans for the use and development of the area, including cooperative financing of the construction of access roads and public recreation facilities.

Classification action was also completed on the Lower Deschutes River land management area by an agreement with the Oregon Fish and Game Commission providing ample tenure for the development necessary to protect, preserve, and foster access to this nationally known fishing area.

Under the Recreation and Public Purposes Act, Arizona's Maricopa County has pending lease applications covering approximately 69,000 acres in six areas surrounding Phoenix. The tracts range from 1,200 to 28,000 acres and are planned for development as regional parks under the county Parks and Recreation Department.

Utah has initiated the development of a State park system estimated to include public domain land for 60 major areas and many smaller areas for parks, campgrounds, roadside areas, and historic sites.

Antispeculation Activities

During fiscal year 1960, emphasis was placed on an intensified program to inform the public of their rights and privileges under the public land laws, and to publicize and implement the Department's antispeculation policy.

This policy strengthens public safeguards by making it virtually impossible to use land exchanges under section 8 of the Taylor Grazing Act and other land laws to make windfall profits by acquiring public domain lands at less than fair market value. Many applications pending at the time the policy was introduced had to have additional evidence supplied by the applicant, or had to be rejected.

The new policy statement on Federal-private land exchanges contains five principal safeguards:

1. The Government will no longer approve exchanges involving people who do not actually own and hold title to the lands they are offering for exchange. Formerly it had been possible for people to make exchanges on the basis of options and purchase agreements.
 2. As a matter of policy, BLM will not approve any exchanges in areas where the real estate market is so unstable or uncertain that values cannot be established with confidence.
 3. No exchanges will be approved where there is a marked dissimilarity in location or character of the offered and selected lands. Under the law, the value of the selected lands may not exceed the value of the offered lands. Marked dissimilarity works against equating of values.
 4. Exchanges will not be approved unless there would be a clear and positive benefit to the Government with the likelihood that the lands gained by the Government will remain in the Federal ownership for many years for resource conservation purposes. The mere fact that an exchange will result in "blocking up" Federal ownerships will not, in itself, be regarded as meeting the legal requirement that the exchange must be "in the public interest."
 5. When the Government blocks out land-ownership patterns for management purposes, private land exchanges will only be used when that means would clearly be a more economical and effective way to obtain the lands than by direct purchase or condemnation proceedings.
- Other policy safeguards were adopted in connection with public sales and other transactions.



In addition to contour trenching on the Boise watershed, grass seed was drilled on every critical acre of public domain land that machinery could reach. Broadcast seeding was done on areas too steep to drill. Note the drilling furrows above the trench on the left.

Land Selections

It is the policy of the Bureau to take final action on outstanding valid scrip and State selection rights as soon as possible.

There was very little scrip activity outside of California where the filing of scrip increased greatly during fiscal year 1960. The majority of this scrip has been filed on lands of substantial value, and in most cases a number of conflicting applications are involved.

Most States have nearly exhausted their selection rights. However, in Alaska, the State's land selection activities are very important. The Statehood Act granted Alaska selection rights to an area larger than California. Alaska has 25 years to complete these selections. So far, selections totaling about 4 million acres have been concentrated in the Anchorage district and include virtually all of the accessible lands in the Kenai Peninsula, Matanuska, and Susitna Valleys, plus other areas of the Tanana, and Nenana River Valleys.

Small Tracts

Strong public interest in small tracts continued in fiscal year 1960. Approximately 10,000 sales were made of over 38,000 acres. Several areas were opened to small-tract application, including one near the White Sands Missile Base to provide homesites for missile workers.

Withdrawals and Restorations

In 1960, 256 public land orders withdrew 180,163 acres of public domain lands and restored 1,259,880 acres from withdrawn status.

A continual review is carried out by all Bureau offices to determine if existing withdrawals are still serving their purposes. During fiscal year 1960, withdrawals totaling about 105,285,000 acres were reviewed.

Minerals

One of BLM's more important responsibilities is conservation and development of publicly owned mineral resources. There have been increasing demands for nearly all types of minerals. BLM has actively pursued a program to encourage the location and development of valuable mineral deposits on public lands by private enterprise. Such a program is absolutely necessary for national defense and, of course, it benefits private enterprise and local economies.

Certain minerals may only be leased for development—oil and gas, potash, sodium, phosphate, coal, and, in Louisiana and New Mexico, sulphur. Mining claims may be staked for other minerals under the United States mining laws. The holder of a valid mining claim, upon meeting the legal and regulatory requirements, may obtain patent to the minerals and the land (plus any surface resources then on the claim).

The Bureau's overall program in fiscal year 1960 resulted in improved and accelerated public service. BLM sought during the year to expedite, through the promulgation of new regulations and procedures, the adjudication of all mineral leasing applications and offers. During the year a study was launched to find methods which would simplify the procedure for obtaining a mineral patent.

BLM's minerals program contributes to many local and State economies. The States share in the income derived from mineral leasing on public lands, and the funds are used for roads, schools, hospitals and many other public facilities.

Mineral Production From Federal Lands

Production of minerals from federally owned lands during fiscal year 1960 showed increases in all commodities. From public lands

came more than 147,100,000 barrels of petroleum, 462,100,000 m.c.f. (thousand cubic feet) of natural gas, some 13,014,000 tons of potash, 5,419,000 tons of coal, 1,410,000 tons of phosphate rock, 159,000 tons of silica sand, 1,013,000 tons of sodium salts, and 130,000 tons of sulphur, plus other minerals in smaller quantities. There was an increase of more than 10 million barrels of petroleum from the plains States and Rocky Mountain areas during 1960. Petroleum production in Alaska amounted to some 209,000 barrels, the first reportable commercial oil production from the new State.

Oil and gas leasing has continued at a high level, with substantial increases in Outer Continental Shelf leasing. Total oil and gas leases increased from 138,400, covering less than 112 million acres on June 30, 1959, to nearly 147,000 leases covering about 121 million acres on June 30, 1960. The biggest increases occurred in Alaska, Arizona, Colorado, New Mexico, Utah, and Wyoming.

Petroleum production from the Outer Continental Shelf increased by 5,041,696 barrels, and acreage under oil and gas lease increased by 340,866 in fiscal year 1960. Gas production from this area increased by 29,181,672 thousand cubic feet.

As provided in the Mineral Leasing Act the States received payments as their share of the revenues from Federal mineral leasing. Payments during 1960 totaled more than \$34,700,000.

Protective oil and gas leases within Camp Breckenridge, Ky., and the Barksdale Air Force Base, La., were issued by the Bureau to protect the United States from drainage by wells on adjoining privately owned lands. Jurisdiction over the mineral deposits in the lands had previously been transferred by the Department of Defense to the Department of the Interior. The lands were leased competitively for bids that totaled \$989,307.

The first competitive salt lease bid opening on Outer Continental Shelf lands was held in 1960. The lands were already under Federal oil and gas and sulphur leases. Leasing of the lands for salt development will result in production of oil, gas, sulphur, and salt from the same leasing blocks. A bonus of \$75,250 was received for the 2,500-acre salt lease.

Oil and Gas Leasing in Alaska

The marked interest in oil and gas leasing in Alaska continued during the past year. The number of oil and gas leases in Alaska increased from 15,100 to 16,500. The area under lease in Alaska also increased by almost 2 million acres to a new high of more than 33.9 million acres. There are 13 producible wells in Alaska—9 for oil and 4 for gas. Eleven of these wells were completed during the last year.

At a competitive oil and gas lease bid opening in Fairbanks, Alaska, BLM opened high bonus bids totaling \$206,000 on 16 tracts covering 9,105 acres in the Gubik gasfield, adjacent to Naval Petroleum Reserve No. 4 and abutting the west side of a 16,000-acre area already under lease.

The bid opening held in early 1960 was the second Federal competitive oil and gas leasing of Alaska lands, both of which involved lands in the Gubik gasfield. The latest area leased lies within a 2-mile buffer zone established around Petroleum Reserve No. 4. Leasing of the area was recommended by the Secretary of the Navy to prevent loss of revenues through drainage resulting from nearby development.

Private development firms have let contracts during the year for construction of two major pipelines in Alaska. One will run from the Swanson River-Soldotna Creek oilfield to docking facilities at Nikishka on Cook Inlet. The other will run from the Kenai gasfield to Anchorage, supplying that city with its first natural gas and opening the way to expanded resource industries in the community.

Regulations

Oil and gas lease operators' drilling bonds have been raised from \$5,000 to \$10,000 to increase protection to the surface owners of land under oil and gas lease.

Drilling bonds protect surface owners from damages to crops and improvements on lands leased by the Federal Government for oil and gas development.

The \$10,000-bond rate is based on rising monetary values of land improvements. The old \$5,000-bond rate has been in effect since the first oil and gas leases were issued under the Mineral Leasing Act of 1920.

New cooperative safeguards over Federal oil and gas leasing have resulted from amendments to the oil and gas leasing regulations. They apply specifically to so-called acquired lands in which the surface of the land is no longer in Government ownership but in which the minerals have been reserved.

The regulations permit the surface owners of acquired lands to suggest safeguards and special leasing conditions which would apply to any mineral leases issued by the Federal Government for subsurface mineral deposits. The regulations specifically apply only to cases where the surface of the land is owned by a State or local government agency or nonprofit educational, charitable, or religious group.

BLM will notify the surface owners about any application for lease and will give them an opportunity to suggest any necessary safeguards



New growth now blankets this area that was burned over 40 years ago. Millions of seedlings are planted each year on burned and cut over areas to hasten the day when a new forest crop will be available for harvest.

to protect the surface use of the lands. This procedure has been informally practiced by the Bureau of Land Management and is now spelled out in the official regulations.

Other new regulations cover filing procedures on wildcat lands where an existing lease is canceled, expired, relinquished, or terminated. The new regulations do not affect regular 5-year extensions of existing leases.

The new system calls for a 5-day period each month during which applications may be filed for lands involved in the previous month's canceled, relinquished, expired, or terminated leases. The 5-day period follows the third Monday of each month or the next working day if Monday is a holiday. On that Monday each BLM Land Office posts a notice on the bulletin board listing the lands available.

All applications received during the 5-day period each month are treated as if they had been filed simultaneously. Priorities of applications will be determined by a public drawing.

The changes in the method of filing applications afford all interested parties an equal opportunity to apply for lands formerly under lease. They save much wear and tear on the public land records. The old system had placed a premium on making rapid searches of Land Office records each morning to find lands newly available for leasing.

The new regulations became effective in January 1960. The first lists of lands were posted in some Land Offices later the same month. More than 14,000 lease offers were received by the Land Offices in February. Approximately the same number were received in subsequent months.

New oil lease regulations require that simultaneous offers for oil and gas leases be accompanied by guaranteed negotiable remittances, covering advance lease rentals, not merely checks which might be drawn against insufficient bank deposits. Only cash, money orders, certified checks, bank drafts, or bank cashier's checks are now acceptable to cover advance rentals. Filing fees are payable by uncertified or personal check. Under the old system an unscrupulous person could file numerous offers accompanied by checks drawn against insufficient funds.

Bona fide purchasers of oil and gas leases who conform to Federal acreage limitations are now protected against loss of their leases even if the previous owners of the leases violated those limitations.

The Code of Federal Regulations has been amended to include the provisions of a law approved by Congress on September 21, 1959. The law protects the title or interests of anyone who in good faith acquired a lease or interest in a lease. Such bona fide purchasers will be dismissed from any cancellation or forfeiture proceedings brought against another party for abuse of Federal acreage regulations.

Legislation

Legislation to repeal the waiver of the second and third years' rental on noncompetitive oil and gas leases and to increase the minimum acreage rental from 25 cents to 50 cents per acre per year has been

sponsored by the Department. The legislation was passed by the Congress and approved by the President shortly after the end of the fiscal year. The present regulations require payment of 50 cents per acre for the first year and 25 cents per acre for the fourth and fifth years. Rental for the second and third years is waived. The rental increase will encourage exploration and help remove the incentive for speculation in leases. Under this legislation, the Government is expected to receive more than \$62 million in additional revenue by 1965.

Other legislation sponsored by the Department would prevent the subdividing of Federal oil and gas leaseholds into leases covering less than 640 acres.

The proposed minimums would protect unwary investors against misleading advertising promotions which imply that many average citizens can "strike it rich" by speculating in a subdivided lease covering a small holding, usually 40 acres.

One necessary exception would be where the entire acreage of an existing valid lease is less than 640 acres.

Other Mineral Activities

Public Law 167 activities continued at a high level during fiscal year 1960. Under this law the Federal Government has the right to manage the surface resources, including timber and forage, on all unpatented mining claims staked after July 23, 1955. For all claims staked before that date, the Government may gain the right to manage the surface resources under a legal procedure provided for in the law.

The law was passed as a conservation measure to prevent mining claims from being staked or used for nonmining purposes and to prevent timber waste. Before the law was passed, neither the Government nor a miner could legally harvest the timber on an unpatented mining claim.

The legal actions spelled out by the law require BLM to examine areas to see if there are any unpatented mining claims. Following examination, a notice is published stating that a determination of surface rights on mining claims will be made. A miner may choose not to respond to the notice—in which case he loses no mineral or mining rights whatsoever, while the Government acquires the right to manage the surface resources. Or he may file a so-called verified statement.

If a miner files a verified statement, BLM then determines whether the specific claim is valid under Public Law 167. If it is valid, the Government will not gain the right to manage the surface. If it is not valid, the Government obtains the right to manage the surface

resources. Public Law 167 proceedings, however, are not used to determine the validity of a mining claim for patent purposes. Under Public Law 167 proceedings no miner loses any possessory rights in connection with his mining or his rights to mine and to use as much of the surface as is necessary in his operations.

At the close of the fiscal year, the Bureau completed preliminary examinations on 5,213,884 acres, with 5,072,965 acres having been published. This resulted in the filing of 505 verified statements for 2,532 mining claims. Over three-quarters, or 2,065 claims, have been examined as a result of filing verified statements.

Determination of surface rights has been completed on nearly 90 percent (4,734,408 acres) of the acreage under preliminary investigation. Of the claims examined, the Government did not acquire surface resource management rights on 560 claims.

In addition to the program on public domain lands, BLM published notices or received requests to publish notices from the United States Department of Agriculture on 74,836,766 acres and has processed verified statements involving 16,137 mining claims. Closing decisions, completing the determination of 23,933,781 acres, have been issued. The Government did not acquire surface management rights on 294 claims.

Sales of materials other than timber under the Materials Act during fiscal year 1960 amounted to \$91,226.12. The free use permits issued are valued at \$748,428. The greater percentage were for sand and gravel for road construction.

Under the general mining laws, the Bureau of Land Management closed 305 cases involving title transfers. New and reactivated cases totaled 284. Mineral patents issued showed an increase over the previous fiscal year. 168 patents were issued for 28,015 acres of mineral land during fiscal year 1960.

Public Law 359 permitted the location of mining claims on lands withdrawn for powersite purposes. By the end of 1960, 11,380 claims had been staked on these lands and recorded in the Land Offices.

Public Law 357 permitted mining claims for uranium on public lands classified or known to be valuable for coal. It also provided for the extraction of uranium intermingled with lignite with the payment of 10 cents per ton for any lignite removed. On June 30, 3,206 claims had been located on public lands (most of which were in South Dakota) and recorded with BLM.

In California a great deal of speculation has resulted from mining claim promoters purporting to "locate" mining claims and do annual assessment work for others. For the most part, the claims are located in areas of rapid expansion and rapidly changing land values. All such "claims" investigated so far have been found to contain no min-



Forest harvest patterns make the mountains look like they have been clipped with giant shears. In old growth Douglas fir clear cutting patterns will be in even aged blocks of second growth. Intolerant of shade, Douglas fir must be harvested in blocks so the new trees all grow up together.

erals. The Bureau is taking aggressive action against invalid claims, so that the questionable practices of these promoters will be exposed and stopped.

Lands and Minerals Appropriations

The lands and minerals activity of the Bureau of Land Management includes a complex array of classifications and field investigations, adjudication, and a records modernization program, plus the public service operations of the Bureau's Land Offices. Total BLM appropriations for the lands and minerals activity in fiscal year 1960 amounted to \$7,205,200.

Adjudication of mineral cases, Bureau of Land Management, fiscal year 1960

Type of case	Unclosed cases, July 1, 1959	New cases during year	Reactivated cases during year	Cases closed during year	Unclosed cases, June 30, 1960
Title transfers:					
Mineral entries (BLM and other).....	502	176	19	213	484
Mineral entries (Forest Service).....	263	74	15	92	260
Land disposition conflicts.....	775	2,766	4	942	2,603
Mineral classification.....	106	85	2	141	52
Total title transfers.....	1,646	3,101	40	1,388	3,399
Permits and leases:					
Oil and gas noncompetitive (public domain).....		113,639			
Oil and gas competitive (public domain).....					
Oil and gas noncompetitive (acquired lands).....	Total 18,069	3,004	34,557	139,231	27,034
Oil and gas competitive (acquired lands).....					
Oil and gas assignments and transfers.....	2,240		1,763	4,494	2,513
Oil and gas overriding royalty assignments.....	7,261	27,739		28,566	6,434
Other permits and leases.....		7,840		7,840	
Coal.....	57	13	243	260	53
Potassium.....	318	195	267	445	335
Phosphate.....	421	257	807	1,291	194
Sodium.....	26	107	25	48	110
Hardrock.....	885	385	528	1,439	359
Mineral material sales (common varieties).....	480	171	266	682	235
Outer Continental Shelf (sec. 6).....	39	194	54	213	74
	33	191	2	218	8
Total permits and leases.....	29,829	153,735	38,512	184,727	37,349
Nonreimbursable investigations:					
Surface management (BLM and other).....	1,167	271	159	845	752
Surface management (Forest Service).....	10,054	4,033	489	4,410	10,166
Powersite mining claims (BLM).....	735	164	802	1,357	344
Powersite mining claims (Forest Service and other).....	56	456	31	379	164
Mineral claims and leases.....	181	91	2	134	140
Multiple use conflicts (non-title transfer).....	852	150	149	586	565
Special laws.....	841	3,438	266	1,311	3,234
Uranium-coal mining claims.....		21		16	5
Other compliance.....		7		1	6
Total investigations (nonreimbursable).....	13,886	8,631	1,898	9,039	15,376
Reimbursable investigations.....	3,477	10,871	137	10,700	3,785
Total minerals adjudication.....	48,838	176,338	40,587	205,854	59,909
Grand total.....	103,771	196,587	59,424	254,536	105,246

Areas leased and bonuses received, competitive mineral leases, Bureau of Land Management, fiscal year 1960

Type of mineral and State	Public domain lands		Acquired lands		Total	
	Acres leased	Bonus received	Acres leased	Bonus received	Acres leased	Bonus received
Oil and gas:						
Alaska.....	9, 105. 00	\$206, 027. 10			9, 105. 00	\$206, 027. 10
Arkansas.....	408. 28	253. 13	3, 682. 68	\$2, 246. 58	4, 090. 96	2, 499. 71
Colorado.....	1, 394. 00	102, 518. 00			1, 394. 00	102, 518. 00
Kansas.....	80. 00	1, 269. 60	160. 00	2, 817. 60	240. 00	4, 087. 20
Louisiana.....	199. 70	2, 091. 20			199. 70	2, 091. 20
Mississippi.....			100. 02	2, 500. 50	100. 02	2, 500. 50
New Mexico.....	3, 036. 00	201, 405. 00			3, 036. 00	301, 405. 00
Oklahoma.....	137. 00	9, 575. 00			137. 00	9, 575. 00
Utah.....	240. 00	195. 84			240. 00	195. 84
Virginia.....			402. 00	2, 042. 16	402. 00	2, 042. 16
Wyoming.....	2, 961. 71	33, 796. 50	40. 00	2, 127. 60	3, 001. 71	35, 924. 10
Total oil and gas.....	17, 561. 69	657, 131. 37	4, 384. 70	11, 734. 44	21, 946. 39	668, 865. 81
Coal:						
Colorado.....	1, 958. 00	6, 575. 00			1, 958. 00	6, 575. 00
Utah.....	1, 160. 00	1, 240. 00			1, 160. 00	1, 240. 00
Wyoming.....	1, 240. 00	1, 240. 00			1, 240. 00	1, 240. 00
Total coal.....	4, 358. 00	9, 055. 00			4, 358. 00	9, 055. 00
Sodium:						
California.....	10. 00	26, 000. 00			10. 00	26, 000. 00
Wyoming.....	4, 973. 24	69, 037. 40			4, 973. 24	69, 037. 40
Total sodium.....	4, 983. 24	95, 037. 40			4, 983. 24	95, 037. 40
Mica:						
Idaho.....			40. 00	40. 00	40. 00	40. 00
Diatomaceous earth:						
New Mexico.....			160. 00	328. 00	160. 00	328. 00
Phosphate:						
Montana.....	400. 00	4, 020. 00			400. 00	4, 020. 00
Utah.....	1, 806. 88	2, 811. 00			1, 806. 88	2, 811. 00
Total phosphate.....	2, 206. 88	6, 831. 00			2, 206. 88	6, 831. 00
Grand total.....	29, 109. 81	768, 054. 77	4, 584. 70	12, 102. 44	33, 694. 51	780, 157. 21

Public Land Surveys

In 1785 the Continental Congress spelled out the basic plan of survey of the lands which had been relinquished to the new Nation by the 13 Colonies. That land was the nucleus of the public domain of the United States. The plan of survey provided for division of the lands into townships 6 miles square, each township being subdivided into 36 sections 1 mile square, with the boundaries running due north, south, east, and west.

That plan of survey of the public lands, with slight modification, has been followed since that time. The plan is simplicity itself and results in a vast rectangular pattern. The orderly fields, laid out as squares which may be seen in a cross-country flight, illustrate the regularity of this plan of survey.

This system of survey, which is the simplest coordinated system of land subdivision that history has recorded, is a necessary fore-

runner to any comprehensive plan of land and resource management. Public land surveys under the rectangular system are called cadastral surveys—a major responsibility of the Bureau of Land Management.

Cadastral surveys include not only the original survey of the public lands but also the resurvey of those areas where old corner monuments have been obliterated or destroyed by the elements or by man in the construction of improvements. By far, the major portion of the unsurveyed area of the public lands is in Alaska. The resurvey work is confined almost exclusively to 11 western States where most of the public lands are located.

The public land surveys in fiscal 1960 saw the virtual completion of the program of survey of school-land grants in Utah. Major emphasis was placed on the surveys and resurveys necessary in the management of the timber resources, particularly in Oregon and California, and to the surveys necessary for providing homesites for the rapidly expanding populations of California and Arizona.

The program also was geared to the needs for boundary determination in the administration of the Federal range and for the development of mineral resources.

In Alaska the program was directed principally to surveys of lands selected by the State under its 103-million acre statehood land grant.

During fiscal year 1960, surveys and resurveys embracing 1,405,488 acres in the public-land States were officially accepted. Of this total, approximately 68 percent were resurveys. Additionally, field work was completed in the survey and resurvey of 1,739,263 acres. Many other surveys which cannot be measured on an acreage basis were also completed in the field during the year.

Expenditures by the Bureau of Land Management for cadastral surveys totaled \$3,016,616. Cadastral surveys were undertaken for other Federal agencies on a reimbursable basis at a total cost of \$181,695, while the Bureau received private contributions of \$51,643 for cadastral surveys.

Alaska Surveys

To handle the surveys of State land-grant selections, BLM has increased its surveying organization in Alaska. During the year, the survey of 432,050 acres was completed in the field of which 297,868 acres were on large special and rectangular survey projects of State selections. Much of the remainder was indirectly connected with State selections involving the identification of lands to which individual rights had been attached.

In the expanded program in Alaska, new survey concepts and techniques have been developed and employed involving the use of elec-

tronic distance measuring devices, photogrammetric procedures, and improved instrumental equipment.

During the year, the State of Alaska filed selections totaling about 4 million acres, indicating need for even further expansion of this program if satisfactory progress is to be maintained in surveying the exterior boundaries of State selections and the boundaries of uncounted thousands of private land claims inside the selected areas.

Protraction Surveys

Following the successful use of protracted surveys of leasing blocks on the Outer Continental Shelf, BLM decided to extend the plan of rectangular surveys over the unsurveyed areas in Alaska and the larger tracts of unsurveyed public land in other States. Protracted surveys are lines drawn on maps that follow the public land survey system, even though the boundaries have not yet been laid out on the ground. This will facilitate mineral leasing by replacing the complicated metes and bounds land descriptions with the simplified descriptions of the public land survey system. The protractions also fit into the orderly development of the new public land records.

In Alaska, the protractions will help the State make selections and will simplify the surveys necessary to define the exterior boundaries of selections.

During the year, protraction folios covering approximately 284,565,000 acres in Alaska were completed. Of these, 870 protraction sheets embracing approximately 250 million acres were officially approved and made available for use in oil and gas leasing and other purposes.

In addition, 92 protraction sheets over unsurveyed areas in Arizona, New Mexico, and Montana were officially approved during the year.

Outer Continental Shelf

The United States Supreme Court held that the boundaries of Texas and Florida in the Gulf of Mexico are three marine leagues from the coast while as for Louisiana, Mississippi, and Alabama, State boundaries are three geographic miles from the coast (363 U.S. 1 [1960] and 363 U.S. 121 [1960]). However, the Court did not specify what constituted the coastline from which these distances are to be measured.

During fiscal year 1960, the Bureau of Land Management continued work with the State of Louisiana and the Coast and Geodetic Survey to map the line of low water along the coast of Louisiana. This project has been undertaken to reach agreement on the line of low water



Fire destroys—This Alaska fire will soon have men on it, as BLM moves in to check the destructive forces of wildfire.

as a basis for settlement of many issues involved in administration of the resources of the Outer Continental Shelf off Louisiana.

During 1960, lease block maps were prepared covering some 6,600,000 acres of submerged lands off the coast of Louisiana and 3,400,000 acres off Texas. These maps extend the lease block system to approximately 100 fathoms (600 feet).

Forestry

Forests are one of the Nation's most valuable renewable natural resources and wood fibre one of its most useful raw materials. The Bureau of Land Management's responsibility for more than 160 million acres of public forest and woodland occupies a prominent place in the Department's integrated resource conservation program.

The post World War II years, especially the past decade, have seen important changes in the Nation's forestry outlook. Although lumber continues as the Nation's primary use of wood, there has been phenomenal growth in the use of wood pulp and plywood. One of the significant conservation achievements in recent years has been the

conversion of huge quantities of formerly wasted sawmill residues into chips for pulp. It has been estimated that the equivalent of at least 1½ billion board feet of waste is converted into pulp and paper each year without causing any added drain on the Nation's supply of standing timber. This is just one illustration of how the Nation is getting more out of what it has.

The forest lands administered by the Bureau of Land Management fall into two principal categories: First, the revested Oregon and California Railroad grant lands and the Reconveyed Coos Bay Wagon Road lands in western Oregon, which together are referred to as the O&C lands; and, second, the public domain forest lands in the western United States.

During 1960 Bureau appropriations for forestry amounted to \$6,037,700. This includes all forest management and development plus fire contract protection.

The Western Oregon Forest Lands

BLM's forestry program for the Oregon and California Railroad grant lands (O&C) and Coos Bay Wagon Road lands (CBWR) deals with one of the most challenging management problems in American forestry. Encompassing about 2.1 million acres, these lands contain some of the finest, high quality, old growth timber in the Nation.

