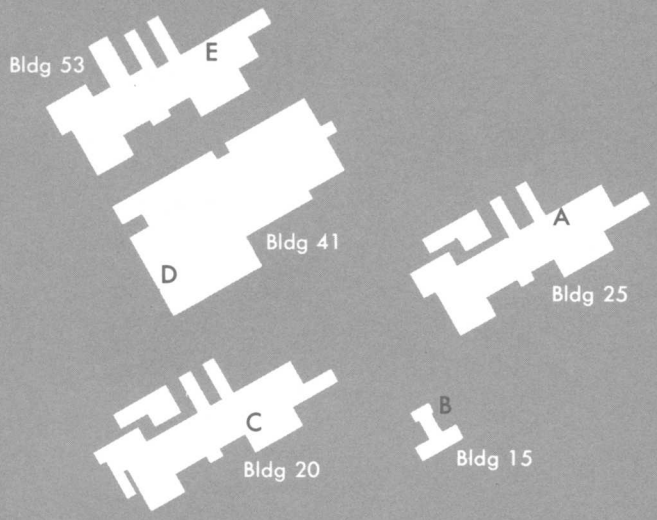
Activities and Services
of the

U. S. GEOLOGICAL SURVEY

Denver Area, Colorado

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

PRINCIPAL GEOLOGICAL SURVEY OFFICES
AT DENVER FEDERAL CENTER



A—Main Information Desk
B—Nuclear Science Bldg.
C—Publications Division, Rm. D2024
D—Map Sales Office, Rm. 112
E—Office of Mineral Exploration (OME), Rm. 200

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Activities and Services
of the

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WHAT THIS BOOKLET IS ABOUT

This booklet is a summary of the activities and services of the United States Geological Survey, written for people who have visited or plan to visit one or more of its offices in the Denver area— as well as to provide general information about the Geological Survey and its work. Sources of additional information are listed on pages 42-43.

What is the U.S. Geological Survey?

The U.S. Geological Survey, an arm of the U.S. Department of the Interior, is the principal Federal agency concerned with preparing accurate maps of the physical features of the country and providing scientific information essential to the development of the Nation's land, mineral, and water resources. It is recognized as one of the world's foremost research organizations in the earth sciences.

What does the U.S. Geological Survey do?

- It makes maps:
  - Topographic maps, showing accurately the shape of the land surface and the location of natural and man-made features— hills, valleys, streams, lakes, highways, trails, buildings, etc.
  - Hydrologic maps, showing the availability and quality of water.
  - Geologic maps, showing the types, ages, and configurations of rock formations that lie at and beneath the earth's surface.
  - A variety of outline maps, mineral-resource maps, geophysical maps, state base maps, and many others.
- It studies the earth's processes that may be hazardous to man and his works, such as earthquakes, volcanic eruptions,

and floods, in an attempt to understand how these processes operate, and hence how their destructive effects may be reduced or prevented.

- It develops new prospecting techniques that can be used by industry in its continuing search for mineral resources.
- It studies the natural processes that form deposits of valuable minerals, because knowing **why** certain kinds of mineral resources are formed in certain locations or in certain kinds of rocks may provide clues that will help to find new mineral resources now hidden beneath the earth's surface.
- It takes a continuing inventory of the Nation's water resources, and studies areas that have special water problems.
- It classifies Federally owned lands for mineral and water-power potential.
- It supervises mining, and oil and gas development, on Federal and Indian lands.
- It does fundamental research in topography, geology, hydrology, geochemistry, geophysics, and related sciences.
- It publishes maps and reports to make the results of these investigations available to the public.

For whom is all this work done?

It is done for the people of the United States. An outdoorsman who plans his hunting or fishing trip with a topographic map; a city water board that uses a water-resource report to plan for development of water supplies; a state highway department that uses a topographic map to choose a route for a new highway; an oil or mining company that uses a geologic report to plan an exploration program; — individuals, public agencies, and industry all are users and beneficiaries of Geological Survey products. Since its creation in 1879, the Geological Survey has made maps and published reports pertaining to every State in the Nation. The knowledge it has acquired and distributed on water, mineral, fuel, and land resources has contributed materially to national development and the national economy. The maps and reports of the Geological Survey are available to everyone.

What does the Survey do in the Denver area?

Although its headquarters are in Washington, D.C., the Geological Survey maintains at Denver one of its major field centers. The principal facilities are at the Denver Federal Center, 7 miles west of the downtown area, and other offices are dispersed within a few miles of the Federal Center (see maps on inside of front and back covers).

- A **Map Sales Office** is at the Federal Center in Room 112, Building 41; this office has a stock of published Geological Survey maps of areas of the United States west of the Mississippi River, for sale by mail or over the counter.
- A **Public Inquiries Office** is downtown in Room 1012 of the Federal Building, 1961 Stout Street, for the convenience of the public; this office has a limited stock of Survey maps for sale, serves as an agent of the Superintendent of Documents in maintaining a stock of Survey reports for sale (mostly concerned with the Rocky Mountain region), and provides information about the work of the Survey.

Denver is the headquarters of some 1400 Geological Survey employees, representing a broad spectrum of scientific, technical, administrative, and clerical talents. This booklet describes the principal kinds of work done by the Geological Survey in its Denver facilities. There are no regularly scheduled tours of Geological Survey offices, but visitors with questions about the Survey's activities and products are welcome, and tours of some activities, such as topographic map compilation and geochemical exploration laboratories, may be arranged in advance for individuals or groups; information on such arrangements may be obtained by calling the Survey Information Desk at 233-3611, ext. 8222. Normal business hours for all Survey offices in the Denver area are 8:00 a.m. to 4:30 p.m., Monday through Friday.

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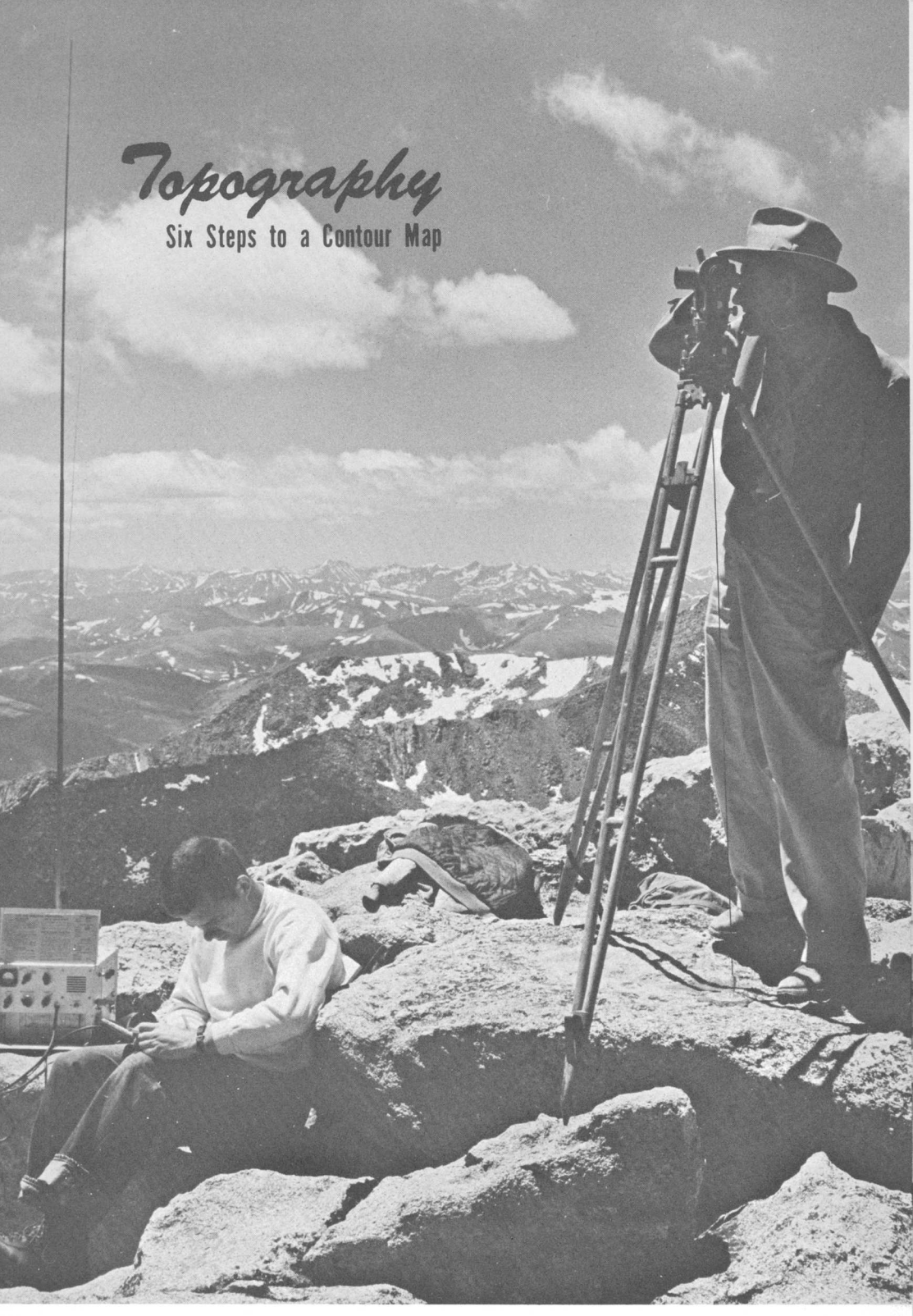

Topography
Six Steps to a Contour Map

One of the most familiar products of the Geological Survey is the topographic map or contour map—a map of the land surface showing accurately the locations of streams, roads, hills, valleys, buildings, and other features, and showing the **shape** of the land surface by means of contours, or imaginary lines of equal elevation. Modern topographic maps are essential to many kinds of work, such as planning highways, communication systems, urban developments, airports, and major dams and reservoirs; making surveys of bedrock, soil, water, and mineral resources; and carrying out the study and application of flood-control, soil-conservation, and reforestation practices. Topographic maps are also a must for the outdoor sportsman; they tell him how many hills he has to climb and how high they are, where there are trails or jeep roads, what creeks or rivers he must cross, and where there are fire clearings or low wet marshes.

One of the major goals of the Geological Survey is the preparation and maintenance of a series of topographic maps that will cover the entire United States and its possessions. These maps are compiled from basic geodetic data (exact measurements of points on the earth's surface), on-the-ground surveys, and aerial photographs. At the Denver Federal Center, topographic maps are compiled for areas in Alaska, Colorado, Montana, New Mexico, Texas, and Wyoming.

Six steps of preparation lead to the publication of a topographic map:

Step 1: Flight plans and control points. Specifications and flight plans are prepared for obtaining aerial photographs by contract, to provide stereoscopic (overlapping) photo coverage of the area to be mapped (Fig. 1). Easily identifiable control points are selected for accurate positioning and leveling of stereoscopic terrain models. Geodetic and plane coordinates are plotted on base maps, and aerial photographs are printed on glass slides (diapositives) for later use in setting up terrain models.

Step 2: Basic field control. Field surveyors use surveying transits and electronic and other surveying instruments to determine latitude, longitude, and elevations above sea level, necessary for orienting the aerial photographs to a uniform base (Fig. 2). Survey data submitted by field parties are used to compute final geographic and grid coordinates and elevations of ground stations, with the aid of analog and digital computers (Fig. 3).

