# Chapter 6.
# Replenishing the Research Capital, 1947–1950

**We must concurrently carry on scientific investigations whose economic benefits cannot be immediately reflected in the balance sheet. It has been abundantly demonstrated that the pure or basic science of today is the applied science of tomorrow. We must develop by painstaking research methods the techniques for the discovery of new mineral deposits.[1]**

**—William E. Wrather**

The treaties signed in 1947 to end hostilities in World War II ensured that 1948 would be for the United States a year of official peace as well as a Presidential election. As part of his campaign, Truman promptly set out his domestic agenda. The President, in his State of the Union Message to Congress on January 7, 1948, set five goals for the Nation. America should secure the essential human rights for all its citizens, protect and develop its human resources, conserve and use its natural resources to contribute more effectively to public welfare, raise the standard of living for all its citizens by strengthening the economy and sharing more widely its products, and achieve "world peace based on principles of freedom and justice and the equality of all nations."[2] To do so, Truman emphasized, required overcoming the problem of inflation that threatened the realization of all of these goals. He called for a national health program, increased support for education and farmers, the conservation of natural resources, and raising the minimum wage from 40 to 75 cents an hour.

On February 2, Truman sent to the 80th Congress a special message on civil rights,[3] urging the legislators to pass measures to ensure more effective statutory protection of the right to vote and to end poll taxes, establish a Fair Employment Practices Commission with authority to stop discrimination by employers and labor unions, end inequity in interstate travel, and act on claims by Americans of Japanese descent confined against their will during the war years. When Congress did not act, two Executive orders[4] on July 26 banned discrimination in Federal hiring and in the armed forces. Unfortunately for women and minorities who were not Federal employees, no President held the authority to end the statutory and informal prejudice and bias elsewhere in American society and especially in the "Jim Crow" Southern States. Wartime service and demographic and related changes during the conflict that increased public awareness of these difficulties and efforts to end or at least reduce them now began to yield limited and slow but cumulative results. In the Northern States, where laws prohibited segregation, State and municipal courts long supported private restrictive covenants that established and maintained segregated urban neighborhoods by prohibiting ownership or occupancy of real estate by specific racial or ethnic groups. In four cases before the U.S. Supreme Court in 1948, the Justices struck down the State and municipal courts' enforcement of these agreements by holding them discriminatory and illegal under the Constitution's 5th and 14th Amendments and the Civil Rights Act of 1866.

Like the President in 1948, the Republican-dominated 80th Congress in its second session continued to wrestle with problems in the Federal domestic programs, including providing support for basic as well as applied science; the

European recovery and the growing cold war remained their principal challenges abroad. On January 12, Truman announced that the budget for the new fiscal year would show a surplus of $4.8 billion of projected receipts over estimated expenditures; he suggested applying the surplus to reducing the national debt. The President requested a total budget for fiscal year 1948–49 of $39.7 billion, of which $11 billion, or $279 million more than in fiscal 1947–48, would go to national defense; $7 billion to international activities and finance; and $1.6 billion to natural resources. The budget provided "for basic mapping and investigations only as part of a long-term program," including an increase from $10 million in 1947–48 to $15 million in 1948–49 "for the basic surveys and mapping of the Geological Survey." Expenditures by the U.S. Geological Survey (USGS) and the U.S. Bureau of Mines (USBM) "for limited exploration and development, mostly for strategic and critical mineral supplies," Truman added, "will continue in 1949 at a slightly increased level. Since these efforts cannot result in the discovery of resources for all foreseeable requirements," he concluded, "we must supplement them by stockpiling materials likely to become deficient."[5]

For the Interior Department in its centennial year, the Truman administration's budget requested nearly $443.5 million, an increase of some $202.5 million more than the appropriation for fiscal year 1947–48. Interior expected its revenues during the coming fiscal year to rise by $5.2 million to a total of $107.6 million. Interior's proposed budget included $16 million for salaries and operations by the USGS, or some $5.9 million more than provided during the previous year but less than the $22.1 million requested by the USGS from the Bureau of the Budget. The USGS asked for $6.58 million for topographic surveys, more than twice the appropriation for fiscal 1947–48. The USGS intended the new sum to cover the $2.2 million required for its surveys of militarily strategic areas, monies formerly supplied by transfers that included $1.9 million in 1947–48, from the Army and its Engineers. The USGS also expected an increase in cooperative funds from States, counties, and municipalities. The USGS wanted $2,988,000 for geologic and mineral-resource surveys and mapping, $400,000 for work in Alaska, $3,496,700 for investigations of water resources, $425,000 for classifying lands, $710,000 for mineral-leasing supervision, and $768,000 for printing and binding. The USGS expected to add to its direct appropriations about $12 million from other Federal and nonfederal sources.

The House appropriations subcommittee on Interior began hearings on its budget on February 16, 1948. Iowa's Benton ("Ben") Jensen, often a harsh critic of Interior and the USGS, succeeded Ohio's Robert Jones as chairman after Jones resigned on September 2, 1947, to join the Federal Communications Commission. Chairman Jensen, after a 7-week trip with subcommittee member Ivor Fenton to inspect Interior's activities nationwide, looked more favorably on the Department than did Jones. As Julius Krug was unavoidably absent, Jensen read the Secretary's opening statement into the record.

Director William Wrather, in his remarks to the House subcommittee on March 15, again "stressed the importance of basic scientific investigations within the Geological Survey"[6] and pointed out the agency's continued development and expanded use of the airborne magnetometer and geochemical methods as effective exploration tools for locating concealed mineral deposits. Part of the proposed increase in direct funds for topographic surveys would expand research toward modernizing mapping techniques. Wrather also emphasized two of the agency's continuing problems—difficulty in hiring adequately trained scientific and technical employees and the present spending limit on personal services in the District of Columbia. "We are already decentralized to the point where the Survey is largely a field organization,"[7] the Director explained, and although the agency must perform most of its professional activities outside Washington, vital administrative and staff

functions must be conducted there. He urged the subcommittee to approve the proposed increased expenditures for personal services in the Capital. If Congress endorsed the USGS request for increased direct funding for fiscal year 1948–49, Wrather and John L. Ramsey, the agency's Budget Officer, said that the expanded budget would provide for 1,400 full-time jobs. USGS regular (permanent) employees in the Capital and in the field rose from a postwar low of some 2,500 persons in fiscal 1945–46 to about 3,320 people in fiscal 1947–48. The increased staff would be more than 3,820 regular (full-time) and some 2,370 part-time (seasonal and other) employees by January 31, 1949, but Ramsey explained that most of the latter group would read water gages and wells.

In responding to Jensen's queries about the requested funds for topographic surveys, Chief Topographic Engineer Gerald FitzGerald emphasized his Branch's continuing efforts to conduct more economical and efficient operations, but he reminded Jensen that some 50 percent of the Nation remained unmapped at currently usable scales. During the last 2 years, USGS topographers concentrated their work on mapping the Missouri River Basin and on special areas selected by the Army. To improve coordination in federally sponsored mapping, the USGS recently formed agreements with the Army and its Engineers, the Bureau of Reclamation, the Coast and Geodetic Survey, and the Forest Service "to provide, insofar as possible, all their map needs."[8] Accepting this responsibility, FitzGerald cautioned, placed a larger burden on the USGS and made it necessary for the agency to seek a staff of sufficient size and talent to accomplish the task. As one measure of the Topographic Branch's efforts toward economy and modernization, FitzGerald reported that it was "using helicopters, not in Alaska but in the West, under a contract to determine how much we can cut our over-all field costs."[9] After Robert O. Davis, Earle Fennell, and other USGS topographers met with representatives of Bell and Sikorsky, the agency requested bids for a 1-month project in Colorado to transport men and equipment in the field. An aircraft company in St. Louis won the contract and began operating, from the Royal Gorge Airport at Cañon City, a Bell Model 47B, the new, four-seat, fully enclosed helicopter known as the "Sioux" in the Army version. The helicopter successfully supported operations at triangulation stations at elevations of up to 10,200 feet above sea level and, subsequently, additional mapping in the Paradox area. Representative William Norrell, whose experience in the oil and mining industries gave him a better appreciation than some of his legislative colleagues of this innovation's importance, suggested that "the Nation could afford a helicopter for your Department."[10]

Fenton, who began the subcommittee's evaluation of the funds requested by the USGS for geologic surveys, agreed with Wrather that topographic mapping and finding new mineral deposits "are inseparable."[11] The USGS significantly reduced the total of funds requested for strategic-minerals investigations after the agency received advice to drop most of these studies at the war's end and return to the peacetime program. In view of the worsening international situation, Chief Geologist Wilmot ("Bill") Bradley suggested that the USGS should restore its work on strategic and critical minerals; the agency, he added, would offer a "sizable item" in its "next budget submission."[12] Wrather then agreed with Fenton that these studies should have "very high or the highest priority"[13] and reported continuing the USGS wartime practice of assigning one or more geologists to each of the important mineral commodities.

In assessing the USGS energy-resources program, Michael Kirwan noted the shortage of oil during the past year and asked Wrather why he thought it occurred. The Director cited as one factor "the prodigious increase in the consumption of oil by new users and in new uses," in home heating, by industry, and in private and public transportation. Wrather had expected a post-war "breathing spell" that would allow the petroleum industry to "take stock" and perhaps cut back on production to "get on an even, sound footing again." Instead, "consumption and

production are going up and up and up." The United States now used nearly 6 million barrels per day, a total higher than the war's peak rate. Wrather, in words eerily reminiscent of his response to Senator Patrick McCarran in May 1943, while trying to explain wartime shortfalls, recalled that

> **[i]n my own experience, I have seen the daily production in this country expand five fold. I remember when in 1919–20 the daily oil production first passed 1,000,000 barrels a day. Today it is 5,300,000 or 5,400,000 barrels a day.[14]**

As part of the USGS response to this problem, the USGS request for increased funds for continued investigations of Alaska mineral resources included nearly $15,000 for petroleum-related studies. Only 43 percent of the Territory's lands were mapped at reconnaissance scales; of that area, just 11,000 square miles were covered at scales sufficiently large for a sketchy appraisal of its petroleum potential. The same held true for part of the Goodnews Bay platinum-mining district, one of two provinces in western Alaska, of whose 12,000 square miles only one-sixth was adequately mapped. Alaska produced minerals worth $904.5 million between 1880 and 1945, but only 0.3 percent of the Territory was mapped well enough to evaluate these resources. Most of the remaining appropriation would go to geologic mapping in and investigations of nonfuel minerals in Alaska, but, with coal now increasingly important, $22,000 would fund coal-resources studies. The agency's request also contained a new item of $12,000, to replace Navy funds, for geophysical and related studies in the Aleutians "to determine whether there is any active movement in the islands, and to find out whether it is possible to determine the periodicity of the volcanoes; how often they are apt to erupt." The USGS tabulated all available historic records from the Aleutians to try to determine if "there is any periodicity that is to be counted on with any assurance."[15]

The USGS also asked for an additional $600,000 for coal investigations as part of geological surveys in the States. Norrell, wishing to reassure his colleagues that the USGS did not compete with water-well drilling or other industries, queried the increase for coal studies. USGS work had increased since the war due to the greater demand for its services, Wrather reminded the subcommittee, and the agency's program reflected pressures for particular types of work. No USGS operations duplicated those of private enterprise and would not do so in the future, "if we can help it."[16] The country should look to its coal, Wrather suggested, in trying to solve the oil problem. Funds were required to begin a 10-year program of appraising the Nation's coal resources at a total cost of $12.5 million. Although the amount of coal-derived energy peaked just before World War I, and petroleum took coal's place since then, Wrather believed that "we are about to see a reversal of these relationships."[17] The change would not be sudden or disruptive, but it was becoming increasingly difficult and costly to find each new oil field, and so more money and time would have to be spent on the search. Advanced techniques of converting coal into liquid and gaseous fuels comparable to petroleum and natural gas would enable the synthetics to compete with petroleum in the foreseeable future. The chemical industry's increasing use of coal as a raw material also created an even greater demand for this resource. The most recent comprehensive estimate of U.S. coal resources was 20 years old, Wrather asserted, and subsequent developments showed that it might be flawed.

Wrather pointed out the need to press on with the search for new deposits of minerals for security in times of emergency and to provide low-cost sources for industry. The gross value of mineral production had risen from $1 billion to $12.4 billion since 1900, as the number of mineral commodities on the market increased from 56 to 150. The strategic list now held 51 of these minerals, and 34 of them were in the vital A group. Stockpiling continued to be an essential activity, but Wrather also emphasized the necessity of discovering new deposits, facilitated

by the newer exploration techniques. He tried to impress on the subcommittee's members, as did Walter Mendenhall during the energy crisis of the 1920s, that it took time to search for, find, and develop mineral deposits. Arizona's San Manuel copper deposit, some 30 miles northeast of Tucson, was known in 1943 but it would not be ready to produce for the market for another 5 years and it would take a full generation to mine. Yet San Manuel contained only enough copper to supply U.S. requirements, at 1947's rate of consumption, for 2 years, and the United States produced only a little more than half the copper it used. "In order to supply our own needs," the Director concluded, "we must find the equivalent of a San Manuel copper deposit every 2 years, a new southwest Wisconsin zinc field every 1½ years, a new Adirondack iron district every 6 or 7 years, and so on for a long list of other minerals."[18]

The USGS budget for geologic surveys included new wording specifying the printing of geologic reports. One of the most critical problems facing the USGS, Wrather noted, involved the agency's inability to publish promptly "the results of investigations and mapping."[19] In 1938 and 1940, respectively, amounts equal to 9 and 10 percent of the appropriations were available for publication. Thereafter, the percentage dwindled rapidly until in 1948 publication funds represented only 3.5 percent of the appropriation. That loss forced the USGS to place on its library's shelves most of the results of its investigations, rather than publishing and distributing them to the public. Some of this backlog, Wrather indicated, might be reduced if Congress authorized the agency to use some of its operating funds and (or) increased funds for printing and binding, including the topographic and geologic maps printed in the USGS' own plant.

At the end of the USGS hearings, Chairman Jensen, in a mellow mood, complimented but also cautioned the Director. "Dr. Wrather," Jensen observed, "it is a pleasure to have you and your staff come before the [sub]committee. We always get the information we seek. Although we may not agree with you and give you all the money you want, we nevertheless like the way you carry on your Department."[20] "I want to furnish you a sufficient staff," Jensen emphasized earlier, "I know this committee does, and I know the Congress does, and I know the American people do, too," before adding phrases reminiscent of some turn-of-the century and subsequent legislators. "But I also know that the Congress and the people and this committee just simply do not want the Geological Survey to get in the same rut that some other departments of Government have gotten into because of the overstaffing of the departments." "I hope," Jensen added, "the Geological Survey never gets in that rut because of the very nature of your work, in particular, which is so important. * * * I feel you have done a good job, and I am a little afraid, if we give you these extra 1,400 men, or a majority of them, that you might get the bureaucratic fever that the rest have."[21]

Secretary Krug, testifying before Jensen's subcommittee on April 29, 1948, the day Jensen introduced a stockpiling bill, remained reluctant to advocate increased-personnel expenditures by any of Interior's bureaus because he deeply desired to effect economies in the Department. When Krug personally looked into the programs of the USGS and the USBM, he found both agencies hesitant to ask for the additional funds required for their programs "because of the difficulty of getting the people to do the work." "Yet they are hopelessly behind a minimum schedule to meet our critical needs," Krug explained, "and the period it will take to catch up is a shocking thing to me. If I were to give priorities in our programs—and I am not trying to say what you should cut—I would like to say, please don't cut these two agencies that are directly related to expanding our mineral resources."[22] Only 10 percent of the United States, Krug later emphasized, was mapped geologically at scales adequate for mineral-resources evaluations. That level of completion placed the Nation, Krug observed ruefully, slightly behind Algeria's coverage but just ahead of Poland's.

The House subcommittee's immediate reaction to Krug's verbal plea was mixed, and its report proved disappointing. Jensen's subcommittee, impressed by the value of USGS work in support of national defense and preparedness, approved an increase in the total requested by the USGS, but it was only $881,000 more than the sum appropriated for fiscal year 1947–48, or just 15 percent of the requested raise. The House did allow the USGS to expend operating funds for publishing its reports rather than continuing to require a separate line item for this purpose. Action on Interior's budget then moved on June 1 to the Senate subcommittee, where Kenneth S. Wherry (R–NE) replaced "Chan" Gurney as chairman. Wherry's subcommittee more than doubled the House's increase to 37 percent of the requested amount, bringing the total appropriation to $13,924,000. The conference committee compromised on a total of $13,027,000 for the USGS for fiscal 1948–49.[23] Of this sum, $237,350 would be used for salaries and expenses,[24] $4,350,000 for topographic surveys, $2,625,000 for geologic surveys, $325,000 for Alaska mineral resources, $3,496,700 for water-resources investigations, $300,000 for classifying the public lands, $690,000 for supervising mineral leasing, and $602,950 for publications; the sum also included a cooperative advance of $400,000 to be "returned to the Treasury not later than six months after the close of the fiscal year 1949 out of reimbursements received from the cooperating agencies."[25] The House and Senate also compromised on the higher limit of $4,750 for attendance at scientific meetings and authorized the USGS "to contract for the furnishing of topographic maps made from aerial photographs, or for the making of geophysical or other specialized surveys."[26]

Truman signed the bill for Interior's appropriations for fiscal year 1948–49 on June 29, 1948. The new law provided the usual transfer funds of $19,500 for stationery supplies; deficiencies legislation, enacted on June 23, 1949, furnished an additional $700,000 for increased pay costs.[27] Transfers from other Federal agencies and funds from States, counties, municipalities, and miscellaneous sources increased the total funds available to the USGS during fiscal 1948–49 to just under $26,712,000, a gain of $4.3 million, or about 19 percent, from the previous year. To this total, States, counties, and municipalities contributed nearly $3,486,000, while about $9,223,000 of the $10,062,000 transferred by other Federal agencies came from seven principal organizations—$3,931,000 from the U.S. Bureau of Reclamation (USBR), $2,602,000 from the U.S. Atomic Energy Commission (AEC), $1,524,000 from the Department of the Army, $517,000 from the Department of the Air Force (as renamed in September 1947), $329,000 from the Navy Department, nearly $243,000 from the Department of State (DoS), and $77,000 from the Tennessee Valley Authority (TVA).

The appropriations statute for fiscal year 1948–49 also authorized the USGS to "acquire from the Department of National Defense or from any disposal agency of the Government without reimbursement or transfer of funds, one aircraft for replacement only; including engines, parts, accessory, and flying equipment."[28] In 1900, Senator Henry C. Lodge (Sr., R–MA) asked a colleague if he doubted "that in time, as the Coast Survey has extended onto the land and become geodetic, the Geological Survey would extend onto the water and get a navy?"[29] In 1948, the USGS still lacked blue-water vessels but now Congress and the President enabled the agency to begin its own air force by searching for a larger plane to replace the Navy's Beech SNB–1 to continue airborne geophysical surveys. In 1949, the USGS acquired a Douglas C–53D Skytrooper delivered to the U.S. Army Air Forces (USAAF) in 1943 and then combat-flown in Europe during 1944–45. The USAAF then leased the C–53D to American Airlines, which operated the aircraft under Civilian Registration Number N19924, before it was transferred to the USGS, was repainted, and began flying magnetic surveys for the agency. In 1955, the U.S. Air Force (USAF) transferred a C–47 (N19950) to the USGS.[30]

As the USGS budget for fiscal year 1948–49 passed through congressional review and modification, the world became increasingly more complex and dangerous as two European nations continued to try to regain control of their former colonies, conflict less than outright combat grew in other regions, and armed disputants in one area began open warfare. In Indochina, the French and the non-Communist nationalists, both the Buddhist majority and the Catholic minority, recognized the independence of Vietnam (Cochin China), within the French Union, in March 1948. They combined to establish an anti-Communist Republic of Vietnam in June under Bao Dai, the former Emperor of Annam, with Ngô Dình Diêm as his deputy. In the north, the French struggled to reimpose their government throughout the country by defeating the Viet Minh, although Hõ Chí Minh's forces grew ever stronger as they continued to operate as guerrillas from their rural bases. In the East Indies, Mohammed Hatta and Achmed Sukarno declared the Republic of Indonesia (Java, Madura, and Sumatra) on August 17, 1945, but The Netherlands refused to recognize the change, and Dutch and British troops clashed with those of the new nation. Negotiations during February–November 1946 produced the Chierbon Agreement in March 1947 for a United States of Indonesia (the Republic, plus Borneo, the Celebes, the Moluccas, and the Sunda Islands) as an equal part of The Netherlands, but significant differences remained and war resumed in July 1947. The United Nations (U.N.) Security Council sponsored a cease-fire and a committee to resume negotiations that led to a second agreement in January 1948 that also dissolved into renewed fighting.

War and disputes continued or began elsewhere in Asia, in Europe, and in the Middle East. Mao's forces gained the upper hand in China's civil war. Korea remained divided, and the low-level conflict grew between the regimes in the north and south halves of the "Land of the Morning Calm." Britain, continuing to grant independence to her colonies, completely freed Burma (Union of Burma, later Myanmar) in January 1948, and made Ceylon (now Sri Lanka) a self-governing unit of the Commonwealth in February. Independence did not guarantee peace. Violence between Hindus and Muslims in India and border clashes, especially in Kashmir, between India and Pakistan, went on before and after a Hindu fanatic killed Mohandas Gandhi in Delhi on January 30 and Mohammed Jinnah died in September. In Europe, the Soviet Union continued to oppose the European Recovery Program's successful operations, and it began to restrict the West's access to Berlin. In the Middle East, Britain gladly ended its difficult and costly occupation of Palestine, under U.N. mandate, and the Muslim-Jewish struggle there flamed into open war.

The Zionists' intention to recreate and repopulate Israel within its historic Biblical lands and the military response promised by Arab rulers made war in the Middle East almost inevitable.[31] The British Government sent its plan for Palestine to the United Nations in February 1947, nearly 30 years after Britain's Balfour Declaration promised to establish there a national home for the Jewish people but without affecting the civil and religious rights of non-Jewish inhabitants. The U.N. General Assembly then sent to Palestine a Special Committee to evaluate the British and other plans for partition, a concept Truman approved early in October 1946. In August, the U.N.'s Committee recommended dividing Palestine into a Jewish state, with an equal number of Jews and Arabs, a 100-percent Arab state, and an internationalized Jerusalem. The U.N. General Assembly approved the plan in November. The Anglo-American Committee's report in 1946 asked that Palestine take in 100,000 more Jews from Europe and recommended neither partition nor independence. The U.N.'s Committee feared additional violent acts by Arab and Jewish fanatics, like the latter's explosive device that destroyed Britain's headquarters for Palestine in Jerusalem's King David Hotel and killed nearly 100 Arab, British, and Jewish people on July 22, 1946. Instead, the Committee suggested

establishing a single Arab-Jewish state under U.N. trusteeship before the British mandate ended on August 1, 1948.

In response to the U.N. General Assembly's approval of its Committee's plan for Palestine, delegations from the Arab countries walked out. Prince Faisal, representing Saudi Arabia, also took the U.S. affirmative vote as a personal affront. In 1945, Faisal signed the U.N. Charter in San Francisco and made a second visit, during July 31–August 1, to Washington, where Acting Secretary of State Joseph Grew assured the Prince that Truman, then at Potsdam, would honor Roosevelt's promises to King Ibn Saud. When Crown Prince Saud visited Washington by invitation in January 1947, principally to request a $50 million loan for economic development in the Kingdom, Secretary James Byrnes promised that the United States would support its independence, territorial integrity, and security and the application of the U.N. Charter but would oppose any British-backed "Greater Syria." When the Security Council failed to endorse the General Assembly's plan, Palestine lapsed into renewed chaos. Britain declared in December that its troops would be withdrawn by the end of its mandated occupation, now scheduled for May 15, 1948.

On May 14, 1948, as the last British military units left Palestine, David Ben-Gurion, head of the Jewish Committee, declared Israel's independence according to the U.N.'s plan. The United States and the Soviet Union immediately recognized Israel in fact. The United States provided no official and little real aid to Israel, aside from a few advisers and other volunteers, but it acknowledged Israel and Transjordan (later Jordan) in law on January 31, 1949. The Arab League, founded, in part as an anti-Zionist organization, by Egypt, Iraq, Lebanon, Saudi Arabia, Syria, Transjordan, and Yemen in March 1945, quickly moved to destroy Israel. Truman, who favored independence for Arabs as well as Jews, decided not to send U.S. troops to make and enforce a peace in Palestine. Truman, with a large Jewish constituency at home but only a tiny Arab one, did not, in the end, fully make good on Roosevelt's pledges, but Truman did continue to inform Ibn Saud by letter and to support Saudi Arabia, to which the President twice sent his personal physician and a medical team to treat the ailing King.

Armies from five members of the Arab League invaded Israel. The Israelis, although aided by their single command and internal lines, repelled with difficulty the 42,000 Egyptian, Iraqi, Lebanese, Syrian, and Transjordanian troops,[32] of which the most effective were the 10,000 in Transjordan's British-trained and British-led Arab Legion. Another 50,000 Palestinians, in less organized local units, provided some aid to the Arab regulars. The Israeli army regulars and reserves, including some veterans of the British 8th Army, numbered nearly 33,000 and had weapons for another 30,000; two terrorist groups held 4,000 more. As Israeli forces grew in strength, professionalism, and confidence, they began offensives. In April 1948, the Israeli army captured Haifa and Jaffa, but it did not retake East Jerusalem from the Arab Legion. In the south, Israeli forces defeated the Egyptians, to whom, like the Syrians, the Soviets furnished arms.

As fighting continued in Palestine, Zionist terrorists assassinated the U.N.'s Swedish negotiator Count Folke Bernadotte on September 17. American Ralph Bunche, Bernadotte's assistant, replaced him and negotiated a temporary armistice in February 1949 and a formal one in May, which received British, French, and U.S. support in 1950, the year Bunche received the Nobel Peace Prize. By the agreement, Israel comprised an area more than 50 percent larger than the country depicted in the U.N. plan and included nearly 80 percent of the former British Palestine mandate, but more Israelis than Arabs paid with their lives for these changes. When Jordan annexed 2,000 square miles of the West Bank, in the area west of the Jordan River, Palestine disappeared entirely into Israel, Jordan, and Egypt, which kept the Gaza Strip and the El Aija area in the Negev Desert. The Palestinian diaspora, their "catastrophe," during 1947–49, displaced more than 700,000 of

the original 1.3 million Arabs in the region. Some 400,000 of these people fled to Jordan's West Bank lands, another 150,000 left for Egypt's Gaza enclave, and an additional 150,000 immigrated to Lebanon and Syria. The U.N. established a Relief and Works Agency for Palestine Refugees in the Near East. Some of the Arabs who remained on their lands within the new democracy chose to become Israeli citizens. Jewish immigration to Israel, especially from Arab countries, resumed and the new country's economy soared.

The major oil-producing Arab countries did not enlist their petroleum resources in the struggle to overwhelm the Israelis during the 1948–49 war, as historian Daniel Yergin noted, but the importance of the Middle East's oil continued to grow, as predicted by Everette DeGolyer's team in 1944. America's petroleum exports last exceeded her imports in 1947. In that year and in 1948 as Yergin recorded, U.S. and British oil companies retained or gained control of most of the Middle East's petroleum,[33] which, except for Iran's, represented just 6 percent of the world's supplies. In Saudi Arabia, Socal (later Chevron) and Texaco (as Caltex) began building in 1947 the Trans-Arabian Pipeline (Tapline), championed earlier by Secretaries Harold Ickes and James Forrestal. To reduce risk and recover part of their investments, the two companies sought additional partners. In view of Ibn Saud's demand that Aramco remain wholly American, and with the King's approval, Socal and Texaco sold 30 percent of Caltex to Standard of New Jersey (later Exxon) and another 10 percent to Socony-Vacuum (later Mobil). Aramco's now four companies signed a joint agreement on March 12, 1947, the day Truman announced aid to Greece and Turkey as part of his "Doctrine," and they completed the merger in December 1948. Meanwhile, Gulf and Royal Dutch/Shell agreed to divide equally during the next 10 years the profits of the Kuwait Oil Company, a consortium joined in reconstructing the Iraq Petroleum Company, and the Anglo-Iranian Oil Company signed a 20-year contract with Standard-Jersey and Socony-Vacuum. Ibn Saud, who might have canceled his Aramco concession, did not. The King continued to view Hashemite Iraq and Jordan, and Arab Communists, as greater threats than Israel. He needed Aramco's royalties for his own and other uses and sought mutual-defense treaties with the United States and Britain. Ibn Saud also convinced some of the Arab League's member nations that Aramco's revenues strengthened Saudi Arabia and thus enabled that country to increase indirect aid to the Arab cause.

As Arabs fought Israelis in 1948–49, the United States continued trying to contain the Soviet Union in accord with the Truman Doctrine by all actions, short of war, "to support free peoples who are resisting attempted subjugation by armed minorities or by outside pressures."[34] The Soviets, although faced with enormous domestic difficulties following the war's devastation, devised and applied a foreign policy that advanced their own nationalist and Communist influence. Starting in mid-February 1948, the Soviets helped to overthrow the government of Czechoslovakia, purged it, nationalized its banks and industries, and established forced-labor camps. To carry out the Soviet-opposed Marshall Plan, the 80th Congress and President Truman approved the Foreign Assistance Act on April 3, 1948. Title I, the Economic Cooperation Act, provided for European and other international economic collaboration as part of continuing American efforts to "promote world peace and the general welfare, national interest, and foreign policy of the United States through economic, financial, and other measures necessary to the maintenance of conditions abroad in which free institutions may survive and consistent with the maintenance of the strength and stability of the United States."[35] The new law provided for "promoting industrial and agricultural production in the participating countries; * * * furthering the restoration or maintenance of the soundness of European currencies, budgets, and finances; and * * * facilitating and stimulating the growth of international trade * * * by appropriate measures including reduction of barriers which may hamper trade."[36] The statute established

the Economic Cooperation Administration (ECA), headed by an Administrator appointed by the President, advised by a National Council and a Public Board, and represented abroad by a special representative of ambassadorial rank and ECA missions in each country. Additional titles covered the International Children's Emergency Fund, provided up to $275 million in assistance to Greece and Turkey, and capped aid to China at $338 million.

Truman appointed Paul G. Hoffman, the president of Studebaker Motors since 1935, to lead the ECA, and the Senate confirmed him on April 7, 1948. Congress furnished $4.3 billion for the initial year, and later $17 billion in all, for the European Recovery Program run by the ECA, which began operating independently of the DoS in the following summer. Several West European nations responded in part by signing a treaty in Brussels on March 17 that established a 50-year economic, military, and social alliance between Belgium, Britain, France, Luxembourg, and The Netherlands, to expand 1947's Benelux agreement among Belgium, The Netherlands, and Luxembourg. The Marshall Plan participants met in Paris and, on April 16, founded the Organisation for European Economic Co-operation. Two days later, the Christian Democrats overwhelmingly defeated the Communists in Italy's national elections. On May 7, a congress of European nations, led by Winston Churchill, met at The Hague to plan for a European Union, in which (West) Germany might play a role. The Western Powers began West Germany's economic recovery in December 1946, when Secretary of State James Byrnes and Foreign Minister Ernest Bevin signed an agreement that fused the American and British zones of occupation as "Bizonia," but France and the Soviet Union refused invitations to join them. Subsequent actions to rehabilitate West German industry culminated in June 1948 in an agreement by representatives of the United States, Britain, France, and the Benelux countries to encourage international control of the Ruhr, link West Germany to the Marshall Plan, draft a constitution for the now two Western zones, and establish for them a military security board and a stable currency.

The Soviet Union responded to these actions in several ways in different parts of the international arena. The Soviets improved their foreign exchange in December 1947 by devaluating the ruble by 10 to 1. By February 1948, they made several parallel economic moves in their occupation zone in Germany. On March 18, the Soviets recalled their advisers from Yugoslavia and then expelled Marshal Tito's country from the new Cominform, producing a potential gap in the Iron Curtain. When Tito denounced the Cominform and Yugoslavia's treaty with the Soviets, Albania withdrew from the Yugoslavian coalition. In August, the Soviet Union ended all consular relations with the United States. The Soviets, building on treaties signed earlier in 1948, established on January 25, 1949, the Council for Mutual Economic Assistance (Comecon) as a response to the Organisation for European Economic Co-operation. By 1950, Comecon included Bulgaria, Czechoslovakia, Hungary, Poland, and Romania; Albania and East Germany joined later. In Germany, the Soviets withdrew from the Allied Control Council on March 20, 1948, and began interfering 2 weeks later with traffic on the previously approved rail and road routes to and from West Berlin. On June 24, six days after the Western Powers established the new West German mark, the Soviet Union denied the Western Powers all access by land and water to the city in an attempt to starve the West Berliners and force the Allies to surrender control of their sectors.[37] Pavel and Anatoli Sudoplatov later asserted that Stalin also ordered the blockade to prevent Truman from authorizing the use of U.S. atomic bombs in China in an attempt to halt the continued advances of Mao's Communist forces and save at least a part of the country for Chiang's Nationalists.[38] On June 24, as Soviets began blockading Berlin, Truman signed the Selective Service Act,[39] to replace the 1940 statute that expired on March 31, 1947, and reestablished registration for all U.S. male citizens between 18 and 25. The new law restricted active service to those more than 19

years old and limited their active-duty service to 21 months. Britain passed its National Service Act, for males 18 to 26 years old, in December. Truman ordered to Germany 60 B–29 bombers, not yet equipped to carry nuclear weapons, and escorting Lockheed F–80 jet fighters.

Pending resolution of the crisis, the Western Powers also responded with Operation Vittles, a massive airlift of food, fuel, and other supplies to West Berlin initially ordered by General Lucius Clay (Sr.), General Eisenhower's postwar deputy and now the military governor of Western Germany and commander of U.S. forces in Europe. On June 28, 1948, Truman approved a full-scale operation to bring relief, via the three major airfields in West Berlin, to the city's more than 2 million residents. Major General Curtis LeMay, now commanding the U.S. Air Forces-Europe, planned and guided Vittles, before taking over in October, as a Lt. General, the Strategic Air Command. Major General William H. Tunner, who oversaw the Allies' wartime airlift over the Himalayas to China, succeeded LeMay as head of the Combined Airlift Task Force. Deliveries by American C–47s and four-engine C–54s, and British transports, flying in good weather and bad, rose from 80 tons on June 26 to more than 5,500 tons on September 18. The Allies closed their zone to traffic from the East in February 1949, and the Soviets ended their blockade in May. By the time the airlift ended on September 30, Allied aircraft had delivered more than 2.3 million tons of cargo[40] in 277,000 flights but at a cost of more than 320 deaths among the crews and an expenditure of more than $200 million.