Since 1937 the U.S. Treasury has gained more than \$28 million over and above all cost of acquiring, holding, and managing these lands. This rapidly growing Treasury surplus, most of which was accumulated since 1951, is already more than four times as much as the original cost of the O&C lands.

The annual harvesting of timber on these lands is limited to their sustained yield capacity. Their average annual capacity, based on an intensive inventory of the growing stock was recalculated at 874.2 million board feet in 1959. As reforestation and other silvicultural practices are intensified, the timber yield is growing.

During fiscal year 1960, salvage sales and improvement cuttings in second growth stands added enough volume to the allowable cut so that a total of more than 1 billion board feet of timber was sold. The total sale price was \$34,328,520.48. Both of these figures—volume and value sold—represent new all time records.

Actual O&C timber sale receipts during fiscal year 1960, based on collections from timber sale contracts amounted to \$28,210,531.86; collections from sales on CBWR lands came to an additional \$1,311,004.64.

The O&C project is one of the most successful forestry enterprises of the Federal Government. Despite the cutting of more than 10

billion board feet of timber since 1937, the volume of timber on these lands today is greater than when the management program was initiated. During the past 10 years the gross forest income per acre has shown a spectacular increase. In 1951 it was \$3.13. In 1960 it was \$13.76.

The importance of the rising level of timber production under good management over the decade is emphasized when it is realized that forests provide more than half the industrial employment in Oregon. Each million board feet cut provides year-round employment for at least 15 industry workers and other employees of dependent service industries.

Public Domain Forest Lands

In thirteen western States, the Bureau of Land Management administers about 33 million acres of public domain forest lands, of which some 4 million acres are classified as commercial forest lands and about 29 million acres as woodland.

The general management objectives for the commercial forest lands in these States is much the same as for the O&C lands. Long-term management, however, is complicated by the fact that these lands are subject to application for entry and possible transfer out of Federal ownership under the public land and mineral laws. Much of the commercial public domain forest land exists in fragmented, wide-spread tracts.

When timber is sold on these lands, the mature and overmature age classes are designated for cutting. This plus other measures, such as fire protection, leave the cutover lands in permanent productive condition.

In 1951 sales from the commercial public domain forest lands amounted to 83.7 million board feet valued at \$1,348,151. By 1960 the volume of timber sold had increased to 138 million board feet valued at \$2,362,000.

The 29 million acres of public domain woodland exist in large, well-consolidated blocks, in BLM grazing districts but have little commercial value at the present time. Most of this acreage is covered with juniper-piñon pine, scrub oak and other woodland types. These lands are important as a source of fence posts and other materials used in range conservation structures.

Alaska Public Domain Forest Lands

In Alaska BLM is responsible for some 125 million acres of forest land, about 40 million acres of which have timber of size and quality comparable to commercial timber in other parts of the United States.

Much of the timber of interior Alaska is spruce which has potential value for pulp and paper.

The Alaska Statehood Act granted authority to the State to select 103 million acres of unappropriated and unreserved public domain land. It is expected that the new State will select a large part of the better forest lands currently administered by the Bureau.

In the meantime, BLM is continuing with its program to manage the Alaskan public domain forest resources, placing particular emphasis on improving the forest-protection program.

In 1959 BLM sold 9.7 million board feet of timber in Alaska valued at \$27,099. In 1960 sales had risen to 14.7 million board feet of timber valued at \$61,447.

Reforestation

Reforestation quite commonly has been a job of nature. Under favorable circumstances and expert planning this can be a successful and generally economical method of obtaining reforestation. Hundreds of thousands of acres of the O&C lands show the successful results of skillful use of natural reforestation techniques.

When nature fails to do a satisfactory job of reforesting land of high commercial forest potential, BLM accomplishes the task by planting seed or nursery grown seedlings immediately after logging. Since prompt reforestation by these methods shortens the natural rotation period required for growing the next crop of timber by an average of 10 years or more, this is good forestry.

A summary of reforestation activities on O&C and CBWR lands during 1960 shows that 6,531,000 seedlings were planted on 12,687 acres and 6,869 pounds of seed were sown primarily by helicopter, on 9,388 acres. Since 1950 more than 110,000 acres have been reforested.

Most of the costs of this reforestation work are financed by funds voluntarily contributed for the purpose by the 18 O&C counties as part of their share of O&C income which they make available annually for access roads, reforestation, and recreation.

In 1956 the Bureau initiated a program to reforest selected blocks of potentially productive public domain forest land. By the end of 1960, 4,463 acres had been seeded or planted under this program.

Access Roads

With the decrease in the amount of privately owned timber sold on the open market, providing access to large areas of BLM administered public timber has become one of the major features of the forestry program of the Bureau of Land Management.

Development of a competently engineered system of forest-access roads is essential for the orderly harvesting of the full annual allowable cut. A permanent network of roads permits the use and conservation of large volumes of good timber which otherwise would be lost. It also permits development of outdoor recreational facilities readily available to the public, and enables better protection of the forests from fire, insects, and disease.

The BLM road program, inaugurated in 1950, provides access to O&C timber where high construction costs either preclude construction through timber sale contracts or would necessitate excessively large sales. BLM conducts small timber sales to provide broadened opportunity for small manufacturing concerns as well as large ones. This policy also results in increased competitive bidding and larger timber sale receipts.

Beginning in 1952, the 18 O&C counties voluntarily agreed to contribute up to one-third of their share of O&C receipts for an expanded access road construction program. Through fiscal year 1960, \$32,374,135 has been appropriated for construction and purchase of permanent, heavy-duty mainline roads, suitable for year-round log transportation. Through the end of the 1960 fiscal year, 185.7 miles of mainline access roads have been completed, and 34 high-standard bridges constructed. Projects under construction include 112.1 miles of roads and 15 bridges.

Disease and Insect Protection

While fire is a spectacular enemy of forests, there are other enemies that are constantly taking an enormous toll of timber—insects, disease, and windstorm.

BLM foresters are constantly on the alert to detect any signs of attack by these destructive agents, and cooperate with Federal, State, and private land owners and managers in investigations and control measures.

With extensive acreages of white pine forests located in southwestern Oregon, including a smaller acreage in northern Idaho, BLM operates a blister rust control program to protect these valuable forests from the ravages of the white pine blister rust, a fungus disease.

BLM has now worked 87 percent of its control acreage for the first time and has 55 percent of its areas on a maintenance basis.

Several small groups of rust-resistant sugar pine trees of seedbearing size have been identified. In cooperation with forest geneticists, the seed cones of these trees are being pollinated with pollen from other rust-resistant pines. The purpose is to produce a rust-resistant strain of sugar pine which ultimately may be usable for the reforestation of lands best suited for the growing of sugar pine forests.

Range Management

Progress in the administration of grazing was made during the year with emphasis placed on reducing overuse and continued corrective treatment.

Under provisions of the Taylor Grazing Act of 1934, BLM is responsible for the administration and conservation of approximately 436 million acres of federally owned range lands. About 140 million acres are within 59 established grazing districts. The lands outside grazing districts are known as section 15 lands, after that section of the Taylor Grazing Act under which they are managed. In addition, the Bureau handles grazing on about 1¼ million acres of public domain lands in Alaska.

New Rules Speed Conservation

To hasten the restoration and rehabilitation of public range lands new rules will speed up conservation efforts on rundown public range lands. In the past, some ranchers have "bought" the time necessary to make orderly range-use adjustments by filing costly and time-consuming appeals, first to the Director and then to the Secretary. Such appeals have slowed down the rebuilding of the range and retarded needed range-use adjustments. Orderly schedules for range use will replace this delaying process.

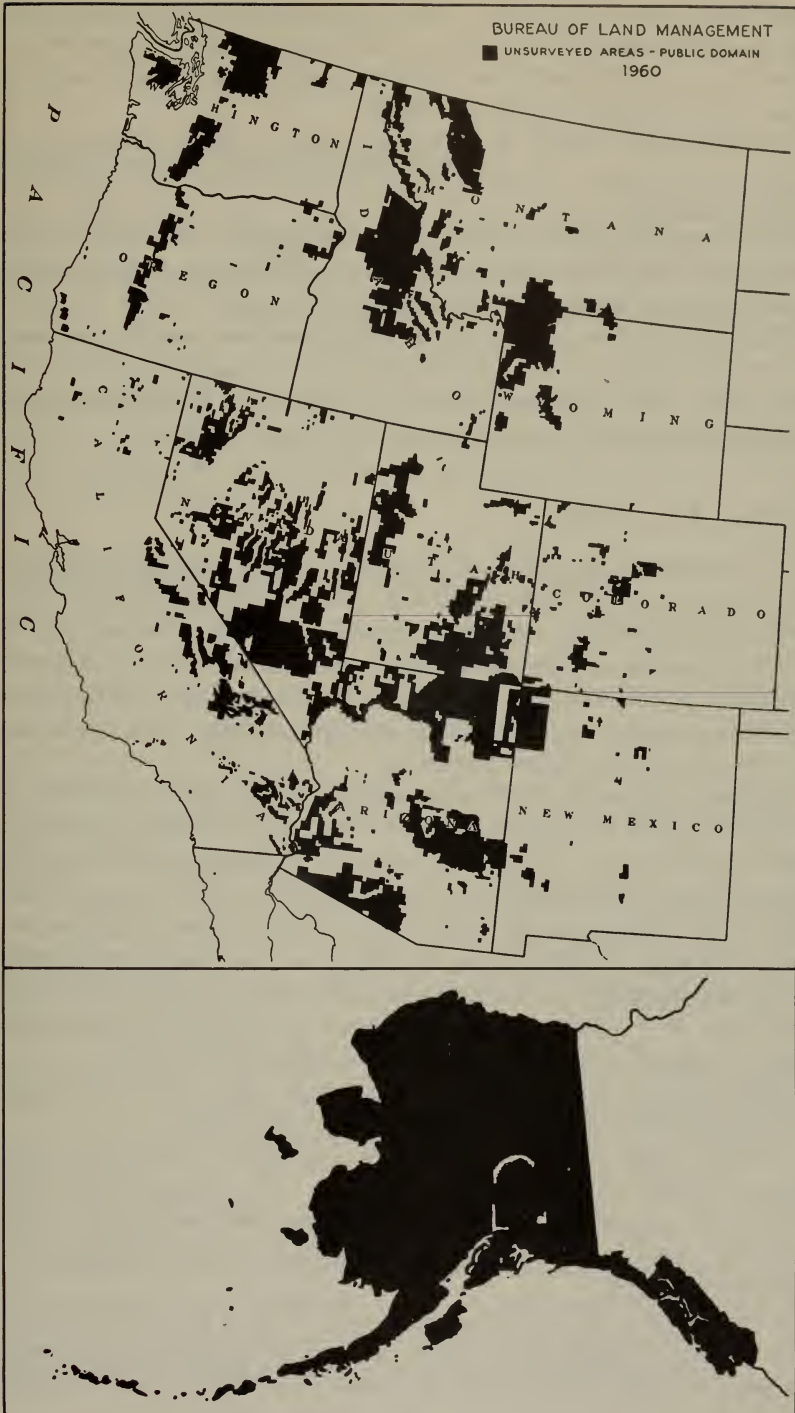
Adjustments in livestock licensed to use the range are necessary when a range study demonstrates the range is overobligated and deteriorating. Licensed use must then be reduced to the level the available forage will support.

The new amendments to the Federal Range Code for Grazing Districts will permit the Bureau to spread grazing adjustments of 15 percent or more over 2 or 3 years in special cases and begin the job of rehabilitating the range immediately. At the same time the affected users can acquire additional sources of forage, make any necessary livestock disposals, or complete other operational adjustments.

The new rules do not affect BLM's assigned responsibility to carry forward its range program on an immediate, across-the-board basis when circumstances demand fast action. BLM district managers may, in cases of emergency, put any range-use adjustments in full force at any time.

Farm Tenant Lands

An order added about 1,807,000 acres of land utilization (LU) project lands to four Montana grazing districts, and 239,000 acres to two



New Mexico grazing districts. The transfer of the LU lands simplifies administration of the areas and facilitates range management and conservation projects on these lands, which are intermingled with and adjacent to other grazing district lands.

The LU lands were part of several million acres purchased by the Federal Government during the 1930's under the Bankhead-Jones Farm Tenant Act.

Other new regulations will enforce a recent law (Public Law 234) banning the use of airplanes and motor vehicles in roundups of abandoned and stray horses and burros on public lands.

The legislation was passed after many people voiced concern about the use of airplanes and vehicles for roundup purposes as cruel and inhumane. Until the new law was passed only State laws applied. Now Federal law and regulations apply to Federal lands.

Grazing Fee Study

An interdepartmental study on grazing fees was initiated during 1960 following a recommendation by the Comptroller General that a study be undertaken. At the suggestion of the Chairman of the House Committee on Interior and Insular Affairs, the joint-grazing fee study is underway to arrive at a uniform basis for fees on all federally owned grazing lands and to eliminate any inconsistencies in the fees charged by Federal agencies.

The grazing fee charged under section 3 of the Taylor Grazing Act for 1960 was 22 cents per animal unit month of forage, the same as that charged in 1959. The fee is based on livestock prices in the West as reported by the Department of Agriculture. A change in fees is made only when prices go up or down at least 2 cents the preceding year. Twenty-five percent of the fee is used for range improvement.

Grazing lease rentals on lands outside grazing districts (section 15 lands) are on a sliding scale based upon the grazing capacity of the lands. Annual rates range from 2 mills to 88 cents per acre.

BLM grazing receipts (including lands both inside and outside grazing districts) during 1960 amounted to \$3,487,992.

Another study of great importance was begun during the year to analyze BLM's range inventory methods. The analysis will include methods of mapping range features, vegetation and soil conditions, potential range improvements, wildlife factors, and proper grazing use determination.

In cooperation with the Intermountain Forest and Range Experiment Station, BLM has undertaken a study of cheatgrass to determine the best livestock grazing methods to use on millions of acres of public

range lands where cheatgrass is found. The study area is near Hammett, Idaho, but the results of the study will be important to other cheatgrass ranges in Oregon, Nevada, and Utah.

Selection of Wildlife Representatives

A Bureau policy was established on the appointment of wildlife representatives to grazing district advisory boards. Nonprofit wildlife groups or organizations will now select candidates. Names of candidates will be referred to the State fish and game department for approval and then to the BLM State Supervisor for consideration and formal appointment.

Appointments will require further approval of the BLM Area Administrator if the candidate is an employee of the State fish and game department or the Department of the Interior's Bureau of Sport Fisheries and Wildlife.

Condition of Livestock and Trend in Numbers

Permitted use of grazing district lands showed a slight increase in 1960. In local areas, however, the animal unit months (a.u.m.'s) of grazing use was less than normal due to drouth. Range conditions resulted in authorized nonuse of 1,083,835 animal units involving 2,702,895 animal unit months.

In Alaska beef and wool production increased sharply. Alaska had an increase of 9,072 a.u.m.'s use in 1960 and an overall increase of 22,703 a.u.m.'s since 1956.

Licenses and permits were issued in 1960 to 18,976 livestock operators to graze 8,506,398 livestock in the 59 grazing districts, totaling 15,263,017 animal unit months of grazing use. Approximately 1,280,000 big game animals obtained more than 1,569,000 a.u.m.'s of forage from grazing district lands.

On section 15 lands, 9,848 leases were issued to 8,883 livestock operators to graze 2,343,780 livestock. Sixty-three grazing leases in Alaska covered 1,233,197 acres.

Range Adjudication

The adjudication of grazing privileges and apportionment of the Federal range is an important task in grazing administration and must be done before issuing or reissuing licenses and permits. The table shows the progress made in range adjudication last year.

Annual progress report on range adjudication, Bureau of Land Management, 1960

State	Opera- tors	Acres	Units	Forage inventory completed on—		Dependent property surveys com- pleted on—		Adjudications completed	
				Acres	Units	Opera- tors	Units	Opera- tors	Units
California.....	367	5,543,279	14	1,826,705	8	221	9	155	7
Oregon.....	1,129	13,694,834	454	5,350,056	42	342	56	207	27
Total, area 1.....	1,496	19,238,113	468	7,176,761	50	563	65	362	34
Arizona.....	542	12,477,693	660	6,689,665	564	542	660	1,542	-----
Idaho.....	2,634	12,860,795	165	7,041,984	103	840	73	953	79
Nevada.....	1,141	47,950,582	155	30,688,298	88	845	108	597	67
Utah.....	2,960	25,008,923	152	14,507,494	76	2,836	152	865	41
Total, area 2.....	7,277	98,297,993	1,132	58,927,441	831	5,063	993	2,957	187
Colorado.....	1,704	8,020,799	86	4,972,358	66	1,619	86	1,303	68
Montana.....	3,116	7,804,930	68	6,173,436	32	1,748	35	1,657	29
New Mexico.....	4,127	13,951,124	-----	12,243,775	-----	1,674	-----	1,412	-----
Wyoming.....	1,242	13,816,288	32	4,832,682	18	856	32	717	24
Total, area 3.....	10,189	43,593,141	186	28,222,251	116	5,897	153	7,804	121

¹ In Arizona and New Mexico adjudication is completed and Federal range divided into individual allotments.

Range Use Supervision

Trespass use by licensees continues to be a major problem in range-use supervision. Penalties imposed by State law are often inadequate to discourage the habitual grazing trespasser.

Supervision has been materially aided by the establishment of individual and group allotments and by perfecting range-line agreements to minimize conflicts in range use. Efforts to make actual use counts of livestock has noticeably reduced this type of trespass.

Range Conservation and Improvement

Along with grazing management BLM is pressing forward a program of soil and moisture conservation authorized by the National Soil Conservation Act of 1935. The Bureau's watershed protection and rehabilitation program is carried out on community watersheds with the active participation of range users. Land-treatment practices are growing as livestock operators become aware of the benefits of seeding, brush control, pitting and furrowing, and deep tillage.

Accomplishments during the year include: Brush control, 90,738 acres; pitting and furrowing, 10,068 acres; deep tillage, 10,087 acres; pest control, 320,151 acres. The Bureau seeded about 140,000 acres of public range land during the fiscal year. In some areas, forage quantity on successfully seeded areas has increased as much as 10 times.

The Bureau has seeded 21½ million acres of public range lands since 1934. In addition, brush plants of little or no forage value have been eradicated or reduced on 1½ million acres. However, more than 44 million acres still need conservation treatment.

Earthfill detention dams, diversion dams, dikes, and water-spreading systems are being built to halt serious gully erosion where land treatment measures cannot do the job. During the year, the bureau built 828 reservoirs, 196 springs, 106 wells, 55 diversion dams and 44 detention dams. Detention dams control gully formation and regulate floodflows. In addition, they provide permanent water for livestock, waterfowl, and wildlife. More than 57,000 additional structural and land-treatment practices are included in the Bureau's long-range inventory of conservation needs. This year's construction of 1,826 miles of range fences increased the Bureau's cumulative total to 19,000 miles.

An emergency BLM flood control and rehabilitation program on 1,000 acres near Deadwood, S. Dak., averted serious flood damage. A fire in September 1959 had stripped the land of vegetation. Treatment consisted of felling timber on the contour, seeding by helicopter and constructing debris basins in the City Creek drainage. Seeding was done under ideal conditions, and with normal moisture a satisfactory vegetative cover should result.

Weed Control

Control and eradication of poisonous and noxious weeds is an important part of rangeland management. In 8 years 600,000 acres of rangeland have been seeded to perennial grasses capable of competing with undesirable weeds and plants. Brush eradication to liberate perennial grasses has been completed on another 80,000 acres. About 200,000 acres have been chemically treated to control halogeton and other poisonous weeds such as locoweed and larkspur.

To combat infestations of the beet leafhopper, approximately 88,000 acres have been seeded and fenced. Medusa-head rye, an extreme fire hazard, has invaded large areas in California, Oregon, and Idaho, reducing the grazing capacity of the infested range from 40 to 75 percent. Cooperative research studies to find new methods to control this weed are underway.

Range Condition and Trend

Comprehensive field surveys of range condition have been conducted continuously for the past 5 years in BLM's 59 grazing districts. At the close of the calendar year, these studies and surveys have covered

about 93 percent of approximately 152 million acres of usable Federal range.

Four and one-half percent of the gross acreage of all districts is considered to be waste or unusable for grazing by either livestock or big game. The most striking accomplishment is the reversal of downward-trend percentage to an increase in percentage of static condition by more than half, and the definite improvement by about one-fourth of the total acreage. This was accomplished with continued grazing use, supplemented by conservation practices to build up the productivity of the lands.

Recreation and Access to Public Lands

Bureau of Land Management offices throughout the West are taking the initiative in working out agreements with private landowners to assure access routes for sportsmen and others to large blocks of the public domain. The agreements are being worked out concurrent with a study of present access routes and recreation areas as part of a concerted effort by the Bureau to help meet the growing recreation needs of America's citizens.

The Taylor Grazing Act, under which BLM manages some 178 million acres in 10 western States, specifically provides that the land will be open to the public for hunting, fishing, camping, and other lawful purposes. In some instances access to large blocks of public lands has been cut off by surrounding private lands.

To meet the growing needs of the public and to provide the basis for working out acceptable solutions to problem areas, BLM issued a formal access policy statement during the year reinforcing the language of the Taylor Act and pointing the way to various answers to specific situations.

BLM will concentrate on providing access to large blocks of public domain. There are many small or isolated tracts surrounded by private lands which have little recreation value or potential. Solutions to access routes may involve land or use exchanges, right-of-way agreements, and, if necessary, legal action.

In addition, the Department has proposed regulations requiring the posting of signs on fences that cross public lands to inform the public that the lands are open and directing them to access routes.

The extent and diversity of interest in the proposed regulations resulted in informal meetings in Oregon, Idaho, Utah, New Mexico, Arizona, Wyoming and Colorado. The meetings improved public understanding of the proposed regulations and will assist the Department in developing the rules in final form.

Fire Protection

Fire destroys. It destroys forests, range grasses, watersheds, tundra, and wildlife habitats. It destroys tens of millions of dollars worth of natural resources.

The resource base available tomorrow depends to a considerable extent on the success of fire prevention and fire control today. One of the most important responsibilities of the Bureau of Land Management is fire protection and suppression on 225 million acres in Alaska and about 150 million in other States, most of which is in the West.

The fire situation in the western States was critical in 1960, especially in Idaho, Nevada, Utah, and Arizona. During the 1959 fire season 1,122 fires burned 876,887 acres, of which 586,535 acres were in Alaska. There were 612 lightning fires on Bureau lands, compared to 539 last year. Man-caused fires totaled 510, a considerable reduction over the 820 in 1958.

Extra-period fires numbered 210. These fires (those that burned uncontrolled more than one day) were inaccessible and hundreds of miles from fire bases. Sometimes a whole rash of fires flared up at one time which overtaxed available facilities and manpower. Of these, 73 burned more than 1,000 acres each.

The destructive forces of fire took severe toll in the Boise, Idaho, watershed in August 1959. Flames devoured virtually every ounce of vegetative cover and organic matter on the steep slopes of the hills north of town. Over 10,000 acres of valuable watershed were destroyed, including about 3,000 acres of BLM lands. A few weeks after the fire, heavy rains poured down the steep denuded hillsides carrying a deluge of mud, rocks, and debris into the city. Three feet of muck, boulders, and flood silt were strewn over nearby residential property and cropland.

Emergency action was necessary. Funds were diverted from other projects to carry out the vitally needed flood control. The Bureau did restoration work on 1,800 acres of public domain lands. Contour trenches, partitioned by check dams every 20 to 30 feet were constructed on 617 acres. Contour furrowing was completed on 134 acres. About 200 acres were drilled with perennial grass and bitterbrush. Siberian and crested wheatgrass were drilled on 1,050 acres, while the remaining area was broadcast seeded. Losses from the fire and floods, coupled with rehabilitation costs added up to over \$½ million.

Fighting Fire in Alaska

In Alaska there are an estimated 40 million acres of commercial timber, 85 million acres of woodland, and over 100 million acres of

range and tundra protected by BLM's firefighting organization. These lands are important for timber, for game range, for recreation, and for mineral development.

Alaska has a 5- to 6-month fire season with long daylight hours, low humidity, little rainfall, high temperatures, and 30 to 60 days of heavy lightning storms which sweep across the center of the Alaska land mass. Lightning fires usually break out in areas that can only be reached by air. Such fires, if not controlled soon after they start, may burn over areas equal to the area of Rhode Island or Delaware.

During the past 3 years, helicopters and specialized planes including those converted to drop fire retardants, large capacity cargo drops, along with high speed reconnaissance aircraft and smoke-jumpers have been successfully used. BLM set up a 15-man smoke-jumper installation in Fairbanks in 1959, which in 1960 fought 34 fires at an average distance of 210 miles from the base of operations. No smokejumper fires went uncontrolled. Continuation and expansion of this unit is planned for the years ahead.

BLM's Alaska fire control program entered its first phase of expanded development in fiscal year 1960, and by the end of the fiscal year funds were already assured to begin the second phase. Phase three will go into effect in another year.

Better Tools to Fight Fires

Accomplishments in fire control made during the fire season included strengthening BLM's detection and communication systems and refining the fire-danger rating system. Borate mixing, storage, and loading facilities were established at Anchorage and Fairbanks, Alaska; Boise, Idaho; and Baker, Oreg. Bentonite slurry is being tested to determine how well it works compared to borate. Fire prevention was stressed through public education programs. To prevent man-caused fires, BLM sought strict law enforcement and closer supervision of controlled burning. When necessary, high fire-danger areas were closed to the public.

Fire weather data was studied to determine daily fire-danger rating and burning indexes. Thirty-two fire training schools were held for BLM personnel before the fire season, and grazing districts conducted many training sessions for temporary and emergency presuppression employees.

Fire protection on some BLM land in California, Oregon, Washington, Idaho, Montana, New Mexico, and Minnesota is handled by contracts with other Federal, State, or local agencies. On lands under contract protection 245 fires destroyed 42,803 acres in calendar year 1959. Contract fire protection cost \$996,034 for 6,614,383 acres in fiscal year 1960.

High temperature, low humidity, and dry vegetation created a serious fire hazard over many range and forest areas of the West at the end of the fiscal year.

Fire control involves two appropriations. The one for presuppression operations must take care of all the costs necessary to acquire and maintain BLM's firefighting equipment, supplies, buildings, aircraft, and so forth. It pays for training crews and pays their salaries while they are not actually at fires. It also pays for all of the fire-protection contracts. The other fire appropriation covers the actual cost of fire suppression.

The BLM appropriation for presuppression during fiscal year 1960 was \$891,000, of which, \$637,000 covered costs in Alaska. Fire suppression costs during fiscal year 1960 totaled \$2,950,617, of which \$1,479,074 was spent fighting fires in Alaska. Fire protection and suppression costs money. But it is a small price to invest in preserving priceless natural resources.

Eastern States

The remaining scattered public domain lands in Alabama, Arkansas, Florida, Louisiana, Mississippi, Michigan, Wisconsin, and Minnesota are administered by the Eastern States Office. Under its program the area of public domain lands in the East is rapidly diminishing, as lands are transferred out of Federal ownership to States, local governments, organizations, and individuals.

In 1960 the Eastern States Office transferred title to 6,275 acres of public domain lands to non-Federal ownerships. 1,640 acres were sold at public auction, in addition to 3,787 acres transferred to individuals under the Color-of-Title Act. Seventy-seven acres were transferred to States and counties and local groups under the Recreation and Public Purposes Act in addition to 340 acres under State grants and indemnity selections.