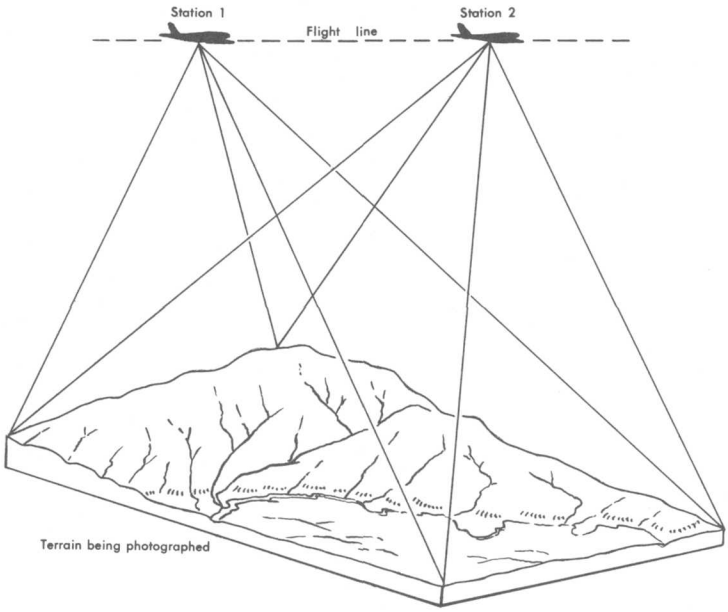


Fig. 1 — Overlapping aerial photographs provide stereoscopic coverage of area to be mapped.

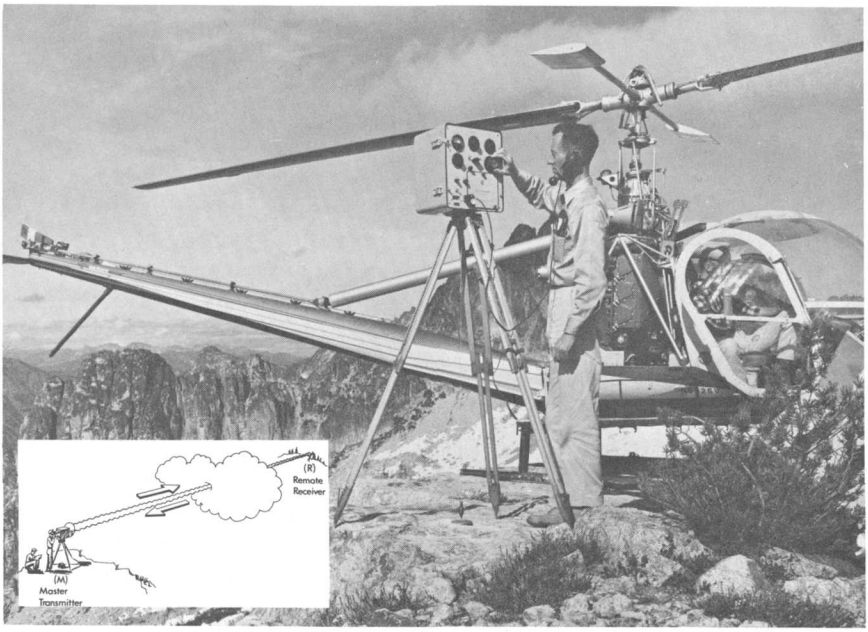


Fig. 2 — Surveyor sets transmitter (M) to send a radio microwave signal to responder (R) at distant point. Transmitter measures time for signal to travel to (R) and back again. Knowing speed of radio waves (about 0.98 foot per 1 billionth second), distance between (M) and (R) is computed with an accuracy of ±0.2 foot.

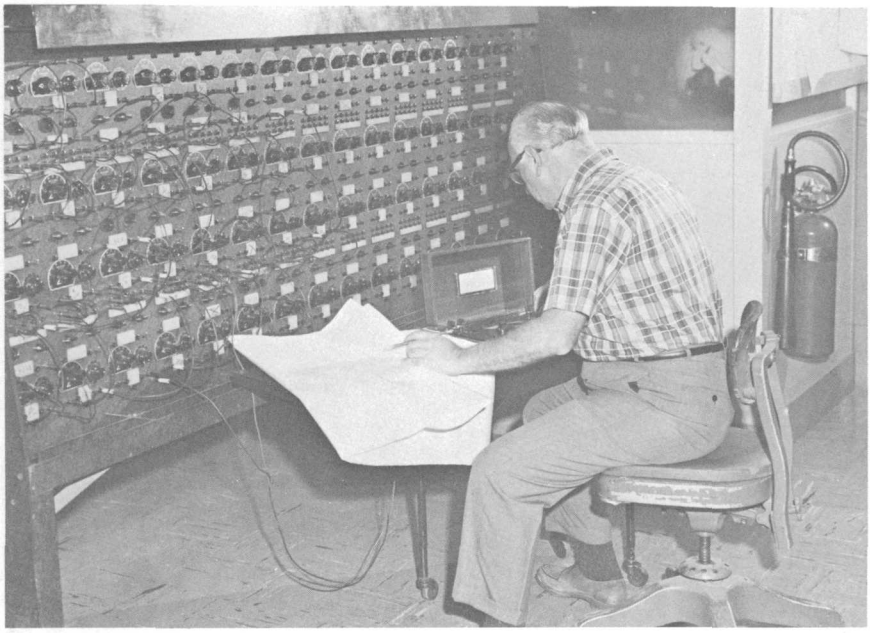


Fig. 3 — Analog computer finds precise geographic coordinates and elevations of control points from data submitted by field survey parties.

Step 3: Preparation of map manuscript. Diapositives of overlapping aerial photos are set up in projectors, using alternating red and green filters, to project overlapping images and produce a stereomodel — a three-dimensional image of the terrain, which the operator, wearing red and green glasses, literally sees in mid-air. This is, in effect, a small-scale reproduction of the land surface as seen from the air (see Fig. 6). Computerized survey data are used to adjust horizontal and vertical positions of projectors so that they accurately duplicate the relative positions of the aircraft when each photograph was taken (Fig. 4). Geodetic control points are plotted on the map base by an automatic plotter (Fig. 5) instructed by magnetic tape from an IBM 360 computer. Photogrammetrists then plot linear features and contour lines on the map base by moving a small "tracing table" (Fig. 6) through the stereomodel so that a dot of light in the center of the tracing table follows the feature being mapped (road, stream, shoreline, or imaginary contour line) without appearing either to float above ground or to sink beneath it. **Orthophoto maps** of selected areas, prepared with the orthophotoscope (Fig. 7), eliminate the perspective characteristics of the aerial photograph and provide a true-scale, undistorted mosaic aerial photograph of an area (Fig. 8) rather than the symbolized treatment of the standard quadrangle map.

Fig. 4 — Heavy plotter establishes horizontal and vertical control for each stereomodel.

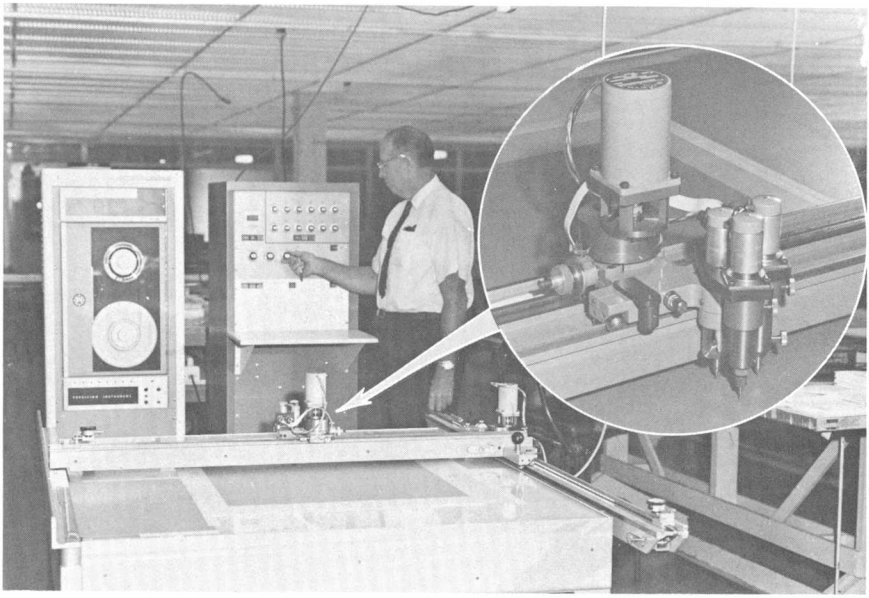


Fig. 5 — Control points are plotted automatically on map base.

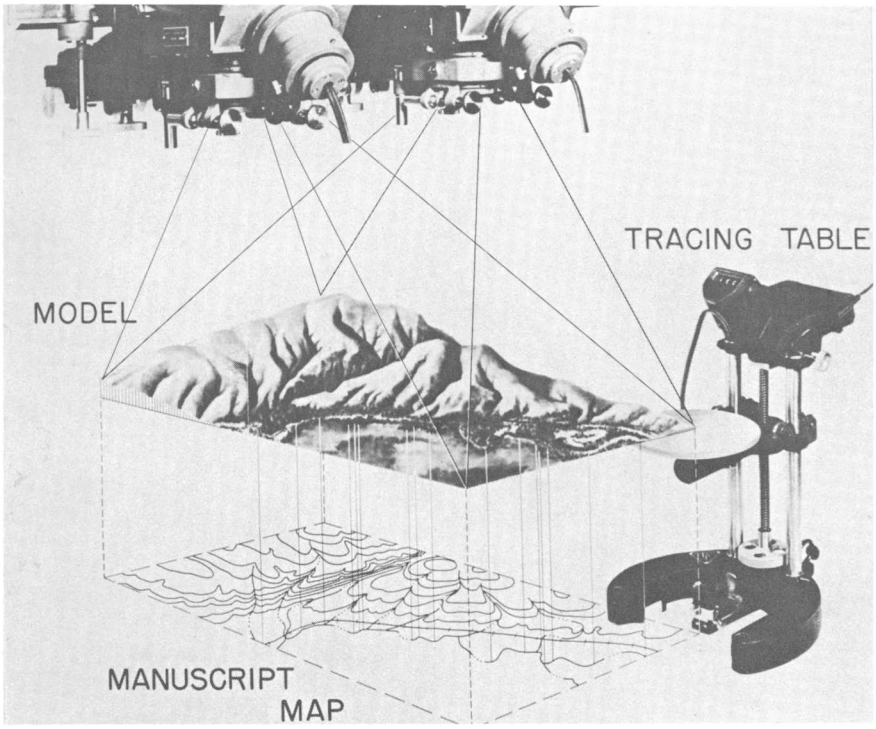


Fig. 6 — Overlapping projected images produce visual stereomodel from which contours and linear features are traced onto map base.

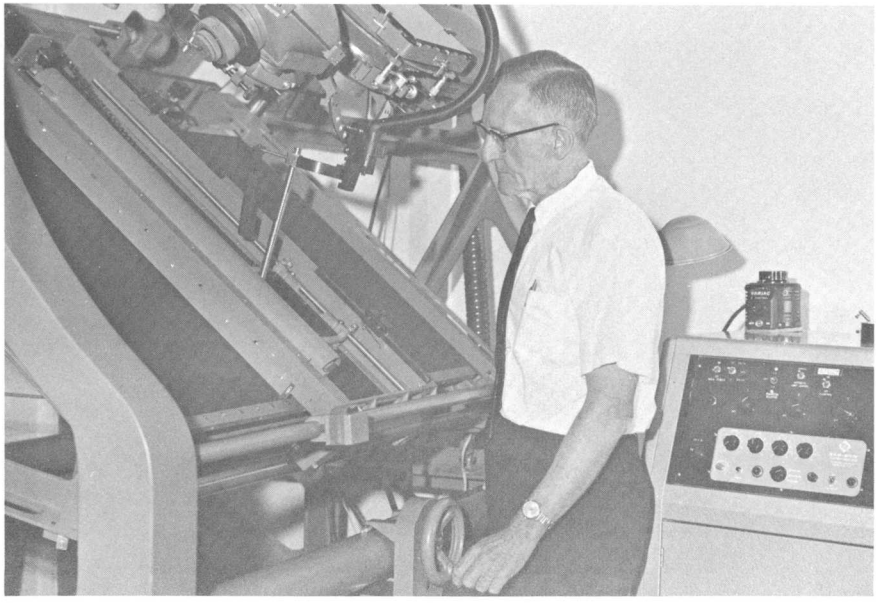


Fig. 7 — Orthophotoscope eliminates perspective distortions of aerial photographs.

Fig. 8 — Absence of distortion on orthophoto mosaic permits direct scaling of distances. Area shown is Austin, Texas.