As the Soviets reevaluated their increasingly ineffective blockade of Berlin and the West's counter effort to halt the eastward flow of its goods, their influence remained strong in the Far East, except in Japan. Mao's Communist troops continued to advance against Chiang's Nationalist forces on all fronts in China during 1948, even though aid from the United States since the end of World War II now topped $2 billion. Some of Chiang's best units were destroyed in combat; his surviving troops could not overcome the results of continued corruption in government and inflation nationwide. The Communists, aided by their ever-increasing heavy artillery, recaptured Yan'an in March. They declared a North China People's Government on September 1, as troops led by Lin Piao (Biao) neared Mukden (Shenyang).

The adjacent Korean Peninsula also remained divided and chaotic.[41] On November 14, 1947, the U.N. General Assembly recognized Korea's claim to independence and then aided plans for peninsula-wide elections to establish a national government and arrange for the withdrawal of all occupation forces. The Soviet Union announced on January 23, 1948, that the U.N. Temporary Commission on Korea, operating from Seoul since January 8, would not be allowed to enter the Soviet-controlled northern half of the peninsula. In Pyongyang, Kim Il Sung and his supporters claimed the entire country, boycotted the U.N.-supervised elections on May 10 of a national assembly for the U.S.-occupied south, and refused to send invited representatives when the rightist-dominated assembly convened on May 28. That assembly established on August 15 the Republic of Korea (ROK, or "South Korea") and chose as its president conservative Syngman Rhee (Yi Sung Man), Korea's provisional-government leader since the 1920s, who opposed the U.S. offer to seek a U.N. trusteeship for the Korean Peninsula. In response, Kim founded the Democratic People's Republic of Korea (DPRK, or "North Korea"), with himself as premier on September 9. Rhee's government agreed on December 10 to accept economic aid from the ECA and the War Department. Two days later, the U.N. General Assembly recognized Rhee's regime in Seoul and formed a second commission to try again to unify the two Koreas. Soviet troops completed their withdrawal from North Korea on December 25, but they left a group of military advisers who would significantly outnumber their American counterparts when the U.S. garrison left South Korea.

On November 23, 1948, as the Soviet forces neared the end of their occupation of North Korea, President Truman approved the revised statement from the National Security Council (NSC) that outlined U.S. objectives and measures to counter Soviet threats to American security. In May, Truman asked Secretary of Defense Forrestal to prepare a defense budget for fiscal year 1949–50 that would not exceed $15 billion. The Soviet's blockade of Berlin on May 24 caused Forrestal and the Joint Chiefs of Staff, believing this level inadequate, to urge the President and the NSC on July 10 to prepare an evaluation of future risks, specific U.S. objectives, and how to achieve the latter. Three draft statements, derived principally from three existing papers by George Kennan and his Policy Planning Staff at the State Department, were merged as NSC–20/4, which Truman approved. NSC–20/4, among recommendations for aims and means in American domestic and foreign policy, called for developing "a level of military readiness which can be maintained as long as necessary as a deterrent to Soviet aggression" and provide "an adequate basis for immediate military commitments and for rapid mobilization should war prove unavoidable."[42]

During 1948, Truman and Congress also faced continuing and significant problems in domestic affairs, especially economic uncertainties fueled by the results of strikes during April–July in the coal, railway, and steel industries. When the Truman administration took action to stop the walkouts by invoking the Taft-Hartley Act, cooling-off interval negotiations led to a third round of postwar increases in wages. The raises included a cost-of-living adjustment in the agreement between General Motors and the United Auto Workers. Responding to the repeated unrest in the coal industry, Interior Secretary Krug, who discontinued the Coal Mines Administration on October 25, 1947, established on May 14, 1948, the National Bituminous Coal Advisory Council,[43] including representatives of the coal companies who met with him on January 27 in Washington. Krug and Under Secretary Oscar Chapman also moved quickly to increase the regional organization of Interior's operations in the Pacific Northwest and Alaska. On May 18, Krug revised the Pacific Northwest Coordination (Field) Committee,[44] composed of representatives from the Bonneville Power Administration, the Bureau of Indian Affairs (BIA, the renamed Office of Indian Affairs), the Bureau of Land Management (BLM), the USBR, the Fish and Wildlife Service (FWS), the National Park Service (NPS), the USBM, and the USGS, and revoked his order that originally established the group in September 1946. Truman's special message, on May 21, 1948, to Congress about Alaska included statehood among its recommendations for the Territory and its 94,000 residents. On July 1, Krug founded an Alaska Field Committee,[45] led by the Assistant Secretary responsible for Alaskan affairs and including representatives from the Alaska Railroad, the Alaska Road Commission, the BIA, the BLM, the FWS, the NPS, the USBM, and the USGS, to meet in Juneau. In 1949 and 1950, Krug and Chapman, Krug's successor as Secretary, began similar field committees for the Colorado-Great Basin (headquartered in Los Angeles), the Missouri River Basin (at Billings, Montana), and the Southwest (in Albuquerque) and named a Northeast Field Staff (in Boston).

During fiscal year 1948–49, the USGS increased its searches for and evaluations of mineral deposits and developed new geophysical and geochemical techniques for those purposes. In addition, the agency undertook new investigations to meet the needs of fast-growing industrial areas, highway construction, and provision of water supplies, as well as those to solve problems attendant on the construction of large dams for irrigation, power development, and flood control. To aid this work, the USGS made significant changes in administration and operations before July 1, 1948, and the agency continued similar modifications during fiscal 1948–49. Wrather established "a fifth [administrative] division [within the Director's

Office] to handle all the 'housekeeping' functions" in the USGS and prevent unnecessary fiscal statements, complaints about unpaid bills, personnel matters, and other issues from reaching his desk "when they should have been stopped at lower levels."[46] On May 10, a Survey order abolished the position of Chief Clerk,[47] established in 1881 and filled on an interim basis since the retirement of the last incumbent on June 30, 1947. The directive also transferred the Division of Map Reproduction, the Division of Accounts, and the Section of Correspondence and Records to Julian Sears, the Administrative Geologist.

Wrather's next Survey order, issued on June 25, 1948, restored the post of Executive Officer, discontinued since 1894, but placed it on the Director's staff (of 78 persons) to have the selectee serve as "an advisor and consultant to the Director and his associates and to the heads of the scientific and engineering branches in problems of business management."[48] This order appointed Glendon J. Mowitt, Executive Officer of the U.S. Railroad Retirement Board in Chicago, as USGS Executive Officer to provide a more objective analysis of how best to centralize accounting, job classification, personnel actions, housing, storage, purchasing, and mail and messenger services. His duties reflected those of Wilbur C. Irving, whom Bradley appointed as the Geologic Branch's Executive Officer during fiscal year 1946–47 to succeed Assistant Chief Geologist Joe Peoples. Wrather made Mowitt responsible for six business and service units: Accounts; Budget; Correspondence and Records; Field Equipment, transferred from the Topographic Branch in December; Map Reproduction; and Personnel. The order also changed Julian Sears' title from Administrative Geologist to Staff Geologist in the Director's Office to enable him "to devote himself more fully, as a scientific consultant and advisor to the Director, to problems of technical planning and coordination," while continuing to serve as Acting Director when both Wrather and Nolan were absent from Washington at the same time. Sears' new avatar marked the agency's "return to the original concept underlying the designation of successive field geologists as Administrative Geologist to assist the Director in various problems requiring a knowledge both of professional objectives and operations and of controlling laws, regulations, and policies."[49]

On January 1, 1949, as part of the Federal Government reorganization and by Wrather's order of December 15, 1948, the USGS abandoned its long-time usage for its administrative and programmatic units; USGS Branches became "Divisions" and their subordinate Divisions or Sections were renamed "Branches."[50] Wrather's order authorized two exceptions to these changes. The Atlantic, Central, Rocky Mountain, and Pacific Divisions of the Topographic Branch became Regions of the Topographic Division. The Geologic Branch's two topical Divisions were abolished, and their constituent Sections were restyled Branches in the Geologic Division.

For fiscal year 1948–49, Bill Bradley's Geologic Branch (Division) drew on directly appropriated funds of nearly $3,145,000 and total transfers of about $4,098,000, for a total of about $7,243,000 for its staff of nearly 530 persons. Other Federal agencies provided some $3,975,000, including nearly $2,554,000 from the AEC, about $885,000 from the National Military Establishment (mostly from the Army and its Engineers), $363,000 from the USBR, and $142,000 from the DoS. States, counties, and municipalities contributed $123,000. One "manager" in the USGS Pick and Hammer Club's annual show, on March 16, 1948, ruefully observed that outside money, shortages of quality geologists, plus some onboard "you oughta fire," and requests by "the brass" for ever more maps overcommitted the Geologic Branch and would bring a future reckoning. Adopting "I Cain't Say No" from "Oklahoma!," the 1943 musical by Richard Rodgers and Oscar Hammerstein 2d, he pleaded:

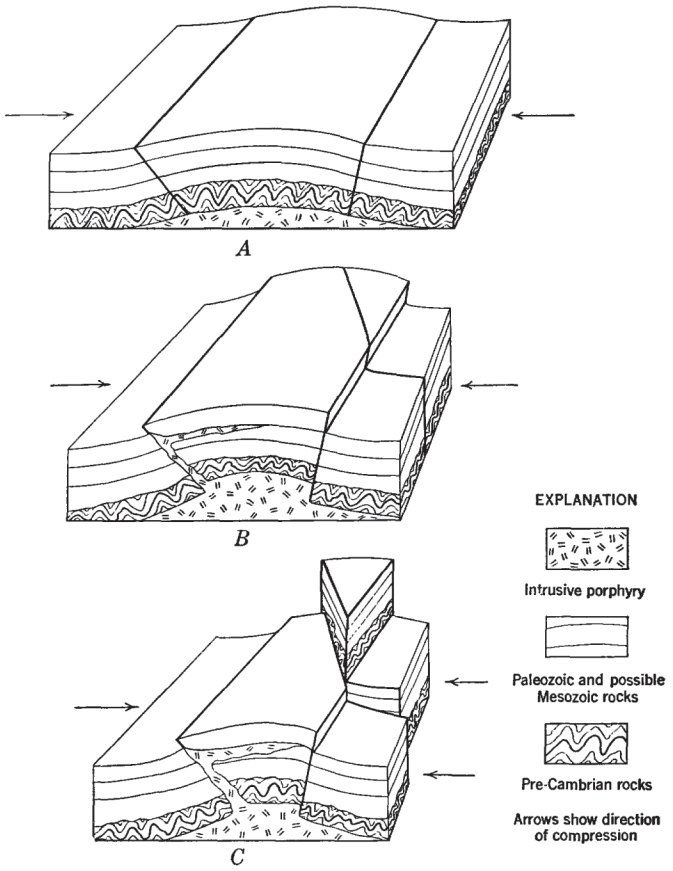
**I'm just a man who can't say "No";**
**Can't seem to say it at all;**
**When I'm approached by Strauss or Krug,**
**Royall, or Lilienthal.**

* * * * *

**I CAN'T SAY NO.**[51]

On December 31, 1948, Wrather approved Bradley's recommendation for the formal appointments on January 1 of Harold Bannerman and Harry Ladd as Assistant Chief Geologists[52] and ended, as required by Wrather's order, the Division of Economic Geology and the Division of Basic Sciences established by Bradley when he became Chief Geologist. Staff Geologist Stephen Capps, on detail to the Military Geology Section since the fall of 1948, died on January 19, 1949, leaving Foster Hewett, Hugh Miser, William G. Pierce, and William Rubey as the principal advisers in Bradley's office. During the second half of fiscal year 1948–49, the Geologic Division contained 12 Branches. Bannerman oversaw Mineral Deposits, the Trace Elements Planning and Coordination Office (TEPCO), Geology of Fuels, and Alaskan and Foreign Geology. Ladd remained responsible for Engineering Geology, General Geology, Paleontology and Stratigraphy, Geochemistry and Petrology, Military Geology, Geophysics, Geologic Information and Reports, and the Library.

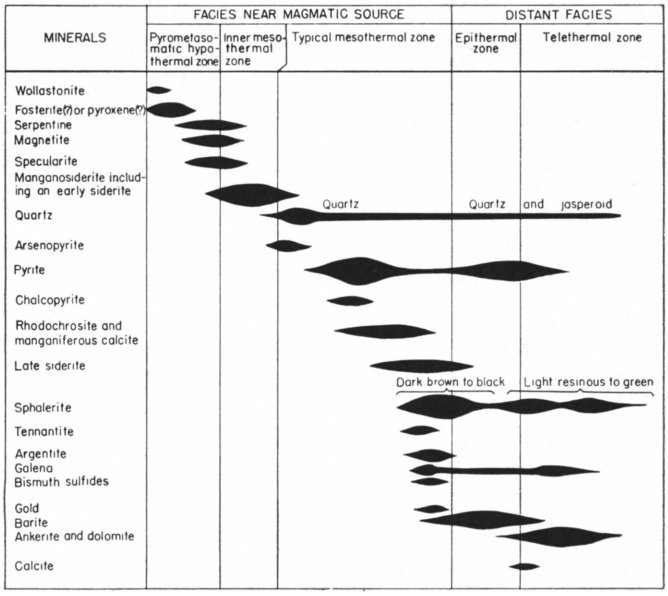
During fiscal year 1948–49, geologists in Olaf Rove's Mineral Deposits Section (Branch) conducted mapping and mineral-resource investigations and increased their emphases on searches for and evaluations of mineral deposits. At the request of the National Security Resources Board (NSRB), the USGS joined other Federal agencies in resuming studies of several strategic minerals. The



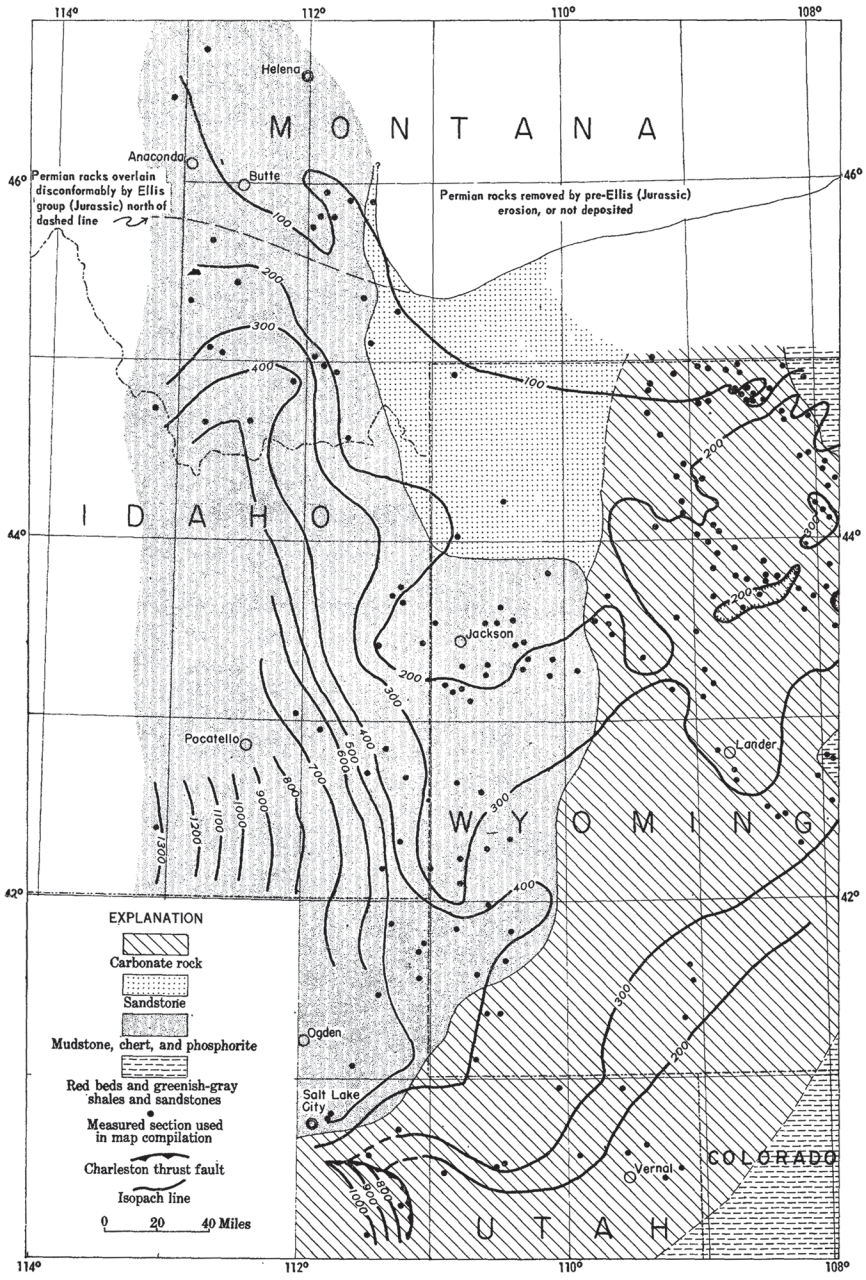

This figure, looking north, shows the sequence of major tectonic and intrusive events in three intervals during the Mesozoic and Cenozoic in the Leadville mining district and the western slope of the Mosquito Range in Colorado, as determined by USGS geologist Charles Behre, Jr., during his investigations in 1928–35 of the area's geology, ore deposits, and tectonic activity. The oldest-to-youngest sequences (shown from top to bottom) include the following: *A*, a typical Laramide (Late Cretaceous) upfold; *B*, a Late Cretaceous–early Tertiary sequence of movement along fractures from flatter thrust faults (Mosquito or Sawatch Ranges) to the west and steeper reverse faults (Front Range) to the east, followed by the intrusion of porphyritic magma and then mineralization; and *C*, continued compression (early Tertiary), especially in the northeast, producing faults oriented oblique to the major regional features. (From Behre, 1953, fig. 62.)

USGS also provided information to the ECA and published a guide for appraising national mineral resources. Branch geologists completed 6 of the 45 field projects underway and began 2 new efforts. On July 15, 1948, David Gallagher, having completed his preliminary reports on Korea's mineral resources, relieved Richard Fischer as chief of the Colorado Plateau Project. Gallagher led three units—Geology, under Fischer; Engineering, headed by Norman E. Ebbley, Jr.; and Administrative, led by Helen J. Butcher—that appraised for the AEC the uranium resources of an area of 40,000 square miles. The Branch's Geochemical Prospecting Unit, while developing prospecting methods based on chemical studies of soils, vegetation, and water, conducted field experiments in ore searches in mining areas in Arizona, Colorado, New Mexico, Utah, and Wisconsin. When results proved encouraging, the mining industry began to try these techniques elsewhere. Vincent McKelvey's team continued its work on the Phosphoria cyclical marine-sedimentary sequences and their phosphate deposits in the West by mapping areas, sampling rocks and fossils for petrologic and paleontologic studies, measuring stratigraphic sections, determining facies relations, and making regional correlations. These efforts, building on their earlier work and on mapping and studies by Joseph T. Pardee and his USGS colleagues before the war, also were designed to produce a genetic model of depositional environments and their subsequent alterations.[53] The discovery of more than 15 million tons of iron deposits in New York, at a cost to the Federal Government of $150,000 (or about 1 cent per ton), followed an 8-year study by the USGS and demonstrated to industry the value of these investigations as aids to exploration.

Wrather and Bradley aided the work of the AEC-funded Trace Elements Program during fiscal year 1948–49 by establishing a new committee and reorganizing the Trace Elements Planning and Coordination Office. On February 23, 1949, they had established a Trace Elements Planning Committee "to consider and propose new lines of investigation of sufficient merit and scope to further the major aims" of the program. John Rabbitt chaired the new committee, whose members included Arthur Butler, Jr., Ralph Cannon, Jr., Thomas Lovering, Vincent McKelvey, Lincoln Page, and William Rubey. Bradley asked the committee to advise him and TEPCO. On June 24, 1949, Wrather and Bradley recast TEPCO, effective July 1, by designating Hubert D. Keiser as its Chief to replace Thomas Hendricks. They also transferred the functions and staff of Frank Stead's Technical Planning



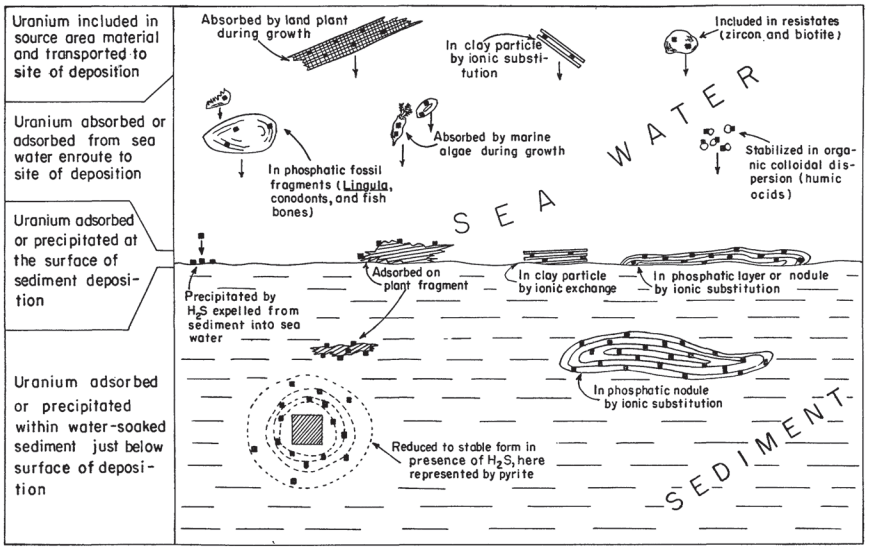

This figure shows the extent (in horizontal length of dark shapes) and timing (in vertical spacing of shapes) of Late Cretaceous–early Tertiary mineralization near to or far from the magmatic intrusions in the Leadville mining district and the western slope of the Mosquito Range in Colorado. Charles Behre, Jr., in his investigations during 1928–35, discerned an inner-to-outer sequence of five thermal "zones," each distinguished by its suites of minerals and grouped in "near" (three zones) and "far" (two zones) mineralization facies. USGS geologist Franklin Emmons began in 1879 the agency's studies of the region's geology and minerals. Knowledge gained was increased by the subsequent work of John D. Irving, Gerald Loughlin, and Charles Behre, Jr. Wartime responsibilities delayed Behre's publication of his investigations. (From Behre, 1953, fig. 63.)




This map (originally at 1 inch = 58 miles) portrays the four dominant rock types and thicknesses (isopach numbers represent thicknesses in feet) of the Phosphoria Formation (Permian) and age-equivalent rocks in the study area occupying parts of five Western States. USGS studies of the western phosphate field, principally the portion in Idaho, Montana, and Wyoming, began in 1910 and continued intermittently thereafter through World War II. These investigations resumed in 1947 for the U.S. Atomic Energy Commission's Raw Materials Division and the Missouri Basin Inter-Agency Committee. Fieldwork by a USGS team led by Vincent McKelvey concentrated on the area of the dark shale-phosphorite-chert facies of the Phosphoria Formation and its contained uranium. (From McKelvey and others, 1959, fig. 2.)

and Development Unit and the functions and field personnel of the Technical Operations Unit and the Technical Plant Development Unit to the Mineral Deposits Section (Branch). Wrather and Bradley also established a Reconnaissance Group, led by Lincoln Page, to investigate domestic sources of radioactive raw materials and reassigned Interior's personnel within TEPCO but kept unchanged the Analysis and Reports Unit managed by Butler. Wrather and Bradley asked Keiser, Olaf Rove, and Wilbur Irving to work out the coeval transfer of funds, property, and records required for these moves. Wrather and Bradley also authorized TEPCO, when preparing the annual budget request to the AEC, to call on the Geologic Division's operating Branches "to draft the estimate and narrative justification of the portions of the program for which they have operating responsibility, and to furnish such other data as may be necessary for preparation of a consolidated budget statement and determination of fund allocations to the respective Branches."[54]

This diagram shows the common organic and inorganic associations of uranium (black squares) in seawater and sediment and the methods of absorption, adsorption, and precipitation by which the emplacement of "uranium in marine black shales may have been localized and incorporated." Of the five types of materials genetically associated with the uranium, those vegetal and phosphatic "probably account for more than 90 percent of the total amount of uranium" in, respectively, the Chattanooga Shale of the Midwest and the Phosphoria Formation of the northern Rocky Mountains. Extensive regional searches by USGS scientists for uranium throughout the United States during 1944–54 included field and laboratory studies of these Paleozoic marine black shales and their origins. (Quotations and diagram from Swanson, 1960, p. 4 and fig. 2.)




Paul Averitt and other geologists in Carle Dane's Geology of Fuels Section (Branch) continued their comprehensive examination of the Nation's coal resources with two closely integrated programs in 1948–49. Regional appraisals of coal reserves provided data on minable-coal thickness, overburden, and data reliability for the reserves in individual beds. Detailed studies and mapping in selected areas yielded specific information needed to facilitate mining or locate new sources. These studies also produced fundamental geologic data upon which to base adequate resource estimates. Montana's coal reserves were reappraised by county, coal rank, and bed thickness; similar evaluations began of coal reserves in Michigan, New Mexico, and Wyoming. Fuels geologists also started detailed mapping of coal deposits in New Mexico's San Juan Basin, Colorado's Durango and Trinidad fields, Wyoming's Spotted Horse field, Washington's Lewis County, and Kentucky's Leslie County. They also completed a detailed map of Montana's Coalwood field and published maps of Alabama's Coosa field, North Carolina's Deep River field, and Oklahoma's Haskell County coal area, in cooperation with that State's Geological Survey, and prepared a similar report on occurrences in Oklahoma's Le Flore County. Exploratory drilling began in parts of Colorado's Yampa field, where large areas remained in the public domain as potential sources of good-quality coal. Branch geologists completed plans for a new coal-geology laboratory at Columbus, Ohio, to be led by paleobotanist and microscopist James M. Schopf of the USGS, who was interested in the origin of coal.

The Fuels Section's (Branch's) investigations of oil and natural gas during 1948–49 continued to provide, as rapidly as possible, the stratigraphic data—about source beds, reservoir rocks, vertical and lateral changes, and regional structure—and other basic information for the Nation's petroleum provinces that promised new discoveries. The USGS published 16 reports in the preliminary series of oil and gas charts and maps, of which by the fiscal year's end more than 115,000 copies had been distributed, including 25,000 of them in 1948–49. The Branch's 30 ongoing projects involved similar studies in 19 States—Alabama, Arkansas, California, Colorado, Florida, Georgia, Kansas, Kentucky, Michigan, Montana, New Mexico, New York, Ohio, Oklahoma, Oregon, Utah, Virginia, West Virginia, and Wyoming. Branch geologists also continued their detailed investigations of the rich deposits in Colorado's Parachute Creek-De Beque area, adjacent to Naval Oil Shale Reserves Nos. 1 and 3, and, in cooperation with the Navy, published a detailed study of these two areas to aid more reliable estimates of potential reserves of oil. Viewing the Fuels Branch's expansion, writers of the Pick and Hammer Club's

annual show, on April 8, 1949, predicted an "Ironic Curtain." To 1934's tune of "Don't Fence Me In," by Cole Porter and Robert Fletcher, cast members concluded that it was

**No earthly use–**
**To complain, when the Dane**
**Begins to reach for more terrain.**
**Now we have heard that the Branch has a prime ambition:**
**When Industry is fu-eled by atomic fission.**
**The A. E. C. will make a very fine addition.**
**They'll fence me in.**[55]

On September 29, 1948, Acting Director Julian Sears approved Bradley's recommendation to abolish the Geologic Branch's Alaskan Section and its Foreign Section and combine the two units' functions, staff, and funds in a new Section of Alaskan and Foreign Geology,[56] headed by William Johnston, Jr., Chief of the Foreign Section. With the continuing sponsorship of the State Department, USGS work on mineral deposits abroad now formally included the training of foreign nationals. Eight months earlier, on January 27, Truman signed the Information and Educational Exchange Act "to promote the better understanding of the United States among the peoples of the world and to strengthen cooperative international relations." The new statute provided for, under the DoS' direction, "an information service to disseminate abroad information about the United States, its people, and policies."[57] The law created advisory commissions on information and on educational exchange "to formulate and recommend * * * policies and programs."[58] The statute established "an educational exchange service to cooperate with other nations in * * * the interchange of persons, knowledge, and skills; * * * [nonmilitary] technical and other services; * * * [and] developments in the field of education, the arts, and the sciences."[59] For these purposes, the act authorized participation, at the request of the Secretary of State, by U.S. citizen-specialists and the use of the service, facilities, and personnel of Federal agencies. The law also enabled agencies, with the Secretary's approval, to order, purchase, and rent materials and equipment, make contracts, and pay the travel and daily expenses (up to $10) of foreign citizens during training and study. Mutual national or scientific interest, or the industrial needs of other countries, determined the nature and scope of the studies.

The Foreign Geology Unit's projects ranged from initial reconnaissance studies in underdeveloped areas to detailed investigations of those partly developed, and researchers sought to discover wholly new deposits, to extend reserves of known occurrences, and to locate new deposits in developed mineralized areas. During fiscal year 1948–49, USGS geologists completed studies in Mexico of manganese at Talamantes in Chihuahua, optical-calcite deposits nationwide, tin placers in San Luis Potosí, antimony deposits at Soyatal in Querétaro, and lead-zinc occurrences at Zimapán in Hidalgo. They also finished examinations of Brazilian barites at Camamu Bay near Bahia, tungsten occurrences in north-central Chile, and groundwater investigations in Haiti and Panama. John Dorr 2d and Philip Guild, aided by Charles Park, Jr., and two other colleagues, continued their work on the Minas Gerais iron deposits in Brazil. George C. Taylor, Jr., completed his studies of Chile's groundwater and surface water. Earl Irving, as chief of party, extended his investigations of mineral resources in the Philippines. Other geologists briefly examined mineral deposits in Afghanistan and Peru. The unit designed the second phase of its program to train promising young scientists and technicians from countries with less developed mineral areas. Their parent organizations, more often than not, also needed additional scientific, technical, and administrative experience, including reviews of practices and procedures in long-range planning for countrywide geological surveys and mapping. In fiscal 1948–49, 10 such trainees

from 6 foreign countries served their USGS internships with field parties and in the Washington, D.C., laboratories.

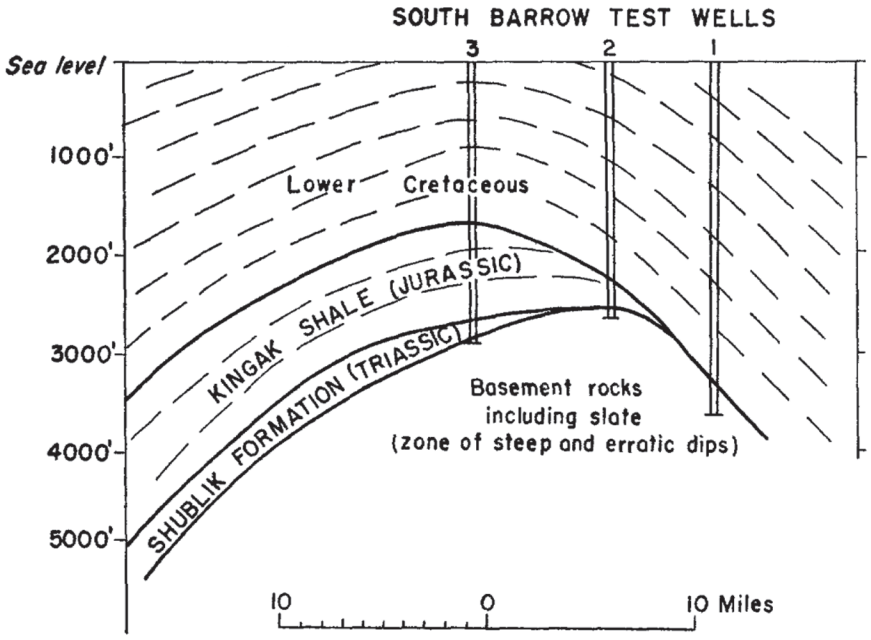
The staff of the Alaskan Unit of the Alaskan and Foreign Geology Section (Branch) investigated metals, nonmetals, and fuel resources in Alaska during fiscal year 1948–49. Intending to serve the best interests of the Territory, the USGS asked for support to significantly increase the existing geologic-map coverage of Alaska at reconnaissance scales, now at 49 percent, and detailed scales, now at less than 1 percent. Robert Fellows, who had served as Acting Chief of the Alaskan Section since its establishment in 1946, returned at his request to fieldwork in the Territory, and Pemberton L. Killeen replaced Fellows in Washington as Acting Assistant Chief of the new unit's activities in Alaska. The Survey order of September 29, 1948, also confirmed Bradley's memorandum of April 22 that designated George Gates as "geologist in charge of the section field office which is to be established in San Francisco this fall."[60] In Alaska, members of the new combined unit continued studies in the Juneau gold belt, the mineralized areas of the central Kuskokwim region, and the Willow Creek mining district. They completed fieldwork on the copper, gold, molybdenum, and tungsten deposits of the northwestern Chichagof area and the high-grade limestone deposits of Heceta Island, west of Prince of Wales Island, undertaken to obtain partial coverage of the extensive belt of limestone in southeastern Alaska. New investigations began in Mount McKinley (now Denali) National Park (and Preserve), in the Juneau-Chichagof area, and on the southern portion of Prince of Wales Island, an area known to contain mineral deposits of potential significance. USGS scientists now believed that more than 250,000 square miles of Alaska might hold petroleum deposits, but of that total, only 11,000 square miles had been adequately mapped. Don Miller and other geologists continued their assessments of the petroleum possibilities in the Gulf of Alaska, finished those on the Alaska Peninsula's Iniskin Peninsula, and began studies from the Iniskin north to Tuxedni Bay to delimit additional specific areas favorable for oil accumulations that warranted further detailed work. Investigations by fuels geologists continued in the Kenai and Nenana coal fields of south-central Alaska, and they completed a report on the reserves of the Kenai's Homer district that summarized the results of nearly two decades of investigations.