As the remaining public lands in the East are reduced through direct sales the transfer of title to those tracts remaining becomes increasingly difficult due to conflicting claims of ownership.

A number of valuable tracts, suitable for recreational and public purposes use because of beach, river, or highway frontage, which have been made available to the States, counties, and community groups, are still under BLM administration. This is due in part to inability of the qualified organizations to raise the required purchase and development funds. Under the Bureau's recreational policy the Eastern States Office may have a continuing responsibility for the areas. In Florida there are 12 such tracts totaling 315 acres.



Electronic surveying has replaced the miles of weary walking to measure distances. Deep in Colorado's Glen Canyon this surveyor will move by helicopter to his next station.

Receipts from land sales amounted to \$123,491, and receipts from noncompetitive mineral leases and permits on public domain and acquired lands amounted to \$4,905,797. The total amount received in 1960 from mineral leasing and permits (including competitive leasing), was \$13,927.

The new field office established in St. Paul, Minn., is providing closer cooperation with the State, quicker action on several large exchanges and selections in Minnesota and increased public lands and timber sales.

The Minnesota Department of Conservation plans to request authorization of the necessary funds to purchase some 33,000 acres of so-called Volstead Act lands under the act of May 1, 1958. Except for several pending State exchanges and Recreation Act applications in Michigan and Wisconsin, unreserved public lands in these two States have been almost entirely transferred out of Federal ownership.

Cadastral surveys were conducted in the States of Alabama, Florida, Michigan, Minnesota, Mississippi and Wisconsin. These surveys were of islands and of public lands omitted through error in the original work, together with resurveys of isolated public land tracts. Such

special surveys were of the equivalent of 18,000 acres of original surveys.

An inventory of unsurveyed islands in these same States has been undertaken looking toward a systematic survey of part of the islands each year.

Outer Continental Shelf

During fiscal year 1960 the Bureau conducted three lease bid openings for submerged lands off the coast of Louisiana and Texas. These sales resulted in 167 leases totaling 745,853 acres with cash bonus bids amounting to \$370,752,186.

In February 1960 the sixth and largest Federal competitive oil and gas lease bid opening ever held resulted in high bonus bids of more than \$282 million for 145 tracts of Outer Continental Shelf lands off Texas and Louisiana. The leasing involved the largest number of tracts ever offered and the largest total of bonus bids ever received in a single bid opening. Counting unsuccessful bids, the leasing involved over \$567 million of private capital seeking oil lease development opportunities in the oil-rich Outer Continental Shelf.

Practically all of the major oil and gas development companies participated in the lease bidding. Bidders included 41 separate companies and individuals. A total of 444 bids was received, distributed among 173 tracts. The highest single bid was \$11,112,000 for a 5,000-acre tract. Three other tracts each received bids of over \$10 million.

On June 30 there were 526 Outer Continental Shelf leases embracing 2,146,349 acres with collections from rentals totaling \$2,509,299. Rentals on 24 pipeline rights-of-way were \$2,405.

International Cooperation

World events emphasized the importance and urgency for dealing with land problems particularly in those agrarian countries where the natural resource base is still undeveloped. Agencies specializing in international activities made continual and increasing requests for the services of BLM involving resource management and conservation programs, and the application of land and mineral laws in the administration of the overall Bureau program.

A continuous exchange of ideas occurred between BLM personnel and officials of essentially all free world countries on subjects involving resource settlement, development, and management. Technical support was provided in the activities of cadastral survey, land records systems, land-use classification, land distribution, mineral leasing, and range and forestry conservation and management.

All requests were fulfilled covering the assignment of BLM technicians to assist other countries. The facilities of the Bureau were utilized by 60 representatives of other countries who observed and studied actual operations of the various Bureau programs.

Appeals

Anyone who has been adversely affected by a decision issued by a field officer of the Bureau of Land Management has a right of appeal to the Director. This right entitles the aggrieved party to have his case reviewed by filing an appeal in accordance with the Department's regulations.

During the year 3,677 new appeals to the Director were received, which with 2,491 appeals on hand at the beginning of the year, totaled 6,168. A total of 3,495 appeals were decided by 1,351 separate decisions. In addition, 2,802 letters and memorandums were prepared relating to appeals. There were 2,673 appeals remaining on hand at the close of the fiscal year.

Of the 3,495 appeals decided during the year, 852 were covered by 27 separate decisions approved by the Department prior to promulgation. These decisions involved desert land and small tract applications prompted by promotional activities of land locators and oil and gas lease offers that had not been filed in good faith but clouded the titles of existing oil and gas leases. A Bureau decision which is issued with departmental approval constitutes the final decision of the Department.

Hearings

Bureau hearing examiners received 505 proceedings for adjudicative hearings in 1960. Examiners began the year with a carryover of 295 proceedings. The new cases involved 1,856 claims, entries, leases, etc., and included 64 proceedings under Public Law 167, involving 347 mining claims; and 267 other contests involving 685 mining claims. They also included 3 contests to cancel 471 mineral leases and 100 grazing appeals involving 187 permittees and licensees.

During 1960 hearings were held in 219 land and minerals proceedings and 41 grazing proceedings involving 96 permittees or licensees. Examiners closed 353 proceedings on their dockets, 201 by decisions after a hearing and 152 on procedural grounds without a hearing. Unclosed proceedings at the end of the year numbered 447. Of these 124 involved grazing and 323 dealt with land and minerals cases.

In 1960 there was a 54-percent increase in cases referred to examin-

ers, a 33-percent increase in cases heard, and a 19-percent increase in cases closed. Grazing cases increased approximately 10 percent, but most of the increase involved mining claims.

Records Improvement

The Records Improvement project is responsible for a program to create a modern system to show the title, use, and availability of public lands and resources administered by the Bureau of Land Management. The contract for new Arizona status records was commenced during fiscal year 1959 and was completed on June 10, 1960, at a cost of \$484,490.

The first new land records project handled by BLM's own employees was performed in Alaska. During the year new records were prepared for 3,724 townships at a cost of about \$407,000. The project will be completed early in fiscal year 1961.

In June work was begun on new records for Montana, a project which will require about 2 years to complete.

Staffing

As of June 30, 1960, there were 2,490 permanent and 793 seasonal employees on the rolls of the entire Bureau. These totals were distributed as follows: Area 1 (Washington, Oregon, California), 747 permanent and 193 seasonal; area 2 (Idaho, Nevada, Utah, Arizona), 539 permanent and 285 seasonal; area 3 (Montana, Wyoming, Colorado, New Mexico), 579 permanent and 145 seasonal; area 4 (Alaska), 280 permanent and 118 seasonal; and Eastern States Office and Director's Office (Washington, D.C.), 345 permanent and 52 seasonal.

Finance

Total appropriations (including supplemental appropriations) during fiscal year 1960 for the Bureau's management operations amounted to \$27,817,000; for construction, \$5,168,135; and \$768,653 for range improvements.

The work of the Bureau is financed by the Management of Lands and Resources appropriation and is divided into 10 functional activities representative of the Bureau's responsibilities. The suppression of fires on BLM timber and grazing lands required a supplemental appropriation of \$2,450,000 in 1960.

The Bureau's construction activity includes access roads to timber resources (principally on the O&C forest lands of western Oregon)

and fire protection facilities in Alaska. Out of all funds used for construction, some \$5 million was voluntarily contributed last year by the 18 western Oregon forest-land counties from funds which they would otherwise have received as part of their share of timber sale receipts. In addition, the counties made available funds for reforestation and access road maintenance.

Funds for range improvements are made available by Congress as a percentage of the fees charged public land range users. This money is returned to the grazing districts to help pay for needed fences, watering facilities, cattle guards, and other improvements.

Receipts

Gross receipts from the sale and management of public lands and resources during fiscal year 1960 totaled \$371,067,867. This total is the highest amount ever received in a single year and was more than double the amount of revenues taken in a year ago. The receipts came from the following sources: Mineral leases and permits \$324,018,288 (including \$229,456,819 from rents, royalties, and bonuses on the Outer Continental Shelf); timber sales, \$36,359,337; sales of public lands, \$5,101,297; grazing, \$3,487,992; fees and commissions \$1,798,817; rights-of-way \$169,263; and \$132,873 from all other sources.

Distribution of Receipts

Bureau of Land Management receipts for fiscal year 1960 were distributed as follows: \$51,841,376 to 26 public land States (of which \$16,258,579 went to the 18 western Oregon timber land counties); \$51,576,949 was deposited to the Reclamation Fund; \$263,320,382 went into the General Fund of the U.S. Treasury; \$3,104,522 was transferred to other Government agencies; \$361,568 was earmarked for Indian trust funds; and \$863,070 was returned to the grazing districts where it will be available in 1961 for range improvements.

Total Receipts Exceed \$2 Billion

All time receipts of the Bureau of Land Management since 1785 have now totaled more than \$2,263,700,000 not counting about \$300 million additional Federal revenues in temporary escrow, pending final solution of the Outer Continental Shelf boundary dispute. Since 1946, receipts have now exceeded \$1.5 billion.

National Park Service

Conrad L. Wirth, *Director*



THE YEAR ENDING JUNE 30, 1956, was a notable one for the National Park Service. An exceptional record of accomplishments was made in new and improved facilities and services in the parks and monuments, with new areas added to the System, an increase in the professional staff in the field, and wide public approval for the Mission 66 program.

At the biannual conference of the Service in Williamsburg, Virginia, in December 1959, an event of transcendent importance to the National Park Service was the receipt of a directive from Secretary of the Interior Fred A. Seaton.

The Secretary lauded the achievements of the National Park Service in its Mission 66 program—designed to meet the needs of increasing visitation in the National Parks and the pressures of a population “explosion” on our natural resources—and added: “Because of the situation which America confronts in this respect, I ask * * * the National Park Service to give high priority to a program of studying and identifying areas which should be preserved for the enjoyment and inspiration of all the people * * * These should include seashores, scenic mountain areas, prairie grasslands, places of national importance in our history, and other nationally significant * * * areas.”

Secretary Seaton’s directions included: development of a plan for a system of reserve areas from which future generations may draw for needed parks and recreation areas; the establishments of new parks, monuments, recreation areas, and historic sites to complete the National Park System and meet the growing need for such areas at the national level; put into effect programs for the most efficient use of the Service organization, and training and career development of its personnel; encourage and assist in the establishment and development of State park systems, and other public lands recreational opportuni-

ties; keep clearly in view the importance of preserving true wilderness areas in the System for future generations; and to keep uppermost in mind the directive of the Congress when establishing the National Park Service in 1916: "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The Mission 66 program—now in its fifth year—was launched on July 1, 1956, for the purpose of staffing and equipping the National Park System to care for an estimated 80 million visitors in 1966—the year the National Park Service will celebrate the 50th anniversary of its establishment.

The year again showed an increase in total public visits to the parks and monuments, from 60,554,000 in fiscal 1959 to 65,959,000 in 1960. This follows the trend of previous years and necessitated stepped up planning for further renovation, conservation and additional facilities to meet the demands of coming years.

During the year the National Park Service began evaluating the accomplishments and experiences of the Mission 66 program to date and measuring them against the overall goals. The Service will put the resultant new ideas and thoughts into workable plans which will be a guide in revamping the Mission 66 program, profiting from lessons of the past and geared to anticipated needs.

Hence, Mission 66 began a study to determine what would have to be accomplished in addition to its original program to attain the objectives set for 1966, and to fulfill the purpose for which the National Park Service was established in 1916: "to conserve the scenery and the natural and historic objects and the wildlife * * * and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."

The Mission 66 program is not only concerned with the large-scale development of new and improved visitor facilities, the reconstruction of roads and trails, and the laying out of campgrounds, it equally emphasizes the preservation of the great wilderness areas in the National Parks and Monuments—America's priceless heritage.

During the 12-month period, 1,252 active projects were under construction involving an investment of approximately \$105,237,292 including new and improved campsites and visitor centers. During this period 528 projects representing an investment of about \$38,000,000 were completed and opened for public use.

Since Mission 66 was launched, 3,357 construction projects involving an investment of \$213,000,000 have been completed or are under construction. In addition, private capital invested some \$20,000,000

in the construction of public accommodations and related service facilities.

Camping increased and continued to tax facilities. Of 4,829,000 recorded camper-days, 11 percent were spent under conditions in excess to the capacity of the parks' campgrounds. The trend in trailer-camping also showed an upward curve with more than one in five camper-days spent in trailers.

To manage the enlarged operations and extended activities in the System, and to meet the need resulting from the greatly increasing number of visitors, additional employees were hired and trained to augment the park and monument personnel which at the end of the fiscal year totaled 4778 permanent employees, while during the height of the visitor-season another 3724 seasonal employees were on the rolls of the National Park Service.

Major road projects placed under contract during the year totaled \$9,181,413, which involved 108 miles of reconstructed roads. A total of 83 miles of reconstructed park routes were completed at a cost of \$9,883,900.

The legislative phase of the National Park Service's program is an all-important one. Under the guidance of the Administration and the Department, the Service obtained gratifying results in the form of congressional action throughout the year.

Legislation was enacted authorizing the establishment of three new parks. The events relating to the beginning of the American Revolution are to be preserved at Minute Man National Historical Park, Massachusetts. Bent's Old Fort in Colorado, a fort and trading post important in the opening of the west, is authorized to be made a national historic site. The Civil War battle which climaxed the campaign to keep Missouri in the Union will be commemorated through the establishment of Wilsons Creek Battlefield National Park.

Highly important is the enactment of law by which there may be removed the threat of adverse developments at the Antietam National Battlefield Site, Maryland. Authority was granted to acquire 600 acres of land and to further preserve the historic scene by obtaining covenants, restrictions, or easements on an additional 1017 acres.

Much needed authority was provided to carry out the Mission 66 program for Mount Rainier National Park, which involves moving the headquarters from Longmire to Ashford, Washington, outside the park.

Important boundary legislation was enacted for Zion National Park, Utah; Custis-Lee Mansion, Virginia; Fort Laramie National Monument, Wyoming; and Stones River National Battlefield, Tennessee. In all 27 laws directly affecting the National Park Service were enacted in fiscal year 1960.

In addition to legislation affecting areas of the National Park System, Congress enacted Public Law 86-523 which reiterates and strengthens the Federal government's policy for the preservation of archeological and historical data which might otherwise be lost as the result of dam and reservoir construction.

Other measures still pending in Congress which are especially important are the proposals to establish national seashores, to create the Chesapeake and Ohio Canal National Historical Park, to revise the boundary and provide an entrance road to Dinosaur National Monument, and to acquire the Storer College property for addition to Harpers Ferry National Monument.

The National Survey of Historic Sites and Buildings, as a part of the Mission 66 program, showed considerable progress. Completed were the following studies: Prehistoric Hunters and Gatherers; English Exploration and Settlement to 1700; Development of the English Colonies 1700-1775; Political and Military Affairs, 1763-1830; The Civil War, 1861-1865; as well as a number of subthemes in Westward Expansion: The Cattlemens Empire; Military and Indian Affairs; The Farming Frontier; the Texas Revolution and War with Mexico; Overland Migrations West of the Mississippi; and two special studies—Fort De Soto, and Fort Union and the Santa Fe Trail.

Largely on the basis of funds donated to the Service by the Society of the Lees of Virginia and others, the Service was able to purchase the Middleton Collection of Lee memorabilia, from the estate of the late Mrs. Robert E. Lee, 3d. The collection, comprising over 200 pieces of furniture, crested silverware, glassware, chinaware, etc., once belonging to General Robert E. Lee, will now be permanently preserved at the Custis-Lee Mansion National Memorial in Arlington.

To accomplish its program for archeological investigations in Service areas and for salvage of archeological data in reservoir areas throughout the nation, the Service negotiated contracts with State and local institutions totalling \$328,500. An additional \$122,000 was transferred to the Smithsonian Institution for archeological salvage work in the Missouri River Basin and in the Walter F. George reservoir (Ala.-Ga.).

Interpretation

The interpretive program of the National Park Service provided additional educational services during the past year to the ever-increasing number of visitors to the parks, monuments and other areas.

Total visits to the units of the National Park System increased

from 58 million in 1958 to nearly 63 million during 1959. Under the Mission 66 program, facilities for visitor comfort, information, interpretation as well as inspiration have increased and were substantially improved during the past several years and this trend continued during the past year.

New visitor centers were added to the system and the museum collections were enriched by accession of valuable objects, such as a replica of the 1902 glider used by Orville and Wilbur Wright at Kitty Hawk, N.C.

Special events continued to emphasize the importance of the Nation's outstanding historic sites, an example of which was the first official raising of the 49-star flag at Fort McHenry National Monument and Historic Shrine at Baltimore on July 4, 1959. Other important special events were the celebration incident to the acceptance of lands for Pea Ridge National Military Park and the celebration at Gettysburg and Abraham Lincoln Birthplace in connection with the Lincoln Sesquicentennial program.

Service to the Public

The interpretive services program continued to offer park visitors guide and lecture services by skilled and experienced naturalists, historians, and archeologists—supplemented by new automatic audio-visual presentations, museum exhibits, self-guiding trails, wayside exhibits, and interpretive signs and markers.

This public service added not only to the park visitor's enjoyment but provided an understanding of the natural and historic environment, which lead to important benefits—a greater appreciation of conservation concepts.

The earthquake in Yellowstone National Park and the eruption of Kilauea Volcano in Hawaii National Park provided outstanding opportunities for vivid interpretation of geologic events which were fully utilized and which will play major roles in future interpretive programs of both national parks.

Some 48 nonprofit scientific and historical societies contributed \$87,896 for aid to the National Park Service in 1959 for research, material and equipment and library purchases in its interpretive program.

Visitor Centers

Visitor centers, constructed under Mission 66, are outstanding features of the parks and monuments and contain much appreciated facilities to help visitors obtain greater benefit and enjoyment from their park visits.



Geysers in Yellowstone National Park, an attractive feature to the ever-increasing number of visitors to the park, reacted violently to the August 1959 earthquakes and many changed their pattern of behavior.

Nine more of these multiple-use buildings were opened to the public during the fiscal year, including centers at Arches National Monument, Utah; Bryce Canyon National Park, Utah; George Washington Carver National Monument, Mo.; Grand Teton National Park, Wyo.; Mammoth Cave National Park, Ky.; Montezuma Castle National Monument, Ariz.; Mound City Group National Monument, Ohio; Zion National Park, Utah; and National Capital Parks in Washington, D.C.

Story-telling exhibits were installed in 12 visitor centers and among these the exhibits for the Rock Creek Nature Center in Washington, D.C., had the additional feature of being designed particularly for students and school children. This center also contains a planetarium, an assembly room and an exhibit room with "work-it-yourself" and living displays.

Roadside and Trailside Interpretation

During the 1960 fiscal year, facilities to guide the visitor along the roadsides and trailsides in many of the parks were expanded. Road-

side exhibits for the entire park were completed at Fredericksburg-Spotsylvania National Military Park. Important new roadside or wayside exhibits were also completed on the Natchez Trace Parkway, at Fort Frederica National Monument, in Rocky Mountain National Park, at Navajo National Monument, and in Olympic National Park.

New interpretive signs and markers were completed at Fort Frederica National Monument, Fredericksburg-Spotsylvania National Military Park, Abraham Lincoln National Historical Park, George Washington Carver National Monument, Grand Teton National Park, Scotts Bluff National Monument, Craters of the Moon National Monument, Olympic National Park, and Isle Royale National Park.

Audio Visual Planning and Installation

The quality and number of audiovisual interpretive programs, supplementing personal services, advanced greatly during the fiscal year. The use of professional script writers and narrators, coupled with improved electronic equipment and production techniques, resulted in higher quality presentations.

Fully automatic slide-sound equipment was installed in 15 visitor centers and 6 new amphitheatres, and 29 audio stations were placed in operation. Loudspeakers were being replaced at audio stations by captioned slides and handphones, reducing the disturbance made by the loudspeakers.

Museum Program

During the year park staffs evaluated and catalogued more than 70,000 museum items, bringing the records up to date and allowing the transfer of items needed for display in new visitor centers.

Equipment needed for the safe storage of museum specimens was purchased for 62 parks. Of particular significance, specialists undertook the restoration of the Gettysburg cyclorama and the ceiling mural of the Senate Chamber in Congress Hall, Independence National Historical Park.

Public-spirited citizens donated museum items of considerable value, notably 16th century objects for Castillo de San Marcos and Fort Caroline, and objects closely associated with the Wright Brothers and George Washington Carver.

The National Museum, the Air Force Museum, the Ohio State Museum and other institutions generously lent or transferred museum items to museums of the National Park Service.



Reenactments of America's historic events, like this one at Harpers Ferry National Monument, recall our Nation's glorious past and heighten the visitors' interest.

Research

Archeological, geological and historical research was continued throughout the fiscal year, among others, in the Virgin Islands; at Effigy Mounds, Iowa; Sequoia-Kings Canyon, Calif.; Death Valley in Calif. and Nev.; Joshua Tree, Calif.; Harpers Ferry, W. Va., and Md.; Jefferson Expansion National Memorial, Mo.; Independence Hall National Historical Park in Philadelphia, Pa.; Theodore Roosevelt National Memorial Park, N. Dak.; and Wetherill Mesa in Mesa Verde, Colo.

The National Park Service also carried on an extensive archeological salvage program in 29 reservoir areas under cooperative agreements with the Smithsonian Institution and 31 State and local institutions. In the Missouri River basin, the Smithsonian Institution put four parties in the field. Surveys and excavations in the Glen Canyon and Navajo Reservoirs—now under construction in the Upper Colorado River basin—were conducted by the University of Utah and the



Rockslides caused by earthquakes in Yellowstone National Park in August, 1959, required extensive repairs to roads and buildings, amounting to several million dollars.

Museums of Northern Arizona and New Mexico. The University of Texas carried on several projects in the Iron Bridge and Ferrells Bridge Reservoirs in Texas.

Geological research in corporation with the Department's Geological Survey involved studies in glaciology as well as geologic mapping in Glacier, Mount Rainier and Grand Canyon National Parks. In the biological sciences, the Service continued the study of elk of Jackson Hole, Wyo., and the study of wolves and moose on Isle Royale in Michigan. Ecological studies were conducted in California in Joshua Tree National Monument and in Death Valley National Monument a study on big horn sheep continued. Marine biology studies continued also at Everglades and Virgin Islands National Parks.

Historical research was inaugurated at San Juan National Historic Site and architectural research in the Virgin Islands, while exhaustive research continued at Independence National Historical Park and at Harpers Ferry National Monument.

Wildlife

The mammals, birds, reptiles, amphibians and fishes in areas of the National Park System continue to be of prime visitor interest. The perpetuation of all native animals in their natural environment is a primary objective of the National Park Service and cooperative research by qualified institutions and individuals, such as the research on grizzly bears in Yellowstone National Park by the Montana State University, is encouraged by the Service.

Management and interpretation of important fishery resources of the parks continued, including the providing of accurate information on native fishes, and the establishment of self-guiding underwater trails in seashore environments.

Park Publications

The phenomenal increase in family camping, recreational pursuits, and education interests in the National Parks and other areas was demonstrated by the mounting demands for informational and educational literature.

The Service produced 11,650 copies of free informational publications during the fiscal year, including new format folders for Crater Lake and Glacier National Parks and nine smaller areas.

Two new historical handbooks—Antietam and Vanderbilt Mansion—were added to the series, and one—The Lincoln Museum and The House Where Lincoln Died—was revised. One natural history handbook—Great Smoky Mountains—was added to that series, and two in the archeological research series—Archeological Excavations at Jamestown and The Hubbard Site and Other Tri-Wall Structures in New Mexico and Colorado—were issued. The Service also produced the report entitled Recreation Today and Tomorrow in the Missouri River Basin, in cooperation with the Missouri Basin Inter-Agency Committee.

The Public Inquiries Unit received 54,984 requests for information during the 1960 fiscal year, which total included 1,235 foreign requests, and 1,182 congressional requests.

A total of 295,715 informational publications was received during the year and bulk distribution used in answer to requests received totaled 213,040, exclusive of sales publications and other miscellaneous publications—such as concessioner publications.

During the year, the National Park Service increased its collection of photographs to better illustrate Service publications and for improved park representation in newspapers, magazines, encyclopedias, and textbooks.

A survey of the demands on the National Park Service from writers, park administrators, governments as well as private institutions in other countries, showed approximately 600 foreign inquiries in a dozen foreign languages received for information and technical assistance.

Cooperation with the Standard Oil Co. of California and the Sinclair Oil Corp., in their respective programs of educational radio programs and instructive magazine advertisements, culminated in both firms receiving the Department's Conservation Service Award for enlightened public-service programs in the field of conservation. Public attention was also given to the 40th anniversary of the nature guide service in the National Park System, begun in 1920 by Dr. and Mrs. Charles M. Goethe. Dr. Goethe was also the recipient this year of the Department's Conservation Service Award.

Historical Commissions

The Civil War Centennial Commission continued its activity in preparation for observance of the centennial years. Meetings were held in Washington and in St. Louis.

The Lincoln Sesquicentennial Commission was continued from March 1 to June 30, 1960, to enable the Commission to complete its final report to Congress.

The Hudson-Champlain Celebration Commission observed the 350th anniversary of the explorations of Henry Hudson and Samuel de Champlain.

The Boston National Historic Sites' Commission, created in 1955 to study historic objects, sites and buildings in Boston and vicinity relating to the Colonial and Revolutionary periods, extended its 2-year study to June 30, 1960, at which time the final report of the Commission was submitted and the Commission disbanded.

The New York City National Shrines Advisory Board, established to promote public cooperation in the rehabilitation, preservation, and development of Federal Hall National Memorial, Castle Clinton and Statue of Liberty National Monuments in New York City, added new members to the body in the spring of 1960—which undertook a revived program to secure donated funds to complete the development of the areas by the opening date of the World's Fair in New York in 1964.

The protection and management of back country has become more critical with the growing interest in the primitive and undeveloped areas of the parks. Studies are under way to determine the patterns of use and provide guides for the future.



A huge rockslide caused by earthquakes in August, 1959, resulted in several million dollars worth of damage to Yellowstone National Park, in Wyoming. Although there were 17,000 people in the park at the time, no one was injured.

The training of park rangers, foresters and supporting personnel, was extended to men in all areas in a variety of programs and subjects tailored to fit the many situations encountered in the Service. Emphasis was placed on safety, forest and structural fire control, radiological monitoring, search and rescue, law enforcement, and mountaineering. The first water safety and rescue seminar was conducted at Everglades National Park for 16 park rangers and 6 other Federal employees. The National Park Service Training Center at Yosemite National Park completed its third successful year, graduating 50 new employees.

During 1959 the Service's system for generating and reporting statistics on public use of the parks was overhauled. Statistical methods are more rigorously controlled than heretofore. The new system is designed to become a basic vehicle in developing data for management and planning relating to park workloads, development priorities, design loads, changes in public pressures and needs, and identification of opportunities for new public services.

Ranger Activities

The divisions in four regional offices have been staffed with division chiefs and good progress was made in improving assistance to the parks in the fields of preservation and protection.

A major revision of title 36, Code of Federal Regulations, chapter 1, was completed and a new edition of the Code was issued. This updates and modernizes the regulations in view of the changes in visitor use practices in recent years.

Mountaineering

The mountainous parks are consistently attracting about 20,000 persons annually toward the rugged summits. It is a recreational outlet with heavy returns in satisfaction, but inherent hazards are always present and 10 lives were claimed this year by those seeking out the high and trackless places. The relatively infrequent accidents are mostly of a dramatic nature and thus become widely known. The effort, time and cost that goes into search, rescue or evacuation is proportionately great.