Step 4: Editing and field checking of map manuscript. The stereoplotted manuscript map is edited for place names, road classification, and other cultural (man-made) data that cannot be interpreted from the photographs. Plane-table mapping in very flat terrain, and field checking for accuracy of elevations and locations of plotted points in accordance with the National Map Accuracy Standards, is performed by field parties.

Step 5: Preparation of final drawings for printing maps in color. Line work from Step 3 is transferred photographically onto opaque-coated mylar sheets; the lines are then traced with a scribing tool, a flat-pointed needle that scrapes the coating off the mylar sheet to produce a negative with high-quality line work (Fig. 9), superior to and less expensive than pen-and-ink drafting used formerly. Lettering and other symbols are printed separately and added. One sheet is prepared for each six colors to be printed on a single map.

Step 6: Final editing. Color separations (sheets for individual colors) are checked and edited for conformance with standard map requirements, and then are sent to the reproduction plant in Washington, D.C., where all Geological Survey maps are printed.

Fig. 9 — Scribing and lettering for final map copy.


Geology
Mineral, Fuel, and Land Resources

The Survey's geological efforts are focused strongly on providing the scientific information needed for evaluation and development of the Nation's resources of minerals and mineral fuels, as well as the resource of the land itself in its suitability or unsuitability for a variety of man's uses. This goal of resource appraisal is pursued through two closely related types of studies: (1) application of the geologic sciences to America's needs for mineral and fuel resources, for geologic guidance in the planning and construction of engineering works, and for practical information about such natural hazards as landslides, earthquakes, and volcanic eruptions, and (2) a search for deeper understanding of the earth and its processes, necessary to support the more directly applied studies. A wide range of studies of both types is carried on in the Denver field center.

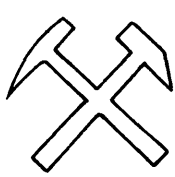
Field studies directed from this center are primarily in the Rocky Mountains-Great Plains region, and include mapping and sampling of rock and soil units, geophysical and geochemical field surveys, interpretation of geologic features from instruments carried by aircraft or orbiting satellites, detailed studies of known and potential resource areas, and scientific and technical assistance to State, municipal, and other Federal agencies. An integral part of most of these field studies is additional work in the Geological Survey offices, laboratories, and library in the Denver area, where information is compiled, interpreted, and compared with other data. The field studies commonly are supplemented in the Denver laboratories by such techniques as chemical analysis, microscopic and X-ray examination of minerals and rocks, identification and interpretation of fossil animals and plants for determination of the relative geologic ages of rocks and inference of ancient environments, absolute dating of geologic materials (finding their ages in thousands or millions of years) by analysis of radioactive isotopes, and determination of physical and mechanical properties of geologic materials.

In addition to such integrated field projects, there is specialized research into fundamental principles and techniques of earth science, development of new methods of resource exploration, and compilation of basic data concerning the origin, occurrence, and distribution of various mineral and fuel resources. Foreign aid provided under the auspices of the Department of State makes it possible for foreign technicians and scientists to receive training in special earth-science techniques in Denver. A branch of the Office of Mineral Exploration (OME) administers a program of assistance to the mineral industry for the development of resources of certain minerals that are in critically short supply.

The geologic and related research in the Denver area is done by geologists, paleontologists, geophysicists, chemists and geochemists, mineralogists, botanists, and technicians. This gathering of talents greatly facilitates scientific activity and provides a stimulating environment for mutually beneficial discussions and the free exchange of ideas. Some of the specific activities carried out in the Denver area are described on the following pages.

Geologic mapping: A fundamental step in the geologic study of an area is the preparation of a **geologic map**, which uses line or color patterns and various symbols to show what kinds and ages of rocks are exposed at the surface, the relations between them, and the probable shapes and structures of the various rock units beneath the surface. The geologist examines rocks and soils on mountain slopes, in streambeds, in quarries and road cuts, or wherever they are exposed, to find out what kinds of materials are present, how they originated, and whether they have been deformed or altered. These examinations of the rocks as they occur in nature are supplemented by specialized laboratory techniques to determine their compositions and physical characteristics, often revealing even more about how the rocks were formed.

Geologists from Denver offices are engaged in general geologic studies of many areas in the Rocky Mountain West which have special interest as known or potential resource areas, are particularly important to understanding the rocks and geologic structures of major regions, or promise to promote a deeper understanding of unsolved geological problems. Most of these studies are aimed at integrating newly obtained field and laboratory data with other known geological relations into a framework of knowledge about geologic regions that may be used for other, more specific needs.



Mineral deposits: Field and laboratory studies of mineral deposits include work on base and ferrous metals, heavy metals, light metals and industrial minerals, and radioactive materials. An area of special importance is the Geological Survey's heavy-metals program (Fig. 10), an integrated resource study of gold, silver, mercury, platinum, palladium, tin, antimony, bismuth, tantalum, and niobium—all metals that are currently in short supply. Denver-based geologists are also engaged in special resource studies of proposed Wilderness areas under terms of the Wilderness Act of 1964 to provide information pertinent to the consideration of these areas for inclusion in the National Wilderness Preservation System.

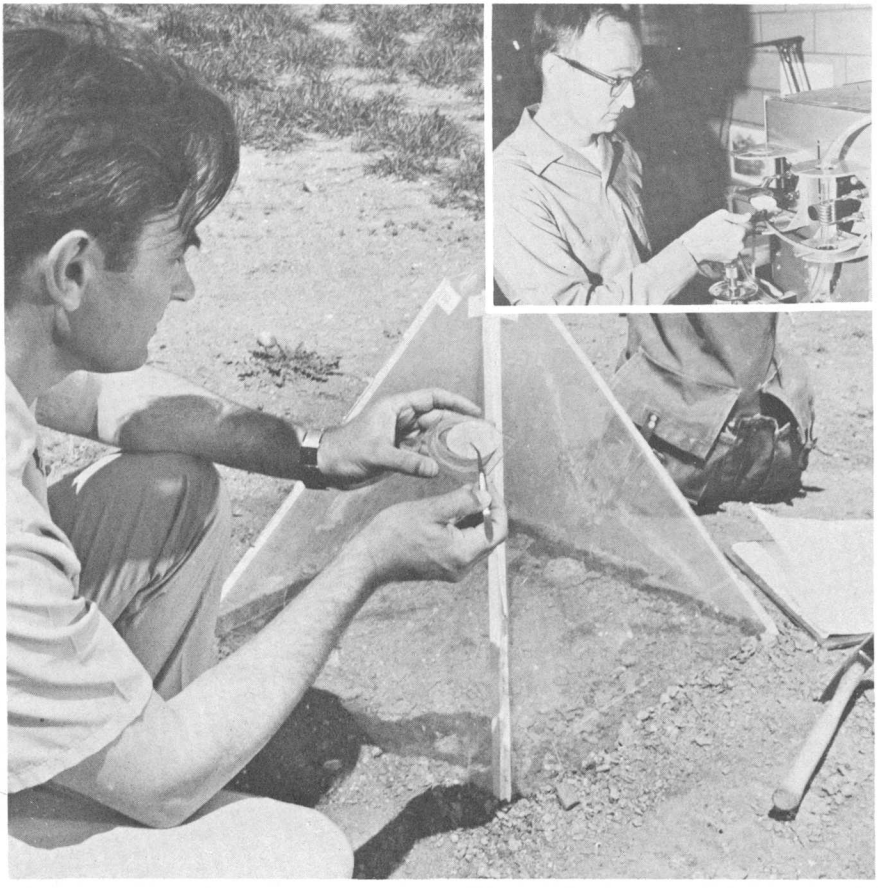


Fig. 10 — New prospecting technique measures infinitesimal amounts of mercury vapor migrating through gravel and soil, as a clue to hidden ore deposits. Circular silver screen placed in opening at top of Plexiglas "tent" traps mercury vapor passing up through soil. Mercury is later measured in laboratory by atomic-absorption instrument (inset). Field tests show that unusual amounts of mercury vapor migrate through soil overlying bedrock deposits of gold and other minerals.

Organic fuels: The distribution, origin, composition, and occurrence of deposits of oil and gas, coal, and oil shale are studied to determine the resource potential of these deposits. Essential parts of these investigations include examination of the successions of rock strata in which the deposits may occur (Fig. 11), theoretical and laboratory analyses of the processes of sedimentation, and considerations of the chemistry, mineralogy, and internal structure of sedimentary rocks.

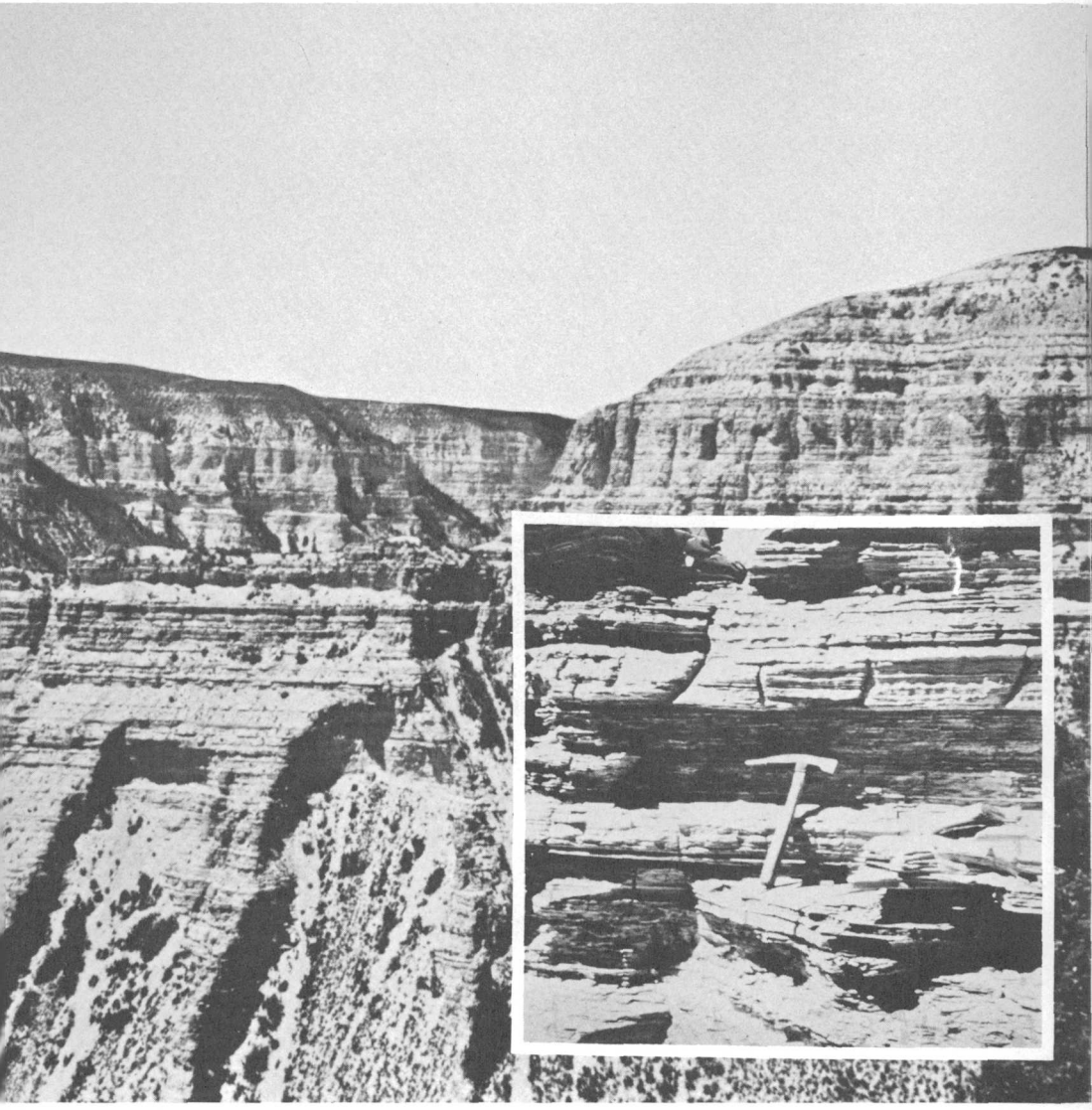


Fig. 11 — Cliffs of oil shale strata in western Colorado. Closeup shows beds (above pick) that contain about 30 gallons of oil per ton.