In Alaska north of the Arctic Circle, the USGS began its fifth year of continuous work in Naval Petroleum Reserve No. 4 (NPR–4). Members of the Operating Committee for NPR–4 had met in Washington for their eighth session on April 20, 1948. Those attending included Commodore William Greenman, who retired on January 1 but was still the Director of Naval Petroleum and Oil Shale Reserves (DNPR); Colonel O.F. Kotick, now Greenman's Deputy Director; John Reed (Sr.), representing Wrather; Lewis MacNaughton, for DeGolyer and MacNaughton; and Walter English. Other attendees included representatives of Hoover, Curtice, and Ruby; Arctic Contractors; United Geophysical; the Navy; and the USGS. The executive branch and the House Committee on Armed Services approved a long-range plan "for five more operating seasons after 1948 at an estimated cost of $28 million with an initial appropriation of $15 million."[61] The program for 1948 included a plan to extend Simpson Test Well 1 to 7,200 feet to penetrate the Lisburne Group (of Paleozoic age), if present, or to reach basement rocks. Two seismographic lines would extend (1) from the existing Simpson-Ikpikpuk line to pass north of Teshekpuk Lake and (2) from Fish Creek southwest to link with the Simpson-Ikpikpuk line. The committee recommended conducting "an experimental test of color aerial photography for use in geologic interpretation" and placing "temperature cables in all core holes and shotholes deeper than 125 feet" to gather data "on permafrost as it affected seismic and other activity."[62]

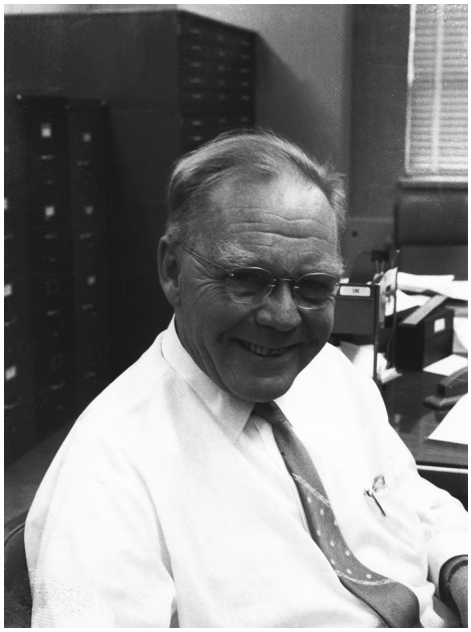
During 1948's field season, the USGS operated three geologic field parties in NPR–4, the first two of which used Navy funds. Edward Webber's Party 1, including Robert L. Detterman and William W. Patton, Jr., restudied the Chandler River

before Webber shifted to areas south of the Colville and before Detterman and Patton transferred to Karl Stefansson's Party 2 to help map structure and measure sections in Lisburne Group exposures near Chandler Lake. Charles Whittington's Party 3, with Edward G. Sable and USGS financing, worked far east of NPR–4, beginning at the Okpilak River and moving westward to Lakes Peters and Schrader, to gain information "useful in interpreting conditions in and near the Reserve." Thomas Payne prepared "a progress report on the evaluation of the oil possibilities of the major stratigraphic units"[63] in NPR–4. Drillers completed the Simpson well to a depth of 7,002 feet in rocks older than the Lisburne Group. Drilling on the first of two test wells on the South Barrow structure was stopped at a depth of 3,553 feet after yielding stains of light oil just below 3,000 feet.

As the USGS continued work in Alaska during fiscal year 1948–49, the Section (Branch) of Engineering Geology, proceeding cautiously under Edwin B. Eckel's leadership to determine its proper scope, reached maturity. The report of the Hoover Commission's Task Force on Natural Resources, by highlighting the lack of existing data on topography, geology, hydrology, and soils in planning major Federal construction activities, indicated the significance of engineering geology for the Geologic Division. Branch members carried out 17 projects in 11 States, Alaska, and Puerto Rico. A device originally designed to rivet plates to damaged hulls of ships seemed to be a useful tool in field measurements of the engineering properties of rock by gaging quickly and accurately the toughness, the porosity, and even the weight per cubic foot of dry and water-saturated rocks. Geologists hoped that additional work with the device might eventually eliminate the need for some of the more costly laboratory tests on rock used by construction engineers. Frank E. Byrne, who had worked part time for the USGS as part of the Missouri River Basin Project and other projects, led a team's investigations of construction materials in northern Kansas. Byrne's group completed, in cooperation with the Kansas Highway Commission, mapping 17 counties by the end of fiscal 1948–49 and published, or made available to interested Federal and State agencies, reports on most of them. Their maps, at a scale of 1:62,500, showed all of the rock units in the counties, plus overburden and other unconsolidated materials, and described their use for concrete aggregate, road material, riprap, and other construction purposes. During the year, the USGS also signed a cooperative agreement with the




This stratigraphic section shows three South Barrow test wells and the northward beveling of Jurassic strata in the Barrow area of Naval Petroleum Reserve No. 4 (NPR–4). Exploration in NPR–4 during 1944–53 did not find economically viable oil pools, but drilling in the South Barrow area's structural "high" discovered locally useful deposits of natural gas. Production in 1949 from South Barrow test well 2, completed to a depth of 2,505 feet, totaled "30,124,000 cubic feet of gas," mostly methane. Using that gas, which represented an estimated 20-year supply, "would save about $275,000 a year in fuel oil." (Quotations from Reed, J.C. (Sr.), 1958a, p. 108; section from Tappan, 1955, fig. 7.)



USGS geologist Edwin Butt Eckel (1906–89), the oldest son of USGS geologist Edwin Clarence Eckel, joined the agency in 1930. E.B. Eckel investigated mineral deposits in the Western United States, concentrating after 1938 on mercury ores. In 1942, he helped to organize the USGS Military Geology Unit; he served as its Assistant Chief during part of 1944. Eckel's investigation of underground facilities in Western Europe for the Army Engineers led to the founding of the USGS Engineering Geology Section (later Branch) in 1944; his service as its Chief (1944–62) produced a growing emphasis on landslides and their hazards. During those years, Eckel also worked in Paraguay and the Caribbean, and on Colorado's mineral resources, before shifting to nuclear-test investigations in Nevada in 1956. (Photograph, 1961, from the USGS Denver Library Photographic Collection, Portraits, in the "Last Name E–F" folder.)

Army Engineers for surveys along Washington's Snake River for detailed geologic maps of a section 80 miles long by 3 miles wide, within which the Engineers expected to build several large power and navigation dams. The Army Engineers needed detailed knowledge of the rock conditions in the river strip, not only for planning the dams and powerplants but also in relocating many miles of railroads and highways. USGS geologists then planned to expand the area covered by preparing standard geologic maps at 1:62,5000 with subsurface interpretation for four quadrangles to also contribute to the industrial development likely to follow river development.

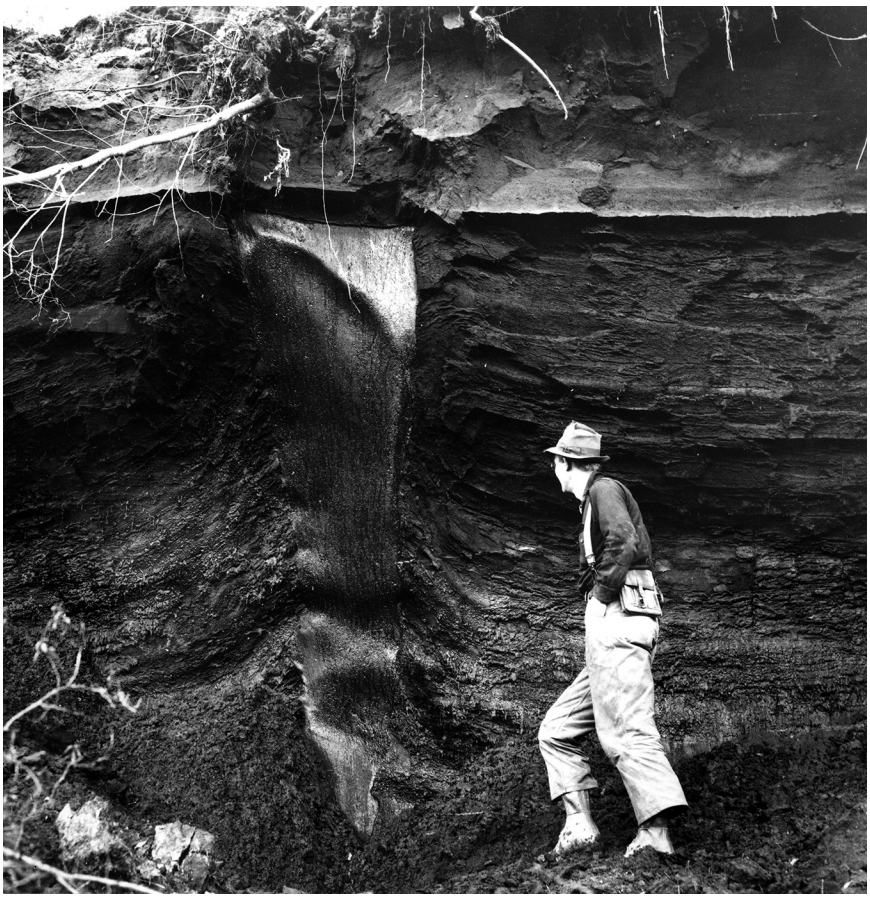
On February 5, 1948, Wrather and Bradley transferred John Hack to the Chief Geologist's staff[64] to help program planning, changed the name of Hack's Section (Branch) of Areal Geology to General Geology, and appointed Charles Hunt to lead the renamed unit from Denver. Arthur E. Granger, who worked on strategic minerals in the Basin and Range and in the Wasatch Mountains, succeeded Hunt as Regional Geologist at Salt Lake City. Carl Dutton (Madison), Robert Laurence (Knoxville), and Albert Weissenborn (Spokane) continued as the other Regional Geologists. The General Geology Section's staff continued to prepare geologic-quadrangle maps, compile State geologic maps, and prepare State indexes to published geologic maps. The 1:500,000 geologic map of Idaho, completed in 1947 by Clyde Ross and James D. Forrester, continued to be distributed. Branch geologists drew near to finishing similar maps of Montana and Oklahoma, issued 10 State indexes to published maps, and published a report on a detailed survey in Rhode Island.

Planners in the General Geology Section (Branch) expected that most of the 35 field projects in progress at the end of the fiscal year would be continued throughout fiscal year 1949–50. These projects included those of Ruy Finch's Hawaiian Volcano Observatory (HVO),[65] which had returned on December 27, 1947, to the USGS after having been managed by the National Park Service since its transfer from the USGS in 1935. Plans were made to integrate the HVO's applied and basic studies to the Branch's research program that already included investigations of volcanoes and related phenomena on the Colorado Plateau, the Aleutians, the Alaska Peninsula, and the Pribilofs. Thomas F.W. Barth used military funds to map and examine St. Peter and St. Paul Islands in the Pribilofs during the 1948 field season. With Frank Byers, Barth also studied volcanism on Akun and Akutan Islands, between Unalaska and Unimak, in the Aleutians. Bradley and Hunt expected all of these studies to produce data that would aid predictions of eruptions and some types of earthquakes. In addition to their application to forecasting these geologic hazards, the volcano-research program's results were considered essential to reaching a greater understanding of hydrothermal and many other kinds of mineral deposits and applying the knowledge gained to assist further exploration.

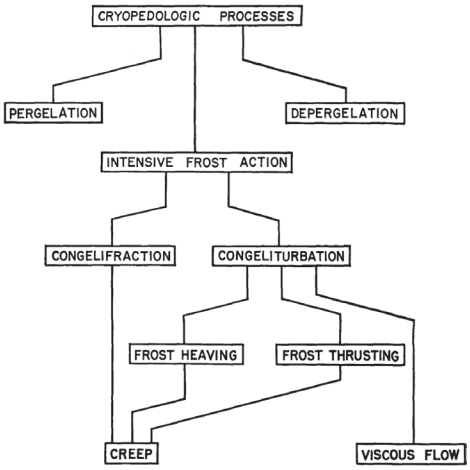
In the laboratories of Earl Ingerson's Geochemistry and Petrology Section (Branch) during fiscal year 1948–49, modification of the flame-photometer method made possible rapid and accurate quantitative determinations of alkali metals in rocks and minerals. Branch geologists developed geochemical-prospecting methods to determine minute amounts of various elements, including copper, lead, molybdenum, nickel, vanadium, and zinc. They designed and tested a chromograph, a new and simple device for making semiquantitative spot tests. The chromograph enabled rapid field analyses that were sufficiently accurate to determine minute traces of copper and nickel. The results could be preserved as a permanent record that eliminated the delay and expense of sending samples to the laboratory and enabled the fieldwork to be immediately concentrated on promising areas. USGS geochemists expected the chromographic method to be important not only in prospecting for ores but also in agricultural studies of soils. Improved spectrographic methods of analysis became the mainstay of the search for beryllium.

USGS standards aided commercial laboratories to improve their analytical results. The geochemical laboratory's staff also identified and studied samples that required special techniques using chemical, optical, spectrographic, and X-ray methods and differential thermal analysis. The laboratory increased its X-ray powder patterns to more than 4,000 films, by which nearly all naturally occurring materials could be identified quickly. The lab's staff described seven previously unknown minerals, three of them new uranium compounds.

In fiscal year 1948–49, the Military Geology Section (Branch [MGB]), still led by Frank Whitmore, Jr., continued terrain-intelligence operations in Washington, D.C., and elsewhere in the conterminous United States, studies of permafrost in Alaska, investigations in Europe, and geologic surveys in the Far East and on the Pacific islands. The MGB's group in the Nation's Capital produced for the Army Engineers 13 comprehensive and 24 special reports on various aspects of military geology. In 1948, the group added analyses of construction materials, mineral resources, water resources, and possible sites for airfields in Eastern Canada, the Caucasus, the Trans-Urals, and Turkey to the earlier reports prepared for Joint Army-Navy Intelligence in 1946 and 1947 about Argentina, south-central China, and the European part of the Soviet Union. For the Army European Command's Campbell Project in Heidelberg, MGB geologists finished terrain and other composite analyses of airfield and road construction, climate, coasts, drainage, groundwater, landforms, mineral resources, rock types, seasonal variation in ground, soils, trafficability, underground installations, and vegetation on 1:1,000,000 maps of Albania, Austria, Bulgaria, Czechoslovakia, Estonia, Finland, Germany, East Prussia (Kaliningrad) and Poland, Latvia, Lithuania, Romania, and Yugoslavia. Maxim Elias summarized German wartime experiences with underground installations,



This photograph shows a ground ice wedge "in permafrost exposed by placer mining near Livengood about 50 miles northwest of Fairbanks," Alaska. In postwar years, USGS geologists continued studies of permafrost in Alaska, begun by Siemon Muller and his colleagues in the Military Geology Unit during World War II and expanded by them to other Arctic areas. They studied a number of cryopedologic processes, including creep, frost heaving and thrusting, and viscous flow, in assessing the hazards of constructing airfields, buildings, roads, and other facilities on and in permanently frozen ground. (Photograph by Troy L. Péwé, September 1949; from the USGS Denver Library Photographic Collection as Ferrians, O.J., foj00003, https://www.sciencebase.gov/catalog/item/51dc43e1e4b0f81004b7b363; published as fig. 9 in Ferrians and others, 1969. Quotation from caption.)




USGS scientists David Hopkins and Robert Sigafoos used this chart to summarize their investigations of the scope of and interrelations among cryopedologic processes, as part of wider studies of vegetation patterns as related to permafrost on the Seward Peninsula in Alaska. They defined cryopedologic processes as all those "involving intensive frost action or perennially frozen ground." Pergelation and depergelation encompassed "the formation and decay of perennially frozen ground." Congelifraction (splitting) and congeliturbation (churning or stirring) were processes of intensive frost action and the "geomorphic processes dependent upon repeated cycles of freezing and thawing." (Quotations from Hopkins and Sigafoos, 1951, p. 53; chart from fig. 17.)

and three MGB geologists joined the European Command's Engineer Division, as special consultants, to extend work begun in 1947 by Frank Reeves. Special reports included analyses of the mineral resources of the Soviet Union and its satellites, the geology and terrain suitability of potential sites for seismic arrays in China, West Germany, Hokkaido, India, and Mongolia (and in Colorado, Maine, and New York), mineral resources in the northern Ryukyu Islands, and occurrences of asbestos, ceramic and refractory materials, graphite, iron, molybdenum, and tungsten in Korea.[66]

In domestic studies, members of the MGB began to prepare a military geology folio of the 6th Army area, where Brigadier General Garrison Davidson, who had returned from Europe, served as Chief Engineer during March 1946–September 1947 before becoming Chief of Staff to General Mark Clark, when Clark returned from command in Austria, and then to Lt. General Albert Wedemeyer, after Clark took command of Army Field Forces in October 1949. MGB staffers also completed gathering field data for the Branch's Folio 2 about Fort Benning in Georgia, planning to finish it during fiscal year 1949–50, and studied possible sites for explosive tests in Colorado, Maine, and New York. In Alaska, Robert Black, Troy L. Péwé, and William L. Barksdale examined permafrost and other terrain features of St. Lawrence Island, the Seward Peninsula, Umiat on the Colville, the Yukon and Kuskokwin Rivers, and the Fairbanks area.

As part of the MGB's efforts in the Far East and the Western Pacific, Frederick S. Blach continued his reports on the water supplies and installations of urban areas in Japan and Korea. By 1950, Blach completed water-supply analyses of nearly 30 cities in Japan and 4 in Korea, including Inchon, Pusan, and Seoul. For the Natural Resources Section of General MacArthur's headquarters in Japan, MGB geologists completed studies of the sources of East Asia's coal and bauxite and compiled a 1:15,000,000 map of the Trust Territory of the Pacific Islands' mineral resources.[67] In the Pacific Geologic Mapping Program (now directed by Sherman Neuschel), Gilbert Corwin, Charles Johnson, and other MGB geologists finished fieldwork during July 1948–July 1949 on Yap, in the Palaus, and on Okinawa, while Preston Cloud, Jr., led a team that began a study of Saipan. Cloud also directed the initial phases of mapping and studies on Guam and Saipan, aided principally by Harold Burke, Dan Davis, Charles Johnson, and Robert George Schmidt. Burke left Saipan in July 1949 to lead Charles Johnson, Harold G. May, and Carl Stensland in mapping adjacent Tinian's geology and soils.

During fiscal year 1948–49, the staff of Henry Joesting's Geophysics Section (Branch) conducted airborne and ground geophysical surveys, by electrical, geothermal, gravity, magnetic, radioactivity, or seismic methods, in connection with geological surveys in many areas of the conterminous United States and in Alaska Territory. The Geophysics Branch's headquarters moved from the Army Map Service's (AMS') building to the Interior Department's building early in April 1949. By then, James Balsley, who led the Branch's Airborne Surveys Section, had flown in magnetometer surveys beyond both polar circles. Mary ("Mimi") Hill, who married USGS geologist John D. Strobell, Jr., that same month, had been a member of Balsley's crews since April 1945. Recognizing the Section's geophysical feats aloft, the USGS Pick and Hammer Club burlesqued these "Flying Sorcerers" in its annual show for 1948. To the music of "The Daring Young Man on the Flying Trapeze," the players applauded the changes since

**Geophysics was tied to the ground—**
**In the days before Jim Balsley happened around;**
**But now that a comf'table plane has been found,**
**The doodlebug's took to the air.**

* * * * *

**They fly over oil fields; they fly over mines;**
**They fly till the maps have been covered with lines.**

* * * * *

**It picks up the bed rock; it spots every vein;**
**It picks up the subway, and sometimes a train.**
**What Mimi's recorded, poor Jim must explain,**
**As the doodlebug doodles along.**

* * * * *

**It flies through the air with the greatest of ease,**
**Recording pulsations that nobody sees;**
**But plot up the curves and you'll have all the keys**
**To geology 'way down below.**[68]

During fiscal year 1948–49, Balsley's team covered nearly 30,900 square miles in 10 States and increased its aeromagnetic-map production some twentyfold by further systematizing and standardizing data compilation, increasing the staff assigned to this work, introducing a training program for new employees, and continuing cooperative surveys. In 1947, the USGS and the Missouri Geological Survey had combined their talents to identify an anomaly at Pea Ridge, whose iron ores the St. Joseph Lead Company later developed. In Pennsylvania during 1948, William B. Agocs and his colleagues from Philadelphia's Aero Service Corporation identified for Bethlehem Steel Company the Grace Mine anomaly in the area previously overflown by Balsley's team in a general survey. Core drilling tested one anomaly near Morgantown in Berks County, Pennsylvania, and discovered Cambrian iron ore at a depth of more than 1,520 feet on December 19, 1949. Members of the Branch's Ground Surveys Section, managed by Joel Swartz from the Baltimore office, used the Hotchkiss Superdip to help identify another anomaly at Pine Swamp near Warwick in Chester County, Pennsylvania. They also made 12 gravimetric and electrical surveys in seven States and in Alaska. An experimental electrical survey in southwest Colorado detected uranium-ore bodies in that area. Other electrical surveys, in cooperation with groundwater geologists of the Water Resources Branch (Division), determined the depth and extent of water-bearing beds and gravel deposits in several localities. The results led to reductions in the drilling required for testing those sources.

During fiscal year 1948–49, the Topographic Branch (Division) remained organized to serve seven principal functions—plans and estimates, production control, geodetic surveys, photogrammetry, topographic surveys, cartography and map editing, and map information—and geographic operations. Chief Topographic Engineer Gerald FitzGerald continued to depend on the principal staff and associates he appointed in 1946 and 1947. On January 1, 1949, the Topographic Division's Washington office included two staff Branches (formerly Divisions)—George Whitmore's Research and Technical Control and Robert Lyddan's Plans and Coordination—and two special operational Sections—John Davidson's Trimetrogon and Oscar Nelson's Special Map Projects. All other operations continued being supervised by the four Division (Regional) Engineers—Dallas Watson, Atlantic at Arlington; Daniel Kennedy, Central at Rolla; Robert O. Davis, Rocky Mountain at Denver; and Conrad Ecklund, Pacific at Sacramento. Kennedy, who served with the Army Map Service during World War II, began his managerial tour on July 1, 1948, replacing Carl Sadler, who retired at the then-mandatory age of 70 after 46 years with the USGS.

For fiscal year 1948–49, the Topographic Division received almost $9,323,000, including about $4,932,000 in direct appropriations, an increase of more than $1.6 million from fiscal 1947–48, for its staff of 1,413 persons. Nearly $3,523,000 of this total came from other Federal agencies, while States, counties, and municipalities provided $850,500. Although the USBR increased its transfers by almost $1.4 million and the Navy doubled its input to nearly $60,000, these gains did not offset the expected reductions of nearly $1.8 million from the Army and $138,000

from the Air Force. The offsetting increases in direct appropriations to the USGS for its topographic mapping now exceeded funds from all other sources by more than $1.4 million, restoring to more than 50 percent USGS control of its topographic-mapping program, including its expanding domestic segment, for the first time since fiscal 1941–42. Acting Director Thomas Nolan, in a memorandum dated December 6, 1948, issued a policy statement for the USGS national topographic-mapping effort. The agency, Nolan noted, had completed standard quadrangle maps for about half the United States but the increasing demand for greater accuracy and larger scales generated a recent revaluation of these sheets. This assessment found that less than 25 percent of the United States and its territories and possessions was adequately mapped for present use. Nolan emphasized that

> **[in] the interest of national defense, the Armed Services have urged the Geological Survey to submit to Congress a program to complete the topographic map of the country in twenty years.[69]**

In response, the USGS had promised to try, with available funds and by coordinating efforts with other mapping agencies, to establish a priority schedule each year that would best serve the country's military and industrial needs. Twice before, in the 1880s and the 1920s, the USGS had pledged but failed to finish mapping the Nation within the following 20-year interval. Those shortfalls followed the results in the early 1890s of Director Powell's failed policies and programs and Congress' refusal to provide more than the first-year's funds for the Temple Act of 1925. To make good on its third promise, the USGS would need better planning, increased funding each year, a larger staff, and improved instruments and methods.

Topographic Branch (Division) personnel mapped in 44 States, Alaska, and Puerto Rico during fiscal year 1948–49. They continued work toward the mapping of some 2,400 quadrangles, helped in Alaska and the Rocky Mountain States by helicopters that transported men and instruments to triangulation stations in continuing experiments to gain easier and quicker access to high and (or) rugged terrain. The USGS, having proven the value of helicopters and portable radiotelephones as aids to mapping in Colorado,[70] chartered three of the former for work in Alaska during the summer of 1948. One helicopter, based at Pelican on the northwest part of Chichagof Island, covered about 1,000 square miles in southern Alaska in taking field parties to 260 stations at elevations of 3,500 to 4,500 feet above sea level. The other two, based in Fairbanks, helped field parties establish geodetic control at elevations up to 9,000 feet for an area of some 2,500 square miles in the Territory's interior. During the 1949 field season, the surveyors used Wallace and Tiernan altimeters, acquired from military sources, to establish supplemental vertical control and tested these instruments by reading them at every 100-foot change in elevation as they carried them up and down the mountains. In Washington, Division topographers completed more than 80 sheets at 1:62,500 and 320 quadrangle maps at 1:24,000. Of the 650 maps reviewed and forwarded for reproduction, 625 were prepared for multicolor photolithography. The Trimetrogon Section continued mapping and charting operations for the Air Force. During fiscal 1948–49, the Section's staff completed entirely new photo compilations for more than 538,000 square miles and cartographic compilations for 118,000 square miles; they also photorevised charts depicting nearly 226,000 square miles.

The Topographic Branch (Division) continued to plan during 1948–49 for future mapping needs and operations. Topographic Division managers and their planning staffs integrated analyses of map requirements submitted by 15 Federal agencies, via the Bureau of the Budget (BoB), with special requests received from map-using State agencies and other sources in preparing the Division's mapping program for fiscal year 1949–50. They exchanged information on mapping programs with Interior's field committees and merged information about topographic

needs received from these committees with the other mapping requests. The Division established new programs in Iowa, Kentucky, Minnesota, and Tennessee. Military requirements and civilian requests for increased map coverage led the Division to step up its program in Alaska, where its long-range program coordinated its efforts with the National Military Establishment, civilian agencies, and Interior's Alaska Field Committee. With support from the Air Force and the Navy, the Division acquired photographs of about 59,000 square miles in Alaska (including 14,000 square miles in NPR–4) that were suitable for standard mapping. At the request of the Governor of Hawaii, the Division also took preliminary steps toward revising some of the maps of the Territory that had been completed two or three decades earlier.

The Topographic Division's staff engineers continued research and development, seeking to improve existing equipment and to design new instruments for the field and office. Morris M. Thompson joined this group when Russell Bean requested Thompson's services with Bean's Photogrammetry Section in Washington. Thompson and William A. Radlinski knew that "Russ Bean was not a prolific author. He encouraged those of us who worked for him to do most of the writing, but we were writing about *his* ideas."[71] Bean's staff engineers completed the polastrodial, and topographers began using it in the Atlantic region. Other field operations tested two commercial elevation meters, and extensive experiments determined the relative speed and economy of several new or improved methods of measuring distances for transit traverses. Division staffers continued to keep up with new developments in the use of shoran so that this electronic method of measuring distances could be applied to control surveys as soon as advancements in its technique attained the required precision.

After Harry Kelsh transferred to the USGS from the Soil Conservation Service (SCS) in 1948, he and other staff engineers in the Photogrammetry Section redesigned the Kelsh stereoplotter to incorporate the use of wide-angle photography and to eliminate the "huge lamp houses" that illuminated "the entire diapositive area" but "gave off unbearable heat." Russell Bean's research team used "swinging compact light sources and a cam arrangement for continuous adjustment of principal distance."[72] Bean's team continued to improve the now-patented Kelsh plotter, and contracts were let for the purchase of 12 wide-angle units. They also worked on the Twinplex, a stereoplotter that used twin Multiplex-type projectors, which Bean began developing in 1945 to increase accuracy and economy in mapping operations. Bean designed the double-projection Twinplex to use "low-oblique, wide-angle photography * * * aligned either along the flight line for precision mapping, or transverse to the flight line for reconnaissance mapping." This plotter used "two unrectified diapositives, corresponding to the two exposures made at one camera station."[73] In addition to the work on the two stereoplotters, a commercial firm successfully duplicated a captured German lens that was nearly distortion free; the Topographic Division expected its future use to influence significantly all of its mapping activities.

By April 3, 1948, Chief Hydraulic Engineer Carl Paulsen established a Water Utilization Committee as the last step in reorganizing the Water Resources Branch (restyled as a Division on January 1, 1949). The new Committee was founded to aid in planning and preparing reports on the water resources of specific areas to improve integrated field performance. Royal Davenport continued as Chief of the Technical Coordination Division (later Branch; the former Water Utilization Division) and its three Sections—Research, Reports, and Technical Control. George Ferguson remained in charge of the Program Control Division (Branch) and its three Sections—Field Relations, Fiscal Control, and Interagency Relations. The Field Equipment Division (Branch) included a Water Resources Section. The four

units of the Business and Clerical Section handled fiscal, personnel, and procurement matters and also mail and files. The leaders of the three program Divisions (later Branches)—Joseph Wells (Surface Water), Nelson Sayre (Ground Water), and Kenneth Love (Quality of Water)—also continued to report directly to Paulsen, whose "friendly, considerate, and quietly aggressive leadership," Wells observed, had gained "the loyalty of the key personnel in all the Branches" and brought "really for the first time * * * all of the segments of the Division together to work as a unit."[74] Henry C. Beckman coordinated the all-Branch effort in the Missouri River Basin, still funded principally by the Army Engineers and the USBR, and he also represented the USGS on Interior's field committee for that basin. Beckman's efforts, aided by Bruce R. Colby, Roy E. Oltman, and other Division members, continued as a principal example of this new internal cooperation. Colby and Oltman published their analysis of discharge and runoff in the Missouri River Basin in 1948 and began looking at trends in its climate-runoff relations.

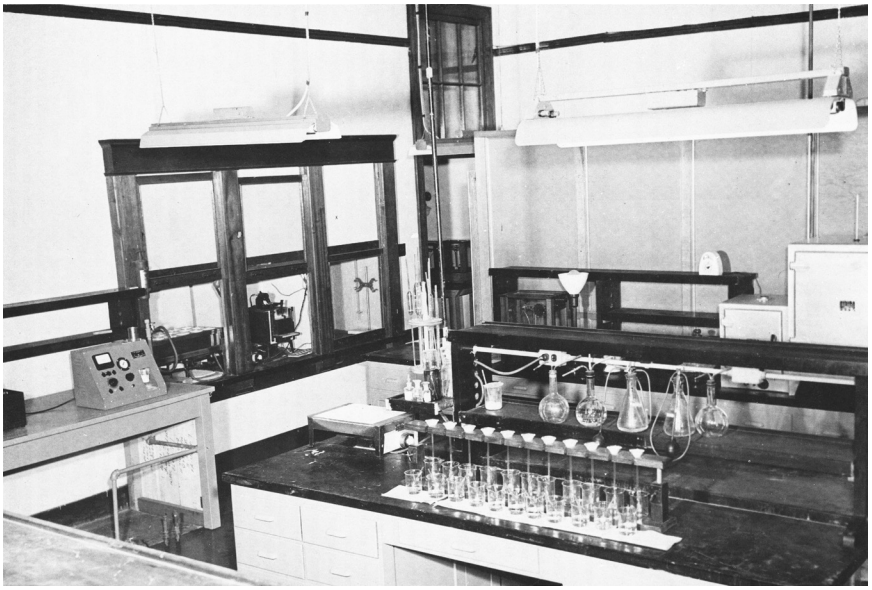
John Cederstrom, Robert Follansbee, Fred Klaer, Jr., Philip E. LaMoreaux, Stanley W. Lohman (Kenneth Lohman's younger brother), Harold Peterson, Joseph F. Poland, George H. Taylor, Charles Theis, and Harold Thomas were among the hydrological engineers and geologists who led the geographic-district offices of Water Resources' units during fiscal year 1948–49. While investigating the Grand Junction artesian basin in Colorado, Charles Jacob and Stanley Lohman measured pressures with Lohman's unique "ink-well"[75] mercury gage to test Jacob's new mathematical theory for determining the storage and transmissibility coefficients from variations in the discharge rate of wells flowing at constant drawdown.

The Water Resources Division (formerly Branch) received for the salaries of and operations by its 1,255 employees, as of January 1, 1949, about $8,688,000 from direct original, deficiency, and supplemental appropriations, transfers, and repay funds during fiscal year 1948–49, an increase of almost $2 million from the previous year. Of the total monies, Congress and the President supplied more than $3.7 million. Nearly $2,362,000 of that sum was available only for cooperative work with States, counties, and municipalities, whose contributions surpassed $2.5 million. The remaining $2,455,000 in transfer funds, about $853,500 more than in fiscal 1947–48, came principally from other Federal agencies. The USBR shifted almost $1.1 million, $815,000 of the military's $830,000 came from the Army Engineers, the State Department provided slightly more than $100,000, the TVA supplied about $77,000, and the AEC transferred almost $48,000. The nearly $4,967,000 in outside funds now represented 57 percent of the Division's total monies.

Joseph Wells' Surface Water Branch included four Sections—Annual Reports, Field Standards, Research, and Special Reports and Investigations. During fiscal year 1948–49, the Surface Water Branch operated about 6,200 streamgaging stations, some 200 more than in the previous year. The Branch expanded its laboratory and shop facilities to seek new or improved equipment for measuring streamflow and, like the topographers who sought better mobility and access to field sites, further tested and improved the snowmobile. Arthur Frazier returned to Paulsen's organization in November 1948 to lead Surface Water's Equipment Development Laboratory in Columbus, Ohio, founded in 1947 to continue improving streamgaging equipment. The Division continued to contribute studies to the commissions for the international-water compacts with Canada and Mexico, and those for the interstate-compact commissions for the Belle Fourche, Cheyenne, Colorado, Pecos, and Republican Rivers, the Rio Grande, and Costilla Creek. On June 30, 1948, the Water Pollution Control Act declared that it would "be the policy of Congress to recognize, preserve, and protect the primary responsibilities and rights of the States" in this effort. Congress also would "support and aid technical research to devise and perfect methods of treatment of industrial wastes which are

not susceptible to known effective methods of treatment," and "provide Federal technical services to State and interstate agencies and to industries, and financial aid to State and interstate agencies and to municipalities, in the formulation and execution of their stream pollution abatement programs."[76] The new law encouraged interstate cooperation, consented to negotiation and entry into interstate-water compacts by two or more States (pending congressional approval), authorized the Justice Department to sue polluters, and approved Federal "surveys, studies, investigations, research, and experiments," under the direction of the Surgeon General, "with regard to the control of water pollution."[77] The statute also established a Water Pollution Control Advisory Board, chaired by the Surgeon General and including representatives from the Army, Agriculture, and Interior Departments and the Federal Works Agency plus six persons appointed by the President. On October 11, representatives of Arizona, Colorado, New Mexico, Utah, and Wyoming signed the Upper Colorado River Basin compact,[78] which Congress and the President formalized on April 6, 1949. By June 30, the Branch's streamgaging program in Alaska, which began with 7 stations in 1947, expanded to 35 stations, and plans called for an additional 20 stations during fiscal 1949–50. The Branch established a district office at Juneau and a field office at Palmer.

Nelson Sayre's Ground Water Branch also comprised four Sections—Ground Water Geology (led by Victor Stringfield), Ground Water Hydraulics, Technical Reports, and Utilization and Equipment.[79] Investigations by specialists in the Ground Water Branch during fiscal year 1948–49 indicated no overall depletion of the Nation's groundwater resources, but they demonstrated that conditions were critical in southern California, Arizona, Texas' High Plains, and many other areas, including some in the humid East. Work in western North Carolina revealed important and hitherto almost unmapped groundwater supplies in thin alluvial deposits along streams in the Piedmont and mountain areas; these studies also suggested the probable existence of similar occurrences in other States. Geophysical studies supplemented test drilling in Champaign County, in west-central Ohio, by locating and outlining the course of a buried-valley deposit of water-bearing gravel undisclosed by surface topography and too costly to identify by drilling. Branch engineers developed a new way of determining flow in steeply inclined and fractured rock strata beneath a blanket of saturated glacial deposits in one of Michigan's iron-mining districts. At Louisville, Kentucky, they analyzed mathematically the way water can be made to flow from rivers to nearby wells. The Branch issued



Cooperative efforts by the USGS, States, and academia succeeded in establishing in 1946 this water-quality laboratory in the Chemistry Building at Oklahoma A&M (later State) College (later University) in Stillwater. Increasing agricultural, industrial, and urban demands on and the contamination of U.S. water resources during and after World War II made water-quality studies increasingly important. The consortium moved this laboratory to a new location in Stillwater in 1952 and then, with the USGS District office, to Oklahoma City in 1954. (From Ferguson and others, 1990, p. 258.)

a map of southwestern Louisiana showing the varying thickness of its freshwater-bearing sands, which helped to outline the problem of saltwater encroachment then threatening the irrigation of rice and sugarcane fields.