Use of Water Areas

The vigorous upward trend in all boating and water activities opens new areas of use and demands for protection services and facilities at an increasingly greater level. This is creating a lag that must be overcome to meet obligations for visitor safety, enjoyment and preservation of park features.

Twelve Months of Service

In 1941, 40 percent of that year's 21 million park visits occurred in July and August. In 1959, 21 million visits occurred in these 2 months alone, but constituted only 34 percent of the year's total of 63 million.

This means that parks now receive during nonpeak travel months over three times the volume of travel that formerly occurred during the peak period. The visitor pattern has shifted so the provision of public services now approaches a year-long operation versus a seasonal one.

Forest Fire Control

The fire control workload increased substantially this year. The fire seasons, particularly in the western mountain parks, extended



The Hurricane Ridge Lodge in Olympic National Park, Wash., is a vantage point giving a sweeping view of the forested Olympic Mountains.

2 to 3 months beyond normal. The occurrence of 517 fires was a significant increase over the previous 5-year average of 368.

Man-caused fires increased 42 percent over the previous year, and lightning-caused fires, 9 percent. However, the 3,061 acres of park vegetation burned was far less than the previous 5-year average of 8,444 acres and the lowest since 1939. The safety record of no disabling injuries during firefighting activities is outstanding.

Greater use was made of aircraft for scouting, detection, movement of suppression personnel and supplies, and application of fire retardants on burning fuels. Smoke Jumpers were utilized for the first time in region four.

Forest Insect and Tree Disease Control

Maintenance control operations kept most insect and tree diseases, and subsequent vegetative losses, low. Barkbeetle infestations in mixed conifers in California increased sharply. Mountain pine beetles have invaded the 60,000 acres of high mountain lodgepole pine



At the dedication of the Cumberland Gap National Historical Park, Department of the Interior Secretary Fred A. Seaton is shown points of interest by Superintendent Millard D. Guy.

in Yosemite National Park which have been weakened by repeated attacks of needleminer. Both infestations were combated by direct control particularly in the public use areas.

Acti-dione, an antibiotic, has proven effective in destroying white pine blister rust infections on western white pine. Control programs in white pine forests are being reoriented since it is now practical to extend protection to infected western white pines not included in the original ribes eradication units.

Wildlife and Fish Management

Fish management was oriented to retain natural wild fish populations and to stress that fishing is an incidental park experience rather than a primary one. Mammoth Cave and Grand Canyon live-trapped deer for transplants in Kentucky and the Navajo Indian Reservation. A bear management policy aimed at reducing personal injury to visitors and returning the bears to natural habitats has been initiated.

Recreation Resource Planning

The preparation of the National Park System plan, a program designed for selecting and preserving, while still available, qualified outstanding scenic, scientific and historic areas of the Nation so that



Campsites, such as this one in Olympic National Park, Wash., are favorite vacation spots to increasing number of visitors to the national parks.

future park needs may be fulfilled, made significant progress during the year.

Fifty-eight areas received field investigation or were otherwise inventoried for possible consideration for national park purposes. In addition, comprehensive studies were made of several areas to determine their national significance and their feasibility and suitability for inclusion in the system. Among these are the Great Salt Lake and Promontory Summit in Utah, Fort Davis in Texas, Fort Smith in Arkansas, Fort Larned in Kansas and Bent's Old Fort in Colorado.

Legislation has been introduced in Congress to establish a Fort Bowie National Historic Site, Ariz.; Hubbell Trading Post National Historic Site, Ariz., and an Arkansas Post National Memorial in Arkansas. The Russell Cave National Monument, Ala., is expected to be established by Presidential proclamation when the lands have been donated.

Other bills introduced in Congress would authorize comprehensive field studies of areas considered to be suitable for national park inclusion in the Northern Cascades region of Washington and Sawtooth Mountain region of Idaho, both of which are now in national forests.

Boundary Adjustments

Legislation authorized addition of lands at Antietam National Battlefield Site, Edison Laboratory National Monument, Independence National Historical Park, Montezuma Castle National Monument, and Wright Brothers National Memorial; additions and deletions at Kings Mountain National Military Park and Zion National Park; exchange and addition of certain donated lands at the Everglades National Park; and transfer of a small portion of San Juan National Historic Site to the municipality of San Juan as a city park.

Legislation also authorized boundary revisions and a change in name for Fort Laramie National Historic Site and Stones River National Battlefield, while boundaries of Muir Woods, Black Canyon of the Gunnison, Cabrillo and Colorado National Monuments were revised by Presidential proclamation.

Public land orders reserved administrative sites near Juneau and King Salmon, Alaska, for Katmai, Sitka and Glacier Bay National Monuments.

The McGraw-Edison Co. donated Glenmont, Thomas A. Edison's home in West Orange, N.J., for addition to Edison Laboratory National Monument. Mr. Wallace E. Pratt of Carlsbad, N. Mex., donated 2,042 acres of lands located in McKittrick Canyon, Tex., for a detached area addition to Carlsbad Canyon National Park. The General Services Administration approved transfer of about 3,600 acres of land from the Atomic Energy Commission for addition to Bandelier National Monument, as proposed by Presidential proclamation.

Bills introduced in Congress during the past fiscal year would authorize boundary adjustments at Castillo de San Marcos, Dinosaur, Harpers Ferry, and Scotts Bluff National Monuments; Coronado National Memorial; Blue Ridge and Natchez Trace Parkways, and Olympic and Shenandoah National Parks.

Other bills would establish a portion of the Tucson Mountain Park as a detached unit of Saguaro National Monument; authorize a boundary revision of the Fort Necessity National Battlefield Site; facilitate certain land exchanges and adjustments pertinent to park administration at Vicksburg National Military Park; provide a new headquarters site for Mount Rainier National Park about 9 miles from the park, and a small addition to De Soto National Memorial.

New Areas Proposed

The Department recommended that the Congress authorize establishment of three national seashores to be located at Cape Cod, Mass., Padre Island, Tex., and Oregon Dunes, Oreg. Studies have continued



Carlsbad Caverns National Park, N. Mex., draws an ever-increasing number of visitors who enjoy its subterranean spectacle as well as the lectures by national park rangers.

for the proposed Point Reyes National Seashore in California and Cumberland Island, Ga.

A Park Service report recommending the establishment of an Ozark Rivers National Monument in Missouri was issued during the year. A Great Basin National Park proposal in Nevada was considered at congressional hearings held in Nevada in December 1959. Progress was made in evaluating a Prairie National Park proposal in Kansas and the Allagash River region in Maine. The Department supported the Chesapeake and Ohio Canal National Historical Park proposal in Maryland.

Areas Authorized or Established

In accordance with authorizing legislation, notice of the establishment of Grand Portage National Monument, Minn., effective January 27, 1960, was given by the Secretary. The Grand Portage Band of Chippewa Indians and the Minnesota Chippewa tribe previously had donated their trust lands within the monument boundaries to the United States for the purposes of the monument.

Important sites along the route traversed by the British military expedition from Boston to Concord, Mass., at the opening of the War of the American Revolution, were authorized to be established and preserved as the Minute Man National Historical Park by the act of September 21, 1959.

The Wilson Creek Battlefield near Springfield, Mo., site of a struggle between the Confederate and Union forces for control of the State in the first year of the Civil War, was authorized to be established as a national park by act of April 22, 1960. Establishment of Bent's Old Fort in Colorado as a national historic site was authorized by act of June 3, 1960.

Park status for these areas becomes effective when sufficient lands have been acquired to warrant establishment.

The act of September 8, 1959 changed the designation of the Abraham Lincoln National Historical Park in Kentucky to the Abraham Lincoln Birthplace National Historic Site.

Horseshoe Bend National Military Park was established by Presidential proclamation on August 14, 1959, pursuant to an act of Congress of July 25, 1956. Lands were donated by the State of Alabama and the Alabama Power Co.

Nationwide Recreation Planning

Inventory of potential recreation areas and studies leading toward the determination of outdoor recreation needs received major emphasis in the continuing work on nationwide planning for nonurban recreation resources.

In addition, efforts were made toward completion of the inventory of existing recreation areas and supplementing inventory data previously collected. Data collected on existing areas were assembled for the Outdoor Recreation Resources Review Commission, as was a general evaluation of recreation opportunities and developments in selected metropolitan areas and counties throughout the country.

Shoreline Surveys

Findings from the 2-year recreation area survey of the Great Lakes shoreline were released in a two-volume report issued by the National Park Service, *Our Fourth Shore and Remaining Shoreline Opportunities*. The report recommends public preservation of important natural areas and responsible planning for industrial areas to reduce their effect on recreation values.

Sixty-six areas were identified as possessing important recreation values. At least three of these, Sleeping Bear Dunes, Huron Moun-

tains, and Pictured Rocks, were believed to be of national significance and were being studied in further detail at the end of the year.

River Basin and Regional Studies

A report on Recreation Today and Tomorrow in the Missouri River Basin, prepared in cooperation with the Missouri Basin Inter-Agency Committee, was released. Cooperation with recreation groups of interagency committees included participation in work of the Arkansas-White-Red Basins Inter-Agency Committee, the Columbia Basin Inter-Agency Committee, the Pacific Southwest Inter-Agency Committee especially on the means of financing recreation development under the provisions of the Colorado River Storage Project Act, and the U.S. Study Commission, Southeast River Basins on a field survey to identify "unusual areas" possessing recreation potential and deserving consideration for meeting present and future recreation demands.

At the request of the Bureau of Land Management, the Service undertook to provide recreation planning assistance on O & C lands in Oregon.

Recreation Research

The field of recreation economics was stressed in research studies made during the year, especially in connection with proposed national seashore areas. Economic surveys of the proposed national seashores at Oregon Dunes and Point Reyes were completed in collaboration with private economic experts, and an economic study on the impact of establishment of the proposed Cape Cod seashore was conducted under contract. Survey work was completed also on a study of the economic impact and sociological effects of recreation use of three reservoirs in the Missouri River basin.

Reports are in process on two special studies being made under contract: (1) a study of present and future needs for organized camping facilities to provide camping opportunities for children in ages 9-16, and (2) a nationwide sample survey to help measure long-term demand for public parks and recreation areas and the types of outdoor experiences that are sought.

A special survey of the demand for water resources for recreation use was made at the request of the Senate Select Committee on National Water Resources.

Advisory and Consultative Assistance

Assistance was given to 47 States on 628 occasions on a wide variety of problems. The amount of such assistance furnished has been in-



Fort Laramie in Wyoming, like many other National Monuments, recalls America's early frontier history and the opening of the West.

creasing gradually for some years, but it is still inadequate to meet the requests arising from the States' expanding recreational programs.

One of the more significant examples was cooperation with the Missouri State Park Board in adapting Service master-planning procedures to the preparation of a master plan for Van Meter State Park. After approval by the Board, it is hoped that this may serve as a guide for other master plans.

Another important example is a comprehensive study of the 50,000-acre Custer State Park being undertaken on a reimbursable basis at the request of the South Dakota Department of Game, Fish and Parks to determine needed acquisition, development, protection and operating methods and procedures required for continued administration as a State park on an adequate and proper basis.

This annual edition of a compilation of reports by State park agencies made upon request of the National Conference on State Parks, reveals (1) 2,433 State parks, historic sites, and related types of recreation areas, embracing nearly 5.7 million acres, (2) attendance in excess of 255 million, including 18 million overnight guests, (3) expenditures of \$51 million for operation and maintenance and \$37 million for capital improvements, (4) revenue from operations amounting to nearly \$21 million, and (5) 6,966 year-round and 9,724 seasonal personnel.



Keeping picnic grounds in the national parks neat and tidy is an unending task for park personnel which has to cope with man and beast.

Real Property Disposal

Recommendations were furnished to General Services Administration for conveying to the States and their political subdivisions for park, recreation and historic monument purposes, 28 Federal surplus properties embracing 2,066 acres.

Most significant was the former Sampson Air Force Base near Geneva, N.Y., with 3 miles of frontage on Seneca Lake, the largest of the Finger Lakes. The Service now has responsibility for enforcing compliance with the conditions of the deeds on 189 properties with a total of 31,872 acres.

The Bureau of Land Management was furnished recommendations on 40 applications from State and local agencies to acquire public domain lands for park and recreation purposes.

Reservoir Planning and Management

Nineteen recreation reports were prepared for the Department's Bureau of Reclamation and also 19 for the U.S. Army Corps of Engineers. A management agreement was negotiated with the Colorado State Park and Recreation Board for the operation and maintenance of the recreation area on the Bureau's Vega Reservoir.

Operations

Recommendations made by the management survey teams during the year should strengthen the Branches of Programs and Maintenance. The former has been given expanded functions relating to operating programs and the latter will be enabled to carry forward a more dynamic maintenance program for the parks.

The Branches of Concessions and Lands have achieved substantial results, respectively, in their fields of providing more and improved visitor accommodations and eliminating inholdings, despite serious obstacles which have had to be overcome.

Probably the most difficult problem ahead in the land acquisition field is the acquiring of inholdings at Antietam National Battlefield Site, Gettysburg National Military Park, and other Civil War battlefield areas, before the forthcoming centennial observances.

Land Acquisition

During the fiscal year \$1,700,000 was appropriated for land acquisition, of which \$450,000 was allotted to the purchase of lands in Civil War areas. Some 20,685 acres of inholdings were acquired by purchase, donation, transfer, or exchange.

Donations of land included 640 acres from the State of Texas for Big Bend National Park; 1,322.75 acres and 37.50 acres from the State of North Carolina and the Eastern National Park and Monument Association, respectively, for addition to the Blue Ridge Parkway; and 1,284 acres from the State of Tennessee for the Foothills Parkway, Great Smoky Mountains National Park.

Completed purchases and approved options cover some 5,385 acres of land in Glacier, Isle Royale, Rocky Mountain, and Yosemite National Parks; Fort Frederica, Joshua Tree, Petrified Forest, and Pinnacles National Monuments; Colonial and Independence National Historical Parks; Manassas National Battlefield Park; Theodore Roosevelt National Memorial Park; and Fort Clatsop National Memorial Project.



The unsurpassed grandeur of the snow-covered Logan Pass on the "Going to the Sun Highway" in Glacier National Park leaves unforgettable memories to millions of visitors.

Water Resources and Water Rights

The special master's report on the *Arizona vs. California* suit over Lower Colorado River water rights was submitted to the Supreme Court in May. The special master limited allocation to the waters of the main stem of the river. The right to the quantity of water from the main stem, which is being used at Lake Mead National Recreation Area, and the right to unspecified increased future use, as needed, were recognized.

Federal rights to the use of waters tributary to the Colorado River remain unaffected at Lake Mead and the other 22 parks and monuments in the Lower Colorado River basin. These rights were recognized as being based both on appropriation under State laws and on Federal withdrawal and reservation of the areas.

Concessions Authorizations

Six concession contracts were negotiated. Five of these included construction programs—three at Lake Mead and one each at Cape Hatteras and Yosemite. Of the six contracts negotiated, three have been finally executed on behalf of the Government.

The review of concession contract language and policies within the Department has caused this activity to be temporarily suspended.

Prospectuses

Seven prospectuses were issued soliciting offers for facilities at Big Bend, Glacier, Isle Royale, Natchez Trace, Blue Ridge, Glacier Bay, and Fort Jefferson. The Big Bend, Isle Royale, and Blue Ridge prospectuses resulted from the decision that no action be taken on the request of National Park Concessions, Inc., for a new contract and the directive that prospectuses be issued for each area in which it operates.

The only offer received in response to the Big Bend prospectus was submitted by National Park Concessions, Inc., and was conditioned upon its being authorized to continue operations at Mammoth Cave. A contract is being negotiated as a result of the Natchez Trace prospectus.

Mission 66 Control Schedules

The Mission 66 Control Schedules for the parks were revised to include requirements for new areas and increased costs. Also, schedules for operating programs were included for the first time.

In preparing this 200-page document, the original Mission 66 estimates for operating programs were reviewed in cooperation with representatives of the Mission 66 Staff and the Branch of Finance. New estimates were developed, taking into account factors not known when the original estimates were prepared in 1955.

In addition to revised control schedules, a 150-page, 6-year program of public works projects was prepared in compliance with Bureau of the Budget requirements, and a tabulation showing estimated costs of Federal, State, and nonurban recreational developments for the 15-fiscal-year period, 1961-1975.

Operating Programs

As a result of recommendations of the management survey teams, the Branch of Programs has been assigned final responsibility for all operating programs, and for developing procedures leading to the preparation and submission annually of formalized programs for all Service functions.

Procedures are in the process of preparation and it is expected that they will be put into effect during the 1961 fiscal year.

Maintenance

Attention has been focused on park needs where water-borne transportation units and floating equipment are essential to efficient maintenance and operation. Arrangements have been made with the Chief of Transportation, Department of the Army, to secure a tug and barges for Isle Royale National Park and a supply ship for Fort Jefferson National Monument.

The Commandant, U.S. Coast Guard, has cooperated in furnishing technical assistance in converting several gasoline-powered craft at Lake Mead to diesel power for more efficient operation and greater safety.

Design and Construction

In fiscal 1960, 1,252 projects were included in construction programs of the National Park Service, including carryover projects from previous fiscal years. By June 30, 1,097 of these projects were completed or under construction.

Severe damage to facilities in Yellowstone National Park due to the recent earthquake, and damage incurred by volcanic activity in Hawaii National Park, required immediate remedial measures to provide facilities for public safety and protection of Government property requiring temporary postponement of some construction projects originally contemplated.

Roads and Trails

Eighteen major roads projects were completed, amounting to 83 miles of stage reconstruction or completion at a cost of \$9,883,900. Twenty-one projects totaling \$9,181,413 were started during the year; one for \$41,994 has been completed; the 20 remaining totaling \$9,128,920 added to six previously started projects costing \$4,801,299 makes a total of 26 projects costing \$13,930,219 under construction at the end of the year.

Important projects consisting of reconstruction completed during the year were 20 miles of the Tioga Road at Yosemite National Park, 5 miles of the Rio Grande Road at Big Bend National Park, 14 miles of the park road at Mount McKinley National Park, 7 miles of the Peaceful Valley Loop Road at Theodore Roosevelt National Memorial Park, and 14 miles of the Cedar Pass Pinnacles Road at Badlands National Monument, and 5 miles of the Park Entrance Road at Mesa Verde National Park.

Parkways

The National Parkways construction program concentrated on several parkways and provided additional visitor facilities along the completed sections. Of the \$16 million contract authorization provided by the Federal-Aid Highway Act of 1958, \$240,000 was programmed for the Baltimore-Washington Parkway—Maryland; \$4,413,700 for the Blue Ridge Parkway—Virginia and North Carolina; \$110,000 for the Colonial Parkway—Virginia; \$1,661,000 for Foothills Parkway—Tennessee; \$2,809,800 for the George Washington Memorial Parkway—Virginia and Maryland; \$6,365,000 for the Natchez Trace Parkway—Alabama, Tennessee, Mississippi; \$165,000 for the Palisades Parkway—District of Columbia; \$35,500 for the Rock Creek and Potomac Parkway—District of Columbia, and \$200,000 for advance planning.

An amount of \$2 million additional contract authority was provided by the Federal-Aid Highway Act of 1959 for relocation of a portion of the Natchez Trace Parkway to be flooded by creation of the proposed Pearl River Valley reservoir near Jackson, Miss.

During the year 32 individual major projects were completed with a total value of \$16 million. The completion of the 18-mile section of the Blue Ridge Parkway in Virginia extending from U.S. No. 60 southwesterly to the existing Peaks of Otter section including the 1,040-foot long James River bridge, was a major accomplishment. The opening of this section eliminated a 25-mile detour and provided motorists with a 211-mile scenic drive from the northern boundary of Shenandoah National Park to U.S. Highway No. 460 near Roanoke. A 5-mile extension of the George Washington Memorial Parkway in Virginia from Spout Run near Key Bridge to the Central Intelligence Agency Headquarters site was opened. On the Natchez Trace Parkway in Mississippi 35 miles were completed on the Jackson-Tupelo unit. Numerous picnic ground facilities, campground roads, comfort stations, maintenance buildings and utility systems were completed.

Forty-five major contracts totaling \$23,715,000 were in process under the Bureau of Public Roads program. They include two projects on the 5,036-foot long Tennessee River bridge in Alabama to carry the Natchez Trace Parkway over the Pickwick reservoir, and the beginning of grading work on the Foothills Parkway in Tennessee.

Field studies were provided jointly by the Bureau of Public Roads and the National Park Service on the location of the Great River Road in Arkansas. All 10 Mississippi River States were provided with similar advisory service.

Buildings

Emphasis on visitors' facilities continued. The building construction program included 18 visitor centers completed or nearing completion, with 7 additional ones under construction or reaching the contract stage. Eighty-four projects involving over 100 historic buildings or structural remains were in progress.

There were 87 permanent dwelling units; 55 multiple units; 9 seasonal buildings and a dormitory under construction. During hearings on the 1961 fiscal year budget, the Service's Revised Standard Plans for Employee Housing were reviewed by a House Subcommittee on Appropriations. The fund limitation of \$20,000 set in 1960 was retained, but a basis was established for clearance of projects expected to exceed that amount.

Programing of the Jefferson National Expansion Memorial was geared to commemorate in 1964 the sesquicentennial of the founding of St. Louis. Revisions in planning and construction since 1959 necessitated several additions and adjustments in the professional services contracts. The architects are currently completing studies of the design, structural and mechanical phases of the memorial arch features.

The Historic American Buildings Survey continued recording historic structures with the aid of summer-student teams and through widening collaboration with professional and historical organizations, universities and preservation groups. In the Virgin Islands a grant by the Jackson Hole Preserve brought to realization the long-standing plans of the Royal Academy of Fine Arts in Copenhagen to undertake a survey of early Danish architecture, under the sponsorship of HABS.

Utilities and Miscellaneous Structures

Major emphasis was given to simplification of design and acceleration of construction of campground and related utilities. Particular attention was given to effecting economies consistent with good practice and National Park Service policy, with respect to number and location of necessary water fountains, lighting, comfort stations, and hydrants necessary for fire protection.

Following a study made for the National Park Service by a specialist on beach erosion, action was initiated in cooperation with the State of North Carolina to provide sand fixation and hurricane protection at Cape Hatteras National Seashore. The objective is to develop an effective barrier against the forces of nature which erode the beach. The design of the Cruz Bay marina to serve the Virgin Islands National Park was completed. Fifty-eight new sew-

age systems were completed and 66 new water systems increased water storage facilities by 2,219,275 gallons. Eighteen new campgrounds were completed as well as 978 additional campsites.

Master Plans

In the new format which was developed in a Mission 66 study the master plan for each park is expected to become an increasingly important and useful document.

The individual plans will define the overall objectives and controls and establish basic requirements for all elements of a park program. The correlation of development to the requirements of administration, protection, interpretation, and public accommodations will be greatly strengthened. Similarly, the conduct of other programs will have their basis in a single document thereby assuring unified direction in accomplishing stated objectives.

National Capital Parks

An estimated 45 million persons used National Capital Parks park facilities in fiscal 1960, with more than 5 million visitors counted at the five major national memorials. There were 367 special events attended by over 2½ million persons, representing a 73 percent increase in special events over 1958 and a 30 percent increase over 1959.

Mission 66 Improvements

A 5-mile section of the George Washington Memorial Parkway along the Virginia Palisades was opened by President Eisenhower on November 3; the Old Stone House in Georgetown was furnished and placed in operation as a historic house museum on January 24; the House Where Lincoln Died underwent major rehabilitation and was reopened to the public by the Secretary of the Interior on July 4; the Netherlands Carillon Tower was accepted on behalf of the people of the United States by the Secretary of the Interior on May 5; the Rock Creek Nature Center was dedicated on June 4; and a new staff quarters at camp 5 and paving circulatory roads were completed at Prince William Forest Park.

A new recreation building at camp 2 was constructed at Catoctin Mountain Park; major road improvement was undertaken in Rock Creek Park and extensions of parking areas completed at the Carter Barron Amphitheater and Mount Vernon; extensive planting and improved landscaping was accomplished throughout the park system, including the addition of 4,687 trees and 7,827 shrubs. Major landscape improvements were made to 14 separate park areas.

Planning and Land Acquisition

A contract was awarded for the design of a six-lane Lincoln Memorial underpass and redevelopment of the Lincoln Memorial Plaza. A lease agreement was negotiated between the Potomac Electric Power Co. and National Capital Parks for 790 acres of wilderness-type land at Great Falls, Va., for a period of 50 years. Such agreement will insure protection for this rugged natural area and may provide for its eventual inclusion as a key unit in the National Capital Park System.

Budget and Finance

While the Service's 1960 appropriations for construction of buildings, utilities and other facilities were less than the amount appropriated for 1959, appropriation increases were provided in 1960 to strengthen the operating programs. There follows a comparison of the 1960 appropriations with those for 1959:

Appropriation item	1959 fiscal year	1960 fiscal year	Increase (+) or decrease (-)
Management and protection.....	\$16,056,200	\$16,772,000	+\$715,800
Maintenance and rehabilitation of physical facilities.....	12,477,100	14,435,000	+1,957,900
General administrative expenses.....	1,429,300	1,475,000	+45,700
Construction.....	20,000,000	16,735,000	-3,265,000
Construction (liquidation of contract authorization).....	30,000,000	30,000,000	-----
Total cash appropriations.....	79,962,600	79,417,000	-545,600
Construction (amount by which roads and trails and parkways contract authorization exceeds cash appropriation).....	2,000,000	6,000,000	+4,000,000
Total new obligational authority.....	¹ 81,962,600	85,417,000	+3,454,400

¹ Includes \$14,765,500 of 1959 contract authorization for roads and trails and parkways construction advanced to the 1958 fiscal year for obligation.

Financial Management

At the close of the fiscal year, the Service's program for improvement in financial management, which has been in progress since 1954, was nearing completion. One important feature of the program virtually completed during the year was that of inventorying and placing under accounting control all of the fixed assets in the park areas that were acquired or constructed prior to the installation of the new accounting system.

For the first time in its history the Service now has complete inventories of all its fixed assets and under the new accounting system such inventories will be kept current at all times. Steady progress was made in the review and revision of the draft accounting handbook which should be ready for General Accounting Office consideration and approval within a few months.

Office of Territories

Anthony T. Lausi, *Director*



IN TERRITORIAL ADMINISTRATION, the fiscal year 1960 culminates a decade notable for the achievements of these areas in self-government.

In 1950 the Congress enacted organic legislation for Guam and laid the basis for commonwealth status for Puerto Rico attained in 1952.

In 1951 the administration of American Samoa and the Trust Territory of the Pacific Islands was transferred from the Navy Department to the Department of the Interior.

In 1952 the constitution for Puerto Rico was approved, and in 1954 the Congress enacted the Revised Organic Act for the Virgin Islands.

The long-sought goal of statehood for Alaska was achieved in 1958 and for Hawaii in 1959.

American Samoa in the South Pacific gained legislative authority for the first time through approval of the first constitution of American Samoa by the Secretary of the Interior on April 27, 1960. Under the leadership of their Samoan-born Governor, Samoan leaders in Constitutional Convention painstakingly reviewed each section of their constitution which they unanimously adopted after full discussion and debate.

Highlighting the recognition of the progress of the Territory of Guam in self-government was the appointment of the Honorable Joseph Flores as Governor of Guam, the first American of Guamanian ancestry to be so appointed.