Fig. 12—Mobile analytical laboratories provide immediate analyses in field areas to guide sampling. Inset shows interior of laboratory.

Geochemical exploration: Denver-based scientists are developing new techniques of exploration for mineral resources. Geochemical sampling around known mineral deposits shows minute traces of rare metallic elements, and sampling for these elements in other areas, where geologic factors indicate possible mineralization, may be used to aid in the discovery of new deposits. Mobile laboratories have been designed and equipped to make analyses in the field for many geologically significant elements in a variety of materials so that the results may be known immediately and guide further sampling and analysis (Fig. 12). Special studies are also made of how deficiencies or excesses of certain trace constituents in soils, rocks, plants, and water may influence the health and diseases of man and domestic animals.

Environmental geology: Geology is being applied to problems that may be encountered in the design and construction of public engineering works and in planning for urban development, and is being used in evaluating geologic hazards to man and his works. These investigations require geologic field work, compilation of available data, and laboratory study of the engineering properties of rocks, soils, and structures. Denver scientists also are actively engaged in cooperative studies with the Atomic Energy Commission in planning and evaluating underground tests of nuclear explosives (Fig. 13).

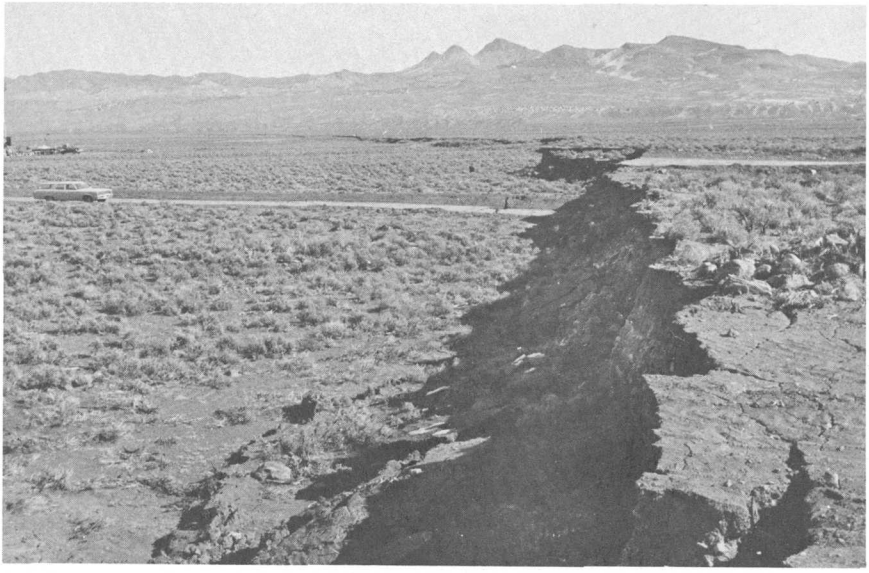


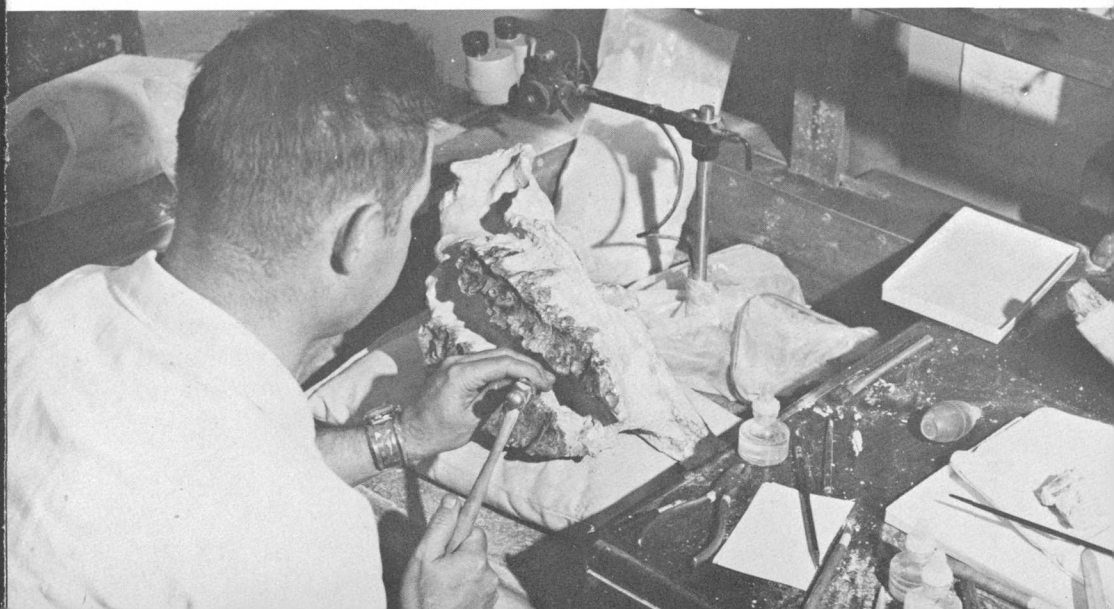
Fig. 13—Studies of surface effects such as this fault scarp aid in planning and evaluating underground nuclear explosions. Vehicle at left indicates scale.

Geophysical surveys and remote sensing: Interpretations of geologic structures and mineral deposits are based not only upon direct observation and sampling of the surface but also upon the use of many types of instruments to measure physical properties of the earth. Some of these measurements, planned and executed from Denver, are designed to reveal relations at or near the earth's surface, for example by detecting reflected infrared radiation or radar echoes. Other measurements, such as variations in the intensities of the earth's gravity or magnetic fields or of the velocities of shock waves transmitted through the earth's crust, may enable scientists to interpret deeply buried features. These surveys may be made on the ground, from aircraft (Fig. 14), or even from instrumented satellites.

Fig. 14—Use of instruments mounted in aircraft permits rapid measurement of earth's physical properties over large areas to aid in interpretation of geologic features.

Paleontology: Fossil organisms found in rocks are examined and interpreted in Denver's paleontological laboratories. Fossil pollen, spores, wood and leaves, and vertebrate and invertebrate animals are studied with the aid of large reference collections (Fig. 15). The data obtained are used to correlate rock strata, to reconstruct the ancient environments in which the organisms lived, and to help unravel the history of organic life on the planet.

Fig. 15—Preparator cleans fossil rhinoceros jaw for study and comparison with other specimens.



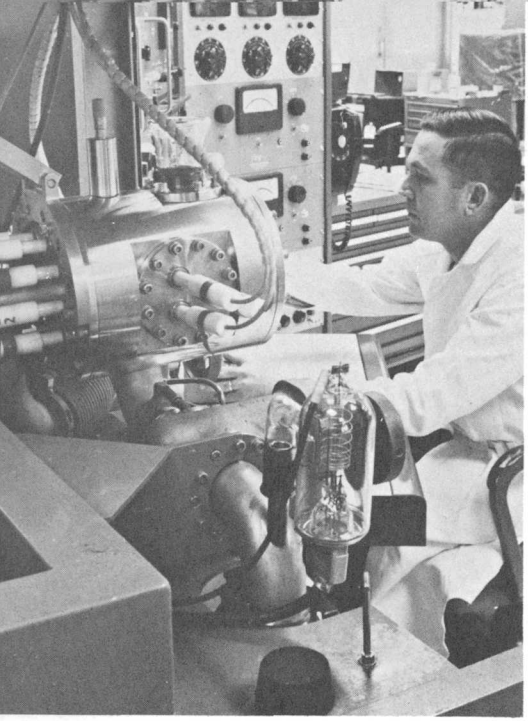


Fig. 16—Physicist uses 12-inch mass spectrometer in analysis of rocks for isotopes of uranium and thorium to determine ages.

Isotope geology: Naturally occurring and artificial isotopes (different forms of the same element with different atomic weights) are utilized in a variety of ways to interpret the origins of rocks and mineral deposits and to further geologic knowledge. Isotopes are used to determine the ages of many geologic materials, as chemical tracers through geologic processes, and as indications of such conditions as ancient temperatures. The Nuclear Science Building at the Denver Federal Center is used for some of these investigations (Fig. 16).

Rock and mineral laboratories: Many well-equipped laboratories in the Denver area are used to support geologic studies and to carry out research on the origin and geologic significance of many kinds of rocks. Among these are laboratories to prepare samples for chemical analysis and microscopic study, to separate constituent minerals from their host rocks, to analyze the major- and trace-element composition of rocks and minerals (Fig. 17), and to identify minerals and study their atomic structure by means of X-ray diffraction. Special studies in other laboratories are concerned with such processes as how sediments are deposited by streams or on sea floors (Fig. 18).

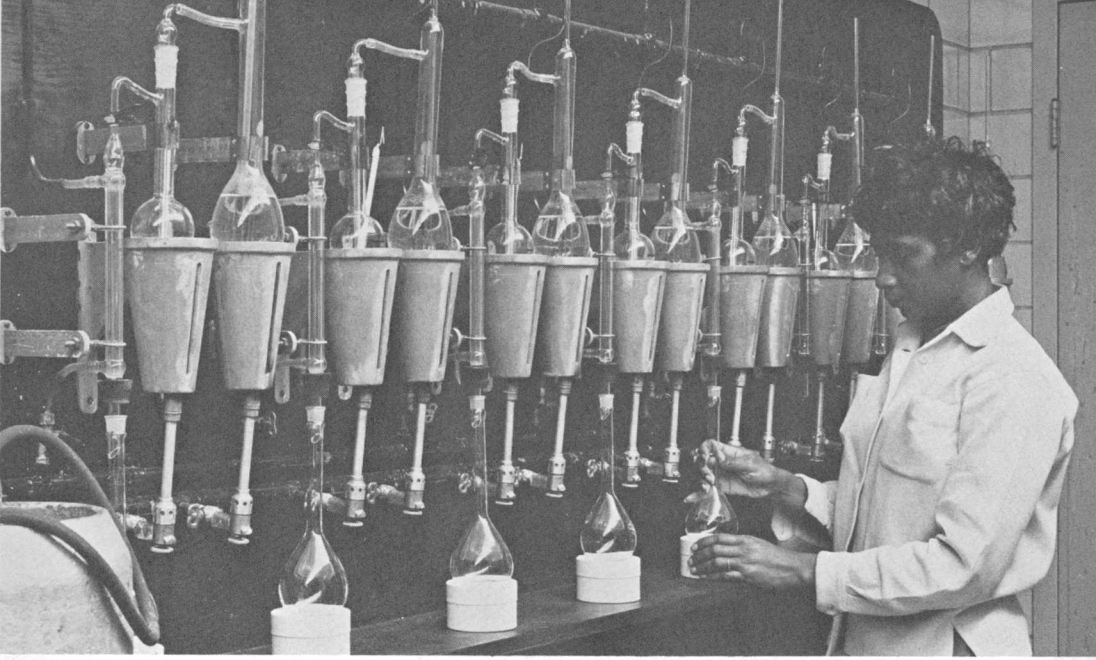


Fig. 17—Standard chemical analysis of rocks determines precise amounts of 16 components that make up nearly all rocks.