In the West, an investigation near the AEC's plutonium plant at Hanford, Washington, demonstrated the geologic and hydrologic factors that limited the disposal of radioactive-waste products through infiltration basins. Other groundwater investigations showed the extent to which the safe yield of the area in California southwest of Los Angeles had been exceeded and the extent to which saltwater advanced inland from the coast. Research continued on the mechanics of unsaturated flow above the water table, including a study of the forces affecting lateral movement of water in the capillary fringe. Branch engineers, increasingly influenced by an analysis of the conduction of heat in solids[80] published in Britain, also developed improved laboratory equipment for determining the permeability of water-bearing rocks. John G. Ferris applied Charles Theis' formula and the image methods to locate hydrologic boundaries.[81] Ferris's chapter on groundwater, in Chester O. Wisler's and Ernest F. Brater's "Hydrology," became a standard reference.[82]

The Branch's continuing studies abroad included work in Chile, Haiti, Panama, and Greece. George C. Taylor, Jr., who completed in January 1948 a 1.5-year study of groundwater in 26 basins and valleys in northern Chile for the State Department and the Chilean Development Corporation, conducted similar work in the arid lowlands and other parts of Haiti, during September 1948–March 1949, with Haitian engineer-geologist Remy C. Lemoine, and then in the rangelands of central Panama, during April–May 1949. Howard F. Haworth supervised the well-drilling operations in Greece, during February 1948–January 1950, by 25 rigs furnished by the U.N. Relief and Works Agency that secured water supplies for many locales on the mainland and on adjacent islands.

Kenneth Love's Quality of Water Branch included three Sections—Chemical Quality, Physical Quality, and Technical Reports. Walter Langbein and three of his colleagues continued to serve at headquarters as Love's senior technical staff. Branch analyzers determined the chemical quality of 37,500 water samples during fiscal year 1948–49.[83] The extent and scope of the Branch's sediment-measurement activities increased slightly when its staff collected and analyzed more than 71,000 samples. To handle more intensive investigations of sediments, the Branch established two new field offices at Riverton in Wyoming and Tucumcari in New Mexico and a field-research center at Minneapolis. The USGS helped the AEC to select some 40 sites nationwide for evaluation to participate in an extensive program of developing and testing nuclear reactors. The AEC then narrowed the choice to two locations—one near Fort Peck, Montana, and the other in Idaho's Snake River Basin. Late in 1948, Arthur Piper and Raymond Nace examined and reported on the basin between Arco and Idaho Falls. The AEC provided $137,000 for the first year, fiscal 1949–50, of a decade-long study by Nace and his colleagues of the geology and hydrology of the Idaho site. The AEC "soon asked Nace to choose a site for the experimental breeder reactor." During construction, the "AEC distorted the Survey's proposals," and Nace's site "later became the burial ground"[84] for radioactive waste.

The managers of the four principal Divisions (Branches) in Harold Duncan's Conservation Branch (Division)—John Northrop's Mineral Classification Division, Howard Smith's Mining Division, Harold Barton's Oil and Gas Leasing Division, and Benjamin Jones' Water and Power Division—continued to serve during fiscal year 1948–49. The Conservation Division received nearly $1.1 million for fiscal 1948–49, all but $77,000 of which came from direct appropriations to support salaries and operations by its staff of about 200 persons. A Secretarial order, signed by Assistant Secretary C. Girard ("Jebby") Davidson on December 30, 1948, clarified

the responsibilities of the Bureau of Land Management and the USGS for "the collection of, and accounting for rentals and royalties under the mineral leasing acts, and other acts providing for the leasing or development of Federal mineral lands or interests, including lands transferred to the Department of the Interior for prospecting and development." The Secretarial order required specific supporting duties from the BLM and the USGS. In addition to supplying promptly the Conservation Division with information necessary for complying with its responsibilities, the BLM would "maintain accounts, collect and deposit filing fees, bonus payments, commissions, and rentals on all applications and permits and licenses, lease sales and nonproducing leases except nonproducing leases in producing unitized areas." The BLM also would answer inquiries in respect to the status of these entities and "maintain a control account over the individual accounts maintained by the Geological Survey." In addition to advising promptly the BLM about complying with its responsibilities, the USGS would notify the BLM "at the time when the operating status of a lease changes as to production or non production."[85] The USGS also would maintain accounts, prepare bills and receive collections for rentals and royalties, and deposit immediately with the BLM's regional administrators the receipts from individual producing lessees and nonproducing lessees in producing unitized areas. The USGS would as well provide them with collection schedules and a monthly statement of bills for and periodic proofs of the correctness of these accounts, answer questions about their status, and review and report any delinquencies.

During fiscal year 1948–49, the Conservation Division's staff acted on nearly 25,000 cases involving disposal of Federal lands, a decrease of about 14 percent compared to fiscal 1947–48; the change was due chiefly to decreased demands during regionalization of the BLM in the early part of the year. As of June 30, 1949, the Division supervised 1,050 properties for the production of coal, oil shale, phosphate, potassium, silica sands, sodium, and sulfur, as well as many other commodities. Transfer of the BLM's functions of preparing statements and receiving collections for rents and royalties due the United States on production from federally owned land broadened the Conservation Division's responsibilities. Potassium production continued to increase and for the second year in a row exceeded in royalty value the coal produced from the public lands. Prospecting for potash in New Mexico during the year disclosed additional valuable deposits. The USGS predicted a total income for the fiscal year of more than $3 million from mining rentals, royalties, and bonuses. The Division also supervised more than 21,270 oil and gas properties on the public lands, an increase of 58 percent from 1947–48, and nearly 6,400 leaseholds on Indian lands; revenue from these operations almost reached $8 million. Truman's Executive order of April 20, 1949, again enlarged California's Naval Petroleum Reserve No. 1 by adding to it another 2,280 acres.[86] Production royalties from the 272 active wells on NPR–2 totaled $982,000.

As the Federal Government conducted its operations during the summer of 1948, both major political parties held their national nominating conventions. Republicans convened in Philadelphia on June 24, the day the Soviets began blockading Berlin, and renominated Thomas Dewey for President and selected California's Governor Earl Warren as their candidate for Vice President. Dewey developed a large lead in the public preference polls before July 15, when the Democrats also met in Philadelphia and nominated Truman for President. The Democrats chose Kentucky's Alben W. Barkley, the Senate majority leader during 1937–47, as Truman's running mate, after Associate Justice William O. Douglas decided to remain in the U.S. Supreme Court. Southern delegates protested the civil-rights plank in the Democratic platform by walking out of the convention. Those "Dixiecrats" nominated for President South Carolina's Governor J. Strom Thurmond, an enthusiastic

advocate of States' rights, white supremacy, and racial segregation. Henry Wallace decided to campaign as a Progressive and that perennial third party nominated him on July 24. Harold Ickes, still bitter over his dismissal, suggested that Truman should retire rather than be defeated, but Truman believed and said that he and Barkley would win.

Truman, calling the Republican-dominated 80th Congress a do-nothing assembly and the worst in U.S. history, ran against the legislators almost as much as opposing Dewey. Truman traveled some 31,000 miles by train, in Roosevelt's *Ferdinand Magellan* coach, as part of his nationwide whistle-stop campaign, during which he proposed halving the defense budget for fiscal year 1949–50 due to continued concerns about deficits and inflation. On August 16, to "aid in protecting the Nation's economy against inflationary pressures,"[87] the President signed an anti-inflation Joint Resolution that authorized the Federal Reserve System to use consumer-credit controls during the rest of the fiscal year to curb installment buying, but the economic recession continued through the fall. On November 2, Truman defeated Dewey by about 2,136,000 votes and received 303 of the 531 electoral votes,[88] disproving the front-page headline, "Dewey Defeats Truman," in the *Chicago Daily Tribune*. Dewey's 189 electoral votes easily outpaced Thurmond's 39 electoral ballots, all from 4 States in the "Solid South," a loss made good by large Democratic majorities from urban black voters in the North. Wallace won no electoral votes, although he polled just 12,000 popular votes less than Thurman's total of some 1,169,000 ballots. The Democrats also regained control of Congress; in the 81st Congress, the Democrats would have a 92-seat majority in the House and a 12-seat advantage in the Senate.

Truman promptly presented programs to attain his foreign and domestic goals. In reporting to the 81st Congress about the State of the Union on January 5, 1949, 2 days after the legislators took their seats, he planned "to encourage free states and free peoples throughout the world to aid the suffering and afflicted in foreign lands, and to strengthen democratic nations against aggression."[89] At home, the President asserted,

> **[e]very segment of our population and every individual has a right to expect from our Government a fair deal.[90]**

In calling for this "Fair Deal," the President asked Congress in his State of the Union Message, supplemented by his Economic Report on January 7, to help generate a budget surplus and reduce the national debt by raising taxes; authorize increased contributions to Social Security and selective control for prices, wages, and the allocation of materials; continue regulation of bank and consumer credit and rent and export controls; support the production of steel and other critical commodities and develop the Nation's natural resources; increase the minimum wage to 75 cents per hour and supports for farm prices; stimulate the economy; provide slum clearance and more low-rent housing; aid local schools; extend health coverage; repeal the Taft-Hartley Act; and enact improved civil rights for minority citizens. Truman's budget message on January 10 predicted expenditures in fiscal year 1949–50 of $41.9 billion, $1.7 billion more than in fiscal 1948–49, but an income of only $41 billion. He asked Congress to provide the additional funds and eliminate the $873 million shortfall by passing new legislation to raise taxes by up to $4.8 billion. Of the $14.3 billion for national defense, Truman promised to give priority in allocations to the Air Force and the Reserves. Although funds for international affairs and finance would fall by $600 million to $6.7 billion, Truman asked Congress to continue to support European recovery and to supply additional aid to Greece, Nationalist China, South Korea, and Turkey. In return, he would request only funds sufficient to keep the other active armed services at current levels.

The United States did not need to rearm, the President concluded, but it should help its allies to do so. The budget's domestic portion included a plea for an energy policy emphasizing conservation of petroleum resources and encouraging commercial development of synthetic liquid fuels from coal, lignite, and oil shale, via methods developed in USBM facilities.

Having refined domestic policy, Truman, at his inauguration on January 20, focused his address on foreign policy. "Each period of our history has had its special challenges," the President recalled, and those "that confront us now are as momentous as any in the past. Today marks the beginning not only of a new administration, but of a period that will be eventful, perhaps decisive, for us and the world."[91] Without specifically mentioning the Soviet Union, he drew a clear line between communism and democracy. Truman declared that "the actions resulting from the Communist philosophy are a threat to the efforts of free nations to bring about world recovery and lasting peace."[92] "In the coming years," he continued, "our program for peace and freedom will emphasize four major courses of action," later termed "points." The United States, the President vowed, would first "continue to give unfaltering support to the United Nations and related agencies" and "search for ways to strengthen their authority and increase their effectiveness." Second, the Nation also would continue its "programs for world economic recovery," keep its "full weight behind the European recovery program," and reduce "the barriers to world trade" and increase its volume. Third, the United States would "strengthen freedom-loving nations against the dangers of aggression" by forming by treaty a new "collective defense arrangement" among the nations bordering the North Atlantic; the treaty would be "within the terms of the United Nations Charter" and would complement the Inter-American Treaty of Reciprocal Assistance signed in Rio de Janeiro in 1947. That pact formalized the recommendation in 1945's Act of Chapultepec to consider an armed attack by any nation against one American country as an assault on all of them and provide the means to respond accordingly. On January 13, 1949, Truman had sent to the Senate the Organization of American States' Charter that was signed in Bogotá on April 30, 1948, by representatives of 21 countries. The United States also would "provide military advice and equipment to free nations which will cooperate with us in the maintenance of peace and security."[93]

Truman, as the fourth point of his inaugural address, called for "a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas." "The material resources which we can afford to use for the assistance of other peoples are limited," he continued, "But our imponderable resources in technical knowledge are constantly growing and are inexhaustible."[94] Joining other countries in distributing knowledge and technology, and fostering capital investment, Truman believed, would counter disease, hunger, and poverty by helping people to help themselves. The President hoped that "these four major courses of action" would "help create the conditions that would lead eventually to personal freedom and happiness for all mankind."[95] Although Truman had rejected Forrestal's request of December 1, 1947, to increase the defense budget for fiscal year 1949–50 to nearly $17 billion, the President signed on July 2, 1948, the National Industrial Reserve Act that provided for "a national reserve of machine tools and industrial manufacturing equipment * * * for immediate use to supply the needs of the armed forces in time of national emergency or in anticipation thereof"[96] and a 15-member Review Committee appointed by the Secretary of Defense. Congress provided $5 million for the expenses of the Federal Works Agency in carrying out the provisions of the law during fiscal 1948–49.

As Truman faced these and other foreign-policy issues early in his second term, ill health led both Secretary of State George Marshall and Secretary of

Defense James Forrestal to resign. When Marshall left office on January 7, Under Secretary Dean Acheson replaced Marshall, and James Webb left the Bureau of the Budget to serve as Acheson's Under Secretary. In 1948, Marshall recommended against providing further aid to Chiang's Nationalists as Mao's forces continued to make gains in Manchuria and in northern and central China. Tientsin (Tianjin) fell on January 15, 1949. When Peiping (Beijing) followed 6 days later, Chiang resigned as president. In February, the United States withdrew the last of its protocol-duty troops from China. The Communists then offered to reach a peace, but, on April 20, the Nationalists rejected demands that included a Mao-led coalition cabinet to govern all of China and trials of Chiang and other "war criminals." Shanghai fell on May 15 and Canton (Guangzhou) followed on October 15.

As the Nationalists' military situation on the mainland continued to deteriorate, their new supreme council, founded on July 16 and led by Chiang, began planning to finish a mass exodus to Taiwan, where Sherman Neuschel completed a military geology reconnaissance. The United States on August 5 suspended all aid to Nationalist China, which the State Department claimed had lost the confidence of its troops and people. On October 1, Mao, as Chairman of the Central Committee, and Zhou Enlai (Chou En-lai), as Premier and Foreign Minister, proclaimed the People's Republic of China (PRC). The Soviet Union and its satellites immediately recognized the new government. India also recognized the PRC, as did Britain on January 6, 1950. Some 2 million Nationalists withdrew across the Formosa Strait to Taiwan, leaving some forces on Matsu, Quemoy (Jinmen), and two other island groups off mainland China's coast between Shanghai and Amoy (Xiamen). The Quemoy garrison repulsed a landing by forces of the People's Liberation Army in October. On December 8, the U.N. called on all member states to respect mainland China's political integrity. Two days later, Chiang flew from Chengdu to Taiwan; he resumed the presidency of the relocated Republic of China on March 1, 1950. After declaring a continuing emergency and securing control of the local population by using harsh methods, Chiang introduced a few of the reforms he had promised while still on the mainland. The "loss" of the Chinese mainland, and Hainan Island in May 1950, gave Republicans another international issue to use against the Truman administration, but the mainland's unification lessened China's internal inflation, continued its land reform, and introduced some equal rights for women along with multiyear economic plans in the Soviet style.

During these military and political changes in China,[97] the Truman administration became involved in an interservice dispute about how best to defend the United States. The pressures of producing a balanced-force military under continuing requests for budgetary restraints, while all three services squabbled over funds and turf, led to Secretary Forrestal's resignation on March 3, 1949. His successor, Louis A. Johnson, took office on March 29. Johnson promoted the President's goals of unifying the services in fact and reducing their yearly expenditures below $15 billion, from Truman's $14.3 billion to about $13.5 billion to cut deficits and fight inflation, but the Secretary's personality and tactics alienated some of his supporters and enraged many of his enemies. In the struggle for strategic domination in the National Military Establishment (later the Department of Defense), Johnson favored the Air Force and its new intercontinental bomber, the Convair B–36 Peacemaker, a huge aircraft powered by six pusher-piston engines enabling it to carry a single 5-ton atomic bomb for 10,000 miles (without refueling) at a top speed of 300 miles per hour (mph) and a maximum altitude of 35,000 feet. The B–36D, with four turbojets added to its powerplant, reached a maximum speed of 435 mph and entered service on August 19, 1950. The Air Force initially tested in December 1947 the Boeing B–47 Stratojet, a smaller, swept-wing aircraft powered by six turbojets, and began developing in 1948 the larger, eight-turbojet, B–52 Stratofortress.

On April 21, 1948, Forrestal assigned primary responsibility for defending the United States to the Air Force, but he promised the Navy that it would continue to control naval aviation. In January 1949, the Hoover Commission's Task Force on National Security, chaired by Ferdinand Eberstadt, also rejected merging naval aviation with the USAF. Some Navy officers wanted to ensure control of naval aviation by adding a strategic capability to its tactical resources. McDonnell FH–1 Phantom twin-jet fighters had operated successfully from *Franklin D. Roosevelt*, and the Navy had modified Lockheed P2V Neptune patrol bombers for operations from *Roosevelt* and *Midway*. Now the Navy began developing its own carrier-capable strategic bomber, the North American AJ–1 Savage, a swept-wing, three-engine (two pistons and one jet) aircraft, to carry a single atomic bomb for 1,000 miles. Johnson followed advice from General Omar Bradley, Army Chief of Staff since February 1948; General Dwight Eisenhower, formerly the informal head of the Joint Chiefs of Staff (JCS) and president of Columbia University since June 1948; and General Hoyt S. Vandenberg, the Senator's nephew, who succeeded Carl Spaatz as Air Force Chief of Staff in April 1948. All of them thought the Navy's strategic aspirations a wasteful duplication of the Air Force's mission. Johnson, without contacting Secretary of the Navy John Sullivan and Admiral Louis E. Denfeld, Chief of Naval Operations (CNO) since December 1947, canceled Navy Day for 1949. On April 23, after only 6 days' construction, Johnson also "sank" the 65,000-ton supercarrier *United States*. Funds thus saved went to purchase additional USAF bombers.

Secretary Sullivan responded by resigning in May, but CNO Denfeld led an admirals' "revolt," principally a verbal and paper mutiny.[98] Those testifying before Carl Vinson's House Committee on Armed Services in October included William Blandy, who led Crossroads in 1946; Omar Bradley, the first formal Chairman of the JCS since August 1949; Clifton B. Cates, Marine Corps Commandant since January 1948; Louis Denfeld; Ernest King; Chester Nimitz; Arthur W. Radford, who commanded the Pacific Fleet and also served as High Commissioner of the U.S. Trust Territory of the Pacific Islands; Raymond Spruance; John Sullivan; Stuart Symington; and Hoyt Vandenberg. The Navy officers opposed the increasing loss of their funds, ships, and roles. They also opposed the $615 million Congress tacked on to the administration's budget request for the Air Force to produce even more B–36s, thought by the admirals to be vulnerable to jet fighters. Francis P. Matthews, Sullivan's successor as Navy Secretary and, like Johnson, another of Truman's political cronies, asked Truman to transfer Denfeld, and the President approved the request on October 27. Denfeld and Blandy retired, rather than accept reassignment and demotion, but Radford returned to his posts in the Pacific.

Vice Admiral Forrest P. ("Ted") Sherman, as Nimitz recommended, succeeded Denfeld as CNO on November 2, 1949. Sherman opposed an independent Air Force but worked with its Major General Lauris Norstad, Forrestal, and Symington to draft the plan for a defense department and contributed to the Truman Doctrine; he did not join the admirals' "revolt." As CNO, Sherman supported cooperation between the services, but he thought carriers essential to ensure control of the seas and wanted far more of them than the eight funded for fiscal year 1949–50. Johnson also differed with Acheson on U.S. policy towards China and began courting Republicans to try to gain their Presidential nomination in 1952. After Symington resigned as Air Force Secretary on April 18, 1950, to protest less-than-requested budgets, Johnson threatened to leave as well when Truman nominated as Symington's successor Thomas K. Finletter, who favored a larger Air Force and chaired the President's Air Policy Commission in 1947. The Commission, advised by General James Doolittle and other experts, recommended in January 1948 an American counteroffensive force of 70 air groups, or 12,000 planes, by the beginning of 1950. The report also called for greater support for naval aviation but predicted, as had Generals Groves and LeMay, that the Soviets would not have

an atomic bomb before 1953. Truman called Johnson's bluff, as he did with Harold Ickes in 1946, and the Senate quickly confirmed Finletter on April 24, 1950. Johnson did not resign and Truman did not request his departure. Symington took over the National Security Resources Board from John Steelman, the NSRB's Acting Chairman since December 10, 1948.

The 80th Congress had been reluctant to provide funds for basic research for the common defense and general welfare, but the 81st Congress proved somewhat more understanding and generous. Although Southern Democrats and other conservatives in the new Congress failed to support the major points of Truman's "Fair Deal" domestic program, the legislators increasingly accepted the importance of natural resources in the national economy and national security. At the request of the NSRB, Krug chaired an Interior committee that looked at the availability of supplies of 16 strategic and critical metallic and nonmetallic materials derived from minerals. These commodities included asbestos, bauxite, bismuth, cadmium, chromite, cobalt, copper, industrial diamonds, iron, lead, manganese, mica, nickel, tin, tungsten, and zinc. On October 9, 1947, the Krug Committee's report, "Natural Resources and Foreign Aid," warned that if a future conflict interrupted foreign supplies of these minerals, the United States would run out of asbestos, bauxite, copper, and nickel within 6 months. Supplies of cadmium, cobalt, industrial diamonds, lead, and manganese would last up to 12 months; bismuth, chromite, mica, and tin for 1–2 years; and tungsten and zinc for 2–4 years. Only iron would last for more than 4 years. An equivalent number of other vital materials derived from minerals, including columbium, corundum, graphite, kyanite, steatite talc, and tantalum, also remained in short supply, and, for them, the United States was increasingly dependent on sources in the Eastern Hemisphere. Alan Bateman, Elmer Pehrson, and their colleagues in academia and government warned, in the style of Charles Leith, that the Soviets planned to control the resources of Eurasia and adjacent areas before striking for world dominance. The United States now relied on the Soviet Union for some 30 to nearly 60 percent of its imports of chromite, manganese, and platinum, a dependence discounted by George Kennan and his planning group at the State Department.

To solve these recurring mineral problems, Krug's team recommended establishing a long-range policy, under a single coordinating agency, for increasing research, domestic exploration and production, imports (while improving infrastructure in the source countries), and stockpiling and for developing alternate sources and substitutes well before any Soviet embargo. The Krug Committee's report, as well as those by the House Select Committee on Foreign Aid, the Nourse Committee, and the Harriman Committee, influenced the appropriation for the Marshall Plan in 1948 and the definition of one of the recovery program's goals—decreasing America's mineral dependence through exchange, repay, and trade. Now the Senate Committee on Interior and Insular Affairs and the House Committee on Public Lands held joint hearings in search of an improved policy for the conservation, development, and administration of the Nation's natural resources. Representatives from a number of Federal agencies participated in these sessions, and their organizations submitted reports on internal problems. Following the hearings, the committees' chairmen asked the senior specialist in natural resources at the Library of Congress' Legislative Reference Service to reappraise natural-resources policies and programs and submit proposals for needed changes and improvements. The discussions and the review generated the filing in House committees of two bills, in September 1949 and January 1950, intended to provide, respectively, for programs for comprehensively and adequately collecting basic data about natural resources and accelerating the surveying and mapping of the United States, its Territories, and its possessions. Both bills were amended and reported favorably to the whole

House in July 1950, but the Representatives took no further action. While bills were being prepared, Truman, recognizing that natural-resource problems were increasingly of worldwide concern, suggested that the United Nations sponsor a Pinchot-like conference on the conservation and utilization of these resources. Secretary Krug and Under Secretary Chapman played leading parts in planning for the meeting, and many officials of the Interior Department participated in its sessions, held under the auspices of the United Nations Educational, Scientific and Cultural Organization (UNESCO), at Lake Success, New York, during August 17–September 6, 1949.

The Hoover Commission's reports influenced those efforts by Congress and the Interior Department. On January 13, 1949, the Commission began transmitting to the legislators the reports (appendixes) by its 18 task forces that the Commissioners received in October and November 1948. These documents included the Task Force on Natural Resources' report on "Organization and Policy in the Field of Natural Resources." The natural-resources group recommended organizational changes to establish "a consolidated Water Development Service" (to include some of the BLM's functions plus some of those in the Army Engineers, the Bonneville and Southwestern Power Administrations, and the Federal Power Commission) and "a consolidated Forest and Range Service" (to include the Forest Service plus some functions elsewhere in the U.S. Department of Agriculture (USDA) and in the BLM). The group also recommended decentralizing both of the new Services and organizing them regionally "by river basins where practicable,"[99] in a partial return to John Powell's innovative but unrealized concept; dividing the Fish and Wildlife Service; transferring some Federal agencies' functions to the USBM; and reestablishing "the General Land Office as a record-keeping and title-holding agency for public lands."[100] In 1879, Clarence King, Powell, and other reformers in the National Academy of Sciences (NAS) and Congress did not succeed in so confining the GLO.

In another return to past unsuccessful efforts, the Hoover Commission's Task Force on Natural Resources proposed to replace the Interior Department by uniting, in a new Department of Natural Resources, the proposed new agencies for Water Development, Forest and Range, Fisheries, and Wildlife, with the existing USGS, USBM, NPS, and GLO. The task force recommended continued Federal ownership of the public domain. Its members also urged modernizing the mining location and patent laws, and leasing statutes, to facilitate discovery and exploitation; aiding private enterprise in commercial fisheries, nonpublic forests, and mineral leases; strengthening Federal-State cooperation in water-resource development; increasing emphasis on recreational values; rectifying legislation conflicts in land use and water development; and making "more adequate provision for the collection of basic data with respect to water, land, and mineral resources."[101] The Task Force especially regretted "the lack of adequate hydrologic data" on "precipitation, run-off, stream flow, etc."[102] that had led to the failure of dams, overextension of irrigation systems, and excessive filling of reservoirs by sediment. Until dependable data could be gathered on the availability of water for "navigation, flood storage, irrigation, water supply, and power development,"[103] the Task Force's members opposed the creation of future valley authorities like the TVA.

The Task Force on Natural Resources' report also called for more intensive exploration of the public domain to provide "a more adequate supply of a long list of minerals to support and strengthen our industrial economy and to ensure our national security." The USBM and the USGS, while continuing to share major Federal responsibility for achieving these goals, now worked "under a coordinated program without objectionable duplication" due to attention and efforts by Wrather, Nolan, and Hewett and their USBM counterparts. The major programs of the USBM and the USGS had not been invaded significantly by any of the 25 other

Federal agencies also concerned with mineral-resources issues that called regularly for services by these two bureaus.

> **The scientific and technical work performed by these two agencies is of a high order and of real value to the Nation. They are now headed by able men who command the respect of the mining and metallurgical professions. Continued support and steady maintenance of their current activities are certainly warranted, but expansion is hardly needed except to meet calls for technical service from other organizations such as the Atomic Energy Commission for special statistical and economic investigations, and for the expanded hydrological investigations recommended elsewhere in the report.[104]**

The Task Force recommended giving the USGS and the USBM "adequate support to continue energetically their work" toward gaining "improved knowledge of the occurrence of mineral deposits * * * and more refined techniques for testing areas for them." Repeating lessons recently learned, the members urged the Federal Government and private enterprise to make greater progress in the "necessarily slow" efforts "to make the best use of the mineral resources and to provide against disastrous lack of critical materials." They also encouraged the legislators to recognize or remember, especially when considering budget requests, that the two agencies needed to keep "personnel and specific projects for adequate periods of time." The report placed minerals and fuels vital to the national economy in three classes. Coal, copper, iron, lead, molybdenum, petroleum, and zinc seemed "in relative abundance within our borders." Bauxite, chromium, manganese, mercury, and tungsten could "be obtained from domestic sources only at considerably greater cost than foreign production and not in adequate quantity or quality to meet the Nation's full needs."[105] Nickel, tin, and other mineral commodities appeared "to be lacking within our boundaries in deposits that offer any hope for significant production."[106] To prevent any additional or future duplication by Federal agencies within or outside Interior, the report recommended consolidation of several functions within the USGS and the USBM to "promote a consistent policy with regards to mineral exploration and development, technical aid to mining and metallurgy, taxes, tariffs, stock piles, and other factors." "All responsibility for mapping, geological study, and exploration for mineral resources on public lands, and for administering all phases of the mining and mineral leasing laws"[107] would go to the USGS, except for the following tasks that would be handled by a reorganized General Land Office: issuing and recording leasing rights; collecting rentals, royalties, fees, and penalties (as determined by the USGS); and interpreting the legal aspects of the mining and mineral-leasing laws, in consultation with the USGS. The USBM's Economic and Statistics Branch (Division) would receive "all responsibility for the collection and economic interpretation of data on mineral resources, mining operations, and the international reserves and movements of metals and minerals"[108] by transferring responsibilities now in the Commerce Department, the NSRB, the Tariff Commission, and other Federal organizations.

During February 9–March 31, 1949, the Hoover Commission submitted to the 81st Congress 22 reports of recommendations for improving the executive branch; the concluding report was transmitted on May 20, 1949. The Commissioners based their suggestions for enhancing the national-security organization largely on the report by Ferdinand Eberstadt's task force, received in November 1948 and sent on to Congress in January 1949. Eberstadt's group, in evaluating the economy and efficiency of the Nation's mobilization programs, considered both the policies for stockpiling strategic materials and the accumulated reserves. They called the stockpile's condition deplorable and urged the Commissioners to consider asking "that full responsibility and authority for formulation of stock-pile policy and its execution be clearly and definitely focused—either in the National Security

Resources Board or elsewhere." The NSRB, they continued, should invite representatives of the AEC and the ECA to the NSRB meetings "when matters that concern them are under discussion," the ECA should "increase its contributions to the stock pile by taking payment for its advances," and the NSRB and the Munitions Board should "have more active civilian and industrial participation in their planning and make fuller use of their civilian advisory committees."[109] The Hoover Commission's report on the national-security organization, from whose preparation and consideration Forrestal recused himself, recommended that Congress act to have "the economic warfare section of the National Security Resources Board develop a comprehensive economic warfare program, aimed at supporting our national security in times of peace as well as war."[110]

On March 15, 1949, the Hoover Commission sent to Congress 15 numbered recommendations and additional suggestions for reorganizing the Interior Department, along with dissenting opinions by Acheson, Forrestal, and four of the other Commissioners on the rejection of the Department of Natural Resources, the transfer of the Army Engineers' civil functions, organization by public works, and other views. A majority of the Commissioners did recommend that Congress authorize for Interior a third Assistant Secretary and an Administrative Assistant Secretary for congressional liaison, finance, management research, personnel, publications, and supply; both posts to be appointed by the President, confirmed by the Senate, and filled from the career civil service. Hoover and his colleagues also urged Congress to thoroughly reorganize Interior by major function, or purpose, to emphasize its mission for developing "subsoil and water resources."[111] They recommended transferring the BIA to a new department for education, Indian affairs, and social security; sending the BLM, except for minerals, to the USDA; and shifting Commercial Fisheries from the Fish and Wildlife Service to the Department of Commerce.[112] Proposed transfers to Interior included flood control and rivers and harbors improvement from the Department of the Army, and public-building construction and community services from the Federal Works Agency. The majority of the Commissioners then recommended five groups of major-purpose assignments of Interior's agencies by services, or functions: water development and use, intended to provide adequate hydrologic data; building construction; mineral resources, including the USBM and the USGS; recreation; and territories and possessions.

In urging a "Better Organization in Mineral Resources Services,"[113] most of the Commissioners followed their task force's determinations in promoting "more extensive geological explorations," "more research into improved methods of mining and recovery," and "more adequate management of the Government relations to title leases, royalties, [and] reservations." After study, they continued, mining laws should be revised, "a center of mineral services" should be established, and some of the 25 agencies that dealt with mineral resources should be consolidated to avoid current "extensive duplication" and to provide "a more systematic source of information and advice."[114] The Commissioners also recommended that the proposed agency for mineral-resources services should provide reports to the Reconstruction Finance Corporation and that RFC's tin smelter at Texas City, Texas, be transferred to the USBM. These recommendations were republished in the proceedings of hearings, held during mid-October 1949, by a special subcommittee of the House's Committee on Public Lands on proposed revisions of the U.S. mining laws. On March 23, 1950, Truman asked Secretary Krug to comment on all these proposals and forward them by April 15 to the Bureau of the Budget's Director. Truman noted that Krug might accomplish some of the reforms by administrative action, if the Secretary considered them practical and necessary, but others might require Executive orders, authority provided by reorganization plans pending in Congress, or new legislation. Where Presidential determinations were

needed, Truman asked for Krug's views about the practicality and propriety of the Hoover Commission's recommendations.