Through education and training the inhabitants of the Trust Territory of the Pacific Islands increased their participation and responsibility in governmental affairs, economic growth, and the public welfare.

With strong support of the President, legislation was introduced in the Congress to provide Guam and the Virgin Islands with non-voting representation in the United States House of Representatives.

During Congressional hearings, witnesses from both Territories and the Department of the Interior recommended enactment.

Greater Resource Use

Political developments were matched by significant advances in the economies of all Territories. Total local revenues collected during the fiscal year reached new heights as a result of intensive efforts to develop the local resources. Major emphasis on public welfare measures will enable a better educated and more healthy younger generation to assume future leadership.

These rapid changes in the developing Territories, because they were accomplished by the participation of the people themselves, have taken place in an atmosphere of stability and without the disrupting effect on social and cultural patterns of the people which have occurred in some of the other areas of the world. A firm foundation has thus been laid for further progress in political, economic and social development in the Territories.

American Samoa

The promulgation of the first constitution for American Samoa by the Secretary of the Interior on April 27, 1960, was the most significant event of the year in American Samoa.

The constitution was written by a drafting committee after 6 years of study and preparatory work by a prior committee established in 1954. The Constitutional Convention, held April 20-26, gave intensive consideration to every provision of the constitution. Each of the 68 members of the convention, selected by village councils according to custom and tradition, spoke and debated. The members included the ranking chiefs and most of the legislature. Unanimous agreement was hammered out by full debate and compromise using the Samoan language throughout.

In a historic ceremony, 5,000 persons witnessed the signing of the constitution by each member of the convention, followed by the Governor and the Secretary of the Interior, whose signature marked the final act of approval and promulgation.

The signing climaxed a 2-day ceremony commemorating the 60th anniversary of the raising of the United States flag on Samoan soil in 1900.

A significant feature of the Flag Day and constitution ceremonies was the raising of the first flag of American Samoa.

The past year witnessed the acceptance of the Governor of American Samoa for the first time as a member of the national Governors' Con-



Accompanied by Peter Tali Coleman, Samoan-born Governor of American Samoa, Secretary of the Interior Fred A. Seaton completes the final act of signing the first constitution of American Samoa on April 27, 1960. The actual signing of this constitution by the 68 delegates to the Constitutional Convention, Governor Coleman and Secretary Seaton was witnessed under sunny skies by more than 5,000 people on the occasion of the 60th anniversary of the raising of the United States flag in American Samoa. One of the signers, High Talking Chief Mulituaopele Tamotu, looks on.

ference. Legislative leaders also participated in conferences at the national level. The president of the Samoan Senate and the speaker of the Samoan House attended the National Legislative Conference held in October 1959 in Denver, Colo., followed by a visit of two legislators to observe legislative processes during the first session of the Hawaii State Legislature.

Improved Transportation

Air and surface transportation to and from Samoa improved during the year. Weekly flights commenced in October 1959 between Samoa

and Honolulu and daily flights now connect the two Territories of American Samoa and Western Samoa. In July 1959, asphalt surfacing was placed on the existing 6,000-foot airstrip to help accommodate larger aircraft. The timely procurement in June of a large amount of heavy construction equipment from excess stocks is expected to permit meeting the scheduled completion date of mid-1962 for the new jet airport.

The level of economic activity continued to increase. Local revenues reached the \$1 million mark for the first time, for a final figure of \$1,003,923.49 as of June 30, 1960.

Health Activities Increased

Intensive efforts were devoted to public health activities and preventive medical care. The employment of a Sanitarian with a background in public health helped to strengthen and expand Women's Health Committees and subdispensaries in each village.

Visitations by medical and public health teams to each village for baby clinics and cleanup campaigns have led to improvements in sanitary facilities and practices, lessened the incidence of intestinal diseases and eye and skin diseases, and resulted in reduced hospital admissions. Health education introduced into the strong Samoan culture has been the keynote. The visit of a South Pacific Commission health education specialist helped develop the village health education program.

At the request of the Governor, the United States Public Health Service sent a medical team to American Samoa to make a leprosy survey. The survey report was expected in the next fiscal year.

Guam

Major enactments of the 1960 Guamanian legislative session were: Land Recording Law; Marketable Title Act; Amendments to the Uniform Security Act; Financial Responsibility Law; authority to enter Western Interstate Correction Compact; disclosure of juvenile violators, and abolition of the Office of Police Court Judge.

Notable projects in government operations and service to the public were reorganization of the Public Health Division and initiation of programs in Maternal and Child Health Care, Crippled Children Services and Clinics for the Aged. Four public health buildings were completed in Asan, Mangilao, Piti and Talofofu Villages.

Economic trends were encouraging. A commercial airline expanded its service to Guam and Okinawa, and the major airline now serving Guam has extended jet service to Guam.



Tumon Junior-Senior High School, Guam.

A memorandum of understanding was signed between the Governor and the commander, Naval Forces Marianas, granting an additional power allocation to the civilian community. A joint Guam-Navy venture was underway for the construction of a new generating plant and the installation of a mobile unit supplementing present power production.

In order to continue to provide more efficient service at the commercial port, and to reduce rates and tariffs, new facilities were installed, including a new carrier agents building and a rehabilitated, retractable fender system. Authorization was obtained to construct a 300-foot warehouse for incoming vans and lumber.

Education Progress

During the year, both George Washington High School and Tumon Junior-Senior High School were accredited by the North Central Association of Colleges and Secondary Schools and the Territorial College received continued accreditation from the Western College Association.

The Trade School was opened and will help alleviate the critical shortage of skilled and semiskilled workers. Construction of the Territorial College and the Tumon Junior-Senior High School was completed. Construction of the Agat Junior High School and 16 new classrooms at Andersen Elementary School was under way with completion scheduled for the first half of fiscal year 1961. Design contracts were entered into for Barrigada Junior High School and East Barrigada Elementary School.

The agricultural program emphasized modern techniques of farming and the new Division of Wildlife and Fisheries was established with recruitment of technical personnel.



Trust Territory of the Pacific Islands—Young women as well as men show interest in science experiments at PICS (Pacific Islands Central School), in Ponape. This school offers high school training to students from all districts of the Trust Territory.

Trust Territory of the Pacific Islands

Through education, training and cooperative effort, the 73,000 Micronesians inhabiting approximately 90 atolls and islands (some 2,000 other atolls and islands are uninhabited) are being prepared to assume an increasing share of the responsibilities for government, economic growth, and public welfare.

Opportunities are being offered through improving school facilities at home, grants for study abroad, and in-service training. Through on-the-job experience and local-government participation, increasing numbers of Micronesians are acquiring the skills to carry out the varied functions of this threefold program.

Within the Executive Branch, three Micronesians were promoted to newly established positions of administrative aide, fortifying their previous education and training with high level administrative work. Throughout the districts and departments, Micronesians have been advanced to higher grades.

In the legislative field the program of chartering municipalities gained momentum through diligent efforts of Micronesians on district staffs, who visited outlying communities in teams to explain and answer questions on functions and procedures of chartered municipal

government. District congresses accepted added responsibilities in fields such as education and youth fitness.

Designation of a social affairs subcommittee which met in the interim between the 1959 and 1960 Inter-District Advisory Committee Conferences enlarged the scope of this annual gathering of Micronesian leaders. A trade fair for exhibits of crafts and products was scheduled in connection with the 1960 Conference.

Local Economy Improving

Fisheries and cacao were emphasized as a part of the economic development program. As the result of a Government pilot fisheries project in Palau and a newly organized fisheries cooperative in Ponape, fish production, sales and exports soared over any previous year under United States administration. A partial subsidy to stimulate cacao plantings met enthusiastic response and many new stands were established. The first commercial shipment, although a small sample run, was exported to test acceptance in the world cacao market. Coconut rehabilitation continued.

In two districts, trading companies functioned successfully under all-Micronesian management. Selected Micronesian personnel from the districts, brought to headquarters in small groups, received advanced training in their respective occupations.

Educational Advancement

Great emphasis was given to the advancement of Micronesian education. Eight Micronesians on government scholarships are working toward college degrees; 29 are in colleges in the United States, Guam or the Philippines on 2-year or special government grants, while various others are studying abroad under private auspices.

A major event was the dedication of the new Pacific Islands Central School (PICS) with an enrollment of 140 representing all districts. Set amidst the mountains of Ponape, the new high school includes a library, auditorium, classrooms, science and vocational arts buildings, and three dormitories. Two qualified Micronesians appointed to the PICS faculty served effectively, along with six Americans.

Reorganization and standardization of elementary school curricula were completed. Training sessions for elementary teachers continued and teacher trainers visited island schools providing guidance and assistance. Additional elementary schools were built with the help of government grants-in-aid.

In public health all district programs came under Micronesian direction. Two American doctors supervised and provided training.



A single family unit of the Virgin Islands Emergency Housing Program.

Eleven students, one a young woman, are preparing for careers as medical officers at Central Medical School, Suva. Two of the eight "degree" students entered the University of the Philippines for work leading toward M.D. degrees, the first to embark upon medical-degree study under government sponsorship.

Other public health training included the School of Nursing at Palau, a newly formed continuous 2-year School for Dental Hygienists in the Marshalls, a course in community hygiene and sanitation held at Truk, specialized training for medical officers at the Naval Hospital, Guam, and a continuing program for health aides in all districts.

Virgin Islands

Operations of the government of the Virgin Islands showed notable improvements during fiscal year 1960. Government services were strengthened and revenues were the highest in the history of the territory.

Local revenues collected during the fiscal year totaled \$7,274,353.62, an increase of 38 percent. Total Internal Revenue Matching Funds amounted to an additional \$4,917,952.15.

The Office of the Government Secretary continued to develop a modern real property tax assessment program. Directed by experienced tax consultants, work progressed on surveying and mapping of real property and the establishment of uniform and equitable assessment criteria and procedures.

The population of the Virgin Islands as of April 1, 1960, according to a preliminary count of the returns from the Census, was 31,904 as compared with 26,665 on April 1, 1950.

The Department of Tourism and Trade estimates that over 200,000 visitors came to the Virgin Islands. The gross tourist revenue was estimated at \$24 million, a substantial increase over the preceding year.

Water Problems

The lack of a continuous supply of potable water remained a major problem. Improvement in the supply situation was effected when a contract was signed with a private concern to haul water from Puerto Rico. Though records show a total rainfall of 58.43 inches in St. Thomas, the island suffered one of its severest droughts, not relieved until the flood of May 8-9, 1960. The flood, however, caused severe damage to roads, streets, sewers, potable and salt water lines, and other public facilities.

In the Department of Health, two full-time house physicians were added to the staff of the hospitals in St. Thomas and St. Croix. The Department of Social Welfare cooperated with the Commission on Aging in studying the needs of senior citizens in the Virgin Islands. Completed units in the Emergency Housing Program provided quarters for 19 families totalling 97 persons. Additional units have been purchased and are under construction.

In public safety, highway patrol activities were increased, a system of uniform traffic tickets instituted, and additional patrolmen employed in both islands. There has been a drastic decrease in the highway accident and fatality rate.

The Department of Agriculture and Labor recently appointed a marketing specialist to conduct a study of demand and supply schedules for farm products in order to promote an improved diversified agricultural program.

Government Comptroller

The Office of the Government Comptroller of the Virgin Islands, created by Public Law 517, 83d Congress, approved July 22, 1954, has operated as a Federal agency under the supervision of the Secretary of the Interior since July 1, 1959. The functions of the Govern-

ment Comptroller's Office are somewhat similar to the functions of the General Accounting Office.

During fiscal year 1960, the government comptroller made several comprehensive audits and a number of limited audits. The audit of all cashiers' receipts beginning with September 1, 1957, was undertaken and other reports and investigations were made from time to time. An important function of this office is the certification of net revenues made yearly for matching fund purposes. The comptroller also prepares an Annual Report on the Financial Condition of the Government of the Virgin Islands.

The comptroller's office is also responsible for validating all documents for essential public projects and the submission of quarterly progress reports thereon.

Virgin Islands Corporation

Electric facilities in the Virgin Islands have been severely taxed by the rapid expansion of tourism, the establishment of new industries, and home construction. Power expansion plans have been accelerated and combined with the program to provide badly needed potable water for St. Thomas. Engineering studies for construction of a salt water distillation plant with a minimum capacity of 250,000 gallons per day have progressed and the major components are under contract. The plant is expected to be in operation in late 1961.

Power activities showed a loss over the past year and substantial maintenance costs were necessary to keep all available equipment operating at full capacity. Failure of a new 2,500-kilowatt generating unit required installation of emergency generating equipment on St. Thomas. Through the cooperation of the Navy a serious outage was averted, and increased loads were met. The growth of St. Croix also severely taxed generating facilities, and a 2,500-kilowatt generator is planned as an addition to this system by mid-1961.

Severe drought conditions set back production and processing of sugarcane, the principal activities of the corporation on St. Croix. Only 71,076 tons of sugarcane were ground and 6,970 tons of sugar, raw value, manufactured. This was some 6,000 tons of sugar less than the previous year, also a mediocre year. A study of rainfall over the past 15 years shows a close correlation between total rainfall, rainfall during the last 6 months of the growing period, and yield of sugarcane.

The earth dams construction program on St. Thomas and St. Croix continued. Six dams with an estimated capacity of over 8 million gallons were completed, and the impounding capacity of two older dams was increased. The program in terms of flood control and prevention of soil erosion has proved its value many times over.

The Forestry Programs showed steady progress. St. Croix mahogany has attracted the attention of a number of artisans who have developed high quality products for sale.

Alaska Public Works

In 1949, by Public Law 264, the 81st Congress authorized a \$70 million program of public works in Alaska to foster economic and social development through provision of facilities for community life. This 5-year act was later extended to June 30, 1959.

Under this program the Federal Government, upon application by a public body in Alaska, finances the entire cost of construction of approved projects and, upon their completion, transfers them to the applicant at prices that will return to the Treasury of the United States not less than 50 percent of the total cost.

Through June 30, 1959, congressional appropriations totaling \$69,976,200 have become available. Allotments have been made in the amount of \$69,286,150 to 172 projects to provide schools; hospitals and health centers; municipal buildings; sewer and water projects; other projects such as streets, utilities and small boat harbors; and emergency relief units. Of these, 156 projects valued at \$58,284,000 are complete. Another 5 projects estimated to cost \$4,091,400 are substantially complete and in use, and 11 with an estimated value of \$6,909,850 are in the construction stage.

The Alaska Railroad

Robert H. Anderson, *General Manager*



OPERATIONS OF THE Alaska Railroad produced gross revenues of \$14,538,646.27 during the fiscal year. Expenses amounted to \$14,307,374.87. The net income of \$231,271.40 was adjusted, however, to give effect to policy changes with respect to depreciation rates and the accounting treatment of losses on retirements of nondepreciable properties. Depreciation charges were increased by \$489,726.38, which resulted in a deficit of \$258,454.98 for the year.

The railroad carried 1,248,542 revenue tons of freight during the year, a decrease of 1.89 percent compared with the prior year. Revenue passengers totaled 76,991 compared with 79,462 carried during the prior year, or a decrease of 3.11 percent.

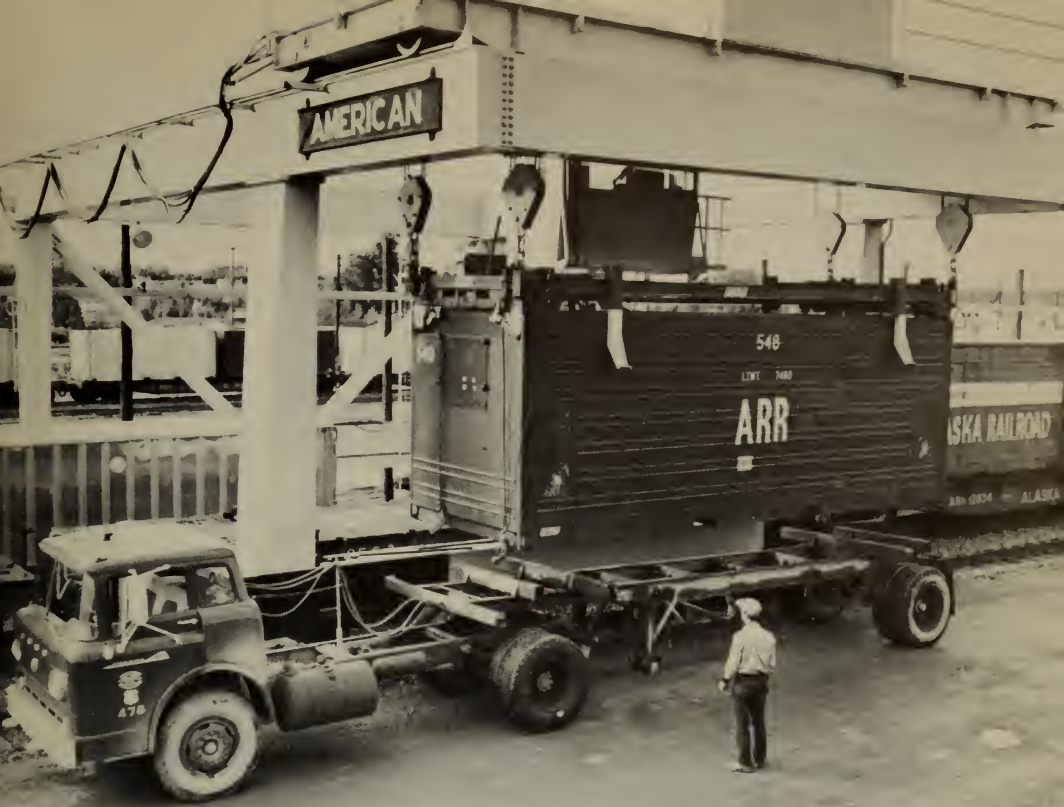
After several years of negotiation, the railroad disposed of its interest in the Knik Arm Power Plant, a steam power facility located at Anchorage, Alaska. The purchase was made by the Chugach Electric Association, Inc., joint owner of the plant, at a price of approximately \$2,350,000.

On December 16, 1959, the Secretary designated the railroad as a bureau of the Department of the Interior, reporting to the Assistant Secretary for Public Land Management.

During fiscal 1960, the railroad completed the ballasting and tie-renewal of some 30 miles of track north of Healy. Additionally, the railroad began the ballasting and tie-renewal of an additional 25 miles of track south of Curry.

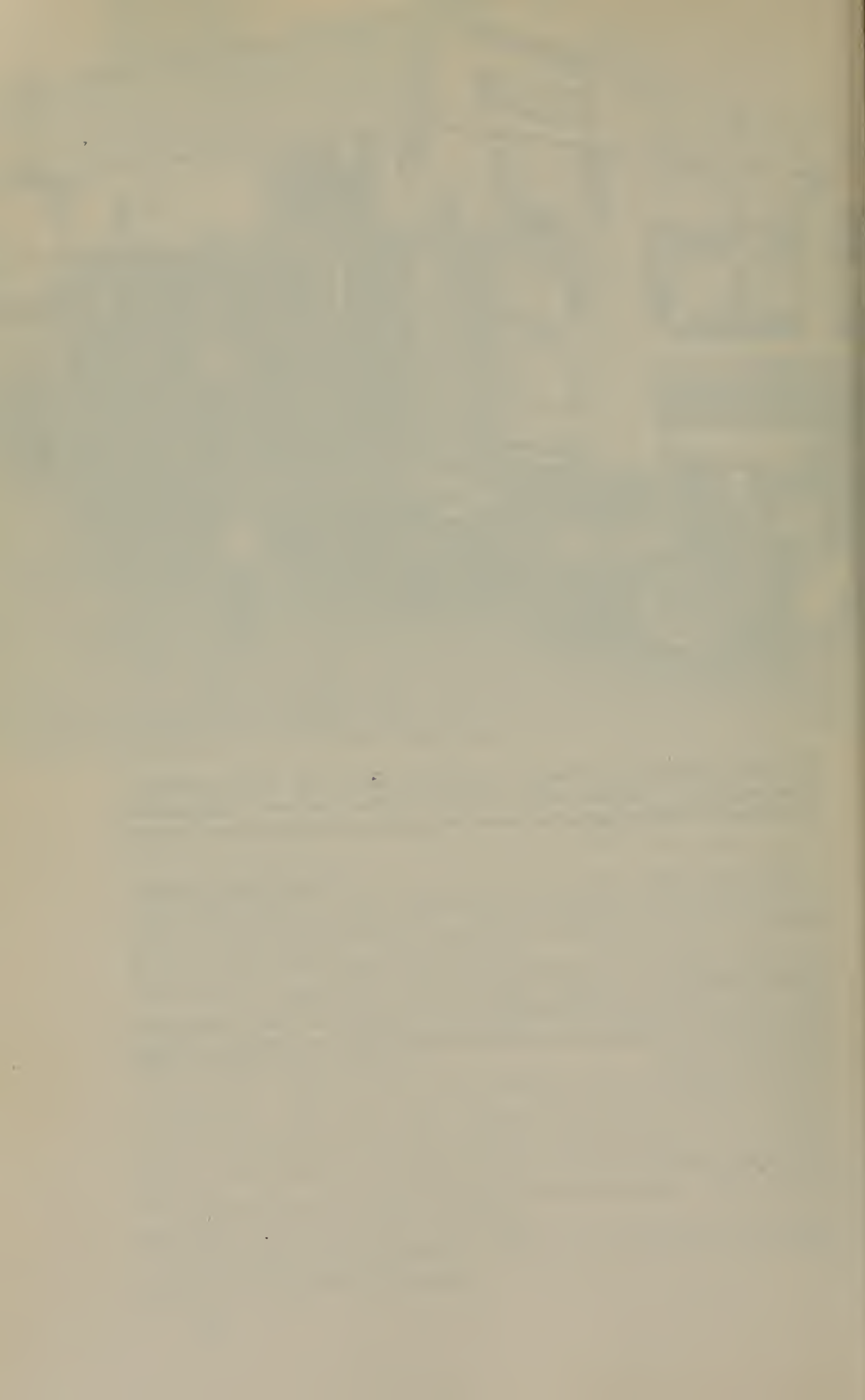
On March 3, 1960, the Secretary dedicated the new passenger depot at Fairbanks. The new depot replaced one built in 1923. At the time the old depot was placed in service, it was served by a three-rail track to permit standard gauge operation on the railroad's main line, and narrow gauge operation on the Chatanika branch. The narrow gauge branch was closed down in 1933.

A new section house at Garner, Alaska, was completed and placed in service during the fiscal year.



The Alaska Railroad's new Gantry crane, able to lift 40 tons, makes child's play of unloading one of the railroad's cargo containers from a flatcar to a waiting truck. The crane has greatly speeded the process of switching from train to motor truck.

During the fiscal year, the railroad completed and placed in operation an all-electric traveling Gantry crane, with a capacity of 80,000 pounds. This installation was made to facilitate the rapid transfer from rail freight car to motor truck of the unit rail vans used by the Alaska Railroad and motor freight carriers of Alaska. This traveling crane is equipped with a special lifting device which enables the crane operator to fasten on to the unit rail boxes for lifting purposes by remote control.



Office of the Assistant Secretary

Fish and Wildlife

Ross Leffler, *Assistant Secretary*



THE RESPONSIBILITIES of the Assistant Secretary of the Interior for the Nation's fish and wildlife resources are great and varied, including the direction of such diverse programs as—

▲ *Problems relative to such international questions as the width of the territorial sea;*

▲ *Plight of migratory waterfowl as the result of the long drought in nesting areas; and*

▲ *Improvement of fish and wildlife resources in Federal water-development programs.*

While many of the activities under the direction of the Assistant Secretary pertain to research, there are also direct management responsibilities, such as the management of migratory game birds, the protection of endangered species, and the management of the vast refuge system which aids in the accomplishment of these two things; also the management of the Pribilof Islands seal herd and the operation of about 100 fish hatcheries.

Generally speaking, research programs have two prime objectives: To assure the continued supply and proper utilization of the valuable food supplies of the seas and to assure the continuation of a valuable recreational resource. The results of research are translated into management practices by private and public agencies and by individuals and firms.

To carry out this vast and varied program, the Assistant Secretary directs the United States Fish and Wildlife Service, which

is headed by a Commissioner and is composed of the Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife.

Migratory Waterfowl Problem

During the fiscal year, one of the management problems of the Bureau of Sport Fisheries and Wildlife related to migratory waterfowl, which had poor nesting success because of drought conditions. The answer was obvious—shorter shooting time and smaller bag limits.

During the year, research, which had been underway for some years, showed that there are three distinct dove population areas in the country, each population virtually independent of the others. This paves the way for consideration of the management of the mourning dove on the basis of these three areas instead of the customary nationwide management.

Studies relative to the protection and enhancement of fish and wildlife resources in large and small river basin developments continued. A comprehensive report to the Senate Select Committee on National Water Resources summarized the problems of fish and wildlife in relation to the water resources program.

Fishery research brought forth such things as the possibility of restoring the endangered Atlantic salmon by planting larger fish than has been done heretofore; more knowledge on how to help hatchery trout survive in planted waters; and valuable information on disease-resistant strains of trout.

Wildlife research continues. There was more "tooling up" in the big research program on pesticide-wildlife relationships; more study on the control of nuisance birds and on wildlife diseases and parasites; more work on animal damage and predator control.

Predator Control Research

The work of the Bureau of Commercial Fisheries was highly successful in many fields. Laboratory research has found chemicals that control oyster predators without damage to desirable fish or oysters, and larger tests are being made to prove the practicability of these findings. The Service's program on the Great Lakes to control the trout-destroying lamprey continues to bring results.

Exploratory fishing has discovered a good groundfish area off the coast of Washington, a fine scallop bed off the coast of Florida, hard clams off the coast of North Carolina, and some unused fish stocks in the Great Lakes.

An outstanding development of the year was the conclusive proof that the unsaturated fatty acids which are so plentiful in fish oils

were excellent depressants of the cholesterol levels in the blood of test animals. So promising was the discovery that the unsaturated acids are now being clinically tested on human beings.

Research is slowly developing and proving out a technique for identifying the origin of salmon taken on the high seas—the first step necessary in any program of management of the salmon stocks of two continents.

The establishment of more quality standards, extension of the inspection service, and more research on refrigeration are advancing the program aimed at providing the consumer with the best possible fishery products. Economic studies, market analyses, and the analysis of foreign trade problems are some of the other types of research performed by the Bureau of Commercial Fisheries.

Fish and Wildlife Service

Arnie J. Suomela, *Commissioner*



THE OFFICE of the Commissioner of Fish and Wildlife reports no agreement was reached at the second United Nations Conference on the Law of the Sea, held in Geneva, Switzerland, March–April 1960, to achieve worldwide agreement on the extent of national jurisdiction over fisheries in coastal waters.

The work of the first United Nations Conference on the Law of the Sea, held in Geneva, March–April 1958, moved a step closer to fruition, however, as the Senate gave its advice and consent to ratification of the Convention on Fishing and Conservation of the Living Resources of the High Seas on May 26, 1960.

The existing international fishery commissions have made steady progress in international cooperation in the conservation of fishery resources, and at the end of the year, a new commission, composed of representatives of the United States and Cuba, and concerned with the shrimp resources in the eastern Gulf of Mexico, held its organizational meeting.

Fishery technicians were on assignment to 14 countries during part or all of the year. In addition to numerous visitors, a total of 14 students and observers arrived in the United States for extended fishery training.

