Chapter 11.
Epilogue: The U.S. Geological Survey, 1939–1961

No epilogue, I pray you; for your play needs no excuse.[1]

—William Shakespeare

The history of the United States and the U.S. Geological Survey (USGS) during 1939–61 played out within two nearly continuous global conflicts—World War II and the early years of the West's subsequent cold war with the Soviet Union. In the Second World War, leaders of Allied and Axis Nations believed that the contributions by their scientists and engineers were essential to their efforts to win the war. In the United States, this civilian-military mobilization produced new organizations that devised novel means of attack and defense. The National Defense Research Committee, the Office of Scientific Research and Development, the Army Engineers' Manhattan Engineer District, and the academic radiation and metallurgical laboratories, among others, facilitated the American-British development or refinement of the atomic bomb, the airborne magnetometer, the proximity fuse, radar, sonar, and other war-winning devices.

In 1945, the coalition of Allied Nations won the worldwide conflict and formalized their association as the United Nations. The Allies partitioned Germany and then the Western powers reunited parts of it as a democracy, the American Marshall Plan helped to rebuild Europe, U.S. forces occupied Japan and aided its democratic development, and a Communist government unified mainland China. Thereafter, the Korean war and lesser conflicts tested the United States and the United Nations. The overriding cold war with the Soviet Union and its Warsaw Pact allies challenged the United States and the other countries of the North Atlantic Treaty Organization. Two subsequent and similar pacts—the Central Treaty Organization and the Southeast Asia Treaty Organization—extended the West's long-term strategy of containing and deterring the Soviet Union and its allies.

In the United States, wartime rationing was followed by a postwar baby boom, the construction of more affordable and better housing for veterans, Federal support for veterans' education, the beginning of the modern civil-rights movement, the end of segregation in the military, and other significant socio-economic reforms. Despite financial bubbles and recessions, the domestic economy continued to grow. America's postwar years also encompassed the evolution of national policies for minerals (including stockpiling of those deemed critical and strategic), fuels, and water resources; the advent and growth of a national foundation for research and education in science; the development of a national science policy; and the appointment of a formal science adviser to the President.

In those years, the USGS provided personnel, other programmatic resources, and advice for defense at home and then war abroad but at the cost of repeated drains on its research capital. Changing conditions and demands fueled continuing debates within the agency about the emphases placed on basic (or fundamental) versus applied (or practical) research. The USGS tried to determine what percentage of its human and monetary resources should be devoted to basic research as part of its efforts to improve understanding of the principles behind the

observations. Most of the Federal committees on mineral- and water-resources policies stressed the need for more basic data and assessment. As a result, USGS emphasis on and plans for supporting basic research during the interval increased from a low of 1 percent to a high of about 10 percent.

Most of the agency's practical work retained some percentage of fundamental studies, reflecting an arrangement begun by Director Clarence King in 1879. That continuing effort helped to facilitate the huge growth of the USGS during the postwar years. As part of USGS efforts to understand geologic processes, including the origin and distribution of nonliving resources as guides to exploration, the agency successfully introduced new or modified ground and airborne technology and methods in geochemistry and geophysics, especially in surveys of magnetism and radioactivity. Members of the USGS also developed other equipment and procedures to improve their understanding of earthquakes and volcanic eruptions, to develop an ability to predict them, and to distinguish between earthquakes and nuclear tests. Agency personnel and cooperators drilled to basement rocks below coral atolls and confirmed the Darwin-Dana model of their origin, expanded and diversified their studies of military geology abroad and at home, began work on landslides and urban engineering geology, assessed options for radioactive-waste disposal, improved spectrographic analyses of minerals, secured more accurate radiometric ages of rocks, and analyzed their deformation, magnetism, and thermodynamics.

The USGS also devised or adopted new tools and techniques in topographic mapping and water-resources investigations and increased its work in supervising the leasing of and resource production from the onshore and offshore public lands. By 1960, the USGS expanded its adequate domestic topographic coverage of the continental United States to 45 percent. Similar geologic coverage rose to 17 percent, aided by new methods in photogeology. Improvements in map preparation and printing, including the results of pioneering efforts in orthophotogrammetry and automation, promised to enable the agency in the coming decades to fulfill its long-standing promise to complete, funds permitting, national topographic coverage at a standard large scale of 1:24,000. The agency also worked toward its long-term goal of establishing a network of self-recording gaging stations and observation wells to provide data for a more systematic accounting of the Nation's surface-water and groundwater resources. The USGS increasingly focused on the broad fundamental aspects of hydrology to continue to solve practical problems in the occurrence, availability, and quality of water resources while adding to the scientific knowledge of streamflow and sediment movement through process-oriented analytical and interpretative studies like those in geology. The USGS expanded its partnerships with Federal, State, county, and municipal government agencies, and with academia, industry, and private citizens, to further the preservation or wise use of the public lands and their nonliving resources. USGS supervisory activities on mining properties by the Conservation Division increased by 60 percent; those on oil and gas leases, especially on the Outer Continental Shelf, grew by 450 percent.