On May 26, Under Secretary Chapman, again acting for Krug, sent Interior's comments to Frank Pace, Jr., who succeeded James Webb as the BoB's Director earlier in 1949 after serving as Webb's Assistant Director. Krug, Chapman, and their advisers considered "inadequate" the Hoover Commission's report on Interior, "despite the validity of certain recommendations." In their view, the report denied "one of the most fundamental principles of organization expressed by the Commission: 'The numerous agencies of the executive branch must be grouped into departments as nearly as possible by major purposes in order to give a coherent mission to each Department.'" "Interior," they continued, "is substantially a natural resources agency, the product of evolution and accretion." Some Commission recommendations, like those for water-resources development, "would amplify this role"; others, especially in public-domain management, would detract, but still others "would add completely unrelated construction functions, turning Interior into a hybrid." Krug and his associates suggested the Commission's views lacked sufficient awareness "of the economic and administrative significance of the job to be accomplished by the Federal Government in the field of conservation and development of natural resources."[115]

In supporting the proposed Department of Natural Resources, Krug and his associates urged that Interior, with its present functions intact, should form the new department's nucleus and recommended that it receive the Forest Service's forest functions (except farm forests), the Soil Conservation Service's responsibilities in hydrology and public lands, and the Army Engineers' harbors and rivers functions. These reviewers also recommended regional authority to ensure "that adequate facilities exist for planning and carrying out balanced resource development programs." Favoring the establishment of additional valley authorities, like the one Truman proposed for the Pacific Northwest, they suggested, alternatively, that "coordinated regional development can be assisted measurably through suitable decentralization" of the proposed department's "planning and operating responsibilities."[116] The reviewers recommended statutory authority to enable the President to carry out any reorganization plan. Their responses to each of the Commission's 15 numbered recommendations included the view that the "proposal for the creation of a Minerals Resource Service raises questions which will require further study" now underway. We "wholeheartedly endorse," Krug and his colleagues continued, "the Commission's general objectives" to establish Interior "as the major center of [Federal] mineral resource programs," to be accomplished by creating a Department of Natural Resources, and "to provide for a greater integration of the policy planning and program direction of the Department's mineral activities." Krug promised to formulate draft legislation to "Define and clarify the existing activities" of the USBM and the USGS, to "[b]roaden and make specific the Department's authority relating to the collection, reporting, and analysis of minerals economic data,"[117] and "authorize the Secretary to provide adequate staff and organize the minerals activities * * * to assure the integration of policy planning and program direction."[118]

While the Interior Department completed its review of the Hoover Commission's recommendations, the Commissioners submitted their concluding report to Congress on May 20, 1949. A complete reorganization of the executive branch to enhance its authority, accountability, economy, and efficiency, the Commissioners emphasized, would reduce to 30 the 52 agencies now reporting to the President. For all Federal agencies, they rejected regional management in place of firm lines of authority that passed directly from the chiefs of units to chiefs of sections, branches, divisions, and bureaus. To sharpen managerial tools, the Commissioners suggested changes in the management of buildings, fiscal matters, personnel,

recordkeeping, and supplies. Among the Commissioners' recommendations to avoid "conflict, duplication, and overlapping,"[119] they retained their Task Force's ideas of merging water-resource development in Interior (although they harbored no illusions about the difficulty of prying some water responsibilities away from the Army Engineers) and land and forestry management in Agriculture. Interior's responsibility for U.S. territories and possessions would join the ECA, the administration of occupied areas, and other organizations in a new Administration of Overseas Affairs. On June 20, 1949, Truman signed a bill that provided "for the reorganization of Government agencies." The Reorganization Act authorized the President to reform at his pleasure the executive branch "to promote the better execution of the laws," "to reduce expenditures and promote economy, to the fullest extent consistent" with "efficient operation," "to increase [operational] efficiency * * * to the fullest extent practicable," "to group, coordinate, and consolidate agencies and functions * * * according to major purposes,"[120] and to abolish agencies or reduce their number. Proposed reorganizations would be subject to a veto by a majority of all Members of the House or the Senate of any plans "transmitted to the Congress before [the time limitation expired on] April 1, 1953."[121]

The Truman administration accepted wholly or in part more than half the Hoover Commission's 270-plus recommendations in the Commissioners' final report when the administration sent to Congress 35 plans for reorganization. On August 20, 1949, the administration had transmitted eight reorganization plans to Congress; the legislators accepted six of them, including Plan 4 of 1949 that transferred the National Security Council and the NSRB to the Executive Office of the President. During March 13–May 31, 1950, the Truman administration sent to Congress 27 additional plans for reorganization, of which the Senate threw out 6, the House disposed of 1, and both bodies agreed on 20. Of the reforms approved in 1950, Plan 3, effective on May 24, added to Interior the recommended third Assistant Secretary and the Administrative Assistant Secretary.[122] Plan 15, also effective on May 24, transferred the Alaska and Virgin Islands Public Works from the Administrator of General Services to the Secretary of the Interior. Plan 25 (effective July 9) moved the functions of the NSRB to its chairman and established a position for a Presidentially appointed civilian as the Board's vice chairman. Congress and the President had established the General Services Administration (GSAd) on June 30, 1949, "to simplify the procurement, utilization, and disposal of Government property,"[123] as part of its ongoing reorganization, by transferring to the new organization the Bureau of Federal Supply, the Federal Works Agency, the National Archives, and (for liquidation) the War Assets Administration.

In another modification on October 28, the Classification Act of 1949 was intended to "establish a standard schedule of rates of basic compensation" and "an equitable system for fixing and adjusting the rates"[124] for Federal civilian employees. The new law repealed the Classification Act of 1923 and replaced its Professional and Scientific Service grades (PSS–1 through PSS–8), Subprofessional Service grades (SS–1 through SS–8), and Clerical, Administrative, and Fiscal Service grades (CAF–1 through CAF–15) with two new grades—General Schedule (GS–1 through GS–18) and Crafts, Protective, and Custodial (CPC–1 through CPC–10). In the new GS grades, the former SS–1 now equaled GS–1; PSS–1, SS–6, and CAF–5 shifted to GS–5; PSS–2, SS–8, and CAF–7 became GS–7; and PSS–8 and CAF–15 became GS–15. The new statute based yearly salaries in the GS and CPC classifications on employees' grades and their lengths of service within each grade, the latter tied to a six-stage sequence of potential in-grade step increases that depended principally on efficiency ratings. The new act applied to most Federal departments and agencies, except the AEC, the Central Intelligence Agency (CIA), the TVA, and other organizations already covered by existing laws.

While the Hoover Commission deliberated, the House's Interior subcommittee began considering, on January 26, 1949, the Department's request for appropriations of $616.7 million for fiscal year 1949–50. Krug estimated that Interior's net revenues for the year would increase by more than $3 million. The larger budget proposed for the USGS, he explained, would enable the agency in "three significant areas" to expand "some urgently needed projects" in topographic mapping, strategic and critical minerals, and water resources, the last of which "should be expanded to match substantially, on a 50:50 basis, the offerings of the States."[125] Hearings on USGS appropriations for the new fiscal year began on February 2. Representative Michael Kirwan now chaired the House subcommittee, including new member Henry M. ("Scoop") Jackson (D–WA).

The USGS requested $17.9 million in direct appropriations for salaries and operations by its nearly 4,400 permanent personnel during fiscal year 1949–50, an increase of nearly $5 million, and the agency expected $13.5 million from all other sources. The USGS cast its budget in somewhat different terms than it had done since the early results of Director Powell's failed policies and practices had forced Congress to require separate estimates for engraving and printing for fiscal 1887–88 and complete line itemization of all budget requests beginning with those for fiscal 1888–89. Most of the subsequent mandatory categories of salaries, topographic surveys, geologic surveys, streamgaging, classification of lands, supervision of mining and oil and gas leases, preparation of illustrations, and printing and binding now were restyled by the USGS. These items, which appeared initially in the annual report of funds available for fiscal 1948–49, included topographic surveys and mapping, geologic and mineral-resources surveys and mapping, water-resources investigations, classification of lands, supervision of mining and oil and gas leases, and general administration. The new language of printing and binding and purchase of reprints replaced the old line items for the preparation of illustrations and for printing and binding. Wrather, in testifying before the House subcommittee, explained that the BoB was instituting a Governmentwide policy "to make the operating funds available for publication of the results."[126] The item for preparing illustrations shifted to salaries, while the amounts for printing and binding went to water-resources investigations and salaries.

Wrather, in presenting justifications for the restyled specific items in the requested budget, continued his firm line on the request for increases in funding even larger than those desired for fiscal year 1948–49. "The Geological Survey is requesting a direct appropriation of $7 million," a 61-percent increase, the Director emphasized, for its topographic program because "The rate of mapping achieved since the 20-year program was proposed in 1946 will result in complete national coverage in about 60 years." "The increased appropriations of the past several years," he continued, enabled the USGS "to completely reorganize and better staff and equip our mapping service" and yielded "a greatly accelerated production of new maps." The "far more efficient organization," and its ability to respond promptly "to a greater work load,"[127] could only finish mapping the Nation within 20 years, Wrather cautioned, if Congress and the President continued to make available gradually increased funds. The $875,000 raise for USGS geologic surveys, to $3.5 million, represented entirely the reintroduced formal request for investigations of strategic and critical minerals within the geologic work. Wrather emphasized the existing shortages for 34 of the 51 minerals still on the strategic list, especially industrial diamonds, nickel, and tin. The USGS also asked for an additional $156,000, to a total of $500,000, for work on Alaskan mineral resources, on its permafrost, and in the Aleutians, and an extra $700,000 for water-resources investigations. The hearing, as it progressed, took on a rather surreal character. Kirwan asked the questions, Wrather replied with long statements, and the other

subcommittee members and USGS managers, including Bannerman substituting for Bradley, said very little. The subcommittee and the whole House voted to cut 13 percent from the Interior and USGS requests, reducing the former to $536.2 million, which provided $126.8 million more than in 1948–49, and the latter to $15,513,000, or $2.49 million more than in 1948–49.

The Senate subcommittee began its deliberations on Interior's budget request on May 23, 1949. In calling for restoration of the House's cuts, Secretary Krug urged the Senators to restore the $1.5 million reduction for USGS topographic mapping. Even the full $7 million, Krug observed, "would provide only for a moderate expansion of the over-all mapping program,"[128] while the National Military Establishment, other Federal agencies, the States, and private organizations continued to ask the USGS to complete mapping the Nation in 20 years. The subcommittee, again chaired by Carl Hayden, evaluated the USGS budget on June 7. Wrather asked the subcommittee to restore the five reductions made by the House. Carl Hayden, who had sponsored the Temple Act in 1925, needed no encouragement to support topographic mapping, but Wrather quoted the Hoover Commission's Task Force on Natural Resources in urging the Senators to restore the funds for studies of water resources to obtain the "basic hydrologic data essential to sound planning and construction."[129] A letter from Karl Compton,[130] still a member of the military's Research and Development Board, to Wrather supported his request for the full $60,000 to continue the USGS role in the Joint Aleutian Geophysical Program, to which each of the three services would add $20,000 during fiscal year 1949–50. Wrather promised the subcommittee that the USGS would ensure that the Aleutian program balanced civilian and military needs. Wrather also asked for $40,000 to add a third full-time member to the HVO's staff and support the staff's salaries and work in geochemistry, geology, seismology, and ground surveys.[131]

The House and the Senate, retaining the old line-item usages, agreed to provide $343,000 for salaries and expenses, $5.75 million for topographic surveys, $3.5 million for geologic surveys, $500,000 for mineral-resources investigations in Alaska, $4,125,000 for water-resource investigations, $320,000 for classification of lands, $725,000 for supervising mineral leasing, $725,000 for engraving and printing maps, and the usual $19,500 for stationery supplies. The USGS also listed among its expenditures in fiscal year 1949–50 nearly $34,400 for soil and moisture conservation, drawn from the $2.8 million for salaries and expenses that Interior received that year for its work in the program that began in 1935 when Congress and President Roosevelt established the Soil Conservation Service. Congress continued unchanged the cooperating advance out of the revolving fund and the authorization for contracting for topographic maps made from aerial photographs and for geophysical or other specialized surveys and the prohibition on paying for drilling for domestic-use water wells. As the USGS requested, the legislators raised the limits on the amounts in each programmatic item that could be spent on personal services in the District of Columbia. They also extended for 1 year USGS authority to acquire surplus equipment, materials, and supplies but limited their total appraised value to $150,000.

Congress provided the USGS with a total of $15,988,000 for salaries and operations during fiscal year 1949–50,[132] and Truman signed Interior's appropriations bill into law on October 12, 1949, 9 days after Krug authorized Wrather to "enter into agreements for the acquisition and accept conveyances of lands or interests in lands whenever * * * [they] are to be acquired for administration through the Geological Survey pursuant to any act of Congress."[133] On June 29, 1950, deficiencies legislation added almost $151,000 for increased pay and travel costs,[134] bringing the total of direct appropriations to about $16,139,000 for fiscal 1949–50, an increase of more than $2.9 million from 1948–49. In the final sum of nearly $30,601,000 managed by the USGS during fiscal 1949–50, almost $3.89 million more than the previous year, outside funds fell to 47 percent of the total.

States, counties, and municipalities contributed nearly $4,160,000, while about $9,562,000 of the nearly $10,446,000 transferred by other Federal agencies came from the usual seven principal organizations. These funds included some $4 million from the USBR, nearly $2,710,000 from the AEC, about $1,587,000 from the Army, some $569,000 from the USAF, a little more than $372,000 from the Navy, nearly $232,000 from the State Department, and almost $92,000 from the TVA. Only the DoS reduced its transfer funds, but $34,000 from foreign governments more than made good that loss. Of these outside funds, the Topographic Division received 35 percent, the Water Resources Division took in 32 percent, and the Geologic Division got 27 percent.

In the new fiscal year that began on July 1, 1949, Wrather and Nolan continued forming special committees to advise them about specific ways and means to improve USGS policies, plans, operations, and products. On July 18, Nolan, acting for Wrather, established a Publications Committee to heighten the quality of USGS "published maps and reports, and to secure their prompt issuance" to justify the earlier request to Congress for authority and funds to end, or at least reduce, the backlog of unpublished products. Julian Sears chaired the new Committee, whose members included one representative of each of the four program Divisions—John Northrop (Conservation), John Hack (Geologic), George Whitmore (Topographic), and Walter Langbein (Water Resources). Nolan asked the Publications Committee to make a "broad and intensive study" of "general governmental and bureau policy, scope, review of technical content, format, mode of publication, and procedures for handling" throughout the USGS, "with a view to analyzing present shortcomings and of devising means of correcting them."[135]

On November 17, 1949, Wrather founded a USGS Executive Committee (ExComm), composed of Nolan (chair) and the four Division Chiefs—Harold Duncan (Conservation), Bill Bradley (Geologic), Gerald FitzGerald (Topographic), and Carl Paulsen (Water Resources). Wrather asked the new ExComm to "consider and review internal policy matters affecting the administration of the Survey; interdivisional responsibilities; and major phases of operating programs." He outlined five specific duties and responsibilities. The new group would (1) assign to the Coordination and Management Services Committees "special problems for study and recommendation" and recommend "to the Director approval or disapproval of internal policy matters submitted by" those committees; (2) review and reconcile the administration of operations consistent with USGS policies; (3) consider "major phases of each Division's operating program"[136] to coordinate and integrate them with the Director's major policies; (4) review for the Director all proposed Survey orders; and (5) present their recommendations on external policy matters to the Director at his Staff Conference or separately in written form. Wrather asked the ExComm to meet each Wednesday at 9:00 a.m. and authorized a secretary to take minutes. The ExComm's meetings, he emphasized, would not replace those of the Director's Staff Conference.

In the first half of 1950, Wrather formed a third new committee and revised the charter for an existing group. On January 4, Wrather created a General Staff Committee to replace the Coordination Committee, chartered on June 29, 1949, to establish USGS policy on Interior's Regional Field Committees. The General Staff Committee (GSC), chaired by an individual chosen by the Director, included representatives of each Division and one member of the Director's Office. Wrather gave his newest Committee five principal tasks. First, the GSC would "perform staff work, as assigned by the Director or the Executive Committee" on matters of interdivisional cooperation, coordination, and integration, other than those of management service and publication. Second, it would report to the Director's Office through the ExComm. Third, the GSC would review the reports and programs of the Interior Department and its agencies, prepare comments and

recommendations, and assist the USGS representative (Paulsen) on the 12-member Water Resources Subcommittee of Interior's Program Committee, whose 10 members included Wrather, as reorganized by Krug on April 14, 1948, and chaired by Lee Muck. Fourth, the GSC would correspond with the representatives of Interior's field committees and coordinate USGS participation in and provide advice on departmental and bureau policies relating to them. Fifth, Wrather asked the GSC to "reach a reasonable compromise or reconciliation of ideas where differences occur."[137] On May 11, 1950, Wrather formalized the USGS Budget Committee, established by memorandum on December 15, 1948. He asked this Committee, composed of Budget Officer John Ramsey (Chairman) and one member of each Division, chosen by the Division Chief, to consider "budget estimates and related budgetary problems"[138] within the USGS and make its recommendations to the Director through the ExComm.

Wrather, in three Survey orders issued before the end of fiscal year 1949–50, also dealt with other pressing problems by making additional changes in USGS administration, operations, and products. On March 29, 1950, the Director provided a formal policy and procedures for the review and approval of "manuscripts and statements [by members of the USGS] proposed for outside publication or oral presentation." He required all writings "in which the Survey has a proprietary interest" and those bearing authors' titles and USGS affiliation to "be submitted to the Director, and be approved or cleared by him, or his deputy, prior to release for outside publication." "In accordance with generally accepted ethics and amenities," Wrather continued, the writings "should include acknowledgments, and/or citations of official authorizations, when and as appropriate as determined by the Director." He suggested that "the frequently used footnote, 'Published by permission of the Director, U.S. Geological Survey,'" was "one satisfactory form of citation." Abstracts of papers or talks also required Director's approval, unless the abstracts had accompanied a manuscript previously approved for publication. Oral presentations did not, Wrather added, require such clearance. He urged USGS speakers to continue to exercise discretion in "content or tone" while discussing "controversial topics," those that might unjustifiably embarrass the agency or criticize "other persons or organizations," reveal "unsettled or unannounced Department or bureau plans and policies," and prematurely disclose "the results of investigations."[139]

Wrather continued his reorganization by appointing a new personnel officer for the USGS and establishing a USGS committee at Denver. Charles A. King, USGS Personnel Officer, retired on December 1, 1949, after more than 40 years of service with the agency. On April 21, 1950, Wrather confirmed his selection of Willard P. McCornack,[140] who had managed personnel elsewhere in the Federal Government and now was a chemical engineer in the Geologic Division, as Charles King's successor as of April 13. On June 16, Wrather established a Denver Survey Committee[141] to facilitate discussions of problems of mutual interest to the USGS units and to coordinate their operations in the Rocky Mountain region. The USGS Budget Officer, succeeded later by the Management Service Officer, who served as secretary, at Denver, and representatives from each of the program Divisions, chosen by the Division Chiefs, composed the new Committee, whose chairman would be elected annually from among its members. Wrather empowered the Denver Committee to make recommendations for improvement to the Executive Officer and the Executive Committee, who would then forward to the Director their opinion of the proposed changes. On the same day, another Survey order founded "a Denver general office" as a public-information facility, like the one in Washington, to handle the "necessary downtown distribution and orders of maps and reports, both sale and free editions."[142]

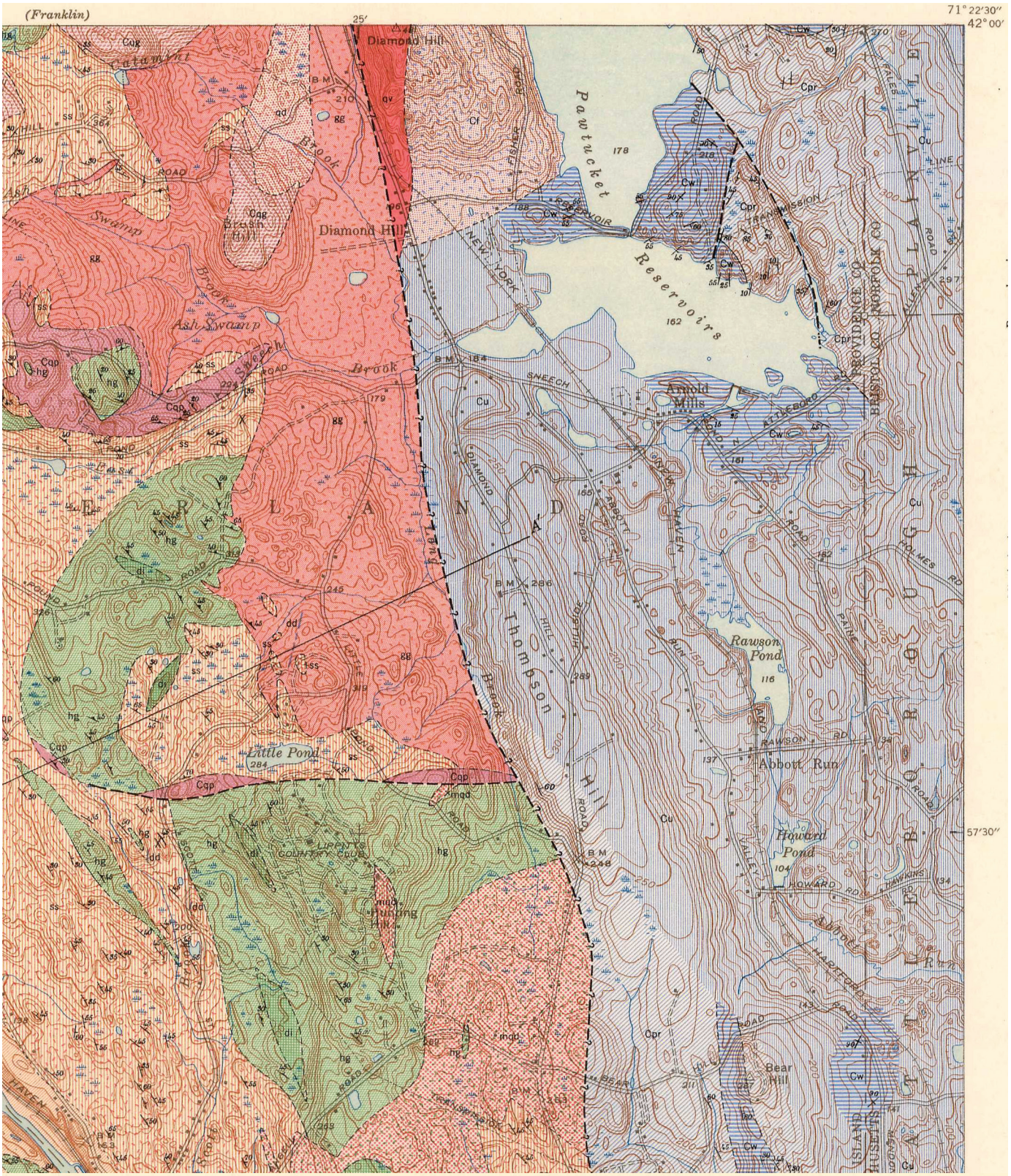
Bill Bradley's Geologic Division managed about $8,407,000 in total funds for salaries and operations during fiscal year 1949–50, an increase of some $1,164,500

from 1948–49. To the direct appropriations of nearly $4,071,000, the AEC added more than $2,495,000 in transfers, principally for the uranium-vanadium program. The Army, the Navy, the USBR, the State Department, the USBM, and other Federal agencies combined to provide about $1,667,500, of which $688,000 came from the Army and its Engineers. The ECA and several foreign governments combined to add another $70,600 to the Division's total funds. States, counties, and municipalities transferred $86,000.

Bradley made four significant changes among his Division's planners and managers during fiscal year 1949–50. Robert Bryson replaced William Pierce as one of the four Staff Geologists. In mid-October, Preston Cloud, Jr., succeeded John Reeside, Jr., as Chief of the Paleontology and Stratigraphy Branch (PSB). Reeside, Chief of the PSB since December 1930, returned at his request to full-time research on ammonite stratigraphy and systematics. Wrather, like Bradley, thought Cloud "exceptionally well qualified"[143] to be the new Chief. Cloud revitalized and expanded the Branch by adding full-time staff and consulting specialists in biostratigraphy, enlarging the space in the U.S. National Museum and elsewhere available for their work, and making the results of these studies in basic chronology and evolutionary biology more useful to the Division's mineral and energy programs. Assistant Chief Geologist Harry Ladd, at his request, also returned to research in January 1950. Wrather noted Ladd's craving, suppressed with difficulty since 1943, to resume his studies on the paleoecology and ecology of mollusks. "Henceforth," the Director noted wryly, "Dr. Ladd will be found in the Survey's quarters at the National Museum; happy as a clam."[144] To replace Ladd as Assistant Chief Geologist, Bradley and Wrather selected Esper Larsen 3d, who led the Military Geology Branch during August 1945–August 1946 before returning to research and serving as Chief of the Petrological Investigations Group in Earl Ingerson's Geochemistry and Petrology Branch. A. Williams ("Bill") Postel replaced Edwin Goddard as Chief of Geologic Information and Reports, after Goddard retired. Postel became Acting Geologic Map Editor in June 1949, as the USGS resumed its series of geologic maps of quadrangles, begun as Folios of the Geologic Atlas of the United States (1894–1945), with Geologic Quadrangle (GQ) Maps 1–4 (1949) that displayed, at 1:31,680 with a 10-foot contour interval, the bedrock and surficial geology of two quadrangles—Pawtucket in Rhode Island and Massachusetts and Mount Grace in Massachusetts.

The USGS geologic program carried out under regular appropriations during fiscal year 1949–50 continued to emphasize surveys and appraisal of the Nation's mineral and mineral-fuel resources.[145] The evaluations included preparing reports for several Federal agencies on bauxite and other specific resources. I. Gregory Sohn, an ostracode specialist who had just rejoined the PSB after serving with minerals units since 1942, began compiling a 1:1,500,000 map to show the geology of alumina occurrences in the Columbia River Basin and to summarize his searches for bauxite-rich clays in the Pacific Northwest. Additional studies began of the Nation's current position with respect to copper, graphite, and talc; investigations soon expanded to cover more than a dozen strategic commodities. The Mineral Deposits Branch operated or began some 90 field projects. They included detailed geologic mapping and related studies of mining districts, extending similar investigations into undeveloped but potentially mineralized areas, developing and testing new techniques of finding ore, conducting basic research on mineral-deposit formation, expanding exploration (including drilling) to obtain geologic data and to test structural interpretations and theories of ore concentration, and compiling maps and preparing comprehensive descriptions for broad areas of diverse deposits.

Well over half of the Mineral Deposits Branch's program focused on strategic minerals and emphasized commodities and areas about which the Geologic Division knew the least and on locales that offered the best chances for new and important discoveries plus providing additional information about geologic processes.


(Franklin)
25′
71°22′30″
42°00′
57′30″
Diamond Hill
Pawtucket
Reservoirs
Diamond Hill
Ash Swamp
Brook
Arnold Mills
Rawson Pond
Howard Pond
Abbott Run
Little Pond
Thompson Hill
Bear Hill
Hunting Hill
Providence Co.
Norfolk Co.
Scale 1:31,680
1 Mile
Contour interval 10 feet
Datum is mean sea level
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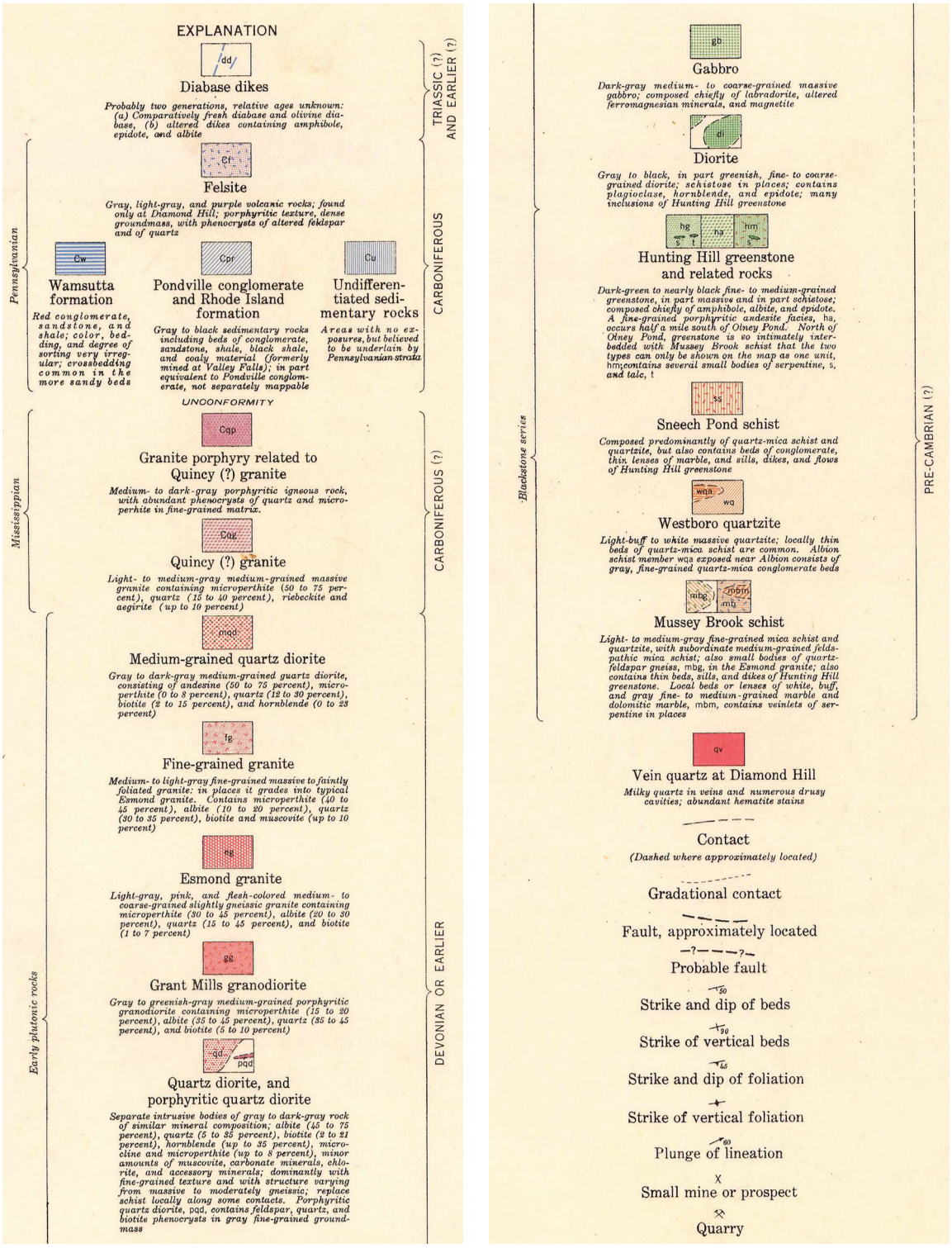
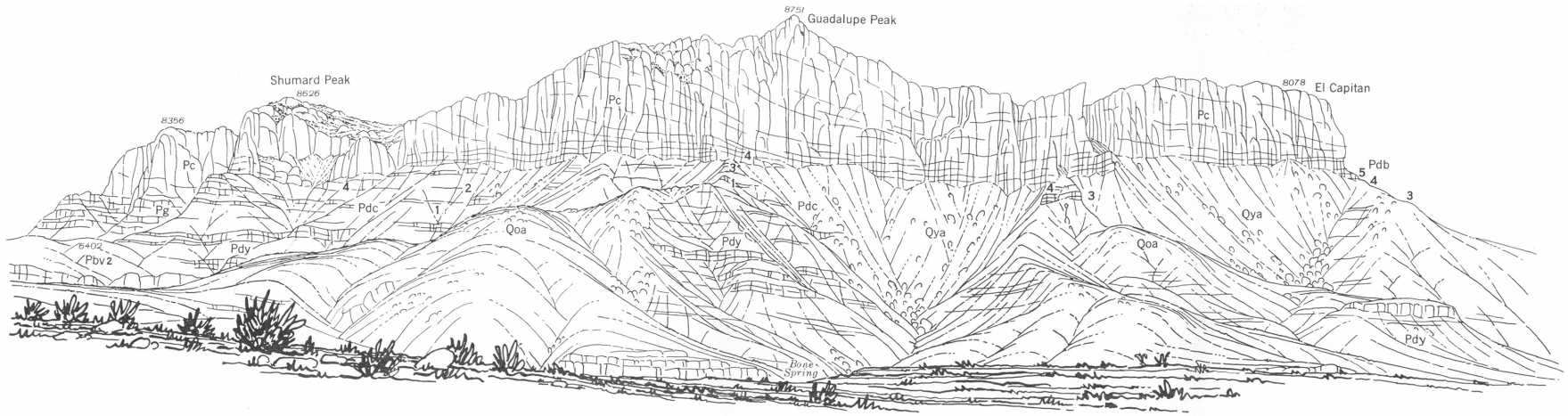
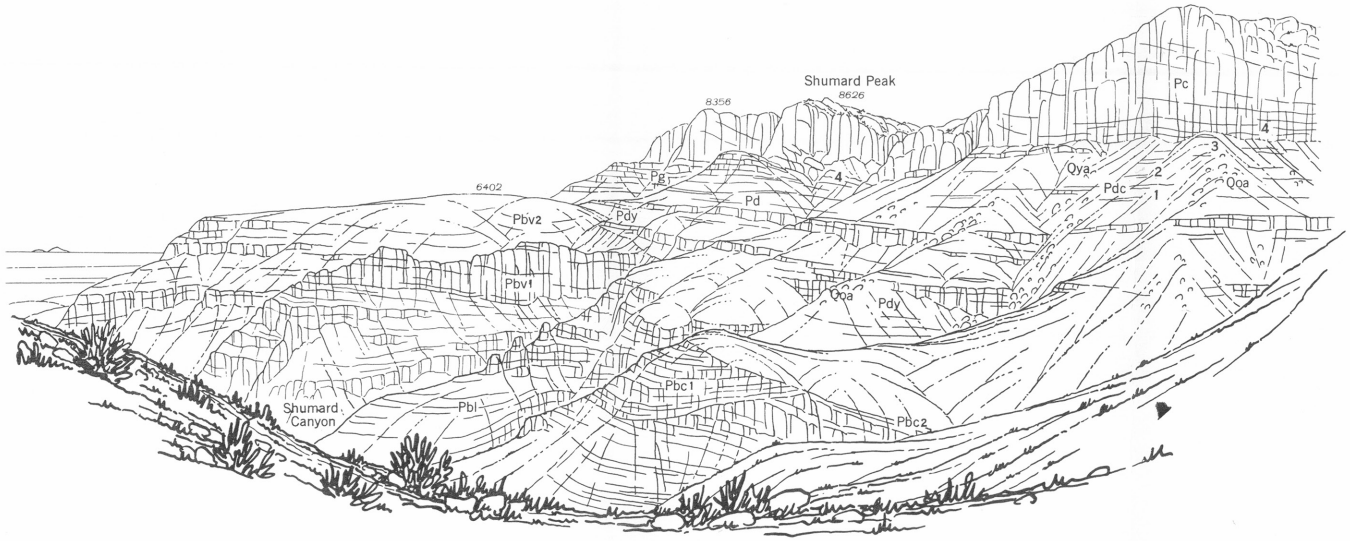



This map (originally at 1:31,680) shows the bedrock geology—Precambrian, Paleozoic, and Triassic rocks—of the northeast quarter of the Pawtucket 7.5-minute quadrangle in Rhode Island and Massachusetts. The map was published in 1949 as USGS Geologic Quadrangle Map 1 (GQ–1) and printed on a once-folded sheet that also contained a title page and a text. The map was accompanied by a geologic section along line *A*–*A*′. GQ–2 portrayed the Pawtucket quadrangle's surficial (Quaternary) geology; see Chute, 1949. The two Pawtucket quadrangle maps inaugurated the USGS series of Geologic Quadrangle Maps of the United States to replace the agency's smaller scale series of Folios of the Geologic Atlas of the United States (numbers 1–227, 1894–1945). Most subsequent GQ maps appeared at the new standard scale of 1:24,000. (From Quinn, Ray, and Seymour, 1949.)