Conservation Education

Activities of the Office of Information were highlighted by two informational programs on migratory waterfowl. During the fall months, efforts were concentrated on acquainting hunters with the plight of the migratory waterfowl, which had been hampered during

the nesting season by extended drought on breeding grounds. A special program was conducted to cut crippling losses resulting from hunters shooting at too distant a range. Another phase of the program was to alert the hunter to the need for waiting until the birds came in close enough to permit identification to assure against killing the endangered redheads, canvasbacks, and ruddy ducks by mistake.

In the spring, the drive for the after-season sale of hunting stamps was launched. The purpose of this program was twofold: Additional stamp sales means increased funds for the purchase of waterfowl habitat, and also affords the opportunity to acquaint the public with its responsibility in the protection of wildlife resources.

In both campaigns, the press, radio, and TV cooperated fully, with a correspondingly good reaction from the public. There was also fine support from other conservation agencies—both State and private.

The Office of Information also added several circulars to its *Conservation Notes* series, inaugurated a new information service for outdoor writers and editors called Conservation Backgrounds, set up fish and wildlife exhibits at several outdoors expositions, besides carrying on its regular activities.

Bureau of Sport Fisheries and Wildlife

Daniel H. Janzen, *Director*



HIGHLIGHT OF THE YEAR for the Fish and Wildlife Service's Bureau of Sport Fisheries and Wildlife was the completion of a long-range plan to provide increasing opportunities for outdoor recreation for the Nation's growing population. The objective of this plan is to maintain satisfactory numbers of fish and wildlife for future generations despite the steady increase of human activities on the habitats used by desirable fish, mammals, and birds.

The trend in the continental waterfowl population, especially diving ducks, continued downward due mostly to drought and, to some extent, drainage of wetlands. Through shorter seasons, reduced bag and possession limits for redheads, canvasbacks, and ruddy ducks, and delayed daily opening, the migratory-bird regulations for the 1959-60 season gave added protection to waterfowl.

During the year, the Bureau recruited and trained technical personnel preparatory to the initiation, in fiscal year 1961, of an expanded program of land acquisition for the conservation of migratory waterfowl. This expanded program is made possible by the 1958 amendment to the Migratory Bird Hunting Stamp Act which raised the price of the "Duck Stamp" from \$2 to \$3 and provided that all of the receipts from stamp sales, less costs of printing and distribution, will be spent to acquire lands for waterfowl. Henceforth, construction and operational funds for migratory bird refuges will be provided through Congressional appropriations.

The Bureau sent three aerial missions to observe the numbers and distribution of waterfowl on important wintering areas south of the United States. For the first time, surveys were made in Venezuela and Colombia where a half million ducks were recorded. Nearly 3

million waterfowl were observed in Mexico and some 93,000 elsewhere in Central America.

The State of Alaska assumed responsibility for the management of its fish and wildlife resources at midyear. As a result of the extensive revisions in the Bureau's programs in Alaska, manpower was realigned and greater attention given to migratory bird problems. The importance of waterfowl protection will be emphasized in native villages through educational programs.

Pesticide Problems

The development and expanded use of new pesticidal chemicals is a continuing problem of increasing seriousness. More than 200 chemical compounds are now used as active ingredients in more than 6,000 pest-control products. The Bureau's research arm has expanded its work of determining the direct and indirect effects of these chemicals on animal life and of devising ways to minimize the hazards to valuable fish and wildlife resources.

The Congress enacted legislation to increase the annual authorization of funds for research on chemical pesticides; authorized funds for research on marine game fish; extended the Bureau's authority to use surplus federally owned grain to prevent waterfowl depredations; authorized construction of a new fish hatchery in northwestern Pennsylvania; and amended the Black Bass Act to provide for interstate commerce of fish or eggs for breeding purposes.

Fishery research and wildlife research staffs perform scientific studies on a wide array of resource problems and provide information basic to the management of our natural resources. Man is exerting ever-increasing pressures on fish and wildlife by reducing or altering natural habitat through agricultural, industrial, and economic development, and as a result of his mounting recreational demands. Research must anticipate and endeavor to develop methods for keeping abreast of these changes. Management techniques developed through Bureau research are used not only by this agency but are applied by the States and other public land-managing agencies.

Wildlife Research

Increased attention was given this year to improving techniques for measuring waterfowl production and determining the effects of hunting regulations on waterfowl.

In a cooperative study with the States in the Mississippi Flyway, hunter kill of ducks was analyzed in terms of species, age, and sex from examination of more than 10,000 wings supplied by hunters.



Field-testing chemicals for controlling alligatorweed.

The findings confirmed the Bureau's July field appraisal that production of the redhead, mallard, and canvasback was poor during the dry 1959 nesting season. Good progress was made, also, in developing a method for measuring reproductive success of arctic nesters such as blue and snow geese through aerial counts of young and adult birds on their wintering grounds.

An extensive survey of waterfowl wintering grounds in Mexico, made in collaboration with the Government of Mexico, showed good food conditions in many areas. Much high-quality habitat was not being fully utilized, and waterfowl populations in many places were lower than previously observed.

Several promising chemical-control methods have been discovered for alligatorweed, now considered to be the principal aquatic pest plant in the Southeast. Studies on this and other pest plants are aimed at developing effective control methods without hazard to fish and wildlife. Surveys of waterfowl food plants were continued in Chesapeake Bay. Cooperative research was initiated on Eurasian watermilfoil, an introduced plant that is threatening prime feeding grounds for canvasbacks and other waterfowl in the Susquehanna Flats and other waters.

Basic studies of soil, water, and vegetation in relation to waterfowl distribution, food habitats, and hunting were continued in the important wintering ground area of Back Bay and Currituck Sound. Early experimental results show a correlation between increase of

waterfowl food and a slight increase in salinity in waters that normally are fresh or mildly brackish.

Extensive banding of nestling mourning doves in the United States has supplied information on dove movements from the time of fledging to the end of the annual hunting season. In cooperation with the International Association of Game, Fish, and Conservation Commissioners, the Bureau is developing a national program of dove research and management.

Animal Damage Studies

Under some conditions, wild animals may cause damage to crops or property; they may become a nuisance or a health factor; and in the vicinity of airports, the larger birds, especially, may be a hazard to human life and aircraft. An example of the latter problem is at Midway Island in the Pacific where albatrosses (or gooney birds) are impeding military operations. After sand dune leveling and black-topping certain areas, as recommended by Bureau biologists and carried out by the Navy, a decrease of 90 percent in birds soaring over the runways was reported, and bird-aircraft strikes were much reduced.

Emphasis was given to finding economical and acceptable methods of controlling damage by blackbirds to crops. Losses of grains amount to millions of dollars annually. Local and sporadic efforts at controlling blackbirds (which are widely distributed and number in the millions) have been ineffective.

Two traps—still in the experimental stage—show promise of being useful in controlling bird damage under certain conditions. With the first, a floodlight trap, up to 100,000 blackbirds and starlings have been trapped at winter roosts in a single night. The second, a decoy trap, captured blackbirds in fields where other techniques failed because of abundance of natural food.

Certain corn varieties have been found to be more resistant to bird damage than others. A technique has been developed for reliably evaluating the resistance factor and for determining the effectiveness of repellents before undertaking large-scale field trials. Studies of direct poisoning techniques involved the evaluation of many different toxicants, none of which proved entirely satisfactory.

At the Denver Wildlife Research Center, several chemical repellents were tested and one was found to be effective in reducing damage to trees by rabbits and meadow mice. A pocket gopher burrow builder, developed in cooperation with the State of Colorado, is now operational. It constructs an artificial gopher burrow and distributes lethal baits in one operation.



Biologists sample waterfowl food plants at the Susquehanna Flats, Md.

Wildlife Diseases and Parasites

Wildlife disease research in 1959 touched closely on human problems with the discovery that many English sparrows in Maryland died from encephalitis, an infection which also produced human fatalities in certain parts of the East. The presence of antibodies to the infection was determined in some blackbirds, starlings, and grackles, showing that these birds had previously contracted the disease but recovered.

Study of trichomoniasis, a protozoan-caused throat infection, was continued among mourning doves. The same disease was found in the white-winged dove.

Pesticide-Wildlife Relationships

In the Southeast, research continued on the effects on wildlife of chlorinated hydrocarbons used to eradicate the imported fire ant and revealed that ground-feeding birds suffered serious losses while tree feeders were little affected. Birds began to repopulate many treated



A pair of Laysan albatrosses on the hospital lawn at Sand Island, Midway.

areas by the second year; on small linear tracts, populations of bob-white quail were near normal, but repopulation of larger tracts proceeded more slowly. Spring dieoff of some ground-dwelling birds occurred the second year after treatment. While some earthworms were killed by the insecticide, others lived and stored up to 20 parts per million of heptachlor epoxide in their tissues within 6 to 10 months after the ground was treated. Studies of the possible effects of this poison on woodcocks which feed on earthworms were intensified.

In the West, studies were started to determine the effects on wildlife of programs to control grasshoppers, alfalfa weevils, and forest insects. Contamination of lake waters with insecticides at the Rocky Mountain Arsenal was evaluated in relation to duck mortality.

Bureau laboratories have determined the toxicities of many pesticides to various species of wildlife. The results of these studies are given in the Bureau's Circular 84, "Annual Review of Pesticide-Wildlife Relationships, 1959."

Marine Mammal Research

In studies of the sea otter at Amchitka, Alaska, and in the eastern Aleutians, data on populations, food habits, behavior, age and growth, pathology, and environment were obtained.



Birds of the "blackbird group"—blackbirds, starlings, grackles, and cowbirds—eat and contaminate food at livestock feed lots.

A total of 4,382 walrus was counted in aerial surveys made over the Bering Sea by Federal and State biologists in February and April when the animals were concentrated at the edge of the retreating icepack. Most of these walrus were found about St. Lawrence Island.

Cooperative Wildlife Research Units

These research units are supported by the cooperative efforts of the Bureau of Sport Fisheries and Wildlife, the Wildlife Management Institute, and the fish and game departments and land-grant colleges or universities of 16 widely separated States. By pooling manpower, funds, technical knowledge, and facilities, results are attained that no one agency could accomplish alone.

During the calendar year 1959, the units carried on research on 291 projects or subprojects, 222 of which were in wildlife and 69 in fishery subjects. By the end of 1959, they had issued more than 3,000 publications. With last year's 238 graduates, more than 3,200 fish and wildlife students had graduated from unit schools. Many earlier graduates hold key positions in the wildlife field. Several States made inquiries during the year looking to the establishment of additional units.

Sport Fishery Research

Findings of a 4-year study of Atlantic salmon in the Sheepscot River, Maine, concluded during the year, suggest that restoration of this endangered species in the United States through artificial propagation depends on rearing the fish to a much larger size than has heretofore been done. Fish of good quality and sufficient size may appreciably supplement natural production through better survival in the rivers or by complete circumvention of river life and attendant hazards.

Continuing progress was reported by established disease and nutrition laboratories. The development of a microhematocrit technique has provided a simple, practical tool for diagnostic examination of the blood of wild or hatchery fish. The protozoan parasite, *Myxosoma cerebralis*, has been shown to be responsible for the whirling disease, studied since it recently decimated the trout at a State hatchery.

A previously unknown, virulent, bacterial disease of yellow perch has been shown to be unusually host specific and its potential as control agent is under study. A cooperative, controlled, experimental operation of the Coleman National Fish Hatchery is underway to pinpoint the source and prophylaxis of a virus epidemic of juvenile chinook salmon. Influences of other dietary factors upon established vitamin requirements have been demonstrated. Use of radioactive isotopes provided information on the major role of absorption in the mineral metabolism of fish.

Improved research facilities were provided during the year for fish-disease and fish-management research and for in-service training of fish culturists. A new fish cultural laboratory was opened at the National Fish Hatchery at Marion, Ala., and staffed for research on bass and catfish propagation requirements. The basic and applied studies on the endocrinology of these fish are expected to lead to practical techniques useful in fish culture of other important species as well.

Fish Farm Experimental Station

Design of laboratory and combination buildings for the new Fish Farming Experimental Station in Arkansas was completed and a construction contract awarded. The main building will contain chemistry, biology, and pathology laboratories, other small laboratories for special projects, and library, photographic, and storage facilities. The combination building includes shop, automotive stor-

age, feed room, and fish-holding tanks. Experimental ponds of different sizes are scheduled for construction.

Studies of the effect of heptachlor on fish were begun in Florida in December to provide data from actual fire ant control operations. Waters exposed to the spray were examined before and after spraying. Samples of water, aquatic vegetation, and bottom mud were collected for chemical analyses to relate the accumulation of heptachlor in those materials with fish losses. Two weeks after treatment with one-quarter pound of granular heptachlor per acre, heavy mortality among bluegill sunfish was observed, and some losses of bass. These losses are particularly significant in view of the low-dosage rate applied here as compared with the 2 pounds per acre used a year ago in the control program. Other pesticides studied included endrin, aldrin, DDT, and toxaphene.

The first full year of year-round trout fishing on four experimental streams under observation by the Bureau in the Great Smoky Mountains National Park was completed in 1960. These waters are designated as "fishing-for-fun" streams and only trophy-size trout more than 16 inches long may be retained. These easy-access streams, subject to heavy fishing pressure, are providing exceedingly fine recreational fishing; catch rates ranged from 5 to 8 trout per hour of angling.

Studies of a little-known fish, the stoneroller, in Great Smoky National Park revealed that it ranges up to 9,500 fish per acre of stream and competes with rainbow trout for spawning grounds. There is little doubt that the large numbers of stonerollers are responsible for poor spawning success of trout in many miles of trout water. Stonerollers are subject to at least occasional heavy dieoffs resulting from columnaris disease; one such mortality was observed in Little River in the Park last year.

Trout Facilities Enlarged

The Convict Creek experimental trout station on the eastern slope of the High Sierras in California, at an altitude of more than 7,000 feet, was enlarged to provide an all-weather laboratory and housing with prefabricated steel structures. A mile-long, four-section experimental stream area was used for a variety of studies on the survival and vitality of wild and hatchery trout. Objectives of the research are to establish criteria of postplanting survival quality in hatchery-reared, catchable-size trout to provide for early recognition in the hatchery of conditions which may lead to poor survival in the wild, and to correct these conditions.



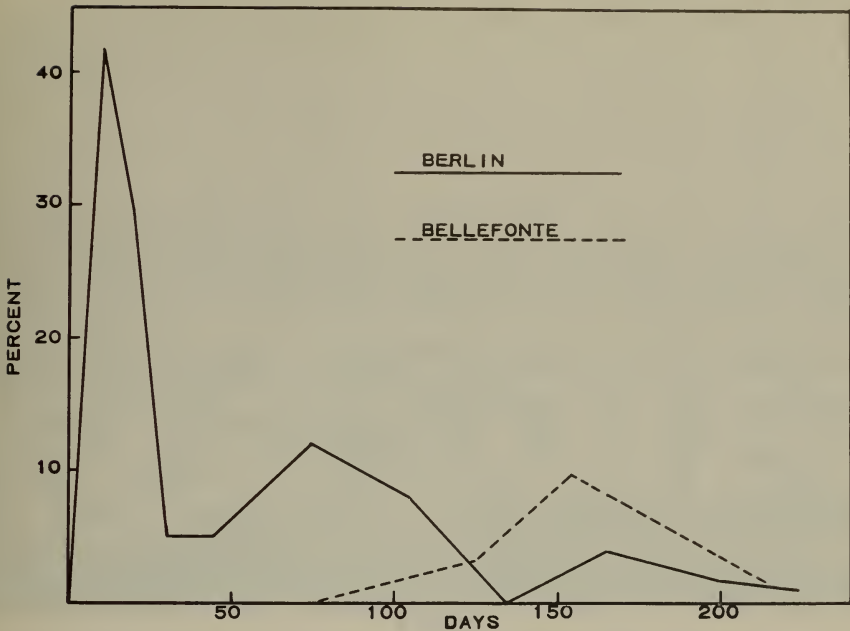
Convict Creek, Calif., experimental stream area showing middle-water control and screen structure. The four sections may be individually dewatered for population and survival counts.

With the appearance of drug-resistant strains of fish disease organisms, Bureau researchers have given more attention recently to finding strains of fish resistant to certain diseases that cause extensive hatchery losses from time to time. In a series of experiments with strains of brook trout from several eastern Federal and State hatcheries, resistance to ulcer disease and furunculosis was studied. In an experiment with two strains of brook trout, losses of 86 percent occurred in one strain and only 51 percent in the other.

In a second experiment that used three trout strains, the highest resistance was demonstrated in Maryland trout from Beaver Creek Hatchery, intermediate resistance in the Pennsylvania strain (Bellefonte Hatchery), and lowest in the New Hampshire strain (Berlin Hatchery).

It is evident that differences in inherited disease resistance occur and that they are of practical importance. Selective breeding to maintain disease-resistant stocks of fish is necessary to make useful application of this finding.

Technical papers were published during the year on a variety of subjects relating to fish management, diagnosis and control of fish diseases, nutritional requirements and feeding of fish, and fish culture methods. Quarterly research progress reports were distributed within the Bureau and to State conservation agencies and other cooperators.



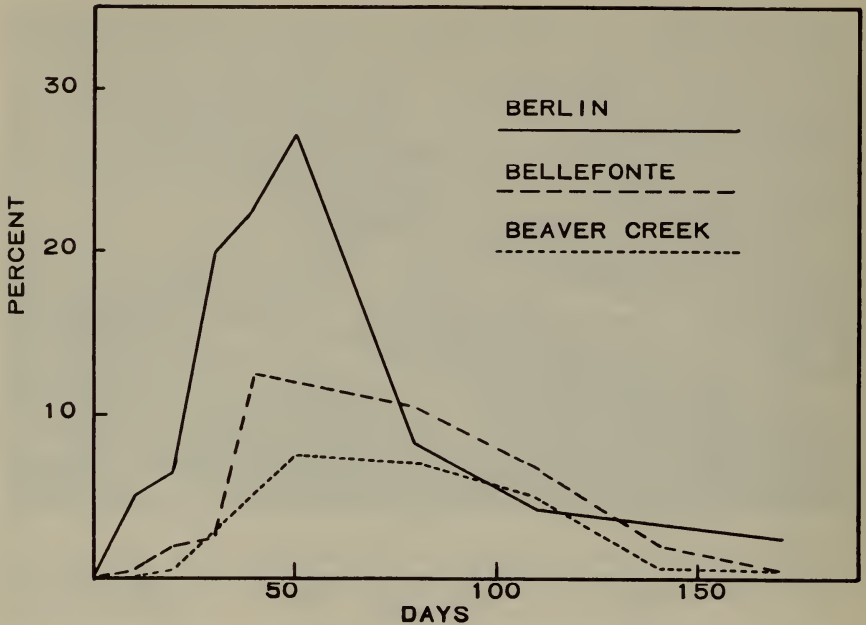
Ulcer disease mortality rates of two strains of brook trout. Berlin hatchery fish were far less resistant to the disease than those from Bellefonte hatchery.

Management Activities

The National Wildlife Refuge System was enlarged by the purchase of 9,734 acres of land in 74 separate ownerships, and the reservation of 15,095 acres of land by public land orders and transfers.

The Migratory Bird Conservation Commission held one meeting during the year. It approved the purchase of 7,498 acres, and the lease of 2,222 acres of land, for a new refuge in Utah, the Ouray National Wildlife Refuge; the lease of 5,532 acres of land for the new Wapanocca National Wildlife Refuge in Arkansas; and the acquisition of 9,040 additional acres of land for 10 existing national wildlife refuges.

Lands for two new fish hatcheries in Arizona were acquired by public land order and lease during the year: The Alchey National Fish Hatchery of 28.48 acres in Navajo County and the Willow Beach National Fish Hatchery of 47.81 acres in Mohave County. In addition, 438 acres of land were acquired for three existing hatcheries, and 213 acres of land were added to the fish-research facility in Arkansas for research in the production of fish on rice-growing areas during the time the land is not in rice production.



Mortality rates from ulcer disease and furunculosis in three strains of brook trout, showing differential resistance to these diseases.

National Wildlife Refuges

The drought occurring over the Northern Great Plains in 1959 demonstrated the value of the national refuges to American wildlife. Although major water units were low on many refuges, they continued to provide food and protection for increasing numbers of waterfowl as nearby water areas disappeared. While the number of refuge breeding birds increased, the production of young declined slightly.

Although refuge management emphasizes production of natural foods, supplemental food must often be grown for migrant and wintering birds. On refuges with heavy waterfowl concentrations or a depredation potential, the staff farms suitable lands, leaving the crop in the field for wildlife use. Elsewhere, refuge fields are farmed by permit on a share basis. Refuge personnel farmed 40 percent of the nearly 105,000 acres cultivated in 1959. Good management practices, planting of grass-legume mixtures and winter grains, and controlled grazing on refuge areas have resulted in better goose-browsing areas and increased numbers of Canada geese on refuges in all four flyways.

Aggravated by prolonged hot weather and low-water levels in Tule Lake Sump, botulism again occurred on the Tule Lake Refuge, Calif. Of 100,000 birds using the area, 1,000 became ill and 300 died. Inject-



Lesser snow geese and Ross' geese near Malheur Refuge, Oreg.

ing infected birds with botulism antitoxin and supplying them fresh water and food hastened recovery. In an outbreak on the Bear River Refuge, Utah, losses were relatively light.

Recreational Use

The nearly 10 million visitors on the national wildlife refuges in 1959 represent a 9-percent increase over the visitor days of public use in 1958. About 32 percent of these were fishermen, 5 percent were hunters, while 63 percent enjoyed wildlife observations, picnicking, and swimming. Recreation is permitted on designated portions of 138 of the 275 refuges where such coordinated use can be accomplished without defeating the primary objective for which the refuge was established.

In order to safeguard range conditions and prevent overgrazing, surplus animals from four fenced big-game refuges were donated to zoological parks or sold to the public for food or display and breeding purposes. Over 300 buffaloes, 100 elk, 110 long-horned cattle, and 600 deer were sold in 1959. Two buffaloes were shipped to the Manila Zoological Park, Philippines, and two to Trinidad.

On a number of the waterfowl refuges and game ranges the carrying capacity of the habitat and wildlife population was kept in balance by regulated public hunting and live-trapping programs. In cooperation with a number of States, many deer, some bighorn sheep,

turkeys, and quail were live trapped and transplanted to available unoccupied ranges.

Rare Bird Protection

The September 1959 count of trumpeter swans in the United States was 681. This number includes 663 swans in the wild with their 99 young and 18 birds in zoological gardens. Since 1957, seven pairs of refuge birds have been loaned to American zoos for exhibition purposes. During the year, the Bureau of Sport Fisheries and Wildlife issued a publication in the North American Fauna series on the trumpeter swan.

The Aransas Refuge on the Texas Coast continued to provide winter protection for 33 whooping cranes. This is the entire world population except for 6 held in zoos.

Three new refuges were placed under administration during the year: Oak Orchard, N.Y.; Buffalo Lake, Tex.; and Mark Twain, along the Mississippi River in Iowa, Illinois, and Missouri.

National Fish Hatchery Program

The national fish hatchery program of the Bureau of Sport Fisheries and Wildlife placed more emphasis on integrating fish production and distribution programs with fishery-management plans for State and Federal areas.

Important phases of the program deal with the rearing of species difficult to propagate that are needed in fishery management; improving fish nutrition and disease control by applying research findings on a production basis; and improving production techniques in hatcheries.

Construction of large multiple-purpose dams and reservoirs has become very important in the program to provide recreational fishing for the Nation's increasing number of anglers. Stocking of trout habitat created in the tailwaters below the dams is creating a sport fishery of amazing proportions that has required new fish hatcheries and is mainly responsible for the increased national program.

The Congress provided funds to continue construction of new hatcheries at Garrison Dam, N. Dak.; Gavins Point, S. Dak.; and Willow Beach, Ariz. Funds were provided to initiate construction of a new hatchery at Alchey, Ariz. Also, the Congress provided funds to continue the improvement and expansion of facilities at eight existing hatcheries.

The production and distribution of all species from national hatcheries in 1959 increased 14 percent, by weight, over any previous year.



Trumpeter swans on Sod House Spring, Malheur Refuge, Oreg.

The increase was about the same for trout and salmon, and slightly higher for warm-water species.

Fishery Management

Fishery management biologists conducted surveys, evaluated fish-stocking programs on Federal waters, and answered thousands of inquiries on fishery subjects during the year. They also held clinics in pond management and demonstrated new and improved fishing equipment for stream and pond surveys. The fishery management services provided to 166 Federal areas (such as military bases and national parks, forests, and wildlife refuges) in 1959 contributed substantially to the 1.7 million fisherman-days spent in those areas. A sampling survey of farm ponds indicated that 5 million people made 20 million fishing trips to ponds that had been stocked by the Bureau. The typical 1-acre farm pond received 64 fishing trips and yielded 286 fish.

Bureau personnel worked closely with State fish and game departments during the year. Fishery surveys on the upper Mississippi River were coordinated for the Upper Mississippi River Conservation Committee and an information leaflet for use of fishermen on the Mississippi River above St. Louis was issued. Work of the Steering Committee for Roanoke River Studies in North Carolina (under Bureau chairmanship) was successfully concluded when recommenda-

tions regarding water-quality standards for oxygen (which established an important precedent) and minimum flows were accepted by all Government and private groups concerned.

Indian tribes of the Southwest are showing an increasing interest in the successful fishery program underway at Fort Apache Reservation, Ariz. Here, a new 250-acre lake built for recreation afforded 55,000 fisherman-days its first season and yielded 178,000 trout. Three other reservoirs were completed on the reservation and stocked with trout in the past year. The Apache Reservation is serving as a model for other Indian reservations in developing their recreational opportunities.

River Basin Activities

In accordance with requirements of the 1958 amendments to the Fish and Wildlife Coordination Act, the Bureau's reports on water-use projects have set forth more detailed information than formerly on fish and wildlife benefits and the measures needed to conserve and improve fish and wildlife resources. Bureau representatives testified at Congressional hearings on several proposed Federal reclamation projects in support of fish and wildlife facilities and benefit evaluations upon which sizable allocations of project costs were based. Typical of these was the Norman project in Oklahoma which was authorized with a substantial allocation of project costs to fish and wildlife in recognition of the fishing and hunting benefits to be provided.

At the request of the Canadian Government, biologists of the Bureau of Sport Fisheries and Wildlife, assisted by Provincial biologists, began a study of the authorized Grand Rapids hydroelectric project in Manitoba to determine the effects it may have on fish and wildlife and to find means of reducing damages to these resources. The project involves 1.5 million acres of land and water and will have an impact of major importance on waterfowl, fish, moose, and fur-animal habitats.

At the request of the Senate Select Committee on National Water Resources, a comprehensive report on "Fish and Wildlife Problems and Recommended Policies in Relation to the National Water Resources Program" was prepared and published in cooperation with the Bureau of Commercial Fisheries. The report points out problems stemming from Federal water and related land-use programs and suggests ways to achieve more adequate recognition of fish and wildlife resources.

The financing of detailed studies by the Bureau on water-use projects of the U.S. Army Corps of Engineers and the Department's Bureau of Reclamation was materially strengthened by inclusion of



School children tour the Guttenberg Hatchery and Aquarium in Iowa.

funds as specific items in Public Works Appropriation Acts for 1960 and 1961 to "provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water-resource development programs."