New methods and tools of automation enhanced the processing, storing, and analyzing of USGS administrative data, as well as scientific and technical data. Advances in code breaking and gunnery enhanced data processing during World War II. In the 1950s, computers were more accurate, more adaptable, faster, and more reliable than those of the 1940s. Increasingly, fully electronic computers replaced those electromechanical, digital systems succeeded analog-based versions, magnetic tape and magnetic cores supplanted paper tape and punch cards, and transistors succeeded vacuum and cathode-ray tubes. A USGS advisory committee and a formal administrative unit increased in-house familiarity with the capabilities of existing computers and also planned for the future rapid acquisition and use of improved versions.

The USGS increased its work abroad during and after World War II. The agency's work outside the national domain had begun with an externally funded study of Hawaiian volcanoes in 1882 and thereafter spread to the Philippines and locales in the Caribbean and Central America. USGS operations expanded to Brazil in 1941 and to seven other Latin American countries as the war progressed. In 1944, the agency began mapping and geohydrologic studies in Saudi Arabia sponsored by the Departments of Agriculture and State. The USGS resumed work in the Philippines during the immediate postwar years. In the 1950s, these efforts spread to Afghanistan, India, Indonesia, Iran, Iraq, Jordan, Libya, Pakistan, South Korea, Thailand, and Turkey. In 1958, the USGS gained specific statutory authority to continue to study and map in the United Nations Trust Territory of the Pacific Islands (TTPI) and in Antarctica to support the International Geophysical Year and follow-on operations on the continent. Under that rubric, the USGS completed work begun in the TTPI in 1946, with Army Engineer support, and continued efforts in Antarctica started in 1946–47 as part of Navy operations. In 1959–60, the USGS extended its investigations across other new geographical frontiers as part of the scientific-technological contest with the Soviet Union. The USGS expanded its operations into outer space by compiling a preliminary geologic map of the Moon's nearside and beginning a formal unit on astrogeology. The agency also lent its expertise acquired in deep drilling on oceanic islands to U.S. operations in inner space aimed at drilling through the Earth's crust into its mantle.

Within this two-decade context, a series of external and internal events and decisions modified and expanded USGS missions and increased the agency's funds and staff. Federal organizations sought and paid for enlarged cooperative services by the USGS during World War II. In the postwar years, these entities increased their requests and funding for services old and new under the demands of wars cold and hot. Between fiscal years 1939–40 and 1960–61, the agency's total funds rose from just over $7.2 million to about $71.3 million, while its staff grew from some 1,320 persons to more than 6,900 permanent and 1,100 seasonal employees as of June 1961. During that interval, direct appropriations to the USGS increased from $3.3 million to $45.9 million, funds transferred by other Federal agencies rose from $1.9 million to $13.2 million, and transfer and repay monies from State, county, and municipal cooperators and from other nonfederal sources climbed from $1.25 million to more than $12.1 million. Although the monetary percentages supplied by each of these sources to each of the four programmatic Divisions in the USGS varied widely, the overall trend during those decades showed a rise in direct over indirect funding, enabling the agency to increase control over its own programs and to hire and keep a qualified specialist staff funded by its own appropriations. In fiscal 1960–61, the direct Federal appropriation for the Conservation Division represented 98 percent of its funds, and that percentage was twice as large as the Water Resources Division's. The Water Resources Division's lower percentage reflected in part its statute-required assignment of funds to match those from nonfederal sources for half of those cooperative programs. In that fiscal year, the Geologic Division received 65 percent of its monies from direct appropriations, and the Topographic Division took in 75 percent of its funds from the same source.

Three principal changes in the 1950s restored, modified, and (or) extended USGS managerial and operational control, flexibility, and influence. The initial alteration followed an agreement by the legislative and executive branches to restore financial and programmatic flexibility to the USGS that was lost in the late 1880s as one result of the failure of Director John Powell's policies and programs.[2] Required line itemization of USGS budgets proved to be a 62-year millstone. Not until 1950 did the Interior Department and the USGS convince Congress and President Truman to end the required line itemization of the agency's budgets in an

effort to increase economy and efficiency. The new statutory agreement returned USGS appropriations to the original block funding of 1879–87, a general and brief format rewritten to provide for surveys, investigations, and research (SIR). The 1950 accord retained the equal-shares requirements, enacted in 1926 and 1928, respectively, of the agency's cooperative topographic mapping and water-resources investigations with the States, counties, and municipalities. The 1950 agreement also continued the dollar limits on the USGS funds that could be spent only for the water-resources cooperative work. With SIR funding, the USGS could and did modify its internal distributions of funds and staff and determine priorities among its program elements without having to consult Congress. That freedom enabled more rapid and efficient responses to changing external circumstances, especially the less predictable types of natural or people-caused emergencies.