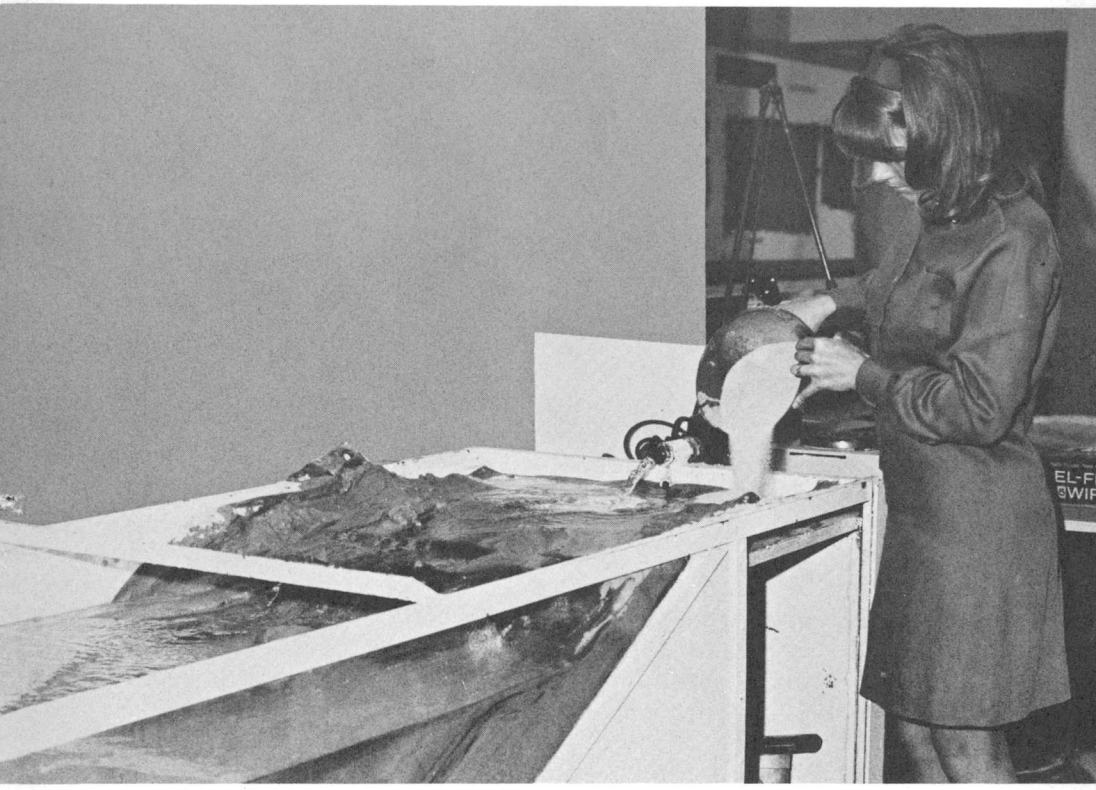
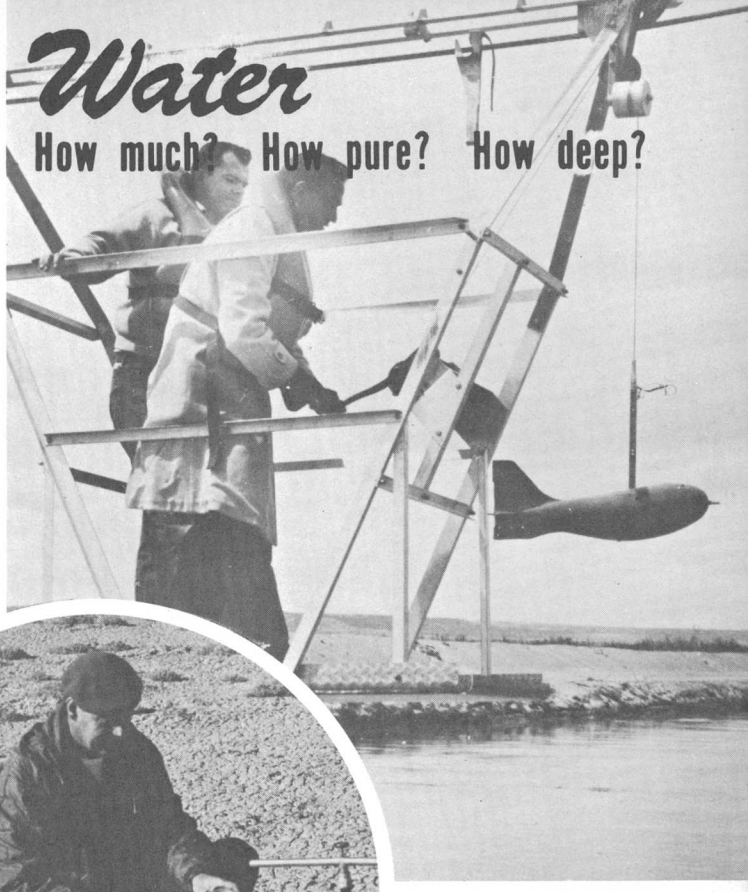


Fig. 18—Experiments in deposition of sediments in water aid interpretation of structures found in ancient sedimentary rocks.

Water

How much? How pure? How deep?



Water resources—their quantity, quality, and availability—are the concern of a large segment of the Geological Survey's work in Denver, which serves as administrative headquarters for water-resource activities in the Rocky Mountain Region as well as headquarters for field operations of the Colorado District.

Ground-water studies: Ground-water hydrologists operating out of the Denver office study the ground-water resources of specific areas—the quantity, quality, and availability of ground water in terms of present and expected future demands—to provide basic information needed for formulating water laws or for planning and managing water developments. Other ground-water research includes the investigation of special problems in the field of geohydrology. Geology is mapped as required to evaluate the ground-water resources of areas being studied. Streamflow data for all gaging stations west of the Mississippi River are processed in Denver in preparation for publication. Records are analyzed to determine hydrologic characteristics of watersheds, and to determine the source, quantity, distribution, movement, and availability of water in streams, lakes, and reservoirs.

Chemical and physical quality of water: Research into the chemical and physical quality of water concerns the nature and amounts of dissolved and suspended impurities and their behavior in water, chemical and other factors that control amounts of impurities in water, the mechanics of solute and sediment transport, and the practical effects of impurities on the use of water for the benefit of man. It concerns the amounts of radium and uranium occurring in ground water in selected geologic terranes in the United States, and the chemical, geologic, and hydrologic factors governing concentrations of radioactive elements. It concerns chemical factors and related effects, such as those of aquatic vegetation controlling solution, deposition, and transport of iron in water. The development and improvement of laboratory and field analytical methods for water-quality studies are also part of this program.

Nuclear research: The Survey's Nuclear Science Building provides facilities for the advanced application of nuclear techniques to the analysis of both geologic and hydrologic problems. The research reactor (Fig. 19) in this building is connected to the analytical laboratories by a pneumatic-tube system that permits introduction of the sample into the reactor and its return to the laboratory by remote control. The activation-analysis laboratories are in the center block of the building and are designed for handling relatively high levels of radioactivity; laboratories that handle lower levels of radioactivity are in a semi-isolated wing extending from the opposite end of the central block. In this way, radioactivity levels within the building may be effectively controlled. A central monitoring system with detectors in each key area feeds into an indicator panel in the health physicist's office and permits reading the radioactivity level of any area of the building at a glance. A 3,000-curie gamma irradiation facility has been installed, and a shielded room is available for anticipated installation of a neutron generator.

Soil and moisture conservation: Studies of soil and moisture conservation practices on public lands include reconnaissance of sites or areas for obtaining stock water by drilling wells, developing springs, or constructing reservoirs. Data on precipitation, runoff, erosion progress, sediment yields, and soil characteristics are collected to provide information for planning land-treatment and erosion-control measures.

Training Center: The Water Resources Training Center recently established in Denver provides for new professional employees a 24-week course of orientation in hydrologic methods. It is staffed by more than 20 specialists in hydrology. The trainees learn the technical operations involved in various phases of hydrologic studies and also gain an overall insight into the whole field of water resources. Advanced seminars and workshops in various phases of hydrology also are provided.

Colorado District: The Colorado District Office is responsible for water records and water studies in the State. The district maintains a network of stream gages and water-quality monitoring stations on the principal streams and tributaries

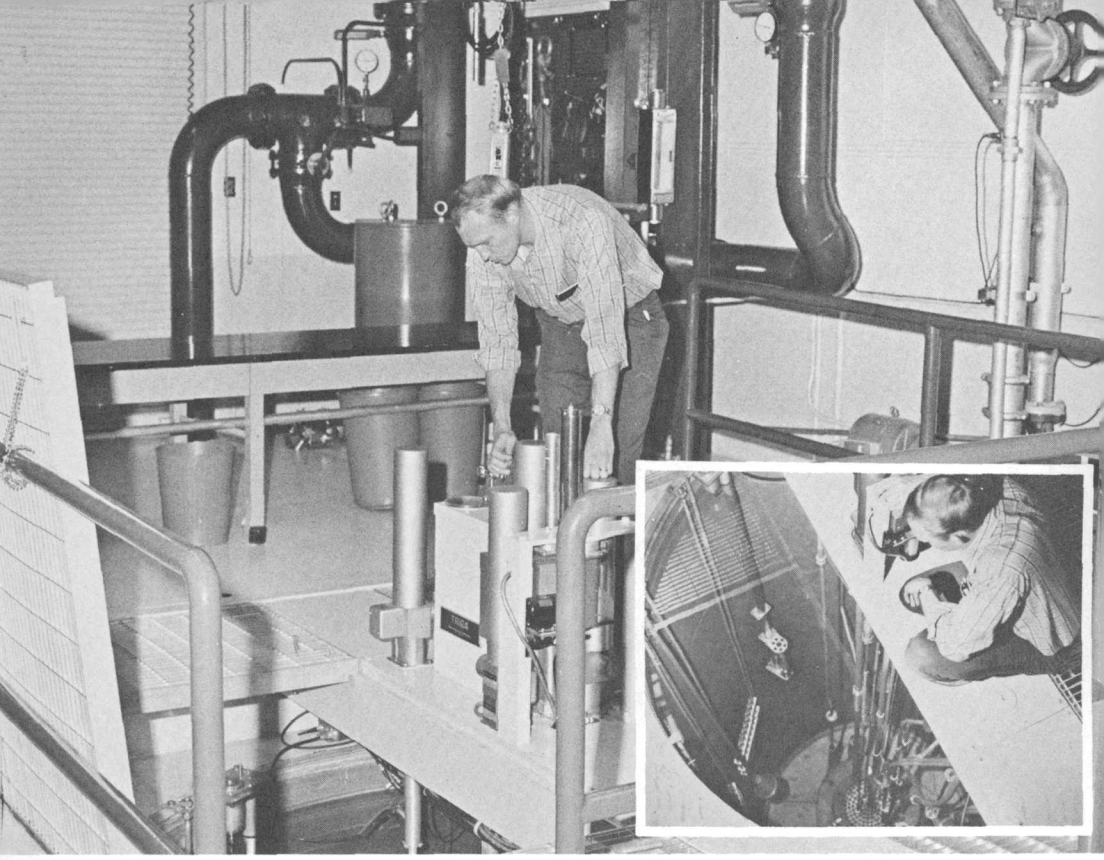
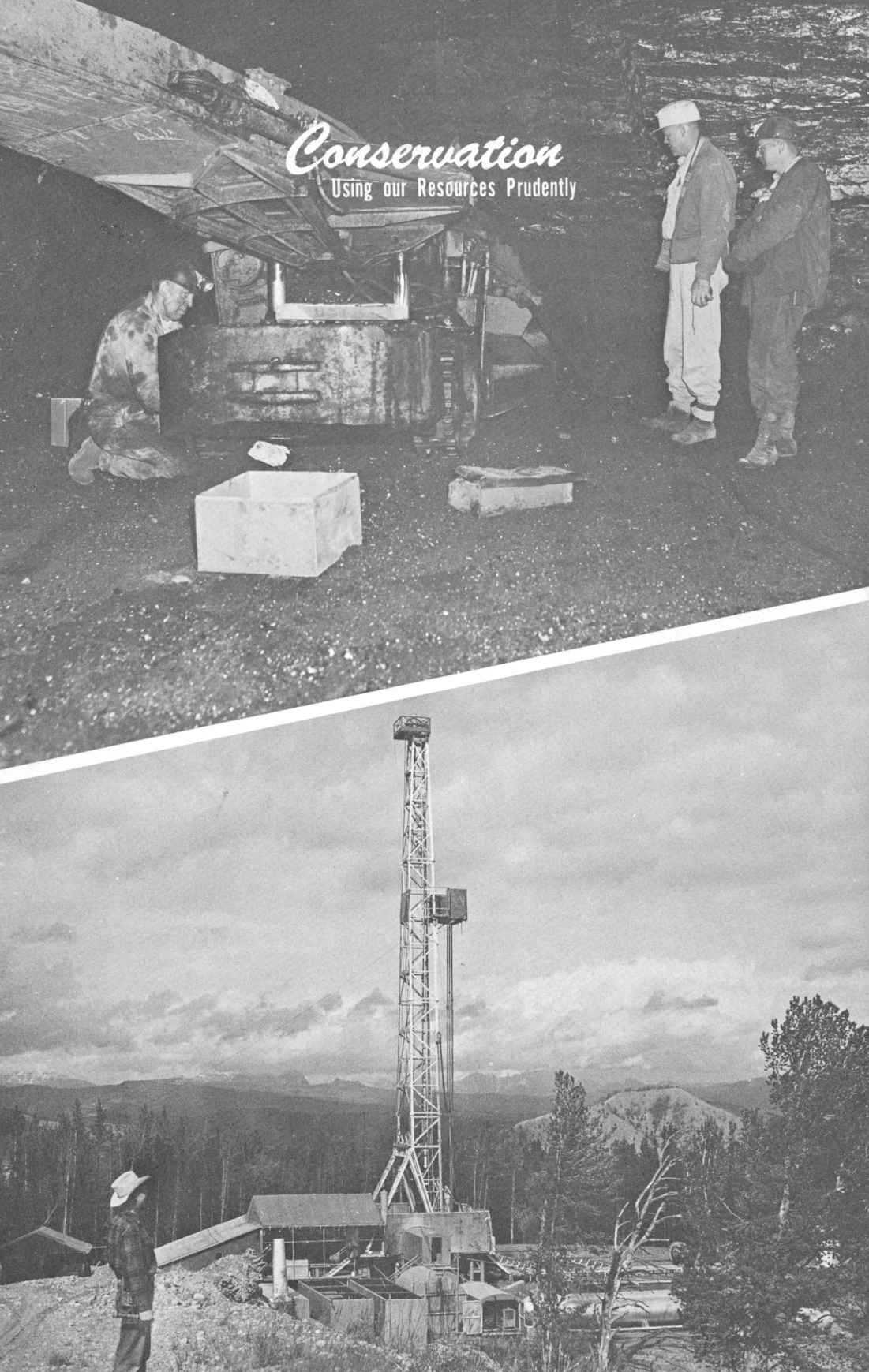