Controlling Harmful Birds and Mammals

The Bureau completed 45 years of successful partnership with agriculture and industry in cooperative programs to minimize damage and disease transmission by wildlife. Human demands have brought increasing problems of coexistence with wildlife, since wildlife species, too, have their "population explosions." The primary object of control work is to maintain a level at which man and wild animals can live compatibly.

During the year, the Bureau in cooperation with State and other agencies treated 4,962,000 acres to control rodent depredations. By concentrating control efforts, livestock losses from predation were held at a low level despite increases in both predator populations and human activity. Special safety precautions were used to prevent injury to humans, pets, and domestic animals from control operations.

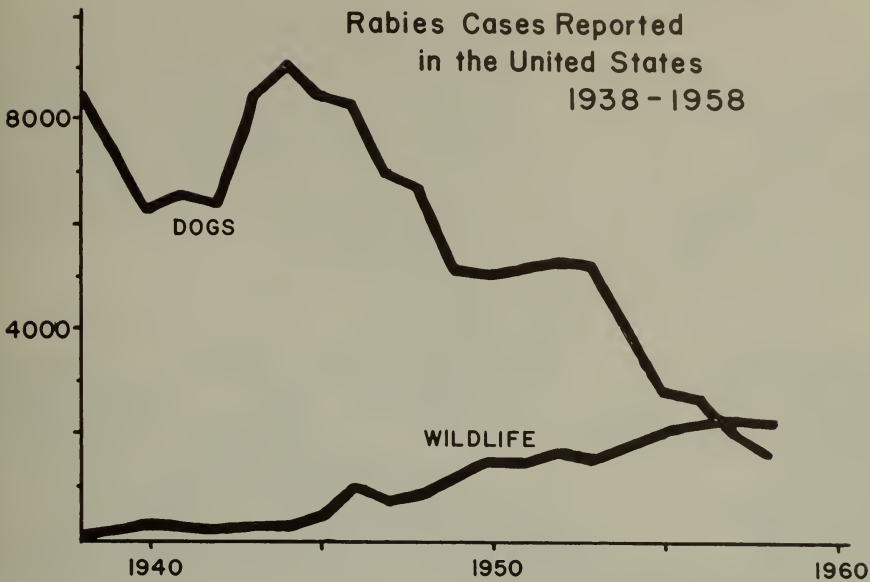
Improved aerial seeding practices using Bureau-developed repellents and control techniques have greatly benefited agriculture and



Sheep-killing bobcat treed by a dog.

industry. Savings of \$18 to \$20 an acre have resulted from control of seed-eating mice in reforestation projects. Significant progress has also been made in the Clean Grain Program in cooperation with other Federal and State agencies.

Modern methods of intensive agricultural practices with high yields per acre are sometimes accompanied by startling economic losses from wildlife deprecations. A commercial rose grower in Arizona lost \$75,000 worth of roses on 20 acres when cotton rats invaded his property. Proper treatment promptly stopped further damage. Growers of ornamental plants and operators of feed lots were plagued by increasingly vast flocks of starlings. These birds consumed 6 tons of cattle feed in 6 hours in one feed yard in November 1959.



While the incidence of rabies in dogs has shown dramatic improvement due to improved vaccination techniques, wildlife cases have increased alarmingly and now account for the majority of reported cases.

Rabies in wildlife species, particularly foxes and skunks, has been responsible for losses in livestock and to many people needing to undergo antirabies treatment. A substantial reduction in the incidence of the disease was accomplished in some local areas through joint efforts of the Bureau and its cooperators to reduce the numbers of infected wildlife vectors, halting transmission from animal to animal.

Techniques for controlling depredations of nuisance wild animals and birds were demonstrated to many groups of farmers, fruit growers, nurserymen, and agricultural students. Specialized training courses were held for personnel of State, local, and other Federal agencies, and radio and television broadcasts on control methods were made in cooperation with State extension services. The Bureau's rabies and rodent-control exhibits were displayed at State fairs, and many sets of colored slides illustrating identification and control of animal damage were widely distributed.

Wetland Preservation Activities

The Bureau is cooperating with agricultural agencies in an attempt to reduce losses of valuable wetland habitat through subsidized drainage in the prairie pothole States of Minnesota, North Dakota, and South Dakota.



Small marsh impoundments such as this provide increased fishing opportunity while stabilized water levels create better waterfowl nesting areas.



Application of a fish toxicant, rotenone, from an airboat. This is an effective management practice for restoring good fishing.



Food-deficient deer winter ranges are revegetated through plantings of bitterbrush, a preferred browse species.

Under an agreement of May 2, 1960, county agricultural committees and field officers of the Soil Conservation Service in selected counties will provide the Bureau with information on applications for drainage assistance.

The Bureau will inspect the wetlands involved and advise the agricultural agencies of their wildlife values. The Bureau will also discuss with the landowners the opportunities for selling or leasing the areas under the Bureau's small-wetlands acquisition program. Where wildlife values are high, it is hoped that Federal aid and technical assistance for drainage will be withheld.

Waterfowl Management and Protection

As in the past, the Bureau met its continuing responsibility under the Migratory Bird Treaty Act to obtain information on the status and distribution of North American waterfowl. The following annual surveys were made:

- A January survey of continental wintering areas to determine the distribution and relative numbers of birds after the close of hunting.

• A survey of hunters immediately following the hunting season to measure size of the kill and effects of hunting regulations on hunter activity and kill.

• A survey of the major continental breeding areas during May, June, July, and August to measure size and distribution of the breeding populations and number of young produced.

Efforts were adjusted wherever possible to give all possible protection to diving ducks while, at the same time, undercover activities were continued by game management agents to curb market hunting and other commercial-type violations. These efforts resulted in the apprehension and prosecution of additional market hunters, including several repeaters along the Eastern Shore of Maryland and Virginia where an outbreak of trapping with the use of numerous small traps occurred.

Violations of fish and wildlife conservation laws administered by the Bureau of Sport Fisheries and Wildlife during fiscal years 1959 and 1960 are compared in the following table:

	Cases pending beginning fiscal year	New cases	Cases terminated	Cases pending end fiscal year	Fines and costs	Jail sentences (days)
Fiscal year 1959.....	859	4,215	4,556	518	\$182,828.85	7,837.5
Fiscal year 1960.....	485	4,808	4,576	717	158,170.27	5,896

Federal Aid in Sport-Fish Restoration

In 1960, Federal funds totaling \$5,300,000 were apportioned among the States and island possessions for research, land acquisition, and other activities concerned with sport-fish restoration.

As in the past, land acquisition in fiscal year 1960 was an important phase of State programs. Development of public fishing areas by providing roads, parking areas, and boat-launching ramps and the creation of new public fishing lakes will ensure anglers places to fish in future years. Development of these public fishing areas, control of rough fish and undesirable aquatics to improve sport fishing in existing waters, and installation of stream-improvement structures have a significant place in the States' sport-fish restoration programs.

Coastal States continue to show increasing interest in their marine fisheries. Creel censuses are being made, life history studies of fluke, striped bass, white sea bass, and barracuda are underway, and the value of artificial reefs in improving the habitat for salt water game fish is being assessed.

The small but steady increase in salaries of biologists employed under the Federal aid program has helped the States attract and hold qualified personnel. Several States have made cooperative agreements with State colleges for statistical services to improve the



Field-border plantings of lespedezas furnish both food and shelter for small game. Many States are using this habitat improvement measure.

design of their projects and to increase the reliability of the project findings and conclusions.

Federal Aid in Wildlife Restoration

The States and island possessions were apportioned \$15,312,778 in 1960 for their Federal aid in wildlife restoration programs.

Research by the States included the collection of data on breeding success, population numbers, and hunting take for all game species to serve as a basis for setting hunting seasons and bag limits. The results of this research have been widely disseminated through the issuance of 363 State publications.

Hunting areas available to the general public are gradually shrinking while hunters are increasing in numbers. This problem is being met by the acquiring of lands for public hunting and refuge purposes to preserve as much land under State control as possible. Acquiring wetlands for waterfowl and winter ranges for big game are the primary objectives of the States' land-acquisition program.

The States have given particular attention to wildlife management and habitat improvement, mainly on acquired lands. They are improving and creating desirable wildlife habitat by creating clearings in dense cover, planting areas to wildlife food crops, and restoring cover and creating water areas where needed. Access roads and minimum public-use facilities help assure maximum public use of these managed areas.



Bureau of Commercial Fisheries

Donald L. McKernan, *Director*

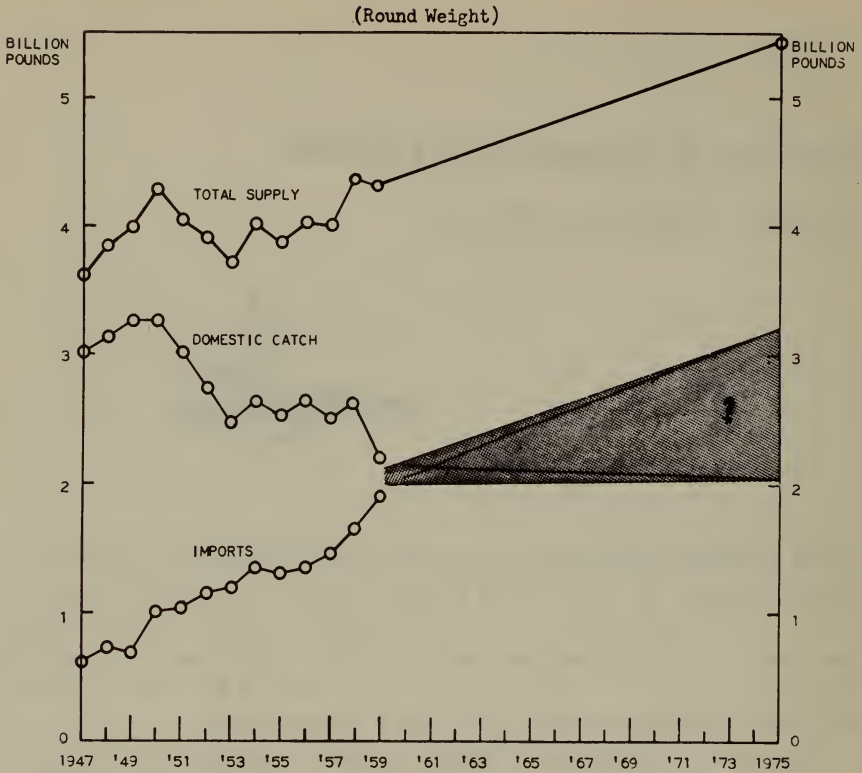


THE UNITED STATES catch of fish and shellfish in 1959 was 5.1 billion pounds, or 152 million pounds less than the record catch of 1956. The total value of the catch was \$342 million, or \$31 million less than in the previous year and \$11 million less than the previous 10-year average. For the first time, the catch of fish for industrial purposes exceeded the catch for human consumption.

Per capita consumption of fishery products remained static at 10.7 pounds. The increased supply required for our growing population came from imports which reached an all-time high of 1.9 billion pounds of edible fishery products and 1.3 billion pounds of nonedible. Foreign fishermen supplied more than 45 percent of the food fishery products used in the United States in 1959.

In this background, the Bureau of Commercial Fisheries has worked, during the past year, to fulfill its twofold continuing program: Strengthening a troubled fishing industry in the public interest and conserving and managing the natural resource upon which the industry depends. Attention has been focused on the economics of the domestic fishery and the problems created by a vigorous and growing foreign competition. Through membership and active participation in eight international fishery commissions, consultation and advice on trade and tariff agreements, assembling and analyzing worldwide information on developments in foreign fisheries, and through reports to the Congress and the public on special industry studies, services were provided the domestic fisheries that helped to stabilize trade and promote profitable fishery production and marketing.

Material advances in fishery science, technology, and administration have been made during the past year, and the progress continues. The



The Nation's supply of edible fishery products, 1947-59, and estimated requirements, 1960-75. Can the domestic catch supply food for our growing population or will a still greater share come from imports?

following highlights of the year are only examples of individual projects which have reached virtual completion with substantial accomplishment.

- A successful means of killing pests and predators on oyster beds has been found, and it is being evaluated for wide application by oyster farmers.

- A successful chemical lampricide for controlling the sea lamprey has been applied to all but 11 streams tributary to Lake Superior and treatment of streams tributary to Lake Michigan is under way.

- Studies on protection and restoration of the Atlantic shad fishery have been substantially completed and recommendations for management have been made to the Atlantic States Marine Fisheries Commission and to the member States.

- Exploratory and experimental fishing by Bureau vessels have revealed new resources of commercial value in various offshore areas—bottom fish off Washington, scallops off the east coast of Florida, hard

clams off North Carolina, and trawlable stocks of virtually unused fishes in the Great Lakes.

- Technological studies on fishery byproducts have revealed in fish oils highly unsaturated fatty acids that are effective in reducing blood-cholesterol levels in animals and, hence, have probable value in pharmaceutical applications; and they have discovered valuable growth factors in fishmeal, an effective and economical supplement in poultry and stock feed.

- Rapid progress has been made in developing quality standards for fishery products and in implementing the system of voluntary government inspection at industry expense. Thirty-six fish-processing plants are under continuous inspection requiring 44 U.S. Department of the Interior inspectors. This program will contribute materially toward maintaining the quality of fishery products and enhancing their popularity.

The activities of the Bureau of Commercial Fisheries are organized by major geographic areas of the United States (including Alaska and Hawaii) so as to bring to bear upon the difficulties and problems of producers, distributors, and consumers the combined knowledge and skill of the Bureau's experts. Bureau activities for the year are briefly recounted.

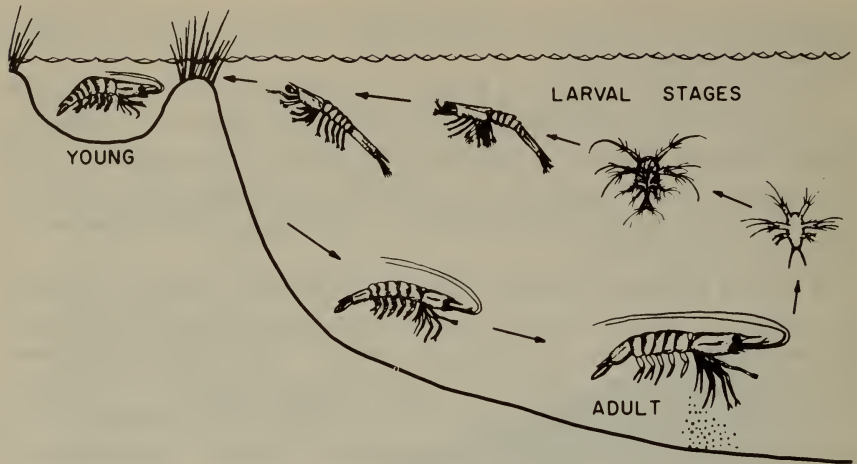
Biological Research

Research on the marine fishery resources of our coastal and offshore waters has continued in order to meet many problems of the fishing industry, particularly determining future supplies and understanding how changes in fishing effort or in the natural environment affect distribution and abundance. Engineering projects that modify the coastal environment also received special attention.

Studies on the proposed Passamaquoddy Bay project in Maine in relation to the herring stocks and other fisheries were completed with the conclusion that power dams across the mouth of the bay probably would have slight effect on the fisheries in the area.

Along the Atlantic and Gulf coasts investigations were commenced to determine how dredging of channels, reclamation of land, or the introduction of insecticidal and pesticidal chemicals influence the survival of young fish and shellfish. Chlorinated hydrocarbons, in traces as low as 5 parts per billion, in the Gulf of Mexico, were found toxic to shrimp larvae.

The superabundance of the 1958 year brood of the Atlantic menhaden has been observed in catches during 1959 and 1960. The average size in this group is small compared with those of other years,



Life cycle of shrimp. Spawning in the ocean, the larvae (here greatly magnified) migrate to inshore nursery areas. As the shrimp grow, they return to sea where they support the most valuable of our commercial fisheries.

but total numbers are high and promise to support the fishery well in 1960 and later years.

Haddock of the 1958 year brood are also abundant and have been receiving conservation protection from larger meshes in the nets which have been introduced through international regulations.

The larvae and young of brown and white shrimp from the Gulf of Mexico were described, following successful experiments to spawn and grow the young in laboratory aquariums. This information on the early life stages will aid identification of these species taken in collections at sea and subsequent definition of life cycles and movements to and from nursery grounds. Varying temperatures in the inside waters of Galveston Bay were shown to control the entrance of small shrimp to the nursery grounds and their departure to enter the fishery.

Oceanic conditions along the Pacific coast gradually returned to normal after a period of very warm water since 1957. The Pacific sardine shifted somewhat to the south, when its distribution in 1959 was compared with that of previous years, and catches were best off northern Baja California, although its total abundance was not high there or elsewhere in the fishery. Serological research gave strong evidence that northern and southern populations are genetically distinct.

Opportunities for research on the behavior of tunas in the central and eastern Pacific were greatly improved when the *Charles H. Gilbert* was modified by the addition of bow chambers for direct observation of the fish under water. It was learned that tuna are that



A new sight for fisherman and scientists. A school of tuna seen from the observation chamber of the "Charles H. Gilbert".

frightened by noise or fish blood in the water as fisherman and scientists have believed for many years. Various kinds of new baits have been tested to improve tuna-fishing efficiency.

Studies of oceanography received national attention particularly as a result of reports released by the National Academy of Sciences and National Research Council on the need for increased research in this field. The Bureau's program of fishery oceanographic research is being coordinated with oceanographic researches of other agencies, such as the U.S. Navy, U.S. Coast and Geodetic Survey, the National Science Foundation, and the Atomic Energy Commission, to obtain maximum benefit from the vessels and scientific personnel engaged in marine research.

A modern three-story research laboratory and office building was completed at Woods Hole, Mass., and occupied by the staff of the Bureau's Biological Laboratory during 1960.

Shellfisheries

Research on commercial shellfish seeks to increase production by controlling predators and disease, providing a more favorable environment, and improving cultural methods.

Predators and competitors are the principal cause of loss in oysters and clams. The Milford (Connecticut) Biological Laboratory some time ago began routine testing of various chemicals to find a poison that would kill oyster drills, starfish, and other enemies, or prevent their invasion of oyster beds. Of the nearly 5,000 chemicals screened,



Construction of the underwater observation chamber on the bow of the "Charles H. Gilbert".

about 100 were found to be poisonous to shellfish predators but harmless to desirable fish and shellfish. During the past year, field tests were begun to determine effectiveness of some of these chemicals, to develop methods for their practical use, and to study harmful effects.

Sand treated with chemicals was found to be efficient in holding poison on the bottom. A ridge of treated sand 18 inches wide and a few inches deep was placed around an oyster bed in Long Island Sound, and dead and dying drills were found on and near the barrier. The chemicals were still poisonous to drills 9 months later. Treated sand spread over the oyster bed was effective in killing drills already in the area with no harm to the oysters.

These experiments indicate that chemicals are possibilities for predator control, but further testing in laboratory and field is needed before any chemical can be recommended to the industry.

In 1957, the oysters of Delaware Bay were subjected to a sudden and severe mortality, and an estimated 70 percent of them died. Losses have continued in 1958 and 1959. Oyster losses of a similar type were first observed in lower Chesapeake Bay in 1959. Cooperative studies between the Bureau laboratory at Annapolis, Md., and the

States of New Jersey, Delaware, Maryland, and Virginia are under-way to find the cause of the mass mortalities.

An organism similar to a fungus, found in gaping and dead oysters, is the most likely suspect in the oyster losses. Research is concerned with routine sampling to follow the spread of the deaths, and field and laboratory experiments to attempt cross infection and to study the life history of the suspected organism are under way. Some oysters have been found in Delaware Bay that survived the mortality. Survival of these oysters may indicate resistance to a casual organism and suggests the possibility of breeding oysters that are immune. Selective breeding studies will begin shortly.

Inland Fisheries

Measures being used to control predatory sea lampreys in the Great Lakes are bringing results. In streams tributary to Lake Superior, the numbers of spawning lampreys trapped at electrical barrier sites declined during the past year. More than 20 lamprey-infested streams were treated with a chemical lampricide that kills all generations of developing lamprey larvae buried in the streambed with no appreciable damage to valuable fish. Only six infested streams on the United States shore and five on the Canadian shore remain to be treated. Chemical treatment of streams tributary to Lake Michigan also is underway.

More than 50 electrical barriers were maintained on Lakes Superior and Michigan to prevent reinfestation of treated streams by lampreys and to provide an assessment of their abundance. Thousands of spawning lampreys were killed at the electrical barrier sites.

Biologists working in Lake Erie found that major changes have occurred there in water chemistry, fish-food organisms, and fish fauna since a 1930 survey of the lake. Blue pike and cisco, which formerly comprised the bulk of the commercial catch, have almost disappeared; but smelt, alewife, gizzard shad, and yellow perch are more plentiful than in earlier years. The change seems to have resulted from an increase in water temperatures and in nutrients added to the water by industrialization and population expansion.

In Lake Superior, spawning stocks of lake trout continue to decline; however, it is believed that a sufficiently large brood stock will be available in the lake by the time the sea lamprey population is reduced through control measures now being used. Research in Lake Michigan is directed toward measuring changes in the species of chub and in the size composition and abundance of chub stocks. Preliminary results show an increase over survey estimates of 1954-55 in the abundance of bloater chubs, which offers a promising source of industrial fish.

Anadromous Fisheries

Since anadromous fishes spawn in fresh water but live and grow in salt water, research on these fishes is spread over two very different environments. For the most part, the fresh water phase of the life history has been emphasized, as it seems to be the critical period influencing future production. Research has been directed toward determining the factors that influence production and developing methods to augment survival.

In 1949, the Atlantic States Marine Fisheries Commission requested the Fish and Wildlife Service to study shad to determine the cause of the decline in the Atlantic coast runs and to provide basic information for improving management of the fishery. The Bureau has completed a large part of this work, and scientists found that water quality, overfishing, and stream barriers were the major factors in the decline in runs. The research findings have been reported in 31 scientific papers, and more papers will be issued in the near future.

During March 1960, scientists from the Bureau and from the States of Maryland and Virginia tagged 2,000 striped bass in the Potomac River. Returns of tagged fish now coming in will provide information on the annual and seasonal migrations, mortality rates, and size of the population in the river. Of 1,400 striped bass tagged in the Potomac last fall, 10 percent have been recovered. These recoveries show a general movement of striped bass from the lower and upper sections of the river to the central section during the fall months.

Research was expanded on the blue crab of the Atlantic coast to determine the cause of the great annual fluctuations in their numbers. Research contracts let to the Oyster Institute of North America and Duke University show promise of determining the factors that influence the survival and growth of early larval stages. Recoveries of commercial-size blue crabs tagged during August 1959 in Charleston Harbor and in the North Edisto River estuary of South Carolina show no long migrations from the tagging sites. The two populations appear to be distinct.

Much progress has been made on research for the International North Pacific Fisheries Commission. As certain physical characters of salmon vary by area of origin, it is now possible to identify, with almost 80-percent accuracy, the continental origin of red salmon taken on the high seas in the North Pacific. Scale characteristics and serological methods also are used to separate salmon populations. A large-scale tagging program in the North Pacific is providing detailed information on the extent of intermingling of Asiatic and American stocks—facts vital to international management and protection of the resource.



Testing the 6-pool prototype of the fishway designed for Ice Harbor Dam. The "steps" in this "stairway" are 1 foot high and 10 feet long.

Oceanographic studies in the North Pacific show that the southern limit of salmon in the summer is largely determined by the position of the polar front. Greater experimental catches of salmon, particularly of red salmon, were made from the Aleutian (cold) Current than from adjacent areas.

Fish-passage tests are being conducted at the Fisheries Engineering Research Facility, Bonneville Dam, to evaluate the effectiveness of a 1-on-10-slope prototype fishway of a type authorized for construction at Ice Harbor Dam. The rate of fish passage is determined by observing the fish as they enter the fishway and as they pass over the weir crests or through submerged orifices. An underwater viewing chamber, located adjacent to the uppermost submerged orifice, is used to record fish passing through the orifices. Results to date show that this fishway, while less expensive to construct than the 1-on-16-slope fishway, is passing fish just as effectively.

Through measurements of the blood-lactate levels of salmonids following lengthy ascents in an endless experimental fishway, scien-



Bringing a clam dredge aboard the exploratory fishing vessel, "Silver Bay," on one of the newly discovered fishing grounds off North Carolina.

tists found that salmon do not become excessively fatigued after ascending such heights as 1,000 feet, and fish have been observed to climb vertical distances of more than a mile in more than 5 days.

By use of sonic fish tags, movements of salmon in the Columbia River have been recorded in great detail. Sonic tags have been reduced in size and improved over earlier models so that fish bearing such tags can be detected over longer periods of time, at greater distances, and with less interference. This novel device is providing a great deal of information on the migration pattern and the behavior of salmon.

With the transfer of fishery management responsibilities to the State of Alaska, the research program was redirected into more basic studies such as measurement of the effect of environmental factors on the survival of pink and red salmon. Several methods for measuring the survival of pink salmon were tested and evaluated. In samples of adult chum salmon taken from a number of areas in Alaska, the size and age composition were found to vary widely by area. Divers working in western Alaska lakes were able to learn much about the habits of juvenile red salmon and predator and competitor species.

Marine Mammals

Research on marine mammals was directed primarily to the fur seal and gray whale. The annual census of the gray whale, taken on its migration route along the coast of California, places the present population at about 6,000 animals—a definite recovery from near extinction.

A study of the food habits of fur seals collected in the Pacific Ocean show a variable diet of anchovies, hake, rockfish, squid, saury, sablefish, herring, and salmon. On the Pribilof Islands, research was conducted on the causes of the periodic high losses of newborn fur seal pups and on methods of assessing the size of the Pribilof herd.

Industrial Research

Exploratory trawling operations for bottom fish by the *John N. Cobb* off Cape Flattery, Wash., resulted in the discovery of a considerable area of clear dragging bottom inhabited by commercial quantities of petrale sole, Dover sole, and Pacific ocean perch. This discovery has provided a new fishing area for the Pacific Northwest trawl fleet and the area is being actively fished.

Explorations in the Chukchi Sea, undertaken in cooperation with the U.S. Atomic Energy Commission, provided valuable information on the marine fauna of the area. During April, concentrations of

yellowfin tuna were discovered in the Gulf Stream area of the western North Atlantic by the exploratory fishing vessel *Delaware*. Explorations of the vessel, *Silver Bay*, off the Middle and South Atlantic States revealed the existence of commercial concentrations of calico scallops over a 1,200-square-mile area between Daytona Beach and Fort Pierce, Fla.

Based on information obtained through Bureau exploratory fishing operations, over 900,000 pounds of hard clams were produced in a 2-month period by commercial vessels from grounds off Beaufort, N.C. Experimental fishing with Gulf of Mexico-type trawls in Lake Erie revealed that commercial quantities of smelt can be taken with this type of gear during the summer and early fall.

Experimental midwater trawling by the Bureau's vessel, *Oregon*, has indicated that midwater trawls hold considerable promise for efficient harvesting of midwater-schooling fish in the Gulf of Mexico. Testing of an electroguidance unit, in conjunction with conventional gear used to catch herring (Maine sardines), indicated the need of a unit with greater power. Such a unit has been constructed by private industry and will be used in future experiments.

Through the use of underwater motion picture cameras, diving sleds, and diving equipment, gear specialists obtained considerable information on the performance of shrimp trawls in action. By observing the trawls at work, new and modified trawl designs and operational methods can be developed on a rational and scientific basis.