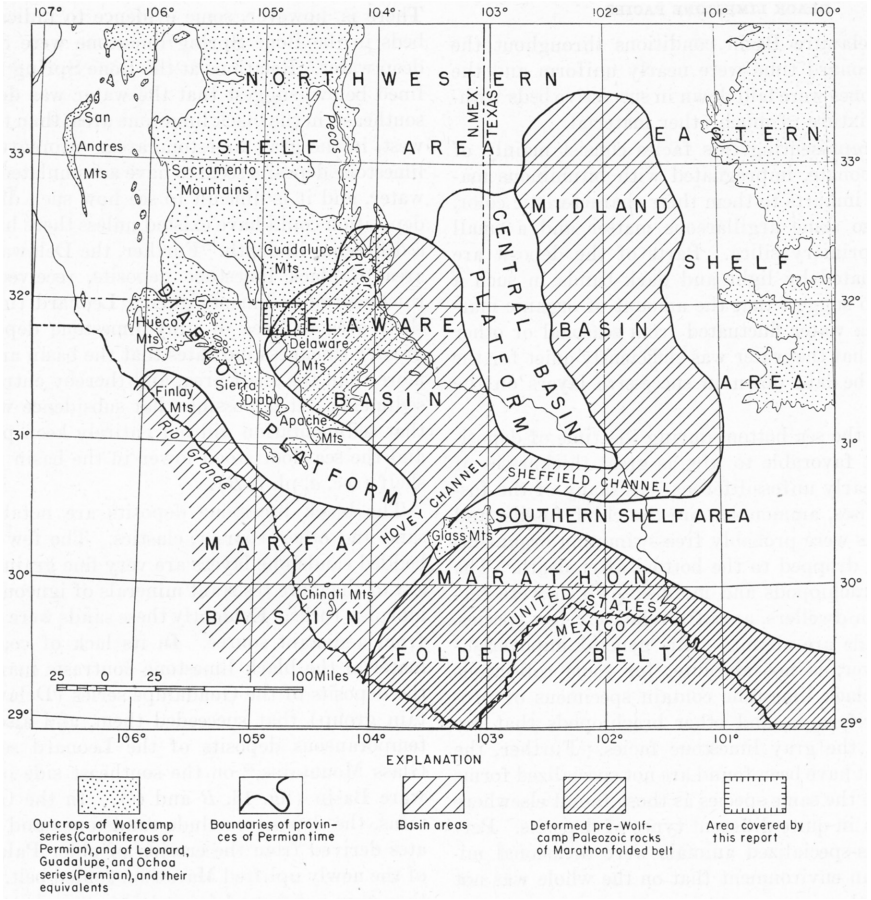

*A.* EL CAPITAN TO SHUMARD PEAK, LOOKING NORTHEAST FROM RIDGE ON SOUTH SIDE OF BONE CANYON.




*B.* NORTH SLOPE OF GUADALUPE PEAK TO SHUMARD PEAK, LOOKING NORTH FROM RIDGE ON SOUTH SIDE OF SHUMARD CANYON.

In the late 1930s, USGS geologist Philip King sketched these panoramic views, looking (*A*) northeast from the ridge on the south side of Bone Canyon and (*B*) north from the ridge on the south side of Shumard Canyon, both in the southern Guadalupe Mountains of western Texas. Units in King's stratigraphic sequence shown here included two Quaternary (Q) units: Younger alluvial deposits (Qya) and Older alluvial deposits (Qoa). The sequence also included the following Permian (P) units: Capitan Limestone (Pc); Bell Canyon Formation (Pdb), and its Pinery (Pdb5) and Hegler (Pdb4) Limestone Members; Goat Seep Limestone (Pg); Cherry Canyon Formation (Pdc), and its Manzanita (Pdc3), South Wells (Pdc2), and Getaway (Pdc1) Limestone Members; Sandstone tongue (Pd); Brushy Canyon Formation (Pdy); upper (Pbc2) and lower (Pbc1) divisions of Cutoff Shaly Member of the Bone Spring Limestone; upper (Pbv2) and lower (Pbv1) divisions of the Victorio Peak Gray Member of the Bone Spring Limestone; and Black limestone beds (Pb1). King was the latest of a number of USGS geologist-artists, whose contributions to scientific illustration began with William Henry Holmes' limning of the Grand Canyon and the Lake Bonneville terraces in 1880 for, respectively, Clarence Dutton and G.K. Gilbert. Elevations are in feet. (From King, 1948, pl. 12.)


This view of the southern Guadalupe Mountains of western Texas looks north toward El Capitan (center, elevation: 8,078 feet), which lies in front of and conceals Guadalupe Peak (8,751 feet). To the west, Shumard Peak (8,626 feet) honors Federal geologist George G. Shumard, who set up an initial stratigraphic section here in 1855 while serving with a U.S. Army expedition led by Captain (later Major General) John Pope of the Corps of Topographical Engineers. USGS geologist Philip King correlated Shumard's older lithologic units (1–4) with some of those in his own stratigraphic section completed as part of field studies during 1934–39. In King's youngest-to-oldest upper Paleozoic sequence, Capitan Limestone = 1 (white limestone), Pinery Limestone Member (of Bell Canyon Formation) = 2 (upper dark limestone), Delaware Mountain Group = 3 (yellow sandstone), and Bone Spring Limestone = 4 (basal black limestone). The letters refer to younger (b) and older (a) Quaternary slope (alluvial) deposits. (Aerial photograph by U.S. Army Air Corps from King, 1948, pl. 1.)

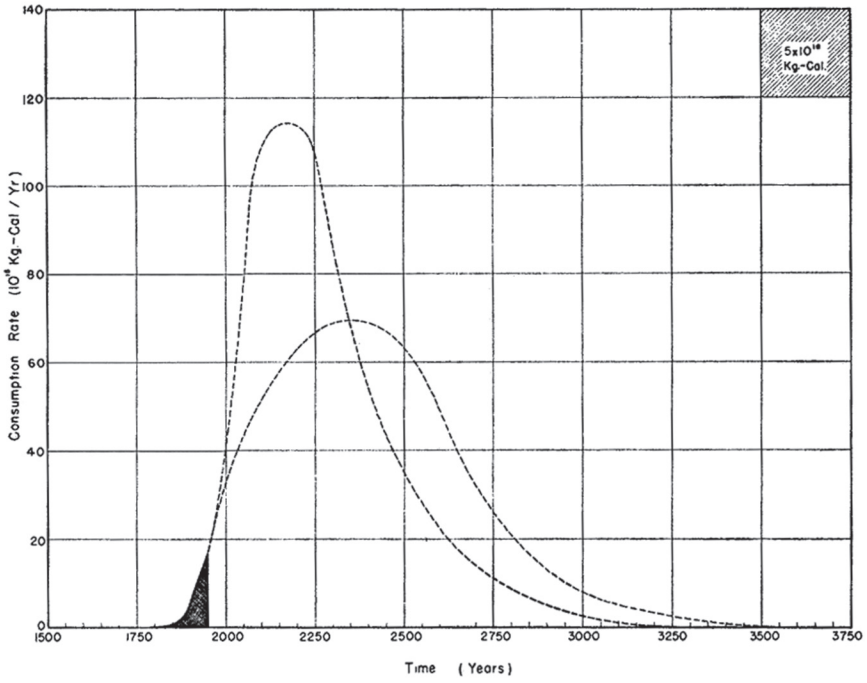



This index map of parts of western Texas and southeastern New Mexico shows the major basins, platforms, shelves, and related paleogeographic features during the Permian. USGS geologist Philip King concentrated on the area (hachured box) between the Delaware and Guadalupe Mountains as part of his investigations of regional geology, depositional provinces, and stratigraphic facies in the upper Paleozoic rocks of the Southwestern United States. (From King, 1948, fig. 3.)

Large-scale exploration for uranium and vanadium, funded principally since 1944 by the AEC, continued on the Colorado Plateau. Only three uranium mines existed on the Plateau before 1948, the year that large deposits began to be found and their products started to reduce the Nation's dependency on shipments from the Belgian Congo and Canada. Branch members worked on other mineral commodities, including chromite, copper, gold, iron, lead, manganese, mercury, silver, and zinc. Nonmetal investigations emphasized phosphate deposits in Florida, Idaho, and Montana; beryllium, mica, and other pegmatite minerals in the Black Hills and in the Rocky Mountain and Eastern States; potash in New Mexico; talc in New York and Vermont; monazite in the Southeastern States; and bentonite and other clays and bauxite nationwide. Diamond drilling in the Wisconsin lead-zinc district disclosed zinc minerals of minable grade in an inactive part of the district and discovered other significant deposits below those previously considered favorable for mineralization.

Other units in the Mineral Deposits Branch continued to support the Branch's fieldwork. Ralph Roberts, brought to Washington in May 1949 as head of the Mineral Deposits Branch's manuscript-processing unit, worked with Julian Sears and their colleagues in improving and extending the series of special maps, especially those in the numbered Mineral Investigations Field Studies (MF) and Mineral Investigations Resource (MR) series.[146] In the separate but related Trace Elements Program, Vincent McKelvey joined TEPCO's headquarters' staff in 1950 as the unit completed installing analytical laboratories at Beltsville and Denver. The unit's new X-ray fluorescence analyzer facilitated easier and more precise determinations of several elements, including cesium, hafnium, niobium, rubidium, tantalum, and zirconium, obtained earlier only with difficulty. Mining companies increasingly drew on geochemical prospecting techniques developed by the USGS. The amount of the agency's service work in geochemistry and petrology increased substantially during the year, as the staff improved its equipment, apparatus, and methods to obtain faster and more accurate results.

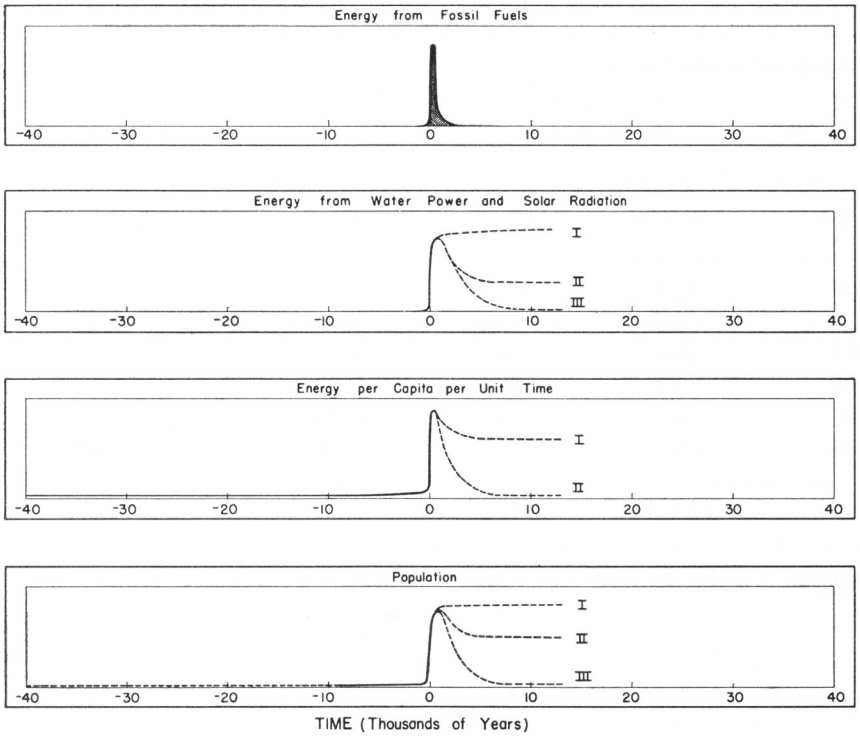
The Fuels Branch directed most of its 54 investigations in 23 States toward acquiring regional data on geologic conditions that continued to aid the search for oil and gas in known and possible producing areas by the petroleum industry. The




Geologist King Hubbert's graph shows the actual rate of the world's fuel consumption between A.D. 1800 and about A.D. 1950 compared with projected consumption at a faster rate (a steeper curve to zero at A.D. 3250) or at a slower rate (a shallower curve to zero at A.D. 3500). "The area under each curve," Hubbert cautioned, "is approximately the same—10 unit squares, each of which represents 5 x $10^{18}$ kilogram-calories." Hubbert based his projections on existing estimates by Wallace E. Pratt and others of the amount of fossil fuels—coal, natural gas, oil shale, petroleum, and tar sands—originally present in the Earth compared with the amount already consumed. A higher peak in the production curve, Hubbert asserted, would produce an earlier and sharper decline. (Quotations from Hubbert, 1949, p. 107; graph from fig. 6.)

USGS published 15 additional maps and 5 charts in its Oil and Gas Investigations numbered series in 1949–50, and more than 20,000 copies were purchased during the year. Beginning with Oil and Gas Investigations Chart 40, the chart numbers bore the prefix OC; with Map 110, the map numbers added the prefix OM. Branch geologists completed their determinations of the distribution, thickness, and reserves of oil shales in the Eocene Green River sequences in the southern part of the Piceance Creek Basin in northwestern Colorado, and they continued work required in its northern and central parts to finish mapping all these deposits. Amidst USGS, other Federal, and industry efforts to increase the Nation's domestic supplies of oil and gas, came another cautionary declaration that these resources were finite. On September 15, 1948, at the Energy from Fossil Fuels Symposium held in Washington, D.C., as part of the American Association for the Advancement of Science (AAAS) centennial, King Hubbert presented his initial application of bell curves to world consumption and impending exhaustion. "The consumption of energy from fossil fuels is thus seen to be but a 'pip,'" he concluded, "rising sharply [on the chart] from zero to a maximum, and almost as sharply declining, and thus representing but a moment in the total of human history [of the displayed 40,000 years before and 40,000 years after the present]."[147] As a response to the coming crisis, Hubbert recommended stabilizing the human population and developing solar power as one of alternatives to fossil fuels.

For coal reserves, Paul Averitt and his colleagues continued their summary reappraisals by States of all available data on the distribution, attitude, and thickness of beds and the amount of overburden. Detailed geologic surveys, on which depended the accuracy and validity of the estimates of reserves and effective planning for development, began or continued in Colorado, Indiana, Kentucky, Montana, New Mexico, North Dakota, Pennsylvania, South Dakota, Washington, and Wyoming. The USGS published a two-sheet, 1:500,000 map of Montana's coal resources, by John X. Combo, Clifford N. Holmes, and H. Reed Christner. Late in the fiscal year, James Schopf's Coal Geology Laboratory at Columbus began providing paleobotanical and petrological data to increase knowledge about the origin and nature of coals.




King Hubbert added additional perspective by comparing in these four graphs the projected amounts of energy expected from fossil fuels ("a 'pip' * * * representing but a moment in the total of human history") to those from waterpower and solar radiation at three possible rates of use. He then projected the energy used per capita (two possible rate curves in kilogram-calories/day) and population growth (three possible rate curves) during the next 12,000 years of human history. Hubbert, at Shell Development in Houston (1943–63), and later with the USGS, here traced the "sharp breaks in all the foregoing curves to * * * directly or indirectly, the tapping of the large supplies of energy stored in the fossil fuels," whose "release is a unidirectional and irreversible process." (Quotations from Hubbert, 1949, p. 108; graphs from fig. 8. See also Doan, 1994, and Deffeyes, 2001.)

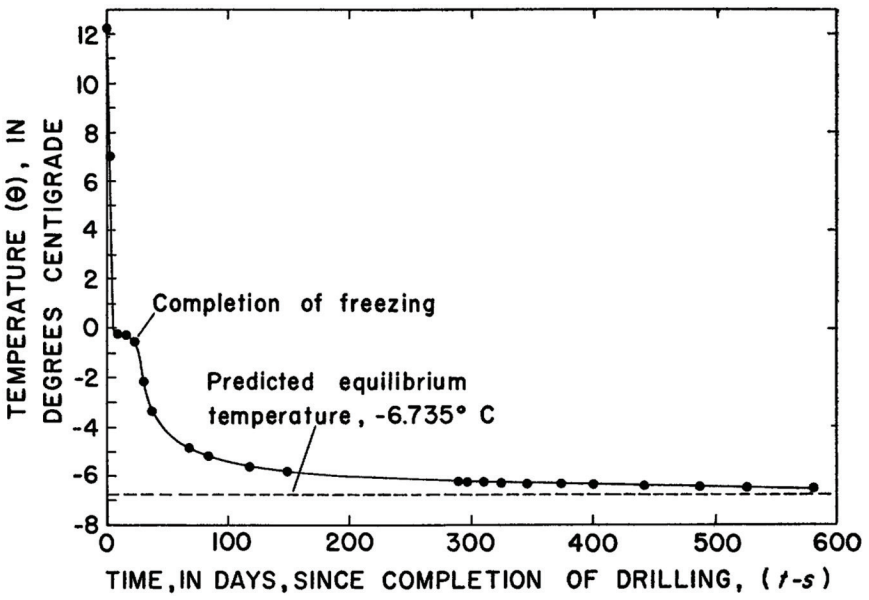
Members of the Engineering Geology Branch continued investigations in selected areas where proposed engineering projects would benefit from the results of surveys of bedrock and surficial formations. Branch geologists mapped areas as part of the Division's overall program of improving the geologic map of the United States but gathered detailed information, such as depth to rock, sources of sand and gravel, and foundation conditions, on specific sites as supplements. Many of these investigations involved ongoing studies in the Missouri River Basin, still funded in part by the USBR and designed to support Interior's development program. Branch geologists also mapped, in cooperation with the Army Engineers, a strip along the Snake River in southeastern Washington that included sites of four dams. In Massachusetts and Rhode Island, they mapped under cooperative agreements with the governments of those States. Coeval investigations in Puerto Rico represented a cooperative effort with the Water Resources Authority of the Territory, which became a Commonwealth in 1952. Geologists also mapped a number of fast-growing industrial areas to provide geologic data pertinent to many types of engineering construction required in these urban areas. Members of the San Francisco Bay project planned to produce 16 geologic-quadrangle maps at 1:24,000 to depict San Francisco, Oakland, and Berkeley. Some of the Bay project's geologic interpretations already proved useful in relocating roads, aqueducts, and sewage tunnels to avoid landslide-prone areas; in finding sources of riprap, bituminous aggregate, and other road materials; in estimating the costs of excavating rock in tunneling; and in analyzing the causes of failure in existing structures in this earthquake-prone area. Branch geologists also mapped parts of other major cities, including Anchorage, Knoxville, and Oregon's Portland. Their research on geologic processes affecting the safety of engineering structures encompassed a study of the landslides along the shores of reservoirs due to changes in the environment that followed the filling of the reservoir and subsequent fluctuations in its water level.

The Military Geology Branch continued comprehensive strategic-intelligence studies for the Army Engineers that produced, during 1949–50, 23 comprehensive reports (10 more than in fiscal year 1948–49) and 25 special reports.[148] These studies included geologic investigations of military areas in the conterminous United States, investigations of the characteristics of permafrost and its effects on military engineering, and studies in the Far East and on the Western Pacific islands. Branch geologists completed field surveys of the construction materials, geology, soils, terrain, and mineral and water resources in the 6th Army's area, and they continued work on the Fort Benning folio. In August 1949, Frank Whitmore invited William E. Davies, earlier a Major of Engineers and the former Chief of the Map Research Department at the Army Map Service, to join the MGB. There, Davies began selecting sites for underground installations in the Eastern United States, especially in the area around Washington. He picked the initial site at Raven Rock (Camp Ritchie) in Maryland. In 1950, Davies completed a preliminary study of the geology and groundwater resources in the Herndon area in northern Virginia, about 20 miles west of the Capital. Coevally, Allan P. Bennison and Charles Milton released a preliminary geological map of Virginia's Fairfax quadrangle, including the Herndon area, and part of the adjacent Seneca quadrangle, at 1:125,000, on a USGS topographic base mapped in 1911–12. In Alaska, studies of terrain and vegetation joined the ongoing permafrost investigations to help solve problems connected with military operations in Arctic and sub-Arctic regions. This work involved a special study at Point Barrow, the selection of airfield sites in six areas throughout the Territory, and field tests by Daniel B. Krinsley, Troy Péwé, and others of the cone penetrometer in areas around Bristol Bay, Fairbanks, Nome, and Yukon Flats. MGB geologists also completed a preliminary report on six industrial sites in the Soviet Union and analogous areas in North America; analyses of terrain, airfield sites, and water supplies in Tibet; terrain in the Pakistan-Kashmir-India area; and underground installations in China, Japan, and Malaya. Members of the Pacific Geologic

Mapping Program continued mapping, at 1:25,000, the engineering aspects, geology and soils of Tinian, conducted rapid reconnaissances of Agrihan, Alamagan, and Pagan Islands in the northern Marianas, and completed a 1:10,000 evaluation of the phosphate deposits and groundwater on Angaur Island in the Palaus.

During fiscal year 1949–50, the Geophysics Branch expanded its program of reconnaissance surveys by air, detailed ground surveys, and research and development to produce increasingly sensitive and precise instruments to record the field data used in analysis and interpretation. Henry Joesting and his headquarters unit had moved from the AMS building to offices in Interior in April 1949. During the subsequent fiscal year, members of James Balsley's expanded Airborne Surveys Section flew 35,000 miles of traverses, compiled 25,000 miles of data, and completed 127 maps released in open file or printed for sale. Balsley hoped the aeromagnetic survey of San Francisco Bay would enable faults to be traced under the bay. Branch mathematicians published theoretical studies on the upward continuation of magnetic total-intensity anomalies that aided in interpreting aeromagnetic surveys. The Ground Surveys Section started testing a portable absolute magnetometer that could measure accurately all components of the magnetic field. The Branch also began a program of magnetic observations with Ruy Finch's Hawaiian Volcano Observatory to gather data on events similar to the striking changes in magnetic intensity that preceded the major eruption of Mauna Loa and provide insights into the geologic processes involved and assist in predicting eruptions. The General Geology Branch decided to continue, in cooperation with the University of Hawaii and the Hawaiian Volcano Research Association, the HVO's quarterly *Volcano Letter*. Seismic instruments installed at the new USGS facility on Adak and other islands in the Aleutians furnished data on the timing, location, and magnitude of earthquakes. Scientists on Adak, like those at the HVO, focused their efforts on obtaining information on volcanic processes to aid in predicting events. Temperature and resistivity measurements by geophysicists in the permafrost area at Point Barrow also were applied in other engineering projects within and outside Alaska.

On August 24, 1949, Truman signed a bill that provided $70 million to the Federal Administrator of General Services to sponsor "a [5-year and matching funds] program of useful public works for the development of the Territory of Alaska," as Ickes had advocated in 1946. Congress designed the Alaska Sales Act, sponsored by Alaska's Delegate Edward J. ("Bob") Bartlett and its Governor Ernest




This graph records the cooling, at a depth of 595 feet, of South Barrow test well 3, in Naval Petroleum Reserve No. 4 (NPR–4), after the completion of drilling on August 23, 1949. USGS geologists Arthur H. Lachenbruch and Max C. Brewer studied this well as part of their investigation of the long-term temperature effects of drilling wells in the permafrost of NPR–4. They deployed evenly spaced electric-resistance thermometers (thermistors) from the surface to 595 feet in well 3. Mathematical analysis of the data gained explained the major features of the cooling curves and the consistent secular changes that occurred in ground temperature "at all depths from 75 to 275 feet." They estimated that conduction produced a decrease from 20°C to 0.1°C in their 6 years of observations. Another 50 years, they predicted, would be required to reach 0.01°C. (Quotation from Lachenbruch and Brewer, 1959, p. 73; graph from fig. 29.)

Gruening, both Democrats, "to foster settlement and increase the permanent residents * * *, stimulate trade and industry, encourage commercial commerce and private investment, develop Alaskan resources, and provide facilities for community life."[149] The new law authorized the sale by public auction of public-land tracts of up to 160 acres previously reserved for commercial or industrial use. In 1948 and 1949, as the Nation's interest in Alaska continued to climb, the USGS received a growing number of public and private requests for information about the Territory's geology and mineral resources. Demand for USGS data, gathered since 1895, on Alaska's gold-bearing areas, long the mainstay of the Territory's mining industry, remained high, while interest increased in coal, petroleum, and natural gas, other metallic and nonmetal minerals, and, to a lesser degree, oil shale. Work continued on exploratory geologic mapping and reconnaissance studies of mineral resources in the lower Kuskokwim and Glacier Bay regions; coal investigations in the Kenai Peninsula field and in the Nenana field north of the Alaska Range; petroleum studies in the Bristol Bay, Iniskin-Chinitna Peninsula, Katalla, and Yakataga areas of southern Alaska; and reconnaissance searches for fissionable materials. Gruening also helped the members of Seattle's Chamber of Commerce and other special-interest groups to convince Secretary Symington not to move Boeing's factory from Everett, Washington, to Wichita, Kansas, out of range of current Soviet bombers. Instead, Gruening and others promoted planning and funding for constructing a radar-based Distant Early Warning (DEW) Line across northern Alaska and Canada to alert and guide the growing numbers of jet interceptors controlled by the North American Air Defense (NORAD) Command's headquarters at Colorado Springs.

The sixth season of fieldwork by the USGS in Alaska's NPR–4 began in June 1949. In February, Commodore Greenman and Edward W. Beltz, the new chief of exploration, visited Fairbanks and then operations at Barrow and elsewhere in the Reserve. Greenman and the Operating Committee held their 10th regular meeting in Washington during April 12–13. George Gryc "summarized the status of geologic information on Pet 4 [NPR–4] and adjacent areas and announced the completion of a geologic map of northern Alaska,"[150] with stratigraphic and structure sections, facies diagrams, and a text that included the results of continuing studies of heavy minerals, microfossils, and sedimentation. Gryc and Ralph L. Miller, who took over the Navy Oil Unit in 1948, also reported the results of its reorganization and the plans for the coming fieldwork by geologic and seismic parties. The committee approved plans for additional magnetometer and gravimeter surveys of and drilling a third test well on the Barrow structure and asked John Reed (Sr.) to determine if a special seismic survey by the USGS project at the Arctic Research Laboratory at Barrow could be used to fix the bottom of permafrost.

During the 1949 season, the USGS placed six geologic parties in the field in NPR–4. William P. Brosgé and Allan N. Kover studied the Titaluk anticline north of Maybe Creek; Charles Whittington and A. Samuel Keller examined Carbon Creek and the upper Meade River; Arthur L. Bowsher and J. Thomas Dutro, Jr., worked on the Mississippian-age rocks and structure along the north front of the Brooks Range; William Patton, Jr., and Irvin L. Tailleur looked at the Okpikruk and Kiruktagiak areas west of the Chandler River; Marvin D. Mangus, Robert Detterman, and Arthur H. Lachenbruch worked along the Etivluk, Kuna, and Nigu Rivers, along the Colville between the Kuna and the Ipnavik, and in the Killik's headwaters; and Robert Chapman and Edward Sable studied areas along the Kokolik and Kukpowruk Rivers. The South Barrow test well 2, drilled to 2,505 feet, produced more than 30 million cubic feet of gas in 1949 to serve the Barrow camp, but No. 3, completed to 2,900 feet, proved dry. The initial test well at Oumalik reached 9,200 feet by year's end, but additional core tests of the Simpson wells proved inconclusive. Greenman and the Operating Committee met again in

Washington on November 17 to plan operations for 1950 that would add Bell helicopters to the fixed-wing aircraft and ground vehicles used to transport personnel, equipment, and supplies for eight field parties during the 1950 season.

The number of geologic surveys and special assignments by the USGS for the ECA increased during fiscal year 1949–50. The Alaskan and Foreign Geology Branch's program of in-service training in geology and administration for foreign nationals grew to include 25 persons from 13 countries. As part of work in the Americas, Carl Fries, Frank Simons, and other members of William Johnston, Jr.'s Branch completed or continued their investigations of Mexico's copper, iron, lead, phosphate, silver, and zinc deposits and the eruption of Parícutin, where Ray Wilcox finished his tour as "permanent observer" on July 31, 1948. Fries relieved Wilcox, who returned to the Aleutians during the field seasons of 1949 and 1950 for additional volcanological studies of the Near Islands as part of the investigations by the USGS unit based on Adak. John Dorr 2d and Philip Guild remained in Brazil investigating and mapping iron and manganese deposits in Minas Gerais; they were joined there briefly by Charles Park, Jr., and also by John Collins, Joel B. Pomerene, and Arthur Rynerson, who began longer term assignments with the project. Branch geologists also studied copper, lead, and zinc in Peru and earthquake damage in Ecuador. For Venezuela, the USGS built a requested water-discharge integrator and furnished detailed plans to enable that country to manufacture enough instruments to serve its entire irrigation program.

The Foreign Geology Unit also began preparing for a considerably larger program abroad in cooperation with the ECA, especially after the Truman administration extended its cooperative economic program to the Eastern Hemisphere. During 1949, William Pierce, while examining lignites in Greece, located major new reserves in areas near Athens that might supply the city's power needs for at least 40 years. The USGS recruited 14 geologists, mining engineers, and topographers for cooperative work in Africa for the ECA-British Colonial Surveys program. Branch geologists also aided the ECA in determining the feasibility of airborne-inductive and aeromagnetic exploration in the French colonies in Africa. USGS geologists began a survey of all mineral commodities throughout Afghanistan, in cooperation with that country's Royal Department of Mines. Glen Brown, William Johnston, Jr., George C. Taylor, Jr., and four Thai specialists completed a 7-month reconnaissance, during September 1949–April 1950, of Thailand's geology, minerals, and groundwater supplies. Brown, after completing his doctorate at Northwestern in February 1949, spent 8 months with Victor Stringfield's Colorado Plateau Project at Grand Junction working on the groundwater origin of uranium ores. Brown returned from Bangkok and finished his Thailand report in September 1950. John Dorr 2d, relieved as head of the USGS Mission in Brazil, reported to New Delhi in March 1950 to conduct, under State Department auspices, studies of mineral resources in the State of Orissa in central-east India. While there, Dorr advised the Geological Survey of India about what geophysical surveys, additional geologic work, and diamond drilling would be required before developing known deposits. Earl Irving and his assistants emphasized studies of manganese resources in continuing cooperative work on the Philippines' mineral resources.[151] In South Korea, during May–June 1949, David Andrews expanded earlier work by David Gallagher's team by briefly examining for the ECA all of the anthracite-producing areas except Samchok. Late in August, Andrews returned to South Korea with Ewart M. Baldwin, Kenneth G. Brill, Jr., and John Reinemund. During November 1949–March 1950, they extended the reconnaissance and used 1:20,000 topographic bases, produced by the Army's 64th Engineer Battalion (Topographic) from the 1:40,000 air photos requested by the ECA and the USGS, to map the Hambaek, Hwasun, Macha-ri, and Tangyang coal fields. Andrews' team specifically recommended a diamond-drilling program to delineate reserves.

The coal shown here lay between brecciated shale blocks near the Macha-ri thrust fault, where Cambro-Ordovician beds were thrust over the coal-bearing Sa-dong Formation (Pennsylvanian–Permian) in the Macha-ri coal field, about 125 miles east-southeast of Seoul, in the Republic of Korea (South Korea). The USGS expanded its immediate postwar studies of South Korea's mineral resources by sending geologist David Andrews and his team, at the Economic Cooperation Administration's request, to the country during 1949–50. Andrews' team concentrated on assessing coal resources to help solve the country's fuel problems. During September 1949–May 1950, geologist John Reinemund evaluated the Macha-ri deposits, South Korea's second largest producing coal field. Most of the field's more than 3 million metric tons produced since 1935 went by a 7.5-mile aerial tramway to the Yongwol powerplant. Half of the remaining coal reserve of 28.3 million metric tons, Reinemund estimated, was recoverable. (From Reinemund, 1957, pl. 8.)