Fig. 19—Operating section of nuclear reactor. Reactor itself is in shielded tank of water 20 feet below floor level (inset).

(350 to 400 stream gages and 50 to 100 water-quality sampling stations). Regional studies of the magnitude and frequency of floods, particularly in small watersheds, provide a basis for improving the design of drainage structures in both rural and urban areas. Continuing inventories of ground-water supplies show how the ground-water resources are being developed.

Detailed studies of major water regions, particularly in the eastern part of the State, are the basis for improved water laws and for managing and planning the development of the resource. Research is developing techniques for predicting changes in the quantity and quality of water resulting from changes in water-management practices.

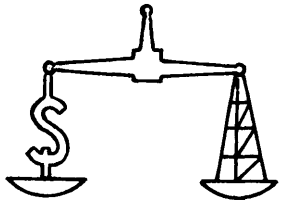
Most of the work represents a cooperative effort with various Federal, State, and local agencies. Major cooperators include the Colorado Water Conservation Board, Office of the State Engineer, and the Bureau of Reclamation. The data and results of the studies are released in publications of the Geological Survey and their cooperating agencies.


Conservation
Using our Resources Prudently

With the aim of assuring prudent use of the Nation's mineral and water-power resources, the Geological Survey serves the public and other Federal agencies by (1) appraising and classifying the public lands as to their water-power and mineral value, and (2) supervising the development and production of the leasable minerals (oil and gas, coal, sodium, potash, phosphate, oil shale, and bitumens) under lease on Federal and Indian lands.

Leasing operations—oil, gas, and minerals: Survey engineers and geologists supervise prospecting for and production of leasable minerals, including oil and gas, on Federal and Indian lands. These activities include engineering and geologic investigation of leases and prospecting permits, computation and collection of royalties due the Government, and supervision of prospecting and mining operations to insure that such operations comply with applicable laws and regulations. Oil and gas operators are assisted in formulating plans for Unit operation of oil and gas fields. Working mines are inspected to insure proper safety and conservation practices. Mineral leasing activities in Colorado, Kansas, Nebraska, and southeastern Wyoming, and oil and gas leasing activities in Colorado, are carried out by engineers and geologists headquartered in the Federal Building in downtown Denver.

Mineral classification: Geologists use surface geologic mapping, subsurface geologic studies, stratigraphic studies, and sampling programs to classify Federally-owned and controlled lands for their leasable mineral potential (Fig. 20). Mineral reports are provided to other Government agencies where needed in the management of the public lands. Mineral classification activities in Colorado, Idaho, Nebraska, Utah, and Wyoming are carried out by geologists headquartered in the Denver Federal Center.



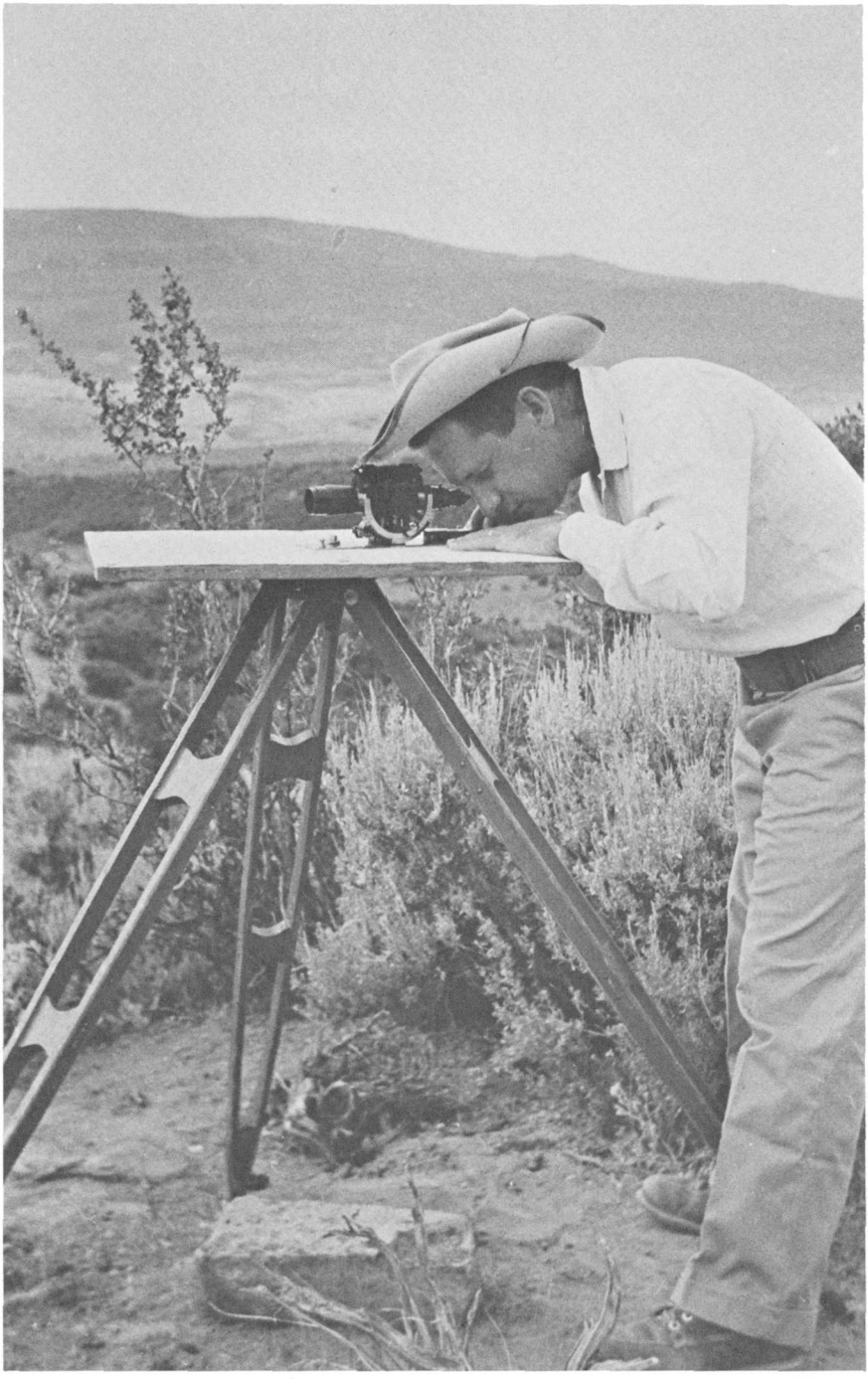
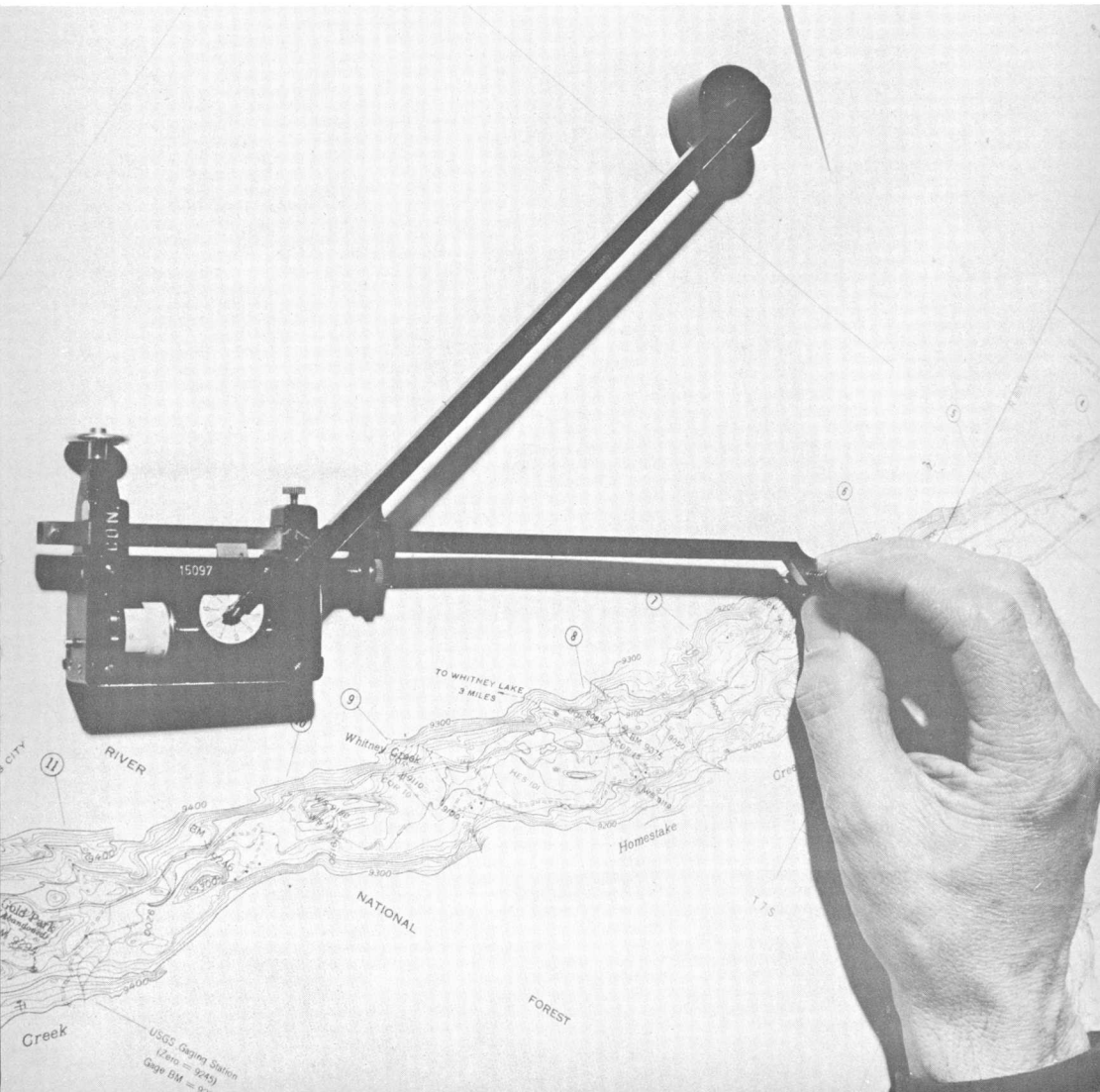


Fig. 20—Detailed mapping of geologic formations is a step in evaluating the potential of Federal lands for production of leasable minerals.