Technological Advances

The new Technological Laboratory in Gloucester, Mass., dedicated during the past year, is specializing in problems associated with the refrigeration of fish. The most modern refrigeration equipment has been installed for research that will benefit the fishing industry of the entire country.

The research program on fish oils resulted in a significant breakthrough in the pharmaceutical field during the year. Fish oils, which form a rich source of highly unsaturated fatty acids, were found to be highly effective in reducing blood-cholesterol levels in laboratory animals. These studies demonstrated that fish-oil fatty acids are considerably more effective in reducing blood-cholesterol levels than is linoleic acid, a major component of vegetable oils now widely used for treatment of atherosclerosis, a common form of heart disease.

Research on fishmeal and solubles concerned with the nutritional aspects of animal feeding has produced the following important findings:

Δ Fish protein in mixed animal feeds increases growth rates approximately 16 percent



Extraction of oil from tuna meal preparatory to evaluating the protein quality of the meal as chick feed component.

Δ Fish meal samples show evidence of the presence of valuable, unknown growth factors

Δ Given levels of nutritional values are attained more economically with fish meal than other supplements.

Rapid strides were also made during the year in the Bureau's highly successful standards—development and inspection program. Nine plants were added to those already under continuous inspection, making a total of 36 inspected plants that require 44 U.S. Department of the Interior inspectors. Cost of the inspection service is defrayed by the industry.



Home economists of the Bureau of Commercial Fisheries demonstrate fish cookery on popular TV homemaker shows.

The most significant recent advance in the standards-development program was promulgation of a standard for frozen raw headless shrimp, the most valuable product of our domestic fisheries. The standardization, inspection, and certification of raw headless shrimp will be of great importance in maintaining quality and consumer acceptance.

Marketing Assistance

Increasing competition from other protein foods and an unusual abundance of certain important fish species in excess of existing demand have caused a number of serious marketing difficulties during the past year.

In meeting its responsibility to the fishing industry, the Bureau cooperated in market promotion of slow-moving fishery products. Recorded radio announcements dealing with the nutritional value of fishery products were distributed to virtually every radio station in the country. Educational materials, recipes, and food photos were made available to newspaper food editors, cooperating radio and television personalities, and the mass-feeding industry.

A new feature of the promotion effort was the national distribution of public service animated television "spots," dealing with the nutritional value of fishery products and the Department's standards and inspection program. Two of the four "spots" developed by the

Bureau were among the winners in the first American TV Commercials Festival and Forum.

Bureau home economists presented 240 cookery demonstrations for school lunch and other institutional supervisory personnel, appeared on 36 television and radio food shows, participated in five national food trade conventions, and developed and distributed kitchen-tested recipes for institutional and home use.

Foreign Trade Problems

The United States has become the world's largest importer of fishery products, and these increased imports have created many problems for the domestic fishing industry, particularly for tuna, groundfish, shrimp, and fishmeal. At the same time, United States producers have encountered increased competition, and in some cases protectionism, in their efforts to sell United States products, such as fish oils and canned fish, in traditional foreign markets.

Actions initiated through the General Agreement on Tariffs and Trade (GATT) liberalized many foreign import restrictions. During the year, restrictions were lifted on a number of fishery products from the United States and Canada. Preparations were made to participate in the 1960-61 GATT trade-agreement negotiations, and the industry was advised of items scheduled for consideration. A conference was sponsored to obtain industry advice on actions the Government might take to increase the sale of United States fishery products abroad.

The Bureau actively assisted the fishing industry in attempting to solve trade and tariff problems created by expanded imports. A "Report to the President and the Congress on Fresh, Frozen, and Processed Shrimp" was prepared at the request of industry. Information was assembled to assist United States domestic fishmeal producers to cope with the adverse market situation that developed during 1959. Careful study was made of fishmeal production and marketing in other countries and the findings reported to industry.

A government-to-government conference was held in Tokyo, Japan, to discuss the tuna resource and its production and marketing with Japanese fishing interests. The Japanese Government gave assurance that efforts would be made to promote stable development of United States markets. An exchange of scientific and technical information between the two countries was arranged.

Economic Studies

The economic problems of the domestic shrimp industry are associated with the decline in catch per vessel and the increase in imports.

A long-range study was undertaken to analyze the factors that impede or retard productivity and to recommend salutary measures. A critical examination is being made of those areas where operational efficiency is vital to the industry's ability to compete with foreign-based industries.

In other segments of the fishing industry, economic studies with particular emphasis on costs of fishing operations have been completed or are nearly completed. A report on costs in the albacore industry in relation to areas fished, type of vessels employed, and other factors of special significance in determining the competitive status of the industry was submitted. A similar report, under research contract, was completed for the New England groundfish industry.

To provide information for the salmon, sardine, and tuna industries in the field of consumer research, a motivational analysis of consumer buying habits for canned fishery products was completed. Studies are in progress on the long-term outlook for the production and consumption of fishery products. Transportation studies and participation in regulatory proceedings led to favorable consideration of rates and services of direct interest to the fishing industry.

Bureau representatives advised and assisted in the organization of four new fishery cooperatives, and provided information and other services to those in operation. Twenty cooperatives were visited to ensure compliance with the provisions of the Fishery Cooperative Marketing Act of 1934.

Resource Development Services

Management of the commercial fisheries of Alaska by the Bureau of Commercial Fisheries was terminated on December 31, 1959, when this responsibility was assumed by the State. The Bureau has worked closely with State officials in the orderly transfer of records and equipment to the State as provided for in the Alaska Statehood Act and the Alaska Omnibus Act.

In 1959, Alaska's fishery products, including fur seal byproducts, had a wholesale value of \$72 million as compared with \$83 million in the previous year. Department regulations for 1959 prohibited the use of traps, except for 11 floating traps operated by native Indian communities in Southeastern Alaska. Fishing gear utilized in the Alaska salmon industry in 1959 (comparable figures for 1958 in parentheses) were as follows: Traps, 11 (243); purse seines, 904 (1,193); beach seines, 387 (340); gill nets, 4,451 (5,309); salmon troll hooks, 32,326 (32,376); and fish wheels, 8 (5). Sixty-eight salmon canneries were operated in Alaska in 1959 as compared with 78 in 1958.



A family group of fur seals on a Pribilof Islands rookery. It includes the harem bull, about 24 cows, and some half dozen pups.

Fur Seal Harvest

The fur seal harvest on the Pribilof Islands in the summer of 1959 amounted to 57,810 skins. Of these, 15 percent were delivered to Canada and 15 percent to Japan under the terms of the Interim Convention on Conservation of North Pacific Fur Seals. During fiscal year 1960, 46,637 skins were sold with gross receipts to the United States Government of \$3,185,584. Under the terms of the Alaska Statehood Act, 70 percent of the net proceeds from the sale of sealskins shall be paid to the State of Alaska. The first payment to the State, \$813,919, was made on February 4, 1960, for fiscal year 1959.

Columbia River Program

The construction of dams on the Columbia River continued to pose serious problems to the maintenance of the salmon and steel-head resources of that basin. Facilities for handling upstream and downstream migrants are now in operation at several high dams; their success, however, must be measured in terms of returning adults over a period of years.

The Columbia River fishery development program, involving the State fish and game agencies of Washington, Oregon, and Idaho, and the Department's Fish and Wildlife Service, has continued under Federal financing. This program includes the operation of hatcheries, screening of diversions, and stream-improvement activities, such as building fish ladders around falls and removing log jams. Objective of the program is the full use for fish production of areas still available to salmon and steelhead, to compensate in part for damages to the fishery resource resulting from the Federal water-development program in the Columbia basin.

Statistical Surveys and Reports

During the year, general statistical surveys to obtain detailed data on employment in the fisheries, number of fishing craft and gear operated, volume and value of the catch, and production of manufactured fishery products for 1958, were completed and published for all sections of the United States. Similar surveys were undertaken for 1959, including for the first time detailed data for Hawaii.

Monthly bulletins were issued on landings of fish and shellfish in 14 coastal States and Ohio. Publication of monthly landing bulletins for Maryland and Virginia was started during the year. Release of these bulletins was particularly important, since about two-thirds of the domestic catch of oysters and one-half of the catch of blue crabs are taken in these States. Publication of annual bulletins in the Current Fishery Statistics series containing monthly data on the landings of fishery products in Washington, Oregon, and Hawaii, was also undertaken. Monthly data are now available on about 97 percent of the domestic catch.

Monthly reports were issued on freezings and holdings of frozen fish, production of fish meal and oil, and foreign trade in fishery commodities. The quarterly report, containing data on the production of fish sticks and portions, by months, was also issued.

A detailed statistical review of the fisheries of the United States for 1959 was published, and data were assembled on the 1959 catch and production of manufactured products for publication in the Food and Agriculture Organization "Yearbook of Fishery Statistics for 1959" for publication in the 1960 editions of Statistical Abstracts of the United States and Agricultural Statistics of the Departments of Commerce and Agriculture, respectively. Detailed economic and biological data on landings of fish and shellfish in the Northwest Atlantic, of shrimp in the South Atlantic and Gulf area, and the United States catch of fish off foreign coasts were assembled and published.

Financial Assistance to the Fisheries

The Fisheries Loan Fund Program, authorized by the Fish and Wildlife Act of 1956, was continued in fiscal year 1960. Loans were made to finance and refinance the operation, maintenance, repair, and equipping of fishing gear and vessels. Most fishing-vessel owners have been unable to obtain loans from other sources because of the depressed condition of the fishery industry.

During the year, new applications were received for 190 loans, totaling \$5,405,446. One hundred and five applications were approved, totaling \$2,220,024; 65 totaling \$1,927,302 were declined or found to be ineligible; and 24 were withdrawn before final decisions were reached. At the beginning of the year the backlog of cases being processed or deferred at the request of applicants was 26; at the end of the year it was 22. The 1959 catch of the vessels receiving loans from this program totaled about 190 million pounds. Collections of principal and interest during the year amounted to \$1,015,300.

Market Information

From the market information furnished the fishing industry by the Bureau's daily Fishery Products Reports, members of the industry can estimate the current market for fresh, frozen, and canned fishery products. These daily reports are issued by seven Market News Service offices, located at Boston, New York City, Hampton, Va., (including data from Baltimore, Md.), New Orleans, San Pedro, Calif. (including data from Astoria, Oreg.), Seattle, and Chicago. The Reports supply information on landings, receipts, stocks, imports and exports, market conditions, and prices for all types of fishery products. They also contain news on developments in United States and foreign fisheries. Increased coverage of prices and market conditions has been a material aid in the orderly marketing of fishery products.

A special report, reviewing the trends and developments in shrimp marketing at Chicago over a period of years, has been issued by the Chicago Market News Service office. Statistical data, covering a 10-year period, on cold-storage holdings of shrimp, United States landings by areas, imports, availability and disposition of shrimp supplies, and related data, are also shown.

The monthly periodical, Commercial Fisheries Review, continues to feature articles and news of trends and developments in the domestic and foreign fisheries.

Office of the Administrative Assistant Secretary

D. Otis Beasley, *Administrative Assistant Secretary*



THE ADMINISTRATIVE ASSISTANT SECRETARY discharges the duties of the Secretary with respect to administrative management. The Office of the Administrative Assistant Secretary consists of seven staff divisions: Administrative Services, Budget and Finance, Inspection, Management Research, Personnel Management, Property Management, and Security.

Each of these divisions is responsible for its designated function for the Department of the Interior and represents the Department before other agencies of the Federal Government which have governmentwide responsibility for like administrative functions.

Administrative Services

The Division of Administrative Services which provides centralized office service facilities for the Department in the Washington metropolitan area as well as staff leadership in this function, recorded the following accomplishments during the year.

It established a permanent translation program in the Central Library so that all offices have access to foreign technical materials; installed new equipment in the Central Duplicating Section to provide a better quality of work at lower unit costs; adopted the "Postage and Fees Paid" system of paying official postal costs on a quarterly basis that provides faster service and eliminates the inventory and audit controls formerly required when postage stamps were used; disposed of 940 cubic feet of obsolete records; continued the renovation and modernization program in the Interior Museum.

Budget and Finance

During the year the Division of Budget and Finance continued its efforts at improving budget justifications and coordinating the bureaus' budget structures with their organizational pattern. The Division continued to cooperate in developing legislation to place the programs of the Bureau of Reclamation, the Bonneville Power Administration, and Southeastern and Southwestern Power Administrations on a revolving-fund basis.

Special analyses of employee health benefits costs were made for the Bureau of the Budget and the Congress. In the accounting field, the Division placed increased emphasis on systems improvements, and special effort was directed to installing systems in three bureaus of the Department. Also, modifications were made in approved systems to make them more useful to management. Plans were completed for accounting for and reporting on the financial results of the employee health benefits program which became effective in July of 1960. Action was taken during this period to define the scope and seek uniformity among the bureaus of the Department in internal auditing.

Inspection

The primary purpose of the Department's Inspection Program is to insure high ethical standards in the management of the Department's affairs. The Division of Inspection provides policy guidance and coordination of this program. During the past year, the division stimulated initiation of inspections by bureaus and offices of the Department.

Inspection experience continued to be applied in the modernization of regulations dealing with employee behavior and in the shaping of administrative policy decisions. The investigative program embodies the use of investigative techniques in inquiries concerning alleged serious administrative irregularities in the discharge of official functions. During the past fiscal year, investigative work was maintained on a current basis.

The Division of Inspection also has responsibilities in departmental handling of matters under the Government Employment Policy enunciated in Executive Order 10590 and related Department regulations. Related Department regulations were revised as advocated by the President's Committee. By directive and otherwise, management appreciation of the nondiscriminatory policy has been extended through supervisory training, reporting systems and recircularization of basic data. Policy administration and enforcement were success-



The Secretariat presented 19 Distinguished Service Awards and two Valor Awards at a departmental convocation held on April 11, 1960. The Distinguished Service Award is the Department's highest honor bestowed on employees.

fully continued, as evidenced by the fact that not one complaint of discrimination in the Department originated this year.

Management Research

During the year, management analysis studies or major organization adjustments were made in the Office of Minerals Exploration, the technical and research organization of the Bureau of Mines, the Geologic Division of the Geological Survey, the construction activities of the Bureau of Indian Affairs, and the organizational location of the Alaska Railroad by the Division of Management Research. The management improvement program was given continued emphasis during the year with more than 150 projects included in the bureau and office reports.

A new publication, A Supervisor's Guide for Work Improvement, was prepared by the staff for use in connection with a department-wide program of training of firstline supervision to be carried out through the bureaus. The bimonthly Division pamphlet, Management Highlights, which is distributed to over 5,000 supervisors, gave particular emphasis to articles on management improvement and incentive awards. In carrying out its directives management responsibilities, approximately 275 documents were processed by the Division for secretarial action.

A series of Federal Register Document Improvement Workshops was conducted by the Division in cooperation with the Office of the So-

licitor and the Division of Federal Register, National Archives, with over 100 employees participating. These workshops were based on the new department handbook on How To Prepare Federal Register Documents. The major steps in the development of the Departmental Manual were the initial issuance of the Delegation Series codifying secretarial delegations of authority and a restatement of policies on the Organization Series of the Manual.

The Incentive Awards Program continued at a high level of activity as indicated by the following comparative statistics with substantial gains in all phases of the program over the past 5-year period:

	1956	1957	1958	1959	1960 ¹	Percent increase 1956-60
Suggestions submitted.....	2,897	4,524	4,589	5,226	4,888	+69
Suggestions approved.....	969	1,422	1,499	2,301	1,508	+56
Superior performance awards and special acts.....	581	845	1,183	1,213	1,501	+158
Distinguished service awards.....	43	37	26	64	40	-7
Valor awards.....		8	6	7	4	-----
Meritorious service awards.....	111	129	139	120	135	+21
Commendable service awards.....	263	329	375	368	446	+69

¹ Over 60 training sessions were held with supervisors and employees in Washington, D.C., and the field covering all phases of the incentive awards program.

Personnel Management

During the past year the Division of Personnel Management placed emphasis on improving the overall quality of personnel management at all levels of operation. To this end, studies of staffing standards have been initiated, improvements have been made in methods of appraising the effectiveness of the personnel function in the Department, and cooperation and assistance have been given to efforts of the Civil Service Commission to improve classification and qualification standards and procedures, training, and executive development. Specifically, 17 new or revised policy directives, 3 new guides to better personnel management, and 2 training guides in safety have been issued.

More than 200 top- and middle-management executives have received specialized training in administrative and personnel management courses, and 40 management trainees have completed 5 or 7 months management training courses in the departmental programs. Continued progress was made in reducing the frequency rate and the cost of disabling work injuries. A group award was made to the Examining and Qualifications Standards Section of the Division for sustained outstanding performance in preparing policy statements and guidelines in the fields of examining, testing, placement, qualification standards and employment regulations.

Property Management

Continuous effort was applied to programs of procurement from small business concerns and from manufacturers or suppliers located in areas of persistent unemployment by the Division of Property Management. All operating bureaus of the Department were encouraged to participate fully in the program of utilization of Government supplies and equipment excess to the needs of the Department of Defense. Conferences were conducted at selected field locations to inform all purchasing officers of new developments and improvements in procurement methods.

During the year personal property acquired at a cost of over \$750,000, but no longer needed in Department programs, was donated to public schools and hospitals to meet urgent local needs. Eleven Records Disposition Workshops were conducted in Washington, D.C., with 162 participants. An estimated 60,000 square feet of filing floor space was freed through disposing of records no longer needed for current business. Technical and administrative liaison between the bureaus and offices and other Government agencies was provided for coordination and assignment of radio frequencies. Departmental instructions and information on radio communication were consolidated and issued as a new part of the Departmental Manual. A program for conversion of the Department's several thousand very-high-frequency land mobile radio stations to narrow-band frequency modulation was begun to conserve essential frequency spectrum space.

Security

Physical security at critical facilities of the Department has been increased by the addition of safeguards under the direction of the Division of Security. A continuing review is being made of such facilities to insure that adequate security measures will continue to be placed in effect as warranted.

The personnel security program is under continuing review to assure that all clearances are kept up-to-date and that only necessary files are retained in the Department. During the current year over 700 files have been returned to the Civil Service Commission. The issuance and recording of all clearances is maintained on a current basis.

The bureaus and offices of the Department have assisted in several emergencies pursuant to a national declaration of a disaster by the President. This includes the floods of Nebraska and South Dakota in April 1960, and the Montana earthquake of 1959.

The radiological defense capability of the Department continues to improve. At the end of the fiscal year, well over 1,000 employees

of the Department were trained in radiological monitoring and capability has been established in 42 States. The Federal Fixed Station Monitoring Network, which includes a large number of stations manned by Department personnel, has progressed to the point where in case of an emergency nationwide patterns of radioactivity can be reported to the benefit of the entire populace.

Office of the Solicitor

George W. Abbott, *Solicitor*



OVER 140,000 MATTERS were considered in the Office of the Solicitor during the fiscal year and the number of matters pending at the close of the year was reduced to 7,648, as compared with 8,026 at the close of the previous fiscal year. More than 55,000 hours were spent in giving oral advice and the attendance at conferences and meetings. Major accomplishments during the fiscal year included the closing of:

- ▲ 58 Contract appeals
- ▲ 389 Indian affairs appeals
- ▲ 669 Tort and irrigation claims, including appeals
- ▲ 384 Land appeals

Requests from the Congress for the views of the Department on legislative proposals continue to grow, as does the number of reports submitted. A total of 1,612 requests were received and 1,178 reports were written. This is a larger number than in any previous session of the Congress.

In connection with the Davis and Featherstone contests to effect the administrative cancellation of oil and gas leases obtained from the Government through alleged violation of acreage limitations, numerous studies were made.

Legal Assistance

Comments were submitted to the Department of Justice concerning the ability of the United States to carry out its functions of regulating the Colorado River, servicing water delivery contracts, and the performance of other Federal functions on the basis of the Special Master's Draft Report of Proposed Findings of Fact, Conclusions of Law and Recommended Decree in the case of *State of Arizona v. State of*

California, et al., No. 9 Original, Supreme Court of the United States.

Assistance was given to the United States attorneys at Los Angeles, Calif., and Phoenix, Ariz., in connection with the institution of complaints filed against squatters along the Colorado River. The Secretary at the close of the fiscal year 1959 had recommended to the Attorney General that such action be initiated.

The attorney general of the State of Washington was given assistance in the preparation of briefs and oral arguments before the supreme court of that State relative to the question of State jurisdiction over matters involving minor Indian children. Two lower courts of the State had rendered conflicting opinions and the Supreme Court granted a writ of certiorari. It is expected that the decision of the court will serve as a landmark in regard to the matter of jurisdiction of State tribunals in certain Indian affairs.

Board of Contract Appeals

In the appeal of the *Caribbean Construction Corporation* (66 id. 334), the Board of Contract Appeals adopted the so-called "jury verdict" approach which had theretofore been espoused by the Court of Claims. The Board held that a full adjustment, on account of changes ordered by the Government in the contract work or on account of changed conditions encountered in its performance, could be made on the basis of a fair and reasonable approximation of the costs incurred, arrived at through a studied consideration of the whole record.

In the case of the *Ocean Tow Inc.* (66 i.d. 409), the Board decided an important issue concerning the scope of its jurisdiction by holding its jurisdiction in appeals was confined to appeals arising under contracts that contain a clause which, irrespective of its form, provides for the determination of disputes by the contracting officer and gives the contractor a right to appeal such determination to the head of the Department or his delegate.

Major Legal Decisions

Two issues, long a subject of controversy, were decided by the United States Court of Appeals for the District of Columbia in *Foster et al. v. Seaton*, 271 F. 2d 836. The court ruled that the Administrative Procedure Act does not place the ultimate burden of proof on the Government to establish the invalidity of a mining claim in a contest brought by the Government and that in order to have a valid discovery in the case of nonmetallic deposits of widespread occurrence there must be a demonstration of present marketability, not merely prospective value. This decision has helped the Department

to dispose of many troublesome cases involving nonmetallic deposits.

Other litigation of particular interest to the Department included the decision of the United States Supreme Court in the case *United States v. States of Louisiana, Texas, Mississippi, Alabama, and Florida*, No. 10 Original. The Court held that the Submerged Lands Act does not grant to the States of Louisiana, Mississippi or Alabama any rights in submerged lands beyond three geographic miles from their coasts; and, that the act does grant to the States of Texas and Florida rights in such submerged lands for a distance of three marine-leagues from their coastlines.

Technical Review Staff

John B. Bennett, Director



THE CONTINUING FUNCTIONS performed by the Technical Review Staff of the Department were redefined as of January 1, 1960, to emphasize its departmentwide responsibilities, and functions which were more readily identifiable as belonging to the fields of certain of the Assistant Secretaries were transferred to their offices.

In its capacity as liaison with the Senate Select Committee on National Water Resources, the Technical Review Staff coordinated 14 major reports, dealing with various aspects of water resource problems, which the committee had requested. The major categories with which these reports dealt were reclamation needs, uses in the minerals industries, fish and wildlife and recreation uses, and surface water.

The work of the Outdoor Recreation Resources Review Commission cuts across the activities of most bureaus of the Department. The Technical Review Staff has served in the past year to coordinate these interests in presentations made to the Commission.

In the coordination of the interests and responsibilities of the Department of the Interior in the minerals, fuels and fisheries fields, as affected by and as they might affect the work of United States participation in the General Agreement on Tariffs and Trade (GATT), the Technical Review Staff supplied a departmental representative to meetings of the contracting parties and several of its committees and working parties in Geneva, Switzerland, and Tokyo, Japan, and also to the Law of the Sea Conference, Geneva, Switzerland.

The Technical Review Staff arranged for official visits to the Department of foreign dignitaries and officials, scientists, and students interested in exchanging information.

The chairmen of the six field committees of the Department were called to Washington for two week-long meetings during the fiscal year, one in November and one in May. The purpose of these meet-

ings was to discuss coordination of the activities of the Department at the field level.

Considerable staff work was done by the Technical Review Staff on the proposed Northeastern Water and Related Land Resources Compact. On January 18, 1960, a bill was introduced in the Senate to give the consent and approval of Congress to this compact. The compact differs from previous interstate compacts with respect to Federal participation.

The Technical Review Staff, in conjunction with the Division of Management Research, coordinated the review of the "Mass Transportation Survey Report—National Capital Region," prepared by the National Capital Planning Commission and the National Capital Regional Planning Council.

The Technical Review Staff maintained liaison with the Inter-Agency Committee on Water Resources; the Atomic Energy Commission on its "Plowshare" program; the National Science Foundation; the Office of Statistical Standards, Bureau of the Budget; the Department of State and International Cooperation Administration; and with other Federal agencies on program matters of mutual concern.

Oil Import Administration

Lawrence J. O'Connor, Jr., *Administrator*



THE SECRETARY OF THE INTERIOR, pursuant to Presidential Proclamation 3279, dated March 10, 1959, established the Oil Import Administration within the Department, issued regulations for the operation of an oil import program, and delegated the authority conferred upon him by the President to the Administrator.

The objective of the oil import program is to insure a stable, healthy petroleum industry within the United States capable of exploring for and developing new domestic petroleum reserves.

In administering the program, the Oil Import Administration:

1. Analyzes data prepared by the Department's Bureau of Mines relating to petroleum demand in the United States, by commodity type and petroleum districts, in order to set the overall amounts of crude and unfinished oil, and finished petroleum products to be allowed into the United States and Puerto Rico.

2. Establishes equitable semiannual oil import allocations for individual eligible oil importers by product type and district, other than residual fuel oil (which is on a quarterly basis), and issues import licenses.

3. Analyzes monthly reports from each importer showing the amount and disposition of petroleum imports entering the Nation under license and issues public reports concerning the oil import situation and the administration of the program.

4. Responds to an increasing volume of requests for information concerning the administration of the program from Congress, the press, foreign governments, other governmental agencies, and the public.

Summary of Activities

During Fiscal Year 1960, the Oil Import Administration issued 1,852 licenses for importation of crude petroleum and its derivatives to eligible importers according to commodity type.

Prior to the close of the fiscal year, the Administrator announced overall oil import levels for the allocation period July 1, 1960, through December 31, 1960, and issued individual oil import allocations to 179 eligible importers.

In order to administer the oil import program more effectively, the allocation period for residual fuel oil was changed from a semi-annual to a quarterly basis effective July 1, 1960.

Oil Import Appeals Board

Royce A. Hardy, *Chairman*



THE OIL IMPORT APPEALS BOARD was established on March 13, 1959, to consider petitions by persons affected by the Mandatory Oil Import Program proclaimed by the President on March 10, 1959.

The Board is authorized, within specified limits, to modify any oil import allocations granted by the Oil Import Administration, on the grounds of exceptional hardship or error; to grant allocations of crude oil in special circumstances to persons with importing histories who are ineligible for allocations; to grant allocations of finished products on the ground of exceptional hardship to persons who are ineligible for allocations; and to review the revocation or suspension of any allocation or license.

Board Activity

During fiscal 1960 the Board reviewed 79 petitions. 64 petitions were considered on their merits, 10 petitions were dismissed because the Board lacked authority to consider them, and 5 others were withdrawn.

Of the 64 petitions considered by the Board on their merits, 35 followed public hearings before the Board, requested by the petitioners. Public hearings were not requested by the petitioners in the remaining 29 petitions and they were disposed of on their records. The Board granted relief in several instances based upon grounds of special circumstances and importing history.

In denying relief, the Board for the most part found that the petitioners had not established exceptional hardship directly attributable to the Mandatory Oil Import Program.

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