During fiscal year 1949–50, the USGS modified aspects of its topographic-mapping program to begin delivering on its third and most recent promise to map the Nation within 20 years, provided the agency received the required funds. As a standard reference geoid, the USGS continued to use the North American datum of 1927 that it adopted in that year, but the agency now moved to standardize contour intervals and scales. On October 14, 1949, Wrather directed that future maps of coastal and navigable-water areas would show underwater contours, certain obstructions, and other landmark features. On March 22, 1950, the Director revised the scales for national and more local coverage for the third time in the agency's history. Originally, mappers in the USGS national program that began in 1882 compiled topography at scales of 1:250,000, 1:125,000, or 1:62,500, "depending upon the degree of complexity of the topography and the geological phenomena, [and] upon the density of population and industrial importance of the region." From 1879, the USGS also topographically mapped areas of specific concern, especially mineral and mining districts, and engineering works, that required coverage at about 1:12,000 or larger scales. In view of the increasing need for more detailed coverage, in the 1890s the USGS discontinued its 1:250,000 series, reduced plans for continuing to map at 1:125,000, and increased the areas to be mapped at 1:62,500. Subsequent demands for even more detailed maps led the USGS to consider another doubling of scale, to 1:31,680, or a half mile to the inch. Engineering preference for a larger map sheet, and direct foot ratios, finally led to the adoption of 1:24,000 scale, or 2,000 feet per inch, as standard for the 7.5-minute series in most areas. The 1:31,680 sheets would be converted to 1:24,000 "at reprint stage as circumstances may permit." The USGS would provide its long-promised national coverage with an atlas of maps at 1:62,500 and cover critical areas with special maps at 1:24,000 to address the increased "needs of engineering investigations, geologic and mineral studies, construction works," and "other projects of restricted area having similar requirements." "When practical," the 1:24,000 maps would use contour intervals "from either the 50-25-foot series, or from the 40-, 20-, 10-, 5-foot series, depending on the type of terrain or other circumstances." "Whenever practical," the maps would "be of standard [Federal] accuracy," be "field tested," and so noted "by an appropriate field engineer."[152]

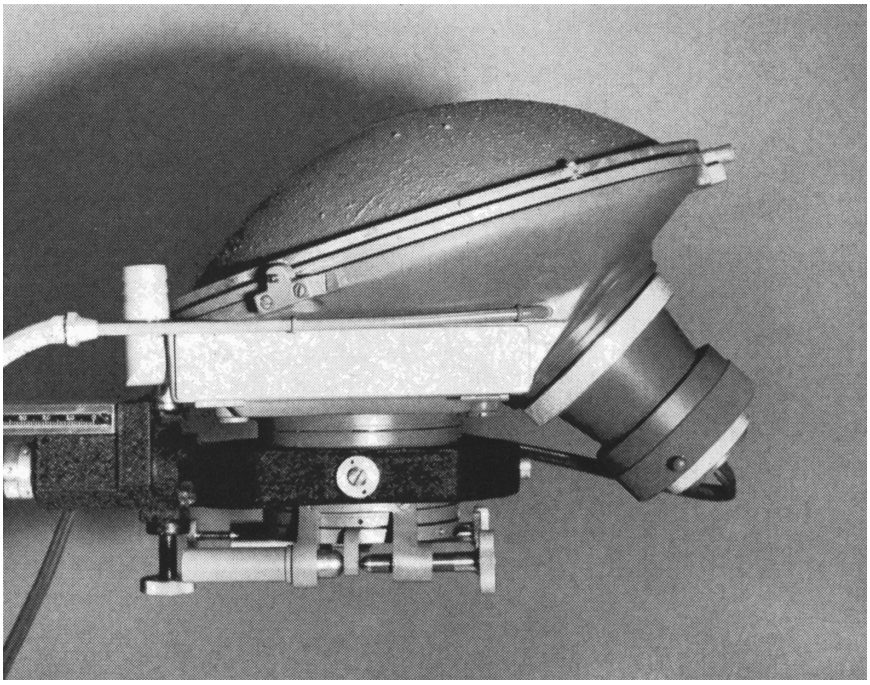
To support the USGS' growing work in Alaska, Wrather now extended to the Territory the basic specifications for the national topographic-map series of the continental United States, established by his Survey order of January 2,

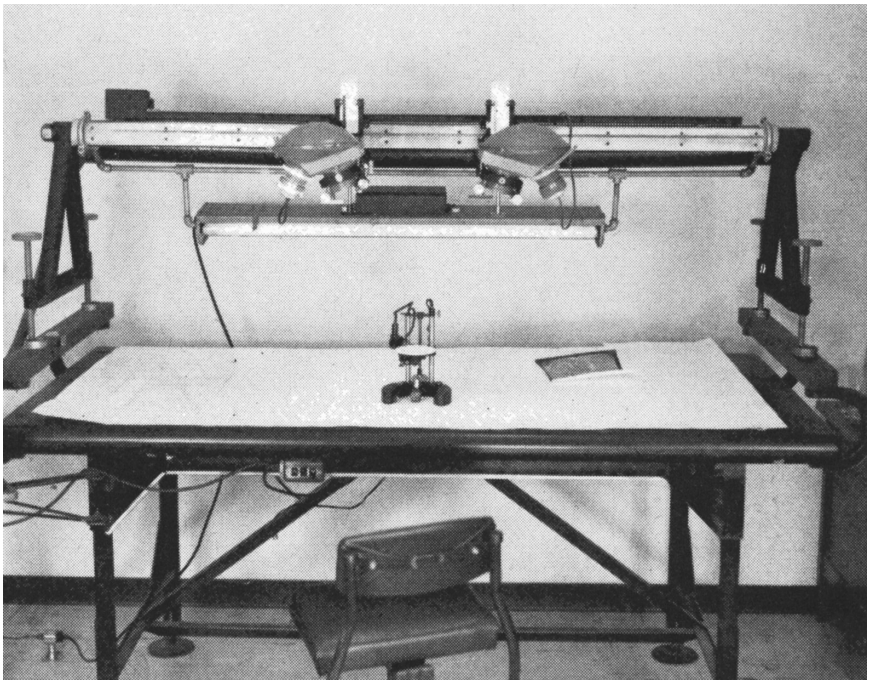
1947.[153] Alaska, he stated, will "be covered as rapidly as feasible with a new series of 1:250,000-scale topographic maps"[154] to provide same-scale coverage as the 1:250,000 program for the States transferred in 1948 to the USGS from the Army Map Service.[155] The AMS adopted the 1:250,000 map series in 1942, when its prewar maps at 1:500,000, including national coverage on 87 sheets prepared in 1938–39, and new theater maps at the same scale proved inadequate for strategic purposes. The AMS correlated the layout of its 1:250,000 sheets with those of the 1:1,000,000 sheets forming the U.S. portion of the International Map of the World (a second edition prepared by the USGS and based on the equivalent AMS series but produced for civilian use) and added Arabic numerals to locate the former within the latter. The AMS had published its initial 1:250,000 map, the Washington, D.C., sheet (NJ 18–4) in 1947. Wrather's order now set the contour interval for the USGS' new 1:250,000 maps of Alaska at 200 feet with exceptions for 100 feet in flat terrain and 500 or 1,000 feet in areas that still lacked vertical control and suitable aerial photography. Wrather asked the Topographic Division to prepare the original and provisional sheets "in an expeditious manner, from * * * control, photographs, and other source materials" immediately available. He and FitzGerald intended to replace these preliminary maps with revised editions "whenever the availability of additional control and/or better source materials would result in substantial improvement." Wrather fixed the USGS mile-per-inch, or 15-minute, series at 1:63,360 in Alaska. Maps at this scale, with contour intervals of 200, 100, 50, or 25 feet, "depending on the type of terrain," would be prepared, "as rapidly as funds permit, for those areas * * * for which there is a specific and well-justified need." The 1:63,360 maps would "generally comply with the Federal standards of map accuracy" but they would not require "routine accuracy testing and field certifications."[156] To simplify the preparation of all of the Alaskan maps at 1:250,000 and larger scales, and to facilitate coordination "with sheets of the National Canadian topographic map series, Wrather required USGS topographers to "henceforth use the Universal Transverse Mercator (UTM) projection instead of the polyconic projection."[157]

FitzGerald's Topographic Division added some $4,531,000 in transfers to its $6,382,000 in direct appropriations for a total of about $10,933,000 for salaries and operations during fiscal year 1949–50, an increase of some $1,611,000 over the previous year. To this sum the States, counties, and municipalities supplied about $1,303,600. Other Federal agencies furnished roughly $3,227,000, including some $2,359,000 from the USBR, slightly more than $551,000 from the USAF, and more than $51,000 from the Commerce Department's Bureau of Public Roads, to support the compilation and printing of the 1:250,000 transportation maps for 28 States. Although the USAF increased its transfer sum by about $40,000, its Aeronautical Chart Service notified the USGS in May 1950 that the ACS planned to internalize all charting operations and to discontinue insofar as possible all contract work with other government agencies. The ACS and the USGS agreed to gradually curtail work assignments from the ACS to the USGS, and the USGS promised to try to finish all assigned work within the next 2 years. FitzGerald planned during the transition to shift all available production capacity in the Trimetrogon Section to the expanded but still understaffed domestic mapping program, the Division's primary postwar responsibility.

In fiscal year 1949–50, Division topographers mapped in all 48 States, the District of Columbia, Alaska, Hawaii, and Puerto Rico, in cooperation with 25 of the States and Puerto Rico but of them, the USGS considered only Massachusetts, Puerto Rico, and Rhode Island adequately mapped for current needs. "At the present rate," Wrather reported that

> **it will take until about the year 2000 before the entire United States is adequately mapped.[158]**





Photogrammetrist Russell Bean and his USGS team developed this ellipsoidal reflector-55 (ER–55) projector (above) for "stereoplotting by the direct double-projection method." The "55" in the ER–55 abbreviation represented the new projector's 55-millimeter principal distance, which facilitated diapositives twice the size of those in the Multiplex to improve image resolution. In 1945, Bean discussed with Charles Davey, Heinz Gruner, and Thomas Pendleton "the basic ideas" involved in crafting and using an ellipsoidal reflector to condense "the light for projecting the image." The Army Engineers aided "the successful fabrication of the [required] special mirror to precise specifications" by the Corning Glass Works, J.W. Fecker, Inc., and the General Electroforming Laboratories. Work on the pilot model began in 1949, and the USGS successfully demonstrated the ER–55 in 1952 at the International Congress of Photogrammetry in Washington, D.C. The patented ER–55 proved to be more economical, efficient, and versatile than the Multiplex's condensing-lens system. ER–55s initially were mounted in pairs on standard Multiplex supporting frames and oriented for vertical or convergent (below) low-oblique photography from Fairchild KC–1 cameras. The prototype Twinplex plotter, also developed by Bean's team, was shown at the American Society of Photogrammetry's meeting in 1950. The Twinplex originally used two Multiplex projectors, but their replacement by two ER–55s decreased "the costs of control and compilation." (Quotations from Bean, 1953, p. 71, 73, and 81; photographs from figs. 1 and 9. See also U.S. Geological Survey, Topographic Division, Research and Technical Control Branch, Section of Photogrammetry, 1952, and Bean, 1954.)

The Topographic Division also continued to concentrate some of its efforts on mapping the Missouri River Basin, of which, FitzGerald told the Senate subcommittee, only 8 percent had been adequately mapped. During the fiscal year, the USGS mapped there an additional 10,630 square miles, part of the domestic compilation of 51,460 square miles. By now, map reproduction by multicolor photolithography and other new methods had nearly replaced copper-plate engraving in the USGS; of the 771 topographic maps reviewed and forwarded for reproduction during fiscal 1949–50, only 19 were produced by the older method. About a third of the 661 maps cleared for reproduction were compiled originally by other

agencies for special purposes. During the fiscal year, the Trimetrogon Section completed entirely new photocompilations for some 408,000 square miles worldwide, photorevised maps for nearly 114,000 square miles, and finished cartographic compilation for some 112,000 square miles. The Special Map Projects Section published two additional sheets—Lake Erie ([N]K–17) and Mount Shasta ([N]K–10)—of the International Map of the World, now being coordinated by the U.N. Cartographic Section. The Trimetrogon Section also continued work on another five of these 1:1,000,000 sheets and, for the Bureau of Public Roads, on the transportation map of the United States.

In 1949, the Topographic Division also began a comprehensive and large-scale project new to Federal domestic mapping. The cooperative program with Kentucky would provide the Bluegrass State, within 5 years, with complete map coverage of its 40,395-square-mile area on an estimated 763 maps, at a scale of 1:24,000 and contour intervals of 10 or 20 feet. Initial and smaller scale coverage by the USGS dated from 1882–1929.[159] The new topographic-mapping program was promoted by the Kentucky Chamber of Commerce, based on advice from State Geologist Daniel J. Jones, and supported by cooperative funds from Kentucky's government. The Division also started other cooperative but less comprehensive agreements with State or municipal governments in Ohio and Utah, and its topographers developed and tested new methods in utilizing trimetrogon aerial photography for mapping at 1:62,500 and used them to map one 15-minute quadrangle in the Beehive State. Additional military requirements and civilian requests increased the Division's mapping activities in Alaska, and field operations began on Molokai Island in Hawaii. The Division continued to use helicopters in Alaska and elsewhere during the 1949 field season to support its field operations, and the AMS and the U.S. Coast and Geodetic Survey (USCGS) also contracted for them for their activities in the Territory. The Division also appraised and classified all of its nearly 12,000 topographic maps and those prepared by other agencies and distributed by the USGS to evaluate their general usefulness and application to the needs of the Nation's expanding economy. On the basis of this work, the Map Information Office compiled two index maps showing the status of topographic mapping in the United States.

To aid current and future field-mapping projects, the Topographic Division revised its instructions for transit-traverse surveys and began preparing two new manuals. One provided fourth-order leveling with the Johnson Elevation Meter; the other replaced its *Topographic Instructions* (Bulletin 788), issued in 1928 as six separate chapters and as a whole volume. The Division planned to distribute its new topographic instructions as a loose-leaf notebook so that future revisions could be made by chapters to keep the guide current. Division engineers devised and evaluated new methods and instruments to increase the ease and efficiency of field and office operations, including shoran control for determining horizontal position and radar altimetry to fix vertical control for photogrammetric mapping in remote areas. Photogrammetric engineers completely redesigned the Kelsh plotter and exhibited the completed prototype of Russell Bean's Twinplex, the new double-projection plotter, at the 1950 meeting of the American Society of Photogrammetry. The Twinplex, "designed to utilize low-oblique, wide-angle photography obtained with two synchronized and rigidly coupled cameras,"[160] initially used Multiplex projectors, but ellipsoidal reflector-55 (ER–55) projectors replaced them in the improved version in 1952. The engineers continued an experimental-mapping project to determine the Twinplex's performance characteristics. They also ascertained the suitability of a German PK nine-lens camera, with a 2-inch focal length and a 130-degree coverage, for preparing small-scale planimetric maps. To lower the costs for and improve the preparation of reproduction copy for maps, staff members tested and evaluated for scribing new drafting papers, scribecoat, and other treated plastics as soon as they appeared on the market.

Paulsen's Water Resources Division received slightly more than $3,933,000 in direct appropriations for fiscal year 1949–50, of which $2,940,000 was available only for cooperation with States, counties, and municipalities, but the usual transfer funds brought the total available for salaries and operations during the year to just under $9,692,000, an increase of about $1 million over the previous year. To these adjunct funds, the States, counties, and municipalities contributed about $2,770,000. Other Federal agencies furnished roughly $2,844,000, including some $1,391,000 from the USBR, nearly $858,000 from the Army, $214,000 from the AEC, and more than $113,000 from the State Department. By July 1, 1949, the Division established Water Resources Councils in all States to serve a practical purpose for two or more district offices. Recent experiences taught the Division's leaders that in addition to determining the occurrence and availability of water, they must also fix the extent and methods of development, utilization, and conservation in areas where the limits of readily available supplies were being reached. Several projects underway appraised the water supplies of highly developed areas by correlating utilization and availability of water and estimating the future potentialities of the supplies. Inventories also were being made nationwide of requirements for water by industries and the total amount of water drawn by all types of users. These studies yielded an estimate of withdrawal of water from streams, lakes, reservoirs, and underground sources of about 200 billion gallons a day, of which about 25 billion gallons came from groundwater. Work also continued to provide accurate and extensive information about water resources in the Columbia and Missouri River Basins, to facilitate the continued economical design and operation of their water development and control projects, and to ensure supplies for livestock watered on all public lands. Division hydrologists completed determinations begun in 1948 of the amount of sediment deposited in Lake Mead behind Hoover Dam. This study, conducted in cooperation with the USBR and the Navy Department, indicated that at the present rate of sedimentation, Lake Mead probably would not be filled before the year 2380. Reservoir efficiency posed a related problem, especially in the West. Some reservoir sites proved unusable because the predicted high rate of evaporation from their surfaces would leave little water for beneficial use. To meet the need for more accurate information on the amount of evaporation from reservoirs, the USGS, again in cooperation with the USBR and the Navy, began in April 1950 a comprehensive investigation of evaporation at Lake Hefner, near Oklahoma City. A month later, Truman dedicated the Grand Coulee Dam on the Columbia, in operation since 1942 and a potential site for a similar study. Members of the Quality of Water Branch analyzed some 40,000 water samples for chemical quality and more than 100,000 samples for sediment content from 170 sites sampled daily and an equal number of sites sampled intermittently.

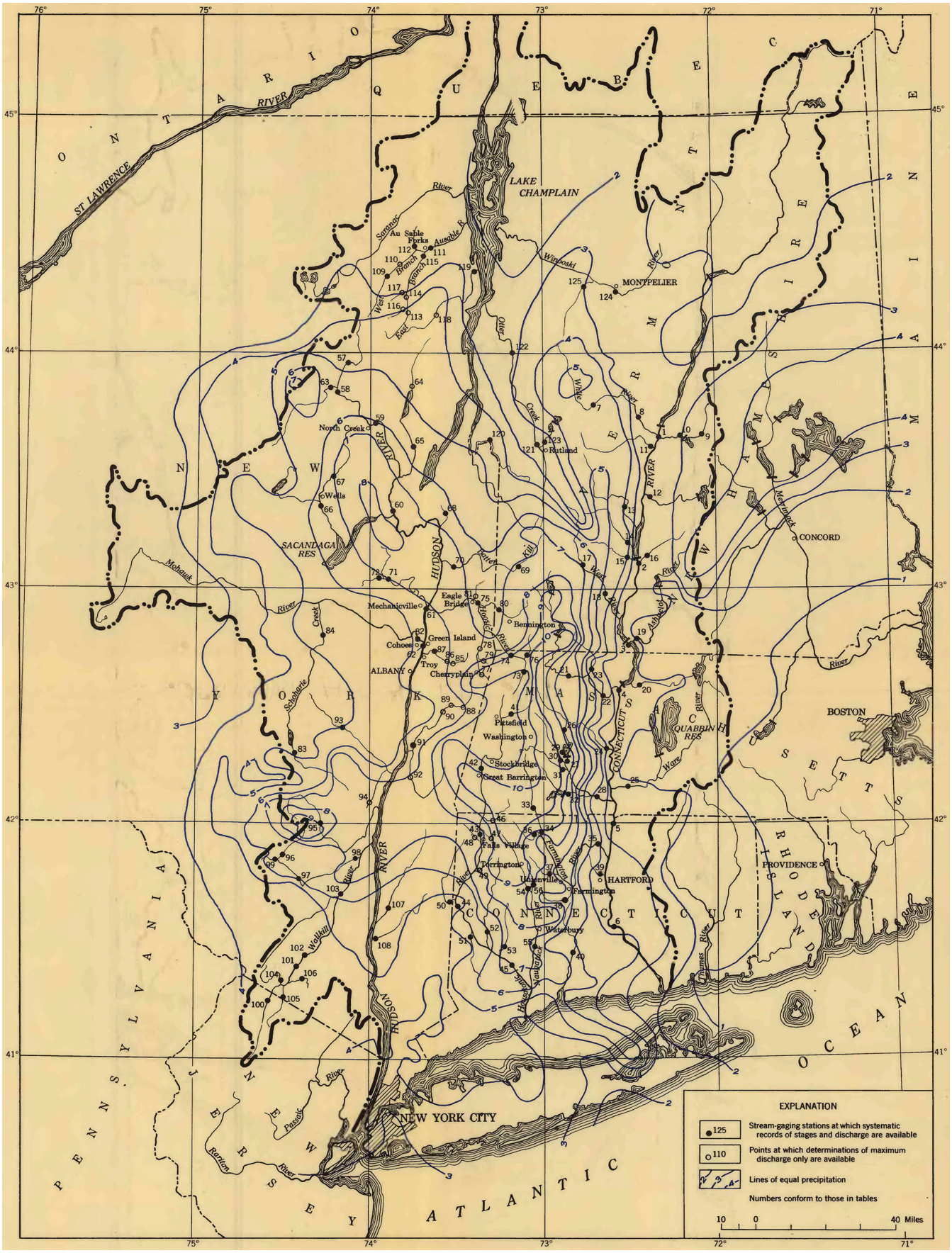
As a measure of the increasing interest in water supplies nationwide, Truman established within the Executive Office of the President, on January 3, 1950, a Water Resources Policy Commission to study and make recommendations "with respect to Federal responsibility for and participation in the development, utilization, and conservation of water resources." Truman directed the new Commission to concentrate on "(a) the extent and character of Federal Government participation in major water-resources programs, (b) an appraisal of the priority of water-resources programs from the standpoint of economic and social need, (c) criteria and standards for evaluating the feasibility of water-resources projects, and (d) desirable legislation or changes in existing legislation relating to the development, utilization, and conservation of water resources."[161] Truman asked the group to send its final report to him by December 1, 1950. The President appointed a seven-member Commission, composed of educators and engineers, and chaired by mechanical engineer Morris L. Cooke.[162] The Cooke Commission met later in January and organized a staff of about 50 persons, gathered largely from Federal agencies and universities, into a series of committees in major fields. Using data from

the Water Resources Division's districts and State councils, Charles L. McGuinness and Arthur Piper prepared the USGS report, requested by the Committee in March and completed in April. Their "Water Facts in Relation to the National Water-Resources Policy" contained three principal parts concerning a national policy, 10 rivers in America's future, and water-resources law. McGuinness summarized two parts of the report in USGS Circulars 114 (U.S. water situation) and 117 (water law) in 1951.

By the end of fiscal year 1949–50, the Surface Water Branch operated some 6,300 streamgaging stations in the conterminous States, 50 in Alaska, and others in Hawaii, an increase of about 100 units beyond those extant in 1948–49. In addition to the usual flow statistics compiled during the year, Branch hydrologists investigated the characteristics of water flow and developed new equipment to improve the accuracy of or to expedite current-meter measurements. Comparative determinations of the relative merits of the mean-section and mid-section methods of computing current-meter discharge measurements led to adopting the latter technique for official use. Flood-frequency analyses continued in several districts, and hydrologists also studied low-flow characteristics of small ungaged streams by using simultaneous-discharge measurements to correlate them with adjacent gaged streams. Measurements of Arizona's Blue Spring, at the bottom of the Little Colorado River's canyon, recorded a flow of more than 100 cubic feet per second, making it the only first-magnitude spring in the State and 1 of about 65 in the Nation. Joseph Wells appointed a committee to explore the possibilities of improving the Branch's annual reports on streamflow to make them more helpful to users. A study for the Army Engineers determined the consumption rate of water by phreatophytes along Arizona's Salt and Gila Rivers as an aid to evaluating the feasibility of salvaging the water for human use by eliminating those plants. The study demonstrated that areas of differing kinds of vegetation could be mapped accurately and rapidly from a low-flying aircraft.

National interest in groundwater, both as an overdeveloped resource in some areas and as a potential source of additional water in others, reached a new high during fiscal year 1949–50. Geologists and hydrologists in the Ground Water Branch conducted investigations in more than 400 projects in the States, Alaska, Hawaii, Puerto Rico, and the Virgin Islands. They also prepared more than 250 formal reports and papers and responses to several thousand requests for information on local and regional groundwater conditions. Those papers included a study of the qualitative aspects of the relation of soil structure to infiltration and unsaturated flow above the water table as a precursor to the results of quantitative work underway. Research and development in the Branch produced a Lucite-tube device to sample earth materials from outcrops and test pits that could be transferred to a permeability measuring instrument without disturbing the materials. Branch members also perfected an advanced design of the permeameter and developed a technique for deaerating the water that passed through it, thereby eliminating past errors of up to 1,000 percent in determinations of permeability. Morris Muskat's "Physical Principles of Oil Production," published in 1949, rapidly became another important reference for USGS investigations of groundwater movement.

In the West, geophysical surveys located water supplies on the water-short Navajo and Papago Indian Reservations and also helped to find a site for a deep test hole on an Army Ordnance depot near Flagstaff, in an area where groundwater occurred at great depth and drilling proved expensive. The Branch's study for the AEC at Valle Grande in New Mexico showed the presence of large amounts of stored water in sediments deposited in the crater of a huge ancient volcano but only a relatively small perennial supply. Harold Thomas' hydrologic reconnaissance of the Green River in Utah and Colorado showed that careful studies of groundwater geology, streamflow, and water quality at carefully selected stations could contribute significantly to a better understanding of the characters of stream systems.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Winooski River
MONTPELIER
White River
Rutland
North Creek
Wells
SACANDAGA RES
Mohawk River
HUDSON RIVER
Raven Creek
Mill Creek
West Creek
Mechanicville
Eagle Bridge
Hoosic River
Bennington
Green Island
Cohoes
Troy
ALBANY
Cherryplain
Schoharie Creek
Ashuelot River
CONCORD
Merrimack River
Pittsfield
Washington
Stockbridge
Great Barrington
Housatonic River
QUABBIN RES
Ware River
BOSTON
Farmington River
Waterbury
HARTFORD
Thames River
PROVIDENCE
Wallkill River
Passaic River
Raritan River
NEW YORK CITY
EXPLANATION
125 Stream-gaging stations at which systematic records of stages and discharge are available
110 Points at which determinations of maximum discharge only are available
Lines of equal precipitation
Numbers conform to those in tables
10 0 40 Miles

◀ This map (originally at 1 inch = 20 miles and on white stock) of flood-flow determinations in 1949 for a 4,500-square-mile area in six northeastern States shows isohyetal (equal-precipitation) lines in blue. Numbers (also shown in blue) denote total inches of precipitation received. Filled circles represent the streamgaging stations with systematic records of stage and discharge; open circles show locations where only maximum-discharge records were available. The area received 5–12 inches of precipitation in December 1949. Analyses of data from 125 streamgaging stations in the basins of the Hudson and Connecticut Rivers that measured water stages and (or) discharges yielded determinations of flood flow. In postwar years, USGS hydrologists continued their studies of the nature and effects of floods, partly to aid efforts at mitigation and also help the insurers and the insured. (From U.S. Geological Survey, Water Resources Division, 1952, pl. 1.)

Arthur Piper and Raymond Nace continued to study groundwater occurrences in Idaho's Arco area, evaluated the area's suitability for large-scale industrial operations, and projected groundwater motion in relation to radioactive-waste disposal from the National Reactor Testing Station, whose Experimental Breeder Reactor No. 1 began producing usable electricity on December 20, 1951.

In the East, a study of the hydrology of Indiana's Eagle Lake produced data for the investigation of the groundwater profile adjacent to the lake as a function of lake level, one intended to facilitate predicting the effect of changes in the lake stage on the water table. New York's Conservation Foundation sponsored a nationwide survey of America's groundwater as a contribution to appraising that situation in relation to other national problems. Research on the disposal of radioactive wastes on Long Island already had yielded useful data on the behavior of various tracers used in mapping groundwater movement.

In federally supported work abroad, Paul H. Jones evaluated, during March–April 1950, groundwater resources in Chile's Río Elqui Valley and the adjacent region, and its Huachipato-Talcahuano area for, respectively, irrigation and industrial uses. In the Azores in April and May 1950, George F. Worts, Jr., assessed for the USAF the geology and groundwater conditions in the volcanic terrain at the east end of Terceira Island and made recommendations for securing needed water supplies for the Military Air Transport Service's Lajes Field. Branch colleagues in the United States helped to train visiting hydrologists from Chile, India, and Venezuela.

The Conservation Division added a little more than $67,000 in transfers to its direct appropriations of nearly $1,066,000 for classifying lands and supervising mining and oil and gas leases during fiscal year 1949–50. Of the Division's total of about $1,133,000, an increase of nearly $40,000 over the previous year, the Navy supplied about $29,000 and the USBR provided some $22,000. In mid-August 1949, Krug's Secretarial order expanded the authority of the Division's regional supervisors of oil and gas and of mining by authorizing them to "act for the Secretary * * * in finally approving applications for suspension of operations and production for periods aggregating 12 consecutive months or less," to "grant temporary approval of applications for suspension for periods in excess of 12 consecutive months subject to final approval, modification or revocation by the Secretary on review," and to "terminate suspensions of operations and production previously granted by the Secretary."[163] Early in October, Krug delegated to Wrather the authority to "enter into agreements for the acquisition and accept conveyances of lands or interests in lands whenever" they "are to be acquired for administration through the Geological Survey pursuant to any act of Congress."[164]

Operations by the Conservation Division's units during fiscal year 1949–50 included actions by the Mineral Classification Branch on nearly 15,900 cases involving the outright disposal of Federal lands with no reservation of any mineral, the disposal of such lands with the reservation of one or more specified minerals, or the exercise under the Federal leasing laws of the Government's right to explore for and produce one or additional mineral substances from lands under its jurisdiction.[165] To aid this work, Robert E. Spratt began serving as Staff Assistant to John Northrop in Northrop's additional role as Chief of the Mineral Classification Branch. The number of completed mineral reports decreased by 9,075 cases, or about 36 percent, compared to those reviewed in fiscal 1948–49, a decline that reflected the public's diminished interest in acquiring oil and gas leases in view of a threat of overproduction of those energy resources. Members of the Water and Power Branch worked in Alaska, California, and the Columbia, Colorado, and Missouri River basins. They surveyed two reservoir sites and 90 miles of river channel and published maps of 300 miles of 8 rivers, 3 dam sites, and 3 reservoir sites. At the end of fiscal 1949–50, power-site reserves totaled more than 6.8 million acres

in 23 States and Alaska. Reservoir-site reserves in nine States totaled more than 137,000 acres. In 1949–50, the Mining Branch supervised slightly more than 1,200 properties under lease, permit, license, and secretarial authorization, of which some three-fourths were on the public domain. Production of energy resources from these sources was valued at more than $85 million, and royalties accrued from them totaled $2.6 million, also a decrease compared to fiscal 1948–49. Coal production also fell following additional strikes by mine workers and increased competition from other fuels. Although potassium production also decreased due to prolonged strikes, its output still exceeded in value that of coal. The use of lower grade ores and lower prices accounted for the decline in lead and zinc concentrates produced from Indian lands in Oklahoma. On April 15, 1950, Truman, wishing to ensure continued competition to hold down prices, vetoed a bill intended to amend the Natural Gas Act of 1938 by removing the Federal Power Commission's authority to regulate sales of natural gas to interstate pipeline companies for resale by producers and gatherers not affiliated with the buyers. During fiscal 1949–50, the Oil and Gas Leasing Branch supervised operations on slightly more than 28,900 properties on public lands, a increase of some 26 percent from fiscal 1948–49, and slightly more than 6,550 leaseholds on Indian lands. Production from petroleum deposits on the public lands fell somewhat during fiscal 1949–50, and royalty returns totaled $21,637,000, a decline of nearly $3.4 million. Royalties from aggregate production from the now 254 active wells in NPR–2 fell to $945,500, a loss of nearly $37,000.

In the late 1940s, the United States significantly increased its security arrangements in both hemispheres. On May 2, 1948, the Charter of Bogotá, signed on April 30 by representatives of the United States and 20 Latin American nations meeting in the 9th Pan-American Conference, founded the Organization of American States (OAS). The new OAS was designed to supersede the Pan-American Union in promoting cooperation and peace in the Western Hemisphere. The OAS charter went into effect on December 13, 1948, when Colombia became the 14th nation to ratify the agreement. The OAS, with headquarters in Washington, comprised four principal parts—Council, Secretariat, Inter-American Conferences (once every 5 years), and Foreign Ministers Conferences. On June 11, 1948, the Senate approved Arthur Vandenberg's resolution favoring U.S. participation in regional security agreements within the U.N. framework. In Washington, on April 4, 1949, representatives of 12 nations—Belgium, Britain, Canada, Denmark, France, Iceland, Italy, Luxembourg, The Netherlands, Norway, Portugal, and the United States—signed a pact, the North Atlantic Treaty Organization[166] (NATO), to maintain, by force if necessary, the region's security. Sweden, Switzerland, and the new Republic of Ireland chose not to join NATO, which did not invite Franco's Spain or Greece, whose civil war continued until October 16. An attack on any NATO member would be considered an assault on all of the signatory nations. The NATO treaty established a council, to plan for joint action and mutual military and other aid, to which new members could be admitted by unanimous approval. Truman sent the treaty to the Senate on April 12, the Senators ratified the pact on July 21, the President signed it 4 days later,[167] and it went into effect on August 24.

As the Soviets ended their blockade of West Berlin on May 12, 1949, the Allied Powers agreed to join their occupation zones and organize them as a new German Federal Republic (West Germany) to give self-rule to the people of the 11 (later 9) western German states and West Berlin. Representatives of those German states prepared a constitution that led to proclaiming the Federal Republic at Bonn on May 23. Reflecting the results of elections in August for the Bundestag, Theodor Heuss, a Free Democrat, assumed the presidency of the new country, and Konrad Adenauer, a Christian Democrat, became its Chancellor on September 15. Six days later, the United States, Britain, and France restored civil status to West Germany. The Soviet Union responded by declaring, in East Berlin on October 7, a

German Democratic Republic (East Germany) to comprise the Soviet zone, except those areas east of the Oder-Neisse line annexed by Poland and Soviet Kaliningrad. The Soviets and their six satellite states in Eastern Europe—Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland, and Romania—did not respond to NATO until 1955, when they organized the Warsaw Pact. From June 1949, Tito's Yugoslavia, unlike its neighbor Albania, now under Communist dictator Enver Hoxha, continued to pursue an independent socialist course that included increased contacts with the West. Hoxha, Albania's premier since 1944, continued to favor the Soviet Union until, in the middle 1950s, he shifted his loyalty to the People's Republic of China.

A week before the Soviet Union established East Germany, with its capital in East Berlin, Stalin added a nuclear weapon to his arsenal. America's postwar confidence that its science and technology were among the best in the world, if not preeminent, was rudely shaken when President Truman and British Prime Minister Attlee announced on September 23, 1949, that the Soviet Union had recently detonated an atomic bomb, at least 3 years ahead of the predictions of most American experts. As the Soviets worked toward ending the U.S. nuclear hegemony, Stalin gave the Ministry of Armed Forces to General Nikolai A. Bulganin early in March 1947. Marshal Aleksandr M. Vasilievsky replaced Bulganin on March 4, 1949, as Andrei Vyshinsky succeeded Vyacheslav Molotov as Foreign Minister, but Stalin had kept General Boris Vannikov and physicist Igor Kurchatov at their vital posts in Lavrenti Beria's atomic-bomb project.[168] Kurchatov's Soviet-German team had begun testing their prototype nuclear reactor in Moscow early in 1946, aided by advice from Niels Bohr and based on information he claimed the Americans had published. The Soviet physicists achieved a self-sustaining chain reaction in June 1948. A second reactor at Chelyabinsk, in the southeastern Urals and near the border with the Kazak Soviet Socialist Republic (now Kazakhstan), produced plutonium, while weapon designers continued their operations at Sarova (Sarov since 1995), 200 miles southeast of Moscow. The latter group included Andrei D. Sakharov, a young physicist, who joined Kurchatov's designers in 1948 to help develop a thermonuclear device.

For their initial nuclear explosion, the Soviets used not their own version but the purloined American "Fat Man" design to build a plutonium-implosion device they called "First Lightning," termed "Joe-1" by the United States, and mounted, like the Trinity "gadget," on a 100-foot tower. On August 29, 1949, a nervous Beria, the two Russians who witnessed the Bikini tests in 1946, and Kurchatov and his team observed the 20-kiloton explosion of the new device at a site some 60 miles west of Semipalatinsk (Semey since 1991) in northeastern Kazakhstan. American weather observers in WB–29s, flying between Japan and Alaska, began recording increased levels of radiation in the skies east of Kamchatka and in other areas on September 3. By September 19, an AEC special committee—Vannevar Bush, Robert Oppenheimer, Robert Bacher, and General Hoyt Vandenberg—confirmed all the radiation data. They advised David Lilienthal and President Truman to announce the Soviet achievement. On September 25, two days after Truman's and Attlee's announcements, TASS, the Soviet news agency, confirmed the successful test. The Soviets followed their success by fabricating and exploding improved atomic bombs of their own design; Joe-2 yielded 40 kilotons.

In any future conflict between the Soviet Union and the United States, the Red Air Force could only deliver its atomic bombs in one-way missions by using its new four-engine bomber, the Tupolev Tu-4, formed from reverse-engineered parts of damaged B–29s that landed in the Soviet Union during World War II. The Tu-4 flew first in May 1947, but without extensive numbers of Tu-4s modified as tankers for aerial refueling (as more than 50 of the nearly 500 U.S. Superfortresses had been modified into KB–29s), the Soviet bombers would be able to reach the United States but then could not return to their bases. The USAF's Strategic Air

Command (SAC) began receiving B–50s, an improved version of the B–29 and also styled Superfortress, in February 1948. To demonstrate the SAC's global reach, a B–50A, refueled four times from KB–29s, completed on March 2, 1949, a 94-hour nonstop trip of 23,452 miles around the world. By then, the SAC operated 70 B–36s and B–50s, almost enough aircraft to deliver all of America's existing atomic bombs. The USAF also continued to develop rocket-powered missiles and aircraft. In 1945, Secretary Stimson had approved establishing a range at White Sands in New Mexico, south of Alamogordo, to test captured German V–2s and newer strategic guided missiles under the guidance of Wernher von Braun and his team. Secretary Forrestal announced late in 1948 that the United States also was working on an Earth-satellite vehicle program. On May 11, 1949, President Truman signed a bill that authorized the Secretary of the Air Force "to establish a joint long-range proving ground for guided missiles and other weapons,"[169] begun later at Cape Canaveral on Florida's Atlantic Coast, and provided up to $75 million for the site's development. The Joint Chiefs of Staff gave responsibility for strategic guided missiles to the USAF on March 15, 1950.