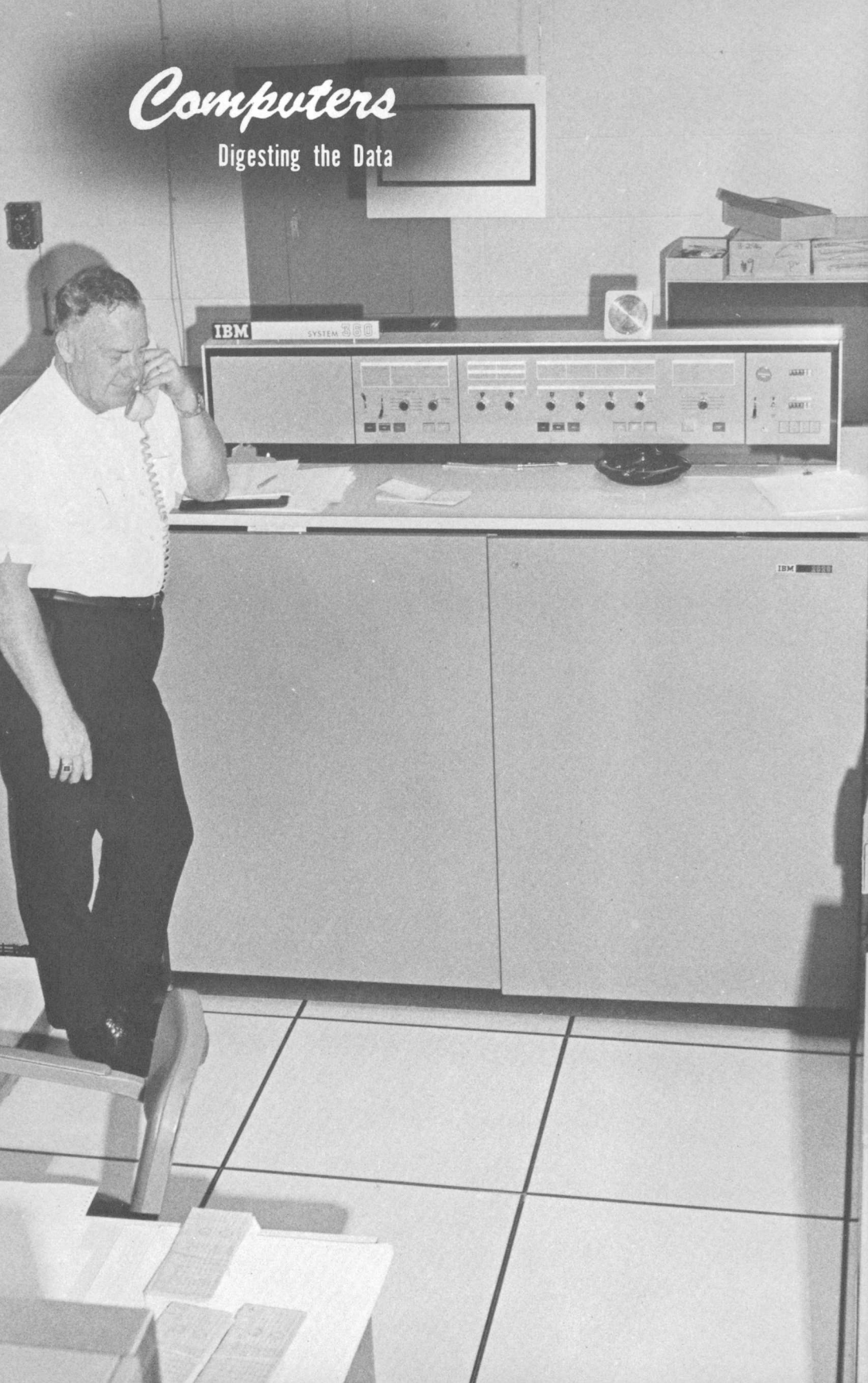
Water-power classification: From data obtained by field investigations and from other suitable work by Federal or non-Federal agencies, hydraulic engineers identify and evaluate potential hydropower and water-storage sites on Federal lands, and classify lands found to have such potential (Fig. 21). In some cases, data and recommendations concerning injurious uses of classified lands are furnished to land administration agencies. An accurate and current system of records shows land location and potential use for water-resource development. Water-power classification activities in Arizona, Colorado, Kansas, Nebraska, New Mexico, eastern Utah, and southern Wyoming, are carried out by engineers headquartered in the Federal Building in downtown Denver.

Fig. 21—Engineer traces mapped outline of river channel with planimeter to determine exact area and potential water-storage capacity.



Computers

Digesting the Data



Few Geological Survey mapping or research projects, whether they are carried out primarily in the field or in the laboratory, fail to accumulate masses of data—rows and columns of facts and figures—that become most useful only when they can be fully interpreted and compared with other data by the use of modern computers. The Denver field center maintains a terminal that is connected by telephone lines to the Survey's central IBM 360 computer in the Nation's capital. Data and programs submitted to the computer in Denver are transmitted to Washington, the computations performed, and the results returned over the lines in a matter of minutes, just as if all processing took place locally.

The computer is available for use by all Geological Survey activities in Denver, for a variety of computation operations springing from Survey activities. Typical computer activities handled in Denver include:

— Calculation of theoretical mineral composition of rocks from chemical analyses;

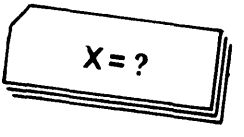
— Statistical analysis of geological, geochemical, and hydrological data, to discern significant trends or patterns too subtle to be observed directly;

— Preparation of mathematical (theoretical) models to aid in interpretation of geophysical observations;

— Automatic inventory and updating of local stocks of published maps available for distribution to the public;

— Computation of geodetic data and preparation of tapes for automatic plotter;

— Statistical analysis of streamflow records.

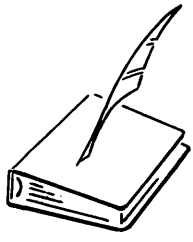


Administration

Personnel, Equipment, Records

Providing administrative services to the entire Geological Survey staff in the Denver area requires a central corps of specialists trained in personnel management, service and supply, fiscal liaison, property maintenance, and space and records management, not only for Denver but for other offices in the Rocky Mountain Region.

Personnel: Personnel specialists furnish complete personnel administrative services and counseling, and personnel management guidance and assistance, to all Survey offices and employees in the 12-state Rocky Mountain Region (Fig. 22). This includes services in high school, college, and university recruiting, placement and staffing, equal employment opportunity, position classification, position management, wage administration, employee relations, union-management relations, employee development and training, management analysis and advice and safety. The Geological Survey in the Region employs many different scientific, engineering, and technical support specialists as well as a wide variety of administrative, clerical, and major crafts support categories. Among these are Geologists, Geophysicists, Chemists, Civil, Hydraulic, Electronic, Nuclear, and Chemical Engineers and Technicians, Physicists, Mathematicians, Botanists, Spectrographers, Mass Spectrometrists, Computer Programmers and Analysts, Aircraft Pilots, Economists, Psychologists, Personnel and Supply Specialists, Administrative Officers, Secretaries, Typists, Stenographers, Warehousemen, and a variety of highly skilled craftsmen.



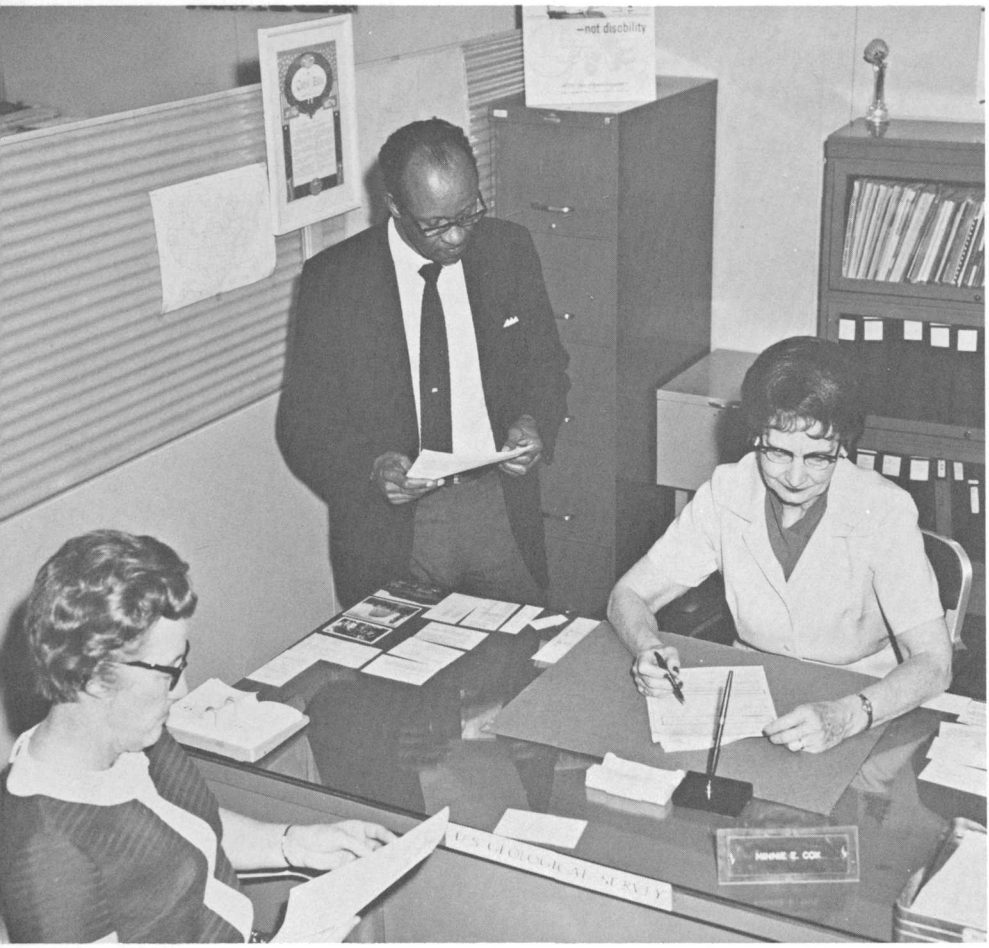


Fig. 22—Specialists furnish personnel services and counseling.

Service and Supply: Here are provided advice and services in procurement, warehousing, property control and management, transportation, and records management.

Property Maintenance: This section is staffed and equipped to maintain, design, and develop optical, mechanical, and electronic instruments and woodworking for laboratory and field use by Survey scientists and engineers (Figs. 23, 24).

Figs. 23 and 24—Special equipment is developed and maintained for Denver scientists and engineers.

Publications

The Final Product Goes to the Public

In bringing the results of its research to the public, the Geological Survey maintains a long-standing tradition of high quality, not only in the accuracy of its topographic maps but also in the clarity of its written reports and its geologic maps and other illustrated publications. This reputation of course originates with the Survey's scientists—who are their own authors but serve also as unflinching technical critics of their colleagues' reports—but it reflects just as much the care with which all Survey manuscripts are edited and processed, and the skill with which the technical illustrations are prepared. Most Survey reports and maps prepared by Survey authors headquartered in Denver are also edited and processed in Denver, and here too are facilities for distributing maps and reports.