In the 1950s, the second boost to USGS managerial style confirmed the centralized control of its operations, via firm lines of authority, when the agency refused Interior's request to regionalize USGS management as part of a departmentwide effort to centralize supervision as well as operations. Beginning in 1949, the two Hoover Commissions and several other examining groups authorized by statute or Executive order, the General Accounting Office (GAO), external committees from academia and industry established by Secretaries of the Interior, and the USGS' own external Science Advisory Committee of scientists and engineers carefully and critically reviewed the agency's management and operations. Those nonpartisan evaluations generally lauded the quality of the agency's personnel and work, but they recommended changes in organization that led to needed reforms, including the better integration of the results of research and improvements in administration. The USGS, also advised by outside financial consultants, responded to the GAO's report to Congress about problems in the agency's accounting and other business practices by instituting significant changes, including the appointment of a Chief Inspector. Among the modifications were those that improved USGS supervision of mineral leases on and resource production from Federal onshore and offshore lands, an agency responsibility since 1925.

The USGS did not adopt the reviewers' recommendations for regional management, a style utilized for the regulatory functions of the Bureau of Land Management, established in 1946, but one not yet proved beneficial in a science and mapping agency. William Wrather, the sixth Director (1943–56), convinced Interior Secretaries Oscar Chapman and Douglas McKay that USGS field operations were almost completely regionalized, as they had been under King before being centralized by Powell, but Wrather continued to oppose the Secretaries' requests to appoint regional directors. Regional directors and their required staffs, Wrather decided, would siphon off funds and personnel better devoted to operations and also would disrupt the enforcement of long-standing high and uniform standards in hiring, ethics, and products throughout the agency. In lieu of regional management, Wrather established a field committee at the center for the Eastern Region, also the national headquarters, at Washington, D.C. He also began similar committees at Denver, Colorado, for the Central Region and at Menlo Park, California, for the Western Region, both with headquarters founded during the postwar years. The regional committees functioned only as advisers; each group was chaired, in regular rotation, by one of its members, and reported to the USGS Executive Committee.

The third change also involved administration within the USGS. The agency's Division Chiefs continued to report to the Directors, who operated without a formal deputy through the tenure of Walter Mendenhall, the fifth Director (1930–43). In 1944, a year after Wrather succeeded Mendenhall, Secretary Ickes approved establishing an Assistant Director for the USGS. This new post was filled by Thomas Nolan, who served as Acting Director during Wrather's detail to Interior's on-site assessment of the Middle East's oil resources led by Everette DeGolyer. Nolan, as Assistant Director, functioned as the agency's chief executive officer,

aided from 1948 by a formal Executive Officer, a post vacant since 1894. In the 1950s, Wrather and Nolan served as alternate members of and technical advisers to Cabinet, departmental, and other Federal committees convened to improve national mineral- and water-resources policies to assure long-term supplies for economic development and national security. When Nolan succeeded Wrather as Director in 1956, Secretary McKay authorized an Associate Director, a position filled by USGS geologist and administrator Arthur Baker. USGS topographic engineer Robert Lyddan replaced Nolan as Assistant Director. Nolan, as Director (1956–65), divided the day-to-day oversight for the Divisions between Baker, responsible for the Conservation, Geologic, and Publications units, and Lyddan, responsible for Administrative, Topographic, and Water Resources units. Baker and Lyddan, like Nolan, were aided by the agency's Executive Committee, its General Staff Committee, and its Science Advisory Committee composed of outside specialists, who received compensation only for their expenses in attending meetings.

During these decades, the USGS continued its practice, begun under King, of trying to hire the best available young specialists and assigning them to ongoing or new projects, where they could be mentored by older and more experienced scientists and engineers. In 1960, 14 USGS scientists were members of the National Academy of Sciences (NAS); 9 of them served full time with the agency, and the remaining 5 were academics employed part time by the agency.[3] USGS scientists, whether NAS members or not, continued to serve on National Academy of Sciences-National Research Council advisory groups, as alternates on or advisers to Federal committees and commissions, and on visiting committees at academic institutions.

A related event provided a more subtle but no less important and pervasive modification of USGS abilities and operations. In 1950, as Congress and President Truman approved SIR funding for the USGS, they also agreed to establish the National Science Foundation (NSF). That decision extended USGS activities in providing science advice and in aiding science education. The USGS–NSF relationship also gave the agency another, if less direct, benefit. The NSF significantly increased during 1956–60 its funds for grants for research and education in the earth sciences. USGS management responded to this shift in funding emphasis by continuing its efforts to increase its direct appropriations and reorganizing its operations and products, especially in the Geologic Division, to reflect a more politically aware and academic style. Recognizing the postwar need for additional trained geologists, the USGS began in 1946 new cooperative programs with several major universities that had been sources of agency employees since 1879. The NSF advanced this relationship when USGS scientists were approved as secondary investigators in requests to the NSF for research grants by their academic colleagues, several of whom continued to serve part time with the USGS. Some of these educators recommended their graduate students for pregraduation and postgraduation employment by the agency to help fulfill its missions and advance science.