Congress and the President responded both economically and militarily to the earlier actions by the Soviets and now acted to counter their latest developments. The National Security Act amendments[170] of August 10, 1949, reorganized the National Military Establishment as an Executive Department—the Department of Defense (DoD)—to improve its fiscal management in promoting efficiency and economy, to provide for a Deputy Secretary and three Assistant Secretaries, to create a President-appointed and nonvoting Chairman of the Joint Chiefs of Staff, and to change the name of the War Council to the Armed Forces Policy Council. On October 6, Truman signed two additional bills to provide more foreign aid. The Foreign Aid Appropriations Act for fiscal year 1949–50 authorized $1.074 billion for the expenses required to carry out the provisions of the Economic Cooperation Act, an additional $45 million to Greece and Turkey, up to $4 million to enable "selected citizens of [Nationalist] China to study in accredited colleges, universities, or other educational institutions in the United States," and $912,500,000 for U.S. Army civil-function expenses in governing or occupying "certain foreign areas."[171] Congress and the President approved the Mutual Defense Assistance Act "to promote the foreign policy and provide for the defense and general welfare of the United States by furnishing military assistance to foreign nations." The act favored "the creation by the free countries and free peoples of the Far East"[172] of a NATO-like organization consistent with the U.N. Charter; authorized up to $500 million, later doubled, for NATO; $211,370,000 more for Greece and Turkey; $27,640,000 for Iran, South Korea, and the Philippines; and an extra $75 million for Nationalist China. On October 17, Truman authorized the production of atomic bombs in greater numbers. In view of America's economic and military reach, Stalin launched a "peace" offensive on December 31, his 70th birthday.

On January 31, 1950, Truman, increasingly concerned about Soviet capabilities and intentions, and unconvinced that the Russians would really change their ways, took further actions. The President ordered David Lilienthal and his AEC "to continue its work on all forms of atomic weapons, including the so-called hydrogen or superbomb."[173] Lilienthal, Acheson, and Louis Johnson had served as a committee to evaluate the proposed development of the "super." On November 9, 1949, Lilienthal reluctantly cast the deciding vote in the AEC's 3–2 decision to recommend the hydrogen bomb to Truman, but Lilienthal then resigned, effective February 15, 1950, as did his assistant William Golden, who remained with the AEC until 1958 but only as a consultant. Karl Compton, David T. Griggs, Ernest Lawrence, and Edward Teller approved the project, but George Kennan and Robert Oppenheimer opposed it on both moral and technical grounds. Teller then took the lead in developing the new fusion or thermonuclear device; on March 18, 1950, Truman ordered a crash program to develop the hydrogen bomb. In January, Truman

authorized a greater role for the CIA in foreign affairs, including the overthrow of governments. On June 5, the President approved a third aid bill, the Foreign Economic Assistance Act, to provide an additional $2.7 billion for economic cooperation, principally via the European Recovery and Point Four Programs, $40 million more for areas in China (including Taiwan) not under Communist control, and $27,450,000 for donations to the U.N. Relief and Works Agency for Palestine Refugees in the Near East. This latest statute authorized up to $35 million for a number of measures including bilateral technical cooperation programs designed to use international "interchange of technical knowledge and skills * * * to contribute to the balanced and integrated development of the economic resources and productive capacities of economically underdeveloped areas"[174] by means of "economic, engineering, medical, educational, agricultural, fishery, mineral, and fiscal surveys, demonstration, [and] training."[175] The law also provided up to $15 million for contributions to welfare work by the U.N. Children's Emergency Fund.

As Truman signed the Foreign Economic Assistance Act, conflicts continued in Indonesia and Vietnam. On January 28, 1949, the U.N. Security Council again tried to end the fighting in Indonesia by requesting a second cease-fire, the return of captured leaders, and independence for the Indonesians not later than July 1, 1950. After negotiations at The Hague, The Netherlands and the Republic of Indonesia finally agreed to shift their sovereignty to the United States of Indonesia on December 27, 1949, and its Government now led by Sukarno as president, with Hatta as prime minister, and operating from Jakarta (formerly Batavia) on Java. The United States of Indonesia comprised 16 states but not Dutch New Guinea, whose association remained to be determined. Amid Communist, Muslim, and other insurgencies, the Indonesian states outside the United States of Indonesia agreed to join it on August 17, 1950. The United States of Indonesia lapsed, and the U.N. admitted the now larger Republic of Indonesia on September 28.

On the Asian mainland, Mao's and Stalin's governments recognized Hõ Chí Minh's Communist-nationalist regime in Hanoi in January and February 1950. On February 7, the U.S. and British Governments recognized the independence of Bao Dai's Republic of Vietnam (including Cochin China), Cambodia, and Laos as Associated States within the French Union, as the French had agreed during March, July, and November 1949. By that understanding, Bao Dai remained head of state, with government centers in Saigon and Hue, and France retained its military bases in the country. Ngô Dình Diêm, Bao's deputy, refused to agree. French forces had withdrawn from Indochina's northern border early in November 1949. In February 1950, the Viet Minh, reinforced by Communist Chinese advisers and weapons, resumed regular attacks. When France requested U.S. aid, Truman decided that NATO needed France's continued active participation. On May 8, 1950, the President agreed to provide an initial $10 million in economic and military aid to French efforts in Indochina. On June 27, Truman, acting on Acheson's recommendation, ordered a strengthening of U.S. forces in and an acceleration of American military aid to the Philippines, increased military assistance to France and colonial French forces in Indochina, and sent a 35-man military team to aid and cooperate with them.

Truman, in his State of the Union Message to Congress on January 4, 1950, asserted that America's situation "continues to be good."[176] "During the past year we have made notable progress," he continued, "in strengthening the foundations of peace and freedom, abroad and at home."[177] The President asked for statehood for Hawaii as well as Alaska and, in view of the 80th Congress' large reduction of taxes, reported a coming deficit but promised to hold Federal expenditures "to the lowest levels consistent with our international requirements and the essential needs of economic growth and the well-being of our people."[178] In a news conference held the next day, Truman also promised that the United States would neither be involved in China's civil conflict nor provide military aid to Taiwan. The President,

in his economic report on January 6, called for specific legislation on a dozen important items, including the establishment of a Columbia River Authority and authorization of a St. Lawrence seaway and power project. His budget message of January 9 predicted receipts of $37.3 billion, or $460 million less than in fiscal year 1949–50, and outlays of $42.4, or $860 million less, to reduce the deficit by $400 million to $5.1 billion. Truman requested adjustments in the tax laws and promised to hold spending for national defense to $13.5 billion, or $7.5 billion less than in the previous year; international programs would receive $4.5 billion.

In the following month, U.S. hysteria over the "Red Menace," both real and imagined, reached a new high. On February 9, 1950, just days after British physicist Klaus Fuchs confessed to spying for the Soviet Union at Los Alamos, Senator Joseph R. McCarthy (R–WI), speaking at Wheeling, West Virginia, held up an undisclosed and unverified list of 205 subversives in the State Department that he claimed were all known to Secretary Acheson but still employed by him. McCarthy based his speech on earlier anti-Communist remarks by both Democrats and Republicans. His complaint that the Truman administration had been slow to remove subversives from the State Department clashed with the results of the 1946 investigation of some 3,000 of its employees. The screening found evidence against 284 of them, 79 of whom were actual perpetrators and were fired.

Senator McCarthy's claim, and those by the Federal Bureau of Investigation (FBI), heightened the ongoing scare,[179] originally brought on by the revelations about Fuchs and the U.S. nuclear spies, the fellow travelers, and the members of the American Communist Party, 11 of whose leaders had been convicted on October 14, 1949, of violating 1940's Smith Act by advocating the use of force and violence to overthrow the U.S. Government. More recent charges of espionage by Harry D. White, Henry Morgenthau's adviser at the Treasury Department since 1934, and by Alger Hiss further fueled the hysteria. White resigned in March 1947 and died in 1948 before he could be indicted. In August 1948, Americans learned about Hiss' alleged prewar passing of secret cables from the State Department to agents of Soviet military intelligence. After Hiss lied to congressional investigators, a second jury found him guilty of two counts of perjury on January 21, 1950. In March 1951, Hiss, his appeals exhausted, began serving a 5-year prison sentence.

Charges by McCarthy and others led to an investigation by a special subcommittee, of the Senate's Committee on Foreign Relations, chaired by Millard E. Tydings (D–MD), who also led its Committee on Armed Services. Exactly how many other Americans sympathetic to communism, and in positions of power or influence, may have acted illegally remained to be discovered and proved.[180] On July 20, 1950, the Senate subcommittee's report declared McCarthy's charges false. This outcome did not stop McCarthy, Senator Taft, and their supporters in and out of Congress, who believed the growing anti-Red hysteria would serve themselves as well as the Republican Party in the coming midterm elections. They continued to search for and expose as subversives alleged Communists and their sympathizers. McCarthy supported Patrick McCarran, now also Chairman of the Senate Subcommittee on Internal Security, who added anti-Communism to his long-standing aversions to liberals and reform. In September, the 81st Congress passed over Truman's veto, the Internal Security Act,[181] sponsored by Senator McCarran and Representative John S. Wood (D–GA), Chairman of the House Committee on Un-American Activities. The McCarran Act established a Subversive Activities Control Board, authorized registering Communist-controlled organizations and interning potential subversives during national emergencies, prohibited the employment of Communists in national-defense work, and prevented from entering the United States any persons who had been members of totalitarian organizations. The U.S. Supreme Court upheld the McCarran Act in June 1951, as it had the convictions of the 11 leaders of the American Communist Party.

On May 10, 1950, as McCarthy continued his crusade against Communists and fellow travelers in the Federal Government, Truman signed legislation that gave him, as historian Merton England noted,[182] the kind of organization for national science that he had sought from Congress since September 1946. Senator Taft's and other legislators' comments on Truman's pocket veto of the Senate's bill in August 1947 ended any hope of enacting a science foundation during the remainder of the 80th Congress' first session. Vannevar Bush and many of the other engineers and scientists who supported the measure continued to hope for and work toward a new compromise acceptable to them, Congress, and the President. Bush and Truman, in discussing strategy in a meeting at the White House on September 27, agreed that Bush, James Webb, and James Forrestal would join in drafting a new bill for Truman's review before it passed to its congressional sponsors. To point out the existing agreements about the foundation, and urge settlement of the remaining differences relating to its organization and operations, Howard Meyerhoff printed in *Science* for November 7, most of Bethuel M. Webster's comments that listed general agreement. Webster, a New York lawyer who served with Bush, Conant, and Jewett on the National Advisory Committee for Aeronautics (NACA) since before the war, emphasized the acceptance by most of those concerned of "freedom of research and education," "civilian administration," "emphasis on fundamental research in universities and colleges," "emphasis on training personnel," "utilization of both laymen and scientists in the program," "appointment and responsibility of the director,"[183] and "status of the board."[184] On March 25, 1948, Harley Kilgore, Warren Magnuson, and Alexander Smith in the Senate, and Charles A. Wolverton (R–NJ) in the House, introduced parallel measures, but their bills died when the 80th Congress adjourned.

The national science foundation's proponents tried again after members of the 81st Congress took their seats on January 3, 1949. Truman, in his budget message, repeated his call for a foundation. Senator Elbert Thomas introduced a new bill that passed out unamended on March 18. In the House, majority whip J. Percy Priest (D–TX) held hearings during March and April and reported out the bill on May 24. Priest's bill encountered ever-growing concerns by Democratic and Republican members about burgeoning bureaucracy, Communist infiltration and subversion, foundation-employee and grant-recipient loyalty (to be verified by the FBI), Federal economy, and agency territoriality (principally impingement on the National Institutes of Health) that also continued to be played out on similar and wider stages within the United States. Both bills lapsed when the 81st Congress' first session ended on October 19.

Vannevar Bush and Frank Pace, Jr., Webb's successor as Budget Director, agreed to continue to emphasize the foundation's role in national economy and defense, and science in higher education, but to revise its budget estimates to provide for reductions after the $25 million requested for the initial 2 years. Early in the 81st Congress' second session, Truman again asked the legislators to pass a foundation bill that he could sign. In *Science* for January 27, 1950, Dael Wolfle, in assessing the foundation's prospects for the year, urged his readers to send their views to their Representatives in the hope of assuring them that Priest's bill "will make important contributions to the nation's welfare."[185] On March 1, the House voted 247 to 125 to send the additionally amended bill to the Senate. After a 10-member conference committee (including Priest, Smith, Taft, and Thomas) melded it with S. 247, the joint measure passed the House on April 27 and the Senate on the following day. On May 5, the day that *Science* reported the bill as "perhaps as good a compromise as could be obtained now,"[186] the Bureau of the Budget recommended approving the bill and its ceilings on the budgets of $500,000 for the first year and $15 million for subsequent years. Truman signed the legislation on May 10 to establish the National Science Foundation.

The National Science Foundation (NSF) Act of 1950 founded an independent agency in the executive branch to "promote the progress of science; to advance the national health, prosperity, and welfare; [and] to secure the national defense." The new law authorized the NSF "to develop and encourage * * * a national policy for the promotion of basic research and education in the sciences," "to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences" by contracts, grants, loans, scholarships, or graduate fellowships. The statute also gave the NSF the power "to appraise the impact of research upon industrial development and upon the general welfare," "to initiate and support" defense-related research "at the request of the Secretary of Defense," "to foster the interchange of scientific information among scientists in the United States and foreign countries," to evaluate Federal scientific programs and correlate its own programs "with those undertaken by public and private research groups," "to establish special commissions"[187] as required, and "to maintain a register of scientific and technical personnel,"[188] to be transferred from the U.S. Employment Service. The act required the NSF to send an annual report to the President for submission to Congress before January 15 of each year. The law established a National Science Board, of 24 voting members, each with 6-year terms and $25 per diem plus travel expenses, led by a chairman and vice chairman elected for 2-year terms by the Board. The law also authorized an executive committee, also chosen by the Board, which prepared the annual report; a director, as ex officio member, appointed by the President with the Senate's advice and consent; and a deputy director, selected by the director. The NSF's four program Divisions—Medical Research; Mathematical, Physical, and Engineering Sciences; Biological Sciences; and Scientific Personnel and Education—each received the authority to appoint committees. The statute's security provisions eliminated support for any research and development in nuclear energy without the AEC's approval. These sections also mandated requirements and safeguards, established by the Secretary of Defense, for NSF research related to national defense, investigations of these concerns by other Federal agencies as requested by the NSF, FBI clearances of the "character, associations, and loyalty"[189] of any NSF employee to be permitted access to restricted information or property, and loyalty declarations from fellowship recipients. The law also gave the NSF the authority to accept transfer funds from other Federal agencies. On September 27, Congress added $225,000 to supplement the $500,000 originally provided for fiscal year 1950–51.

The founders intended NSF's program division for Mathematical, Physical, and Engineering Sciences to provide greater financial support for research in the earth sciences at academic institutions, but the USGS could not legally apply for these funds. USGS scientists might be able to use the NSF to their advantage by joining, as nonprincipal participants, in NSF-sponsored investigations as they continued to do in those funded by the Smithsonian, the scientific schools, and the Carnegie Institute of Washington and other granting organizations. They also might be called upon to advise the NSF, as they had long similarly aided the NAS and the National Research Council (NRC).

On November 10, 1949, Krug resigned as Secretary of the Interior and his resignation became effective on December 1. As Krug's successor, Truman nominated Oscar Chapman on January 5, 1950, and the Senate confirmed the new Secretary on January 18. Wrather, recalling Krug's departure, appreciated his "calm, deliberate air," and his "rational, open-minded attitude toward the affairs of the department," yet Krug gave Wrather "the impression that he was not entirely happy with the job" and took his long inspection trips in the field partly "to get away temporarily from the continuing round of annoying problems * * * in Washington." Krug, Wrather believed, "was heartily glad to be rid of the job and [so] could once more return to his personal affairs."[190] Chapman, Wrather found through several

Oscar Littleton Chapman (1896–1978), the 34th Secretary of the Interior (1949–53) is shown here (seated at right) with President Truman (seated at left) and Assistant Secretary of the Interior Girard Davidson (standing in center). Chapman, a lawyer and Navy veteran, became Assistant Secretary of the Interior in 1933 and Under Secretary in 1946. Chapman succeeded Julius Krug as Acting Secretary on December 1, 1949, and served as Secretary until January 20, 1953. In 1950, Chapman successfully recommended to Congress and the President that they remove the USGS's 62-year-old millstone of line-itemized budgets by returning the agency to block funding for surveys, investigations, and research. Chapman also approved Director Wrather's request not to establish USGS Regional Directors. (Photograph by Abbie Rowe, National Archives and Records Administration [NARA], Still Picture Branch, record 8451352, December 21, 1950, NARA ARC identifier 200262.)

years' experience, "was thoroughly familiar with the normal duties of the several bureaus. He was affable and approachable and was generally liked throughout the Department." Chapman "was tolerant of the views of his associates and expected them to speak out without fear of reprisals." Wrather "did not always agree with him on matters of policy," but the Director felt sure that he lost "none of his friendship or respect by stoutly contending for what I believed was right."[191]

As Secretary, Chapman increased Interior's efforts to regionalize its bureaus' management as well as their operations. Vernon D. Northrup, the former Director of Interior's Division of Budget and Administrative Management and now the Administrative Assistant Secretary, convinced Chapman to move employees out of Washington to regional centers that would consolidate local offices and secure "greater economy and improved administration."[192] For Wrather, "Regionalization had a sinister ring to those familiar with Survey history,"[193] beginning with the disparate views of Directors King and Powell. King favored facilities nearer field areas to require less seasonal travel and facilitate local contacts and cooperation; Powell sought unified control and increased off-season discussions in the Capital. Northrup now wished to extend to the Department the Bureau of Reclamation's scheme in which each region's chief officer handled all of the Bureau's responsibilities in that area, "subject only to supervision from the Washington office." Wrather "did not believe that such a pattern would fit the Survey," as a "regional representative might satisfactorily supervise the work of one division, but he would inevitably clash with the other divisions with whose work he was not equally familiar."[194] Wrather supported Chapman's first goal by continuing to distribute "the work of the Survey to major field centers"[195] and continuing the agency's field committees. Wrather and Nolan planned to extend the Topographic Division's current geographic organization to the other USGS program Divisions. They proposed to Interior five USGS major operational centers—Washington (Atlantic States), Rolla (Mississippi Valley), Denver (Rocky Mountains), Sacramento (Pacific States), and Fairbanks (Alaska)—that could be modified geographically "to accommodate the differing requirements" of the program Divisions. Wrather opposed Chapman's second goal by deciding that

> **There would be no one-man regional directors. Each division would select its own officer-in-charge and line authority would extend to him from his division chief in Washington. The regional officers of the several divisions would constitute a committee to handle all matters common to the center. This committee would choose its own chairman. In this way the integrity of the Divisions would be maintained, and all could enjoy the advantages of unified house-keeping arrangements.[196]**

Chapman agreed.

As the NSF bill made its way through Congress in 1950, the Interior Department under Secretary Chapman followed other recommendations by the Hoover Commission in simplifying its budget estimates for fiscal year 1950–51. On January 10, 1950, when Chapman appeared before the House subcommittee on Interior's appropriations, Chairman Michael Kirwan commended Truman "for having given this post to someone who thoroughly knows the department, its problems, and its workings."[197] Chapman asked for nearly $669.5 million for fiscal 1950–51, some $79.3 million more than the previous year. Following the Hoover Commission's recommendations, the number of Interior's items for congressional action fell from 167 to 42; each of them grouped activities by major purpose intended, in part, to provide the subcommittee "with more concise and useful data" about and "also facilitate [its] action" on the budget. Chapman recognized "that the authorization of funds under a smaller number of appropriation items places greater responsibility upon the Department to control the use of funds for the purpose for which they were authorized." He promised "to demonstrate each year in our

project and activity schedules that we have executed our programs and expended the funds authorized in accordance with the intent of Congress in granting the authorization."[198]

For the USGS, Interior proposed only one item—

**"surveys, investigations, and research"[199]**

—and listed under it the several programs previously shown as separate items. If Congress and the President approved the new format, the USGS would return to block funding for the first time since 1888, when Representative Hilary A. Herbert (R–AL) and his congressional colleagues, irked by what he termed Director Powell's extravagance and his failures to do what Congress authorized, forced the line itemization of the agency's entire appropriation. If now enacted, the recommended change would allow the Director, rather than Congress, again to determine priorities among the various elements of the USGS program and to modify them to meet emergency conditions without recourse to the Federal legislators. The USGS estimated that it would require for its surveys, investigations, and research (SIR) during fiscal 1950–51 a total of $20 million in direct appropriations, an increase of some $3.5 million over the previous year's request. Of the additional funds, $1,975,000 would go to topographic surveys and $1,262,000 to water-resources investigations. The USGS expected to receive another $11.1 million from Federal and nonfederal sources. Congress remained in a mood to economize. The House Committee on Appropriations previously tried to keep appropriations below the estimate; the committee now urged the chairmen of its subcommittees to hold appropriations below those for fiscal 1949–50.

The House subcommittee still looked favorably on the USGS. When Wrather appeared before the subcommittee on January 16, he reminded its members that the Hoover Commission's report recommended that the study of problems of water conservation and mineral resources should go forward regardless of the drive toward national economy. Chairman Kirwan replied "That is national economy." Kirwan made his position clearer by emphasizing that "Billions of our resources have been wasted down during the past 50 years. Now we are starting in the second 50 years of this century and we had better do a better job of trying to protect America."[200] Wrather assuaged the subcommittee's past concerns about the agency's difficulties in "recruiting adequate technical personnel" by reporting that "we are much more able to get competent young fellows to feed in at the bottom of the organization." After recent consolidation, the USGS was "now equipped to absorb a substantial increase in the amount of work done and do it efficiently."[201] On February 8, Henry Jackson supported the shift to SIR by calling it "merely language to consolidate all previous items dealing with this appropriation for the Geological Survey"[202] and Otis Beasley agreed. The Committee on Appropriations allowed the USGS $19,129,000, representing a cut of $871,000 in the estimate but still some $3,085,000 above the appropriation for fiscal year 1949–50. During the floor debate, Ivor Fenton defended the estimate's reduction by emphasizing the USGS' continuing responsibility for discovering, studying, and evaluating the Nation's minerals and water resources. Fenton admitted that the agency had done a fine job with the money it received, but he regretted that even more had not been done. The House approved its Committee on Appropriation's recommendation.

Thomas Nolan, as Acting Director, represented Wrather and the USGS at the agency's budget hearings held on April 5, 1950, by the Senate's appropriations subcommittee. Nolan and Gerald FitzGerald defended the requested increase for topographic mapping. To complete mapping the Nation, Nolan reminded the subcommittee, would require "very close to 50 years * * * at the present [funding] rate."[203] Chairman Carl Hayden asked whether or not the USGS "reduced the cost of topographic mapping per [square] mile by modern devices?"[204] Using shoran-controlled

photography for position and "determining ground elevations from the air,"[205] especially in Alaska, FitzGerald assured Hayden, cut costs for equivalent accuracy. These methods not only improved the maps for the same cost per square mile but they even cut the cost up to one-half for certain types. Maps were now cheaper than 2–3 years ago, even as wages and accuracy requirements increased. The USGS, FitzGerald added, now printed 550 quadrangles each year, and Nolan noted that the agency also "prepared photographic equivalent copies of our multiplex compilation sheets" and made them "available to people with a need for them."[206] Nolan supported the requests to continue mineral surveys and geologic mapping, including trace elements and "a very modest study of volcanoes," begun "as a basis for prediction of new eruptions," by noting other applications. "Within the past week," Nolan reported, "one of the members of the special weapons group in the Army was most anxious to discover what could be made available to him with regard to the unconsolidated materials in one of these volcanic areas." That "member" likely was Brigadier General Herbert Loper, now Deputy for Atomic Energy to the Army's Acting Chief of Staff (G–4), and also the Army's member of the AEC's Military Liaison Commission (replacing Major General Kenneth Nichols), and the Deputy Commander of the Joint Task Force. "We fortunately had a map which we could show him," Nolan continued, "which he could use and which probably is going to be extremely important in the construction of a very large [unnamed] activity in a very critical [but also unspecified] area. That, I think, is * * * typical of the byproducts * * * and of the greatly increasing scope of the demands * * * in all of these activities."[207] Senator Hayden agreed, suggesting that

> **[i]t is just like any other research. You never know just when the facts will develop that will prove to be of tremendous value. You cannot classify them as you go along.[208]**

Carl Paulsen defended the requested increase for funds for USGS water-resources investigations by noting that the Nation's per capita consumption of water "probably more than trebled"[209] in recent years, from less than 200 to 1,300 gallons per day for all uses, due to significantly greater demands by agriculture and industry. Nolan also emphasized Oscar Meinzer's contributions in developing the science and technology of groundwater hydrology. While using the increased funds, Nolan urged that "we must develop more scientists of his kind, if we are to continue to meet these water problems that we have."[210]

The Senate, while reducing still further most of Interior's items, went along with the House's figure for the USGS but added supplemental funds to meet requests by the subcommittee's Dennis Chavez (D–NM), also Chairman of the Committee on Public Works, and other Senators, for collecting water records for operating the new interstate compacts. Congress and the President approved on May 31, 1949, the compact for the Arkansas River that representatives of Colorado and Kansas signed on December, 14, 1948. On June 2, 1949, they agreed on a compact for the Yellowstone River that representatives from Montana, North Dakota, and Wyoming were asked to sign not later than June 1, 1952. The Senate agreed to include $253,000 of the $275,000 the USGS requested to operate the interstate compacts for a total of $19,382,000, slightly less than the estimate, but the House did not approve the additional appropriation.

Wrather hoped that Congress and the President would enact appropriations for the USGS during the new fiscal year before July 1, 1950, but by then yet another foreign-policy crisis, this time on the Korean Peninsula, intervened to modify views in the legislative and executive branches about the amount of and priorities for Federal funds and to make USGS operations dependent on continuing resolutions. On April 19, 1949, the Soviet Union vetoed a resolution admitting the

U.S.-supported Republic of Korea to the United Nations. The last American troops withdrew from South Korea on June 29, leaving only a 500-man Military Assistance Group to advise President Rhee's government. The U.N.'s second commission announced on September 2 its failure to settle the continuing low-level conflict between the two Koreas and its fear that those countries neared outright war. When visiting Rhee in 1948, General MacArthur promised to defend South Korea, but he omitted Taiwan and South Korea from the defense of the Western Pacific. So did NSC–48, a finding issued on December 30, 1949, in which State Department staffers recommended a conciliatory approach to mainland China, hoped for its break with the Soviet Union, and urged ending aid to Chiang's government. Secretary Johnson, Senators Taft and McCarthy, Henry Luce, William Hearst, and others promptly opposed NSC–48. Early in 1950, Truman also objected to protecting Taiwan. In remarks before the National Press Club on January 12, Acheson supported NSC–48 by agreeing that the United States would defend Japan, the Ryukyus, and the Philippines. By not mentioning Taiwan or South Korea, he appeared to leave both outside the U.S. perimeter or even its sphere of influence or strategic concern in the Far East. Acheson did recommend that Truman seek a threefold increase in defense funds for fiscal year 1949–50.

On January 31, 1950, the day Truman requested the AEC to continue its work on the hydrogen bomb, the President asked Secretaries Acheson and Johnson to revise NSC–20 by reexamining U.S. objectives in both peace and war and the effectiveness of American strategic plans, in view of the Soviet Union's forthcoming atomic bomb and its potential for developing a thermonuclear (fusion) weapon.[211] The new statement, like NSC–20, was prepared by the State Department's Policy Planning Staff, where Paul H. Nitze, coauthor of the postwar U.S. Strategic Bombing Survey and head of State's Office of International Trade Policy, replaced George Kennan as Director on January 1. Nitze and his staff completed a draft version of NSC–68 in late February. On March 22, Nitze briefed Acheson, Omar Bradley, and Johnson, but Johnson left the meeting early to protest the seeming challenge to his authority. Johnson reluctantly signed off on NSC–68 on April 6, and it went to Truman on April 14. The authors of NSC–68 recommended a quick and continuing increase of the free world's economic, military, and political strength[212] but included no estimate of the costs involved. Truman promptly returned the document to the National Security Council for reconsideration and a lucid exposition[213] of the necessary programs and their required funds. The NSC's ad hoc committee met on May 2 and expected to finish its revisions by August 1. Meanwhile, Bradley accepted cuts in the military budget for fiscal year 1950–51 to $12.3 billion, and he also approved the $12.1 billion projected for 1951–52. Later, when Eisenhower opposed these reductions, the House and the Senate acted to try to raise military funds for fiscal 1950–51 by as much as $2.5 billion.

As Congress deliberated and Nitze's team modified NSC–68 in response to Truman's request, events in Korea made their decisions even more important. Kim Il Sung went to Moscow in late December 1949 to try to convince Stalin to approve and support Kim's plan to incite a revolt within South Korea, invade and conquer the country, and establish therein a Communist government. On February 14, 1950, Stalin and Mao signed in Moscow a 30-year pact of friendship, alliance, and mutual assistance and then signed several economic agreements. Kim returned to Moscow during March and April and visited Beijing in May. Kim, Mao, and Stalin agreed that the United States would not respond militarily to an attack on South Korea but, if America did so, Kim's forces would conquer Rhee's country before any meaningful U.S. intervention could prevent it.[214] Stalin authorized additional shipments of weapons and supplies, but he did not promise open support. Although the South Koreans elected a more moderate national assembly on May 30, Kim refused to have any dealings with Rhee and his conservative adherents in

the proposed larger body that also represented the north. Kim continued to plan for unification through direct military action. His North Korean People's Army (NKPA) comprised 135,000 men, 30,000 of them veterans of two wars, grouped in 10 divisions and an armored brigade equipped with 120 Soviet T–34 medium tanks. Ample reserves supported the NKPA regulars. South Korea's army mustered on paper about 100,000 men, including 65,000 in eight divisions. ROK divisions lacked tanks, medium and heavy artillery, rocket launchers, and recoilless rifles.

At 4 a.m. on Sunday, June 25, 1950 (local time), just 20 days after Truman signed the Foreign Economic Assistance Act that added $100 million to the $70 million given to South Korea earlier in the year, Kim's forces crossed the 38th parallel in six principal columns, and other units began successful amphibious assaults on the east coast south of that line at Kangnung and Samchok. The North Koreans completely surprised elements of four of the eight South Korean divisions. The main NKPA column on the west broke through the South Korean units, captured Kaesong, and moved rapidly southeast toward Seoul.

The U.S. Ambassador's news of the attack, sent from Seoul, reached Washington at 2:45 p.m. on Saturday, June 24 (local time). The alert also surprised the Truman administration, whose attention was focused on Europe, the Middle East, India and Pakistan, the Communist Hukbalahap ["Huk"] insurrection in the Philippines, the Communist insurgency in Malaya, and other parts of the world where Communist aggression seemed more likely. Truman immediately flew from Missouri to Washington and conferred with principal advisers Acheson, Bradley, Louis Johnson, Finletter, Matthews, Secretary of the Army Pace (formerly Budget Director), Sherman, Hoyt Vandenberg, Webb, and General Joseph L. Collins, the Army Chief of Staff. On the following day, June 25 (Washington time), the United Nations Security Council adopted a U.S. resolution demanding an immediate cease-fire and a pull-back by the North Koreans and called on member nations to assist in carrying them out. The Soviet Union failed to veto the measure because Yakov A. Malik, the Soviet Union's former ambassador to Japan, who replaced Andrei Vyshinsky at the U.N., boycotted all sessions from January 13 to protest the U.N.'s failure to unseat Nationalist China's delegation from Taiwan. On June 26, the U.S. Ambassador, who believed that Seoul would fall before help arrived, ordered all nonessential U.S. personnel and dependents evacuated to Japan. Beginning on the 27th, about 850 persons departed from Kimpo airfield west of Seoul.

Truman did not intend to add South Korea to the list of countries allegedly "lost" to the Communists on his and Roosevelt's watches. Truman saw the new conflict, which he called a bandit incursion, as an opportunity to rearm America, reassure NATO and Japan of his commitment to collective security and containment, and demonstrate that the U.N.'s mandate to keep or restore the peace required deeds as well as words. Unlike World War II, America would not have more than 2 years in which to prepare for combat. On June 27, 1950, Truman ordered General MacArthur to use U.S. air and naval forces in the Far East to defend South Korea. The President termed U.S. intervention a police action and thereby avoided any delay in securing a declaration of war from Congress. Thomas Dewey promptly provided bipartisan support by approving the President's decision to aid South Korea. The President announced that the U.S. 7th Fleet, based principally at Subic Bay in the Philippines, would prevent any further conflict between the two Chinas by patrolling the Taiwan (Formosa) Strait. Truman approved strengthening U.S. forces in and accelerating military aid to the Philippines. He also directed that consideration be given to assisting the forces of France and its Associated States in Indochina and sending a military mission to provide them with close working relations.

On June 27, U.S. air and naval forces began active operations against the North Koreans. As U.S. destroyers evacuated some 900 additional American civilians from Inchon, Seoul's port on the Yellow Sea, American fighter aircraft shot

down seven North Korean planes over Kimpo and the front. Although the U.N. adopted a second resolution calling on member nations to assist the Republic of Korea in repelling the armed attack and restore international peace and security in the area, Seoul and Kimpo fell to the invaders on June 28. On the next day, as Truman approved air and naval actions against North Korea, MacArthur flew to Suwon and traveled north almost to the Han River, where he reported that he also would need U.S. ground units to repel the attack. The nearest American troops were in Japan, the four understrength divisions of the 8th Army, led by Lt. General Walton H. ("Johnnie") Walker, earlier one of Patton's corps commanders, but they lacked medium tanks and effective antitank weapons. MacArthur planned to have two of these divisions slow and then stop the North Korean forces while he led the third and other reinforcements in a seaborne assault on the enemy's western flank.

Vice Admiral C. Turner Joy, who commanded U.S. Naval Forces Far East, ordered the 7th Fleet to Okinawa. Task Force 96 continued its blockade, escort, evacuation, and patrol duties, as Task Force 77, including fleet carrier *Valley Forge*, sortied from Subic Bay and Hong Kong on June 27. The next day, British light carrier *Triumph* and her escorts left the latter port to join the U.N. naval effort. Ships of the Royal Australian Navy sailed for Korea on June 29, followed by vessels from the Royal New Zealand Navy on July 3. As the North Koreans pushed south of the Han River on June 30, additional civilian employees of Federal agencies, including four USGS geologists, began leaving Pusan for Japan. David Andrews had returned to Korea in May, with Raymond C. Robeck and David J. Varnes, to complete work at two coal fields and begin mapping at Samchok; James D. Vine joined Andrews' project early in June. Andrews arrived in Tokyo on June 30 and his teammates there on July 2–3 but without most of their notes, maps, and equipment. Also on June 30, Truman authorized the use of U.S. ground forces against the invaders and a naval blockade of and strikes by U.S. aircraft on targets in North Korea, and MacArthur requested an American regimental combat team from Japan. On July 1, as the civilian evacuees continued to leave Korea, one Army infantry battalion, reinforced but still with more postwar soldiers than combat veterans, arrived in Pusan by air from Kyushu, entrained and moved northwest toward Taejon and the front. Also on July 1, Congress and Truman extended the Selective Service Act for 1 year and agreed to call up individual members of the Reserves for 21 months of active duty. The Second World War, like the First, failed to end war. Only 5 years after the victory of the Allied Nations, many veterans of the 1939–45 war found, or would find, themselves called to participate in a new conflict.