Editorial processing: Survey editors in Denver edit manuscripts and illustrations for Survey scientific and technical publications, prepare manuscripts for the printer, check page proof and binding, prepare indexes, and in general produce publications in good form and as economically as possible. Editors put manuscripts into the style adopted by the Survey and the Government Printing Office; approaching manuscripts as detached but sympathetic readers representing the people to whom the publication will ultimately go, they try to understand the authors' ideas and then make sure that those ideas are expressed clearly and concisely (Fig. 25).

Fig. 25 — Editors check manuscripts for clarity and form.

Technical illustrations: Survey cartographers and other specialists prepare maps (except topographic maps) and related technical illustrations used in the published results of Geological Survey investigations (Fig. 26). In addition to maps and charts, they also prepare multiple-stage views of inferred ancient environments (Fig. 27), three-dimensional physiographic panoramas, paleontological illustrations, and transparent or cutaway views of underground structures for special reports or book publications.

Fig. 26 — Four cartographic steps in the preparation of a geologic map: (a) scribing and color separation; (b) stripping peelcoat; (c) applying patterns; (d) finished color proof.

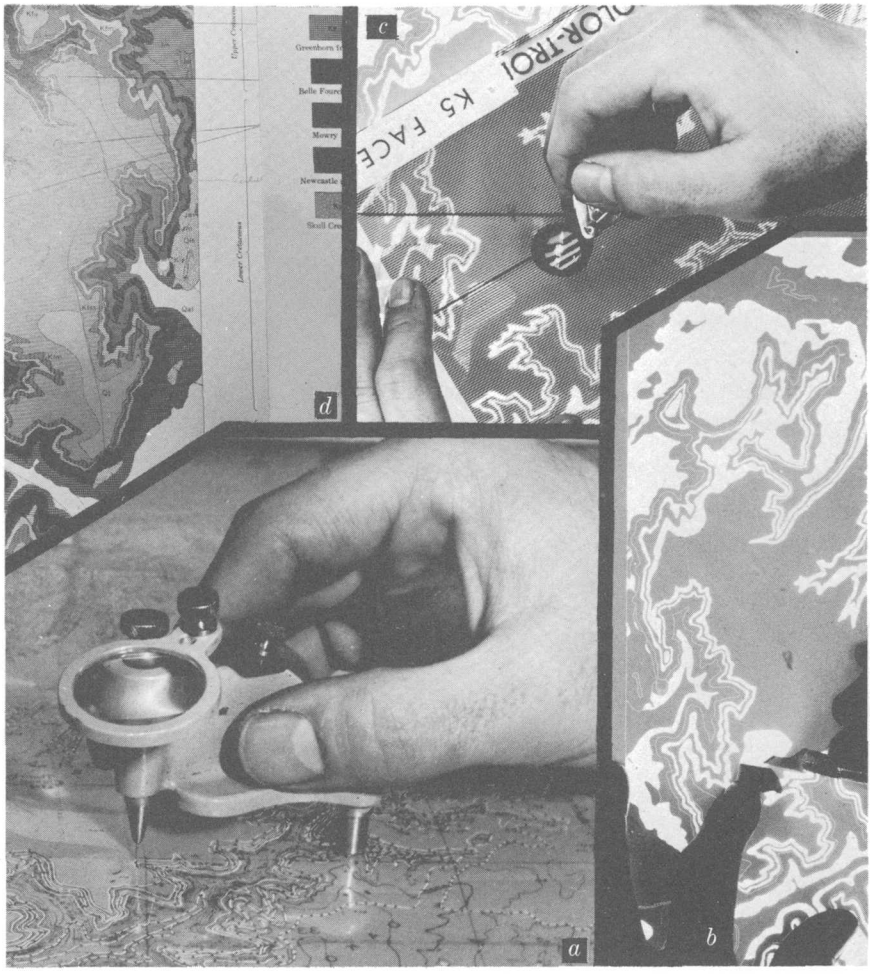


Fig. 27 — Artist paints conception of ancient sea floor as interpreted from geological studies.

Distribution: Finally, the published product is distributed to the public by mail or over-the-counter. The Denver Map Sales Office handles all published topographic quadrangle, State base, river survey, geologic, and hydrologic atlas maps of the Geological Survey for States west of the Mississippi River, including Alaska and Hawaii. State map indexes, available on request, show the availability and price of published maps. Book publications such as bulletins, professional papers, and water-supply papers are available in Washington, D. C., from the Superintendent of Documents and in Denver from the Geological Survey's Public Inquiries Office (see page 42).

INFORMATION SOURCES AND SERVICES

The results of the wide-ranging scientific and technical work of the Geological Survey are disseminated through a variety of media. Information services about the earth sciences provided by the Survey in the Denver area include—

SCIENTIFIC AND TECHNICAL PUBLICATIONS—Comprehensive scientific and technical information about the earth sciences is published in the Survey's professional and water-supply papers, bulletins, circulars, and miscellaneous reports. These may be examined at most public libraries, at the Geological Survey library at the Denver Federal Center, or at the Public Inquiries Office*, or may be purchased over-the-counter from that office or by mail from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402. A monthly announcement, "New Publications of the Geological Survey," is available without charge on request to the Geological Survey, Washington, D. C. 20242.

POPULAR PUBLICATIONS—A wide variety of informative booklets, leaflets, folders, and flyers are distributed free by the Survey to provide the general public and interested students with basic knowledge about geology, water resources, and topographic mapping as well as descriptions of the Survey's programs and activities. Popular publications are available on request at the Denver Public Inquiries Office* and the Map Sales Office**.

LIBRARY—The Geological Survey branch library in Building 25, Denver Federal Center, contains some 75,000 books and periodicals on geology and related sciences, and a topographic and geologic map collection of over 50,000 items. Reference rooms are open to the public.

MAPS AND CHARTS— Geologic maps, mineral-resource maps and charts, hydrologic atlases, and topographic maps are published and sold by the Survey. In addition to maps of the United States, geologic maps of the moon and topographic maps of Antarctica are available. For further information visit the Public Inquiries Office* or Map Sales Office**, or write to the Geological Survey, Washington, D. C. 20242.

PUBLIC INQUIRIES OFFICE—Established to provide a convenient public contact point, the Geological Survey Public Inquiries Office* in Denver has a collection of Survey publications and, like the library, serves as a depository for selected open-file

AVAILABLE IN THE DENVER AREA

reports. This office sells (over-the-counter only) selected Survey book reports (as an agent of the Superintendent of Documents) and geologic and topographic maps relating to the Rocky Mountain region, and distributes free informational literature about Survey activities. Arrangements can be made for obtaining maps or books not carried in stock.

PHOTOGRAPHS—The Geological Survey Photographic Library in Building 25, Denver Federal Center, contains approximately 140,000 photos and transparencies of geologic and historic importance, indexed by geologic subject and geographic location. Copies are available at cost.

AERIAL PHOTOGRAPHY—Information on aerial photography of the Rocky Mountain region may be obtained from the Air Photo Sales Office, Room 2409, Building 25, Denver Federal Center. This is a sales office for aerial photographs and special map reproductions of Geological Survey material. It maintains records and indexes of aerial photographs and advance map materials of the Survey, and also maintains a general index of aerial photographs held by other Government agencies.

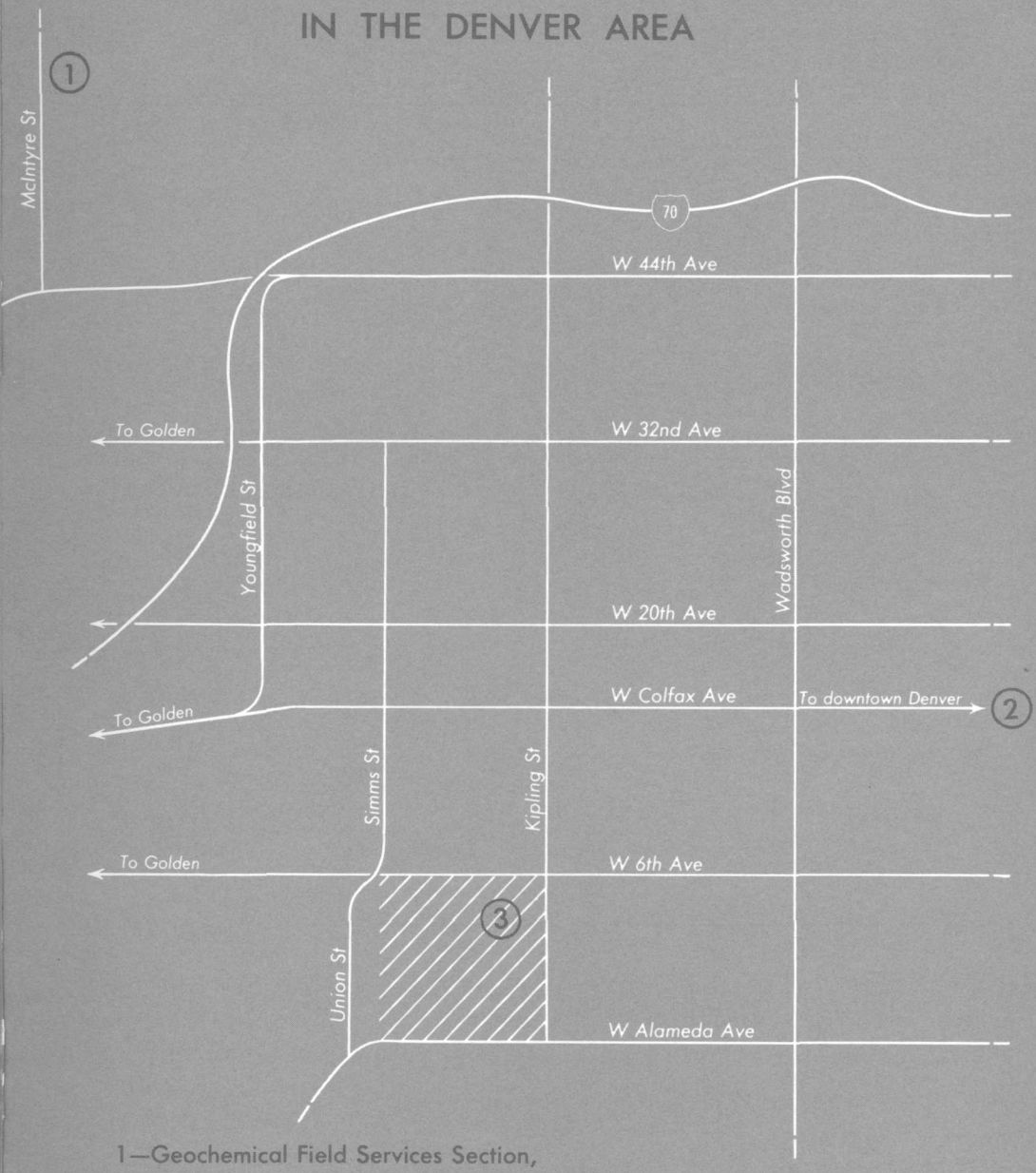
EXHIBITS—Over 200 exhibit panels, available on loan from the Geological Survey for professional society meetings, technical conventions, and similar gatherings, illustrate recent work in geology, hydrology, and topography. They can be obtained with structural supports and lighting for free-standing display. For information about exhibits visit or write the Exhibits Unit, Geological Survey, Building 25, Denver Federal Center.

FILMS—Organizations may borrow 16 mm sound-color motion-picture films dealing with geology, topographic mapping, and water resources for showing by schools and colleges and by professional, civic, and other interested groups. Requests for information on educational loan or purchase of films may be addressed to the Information Office, Geological Survey, Washington, D.C. 20242.

* U.S. Geological Survey
Public Inquiries Office
Room 1012, Federal Building
1961 Stout Street
Denver, Colorado 80202
Telephone (303) 297-4169

** U.S. Geological Survey
Map Sales Office
Bldg. 41, Federal Center
Denver, Colorado 80225
Telephone (303) 233-3611, ext. 8988

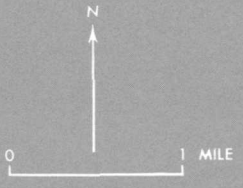
GEOLOGICAL SURVEY INSTALLATIONS
IN THE DENVER AREA



1—Geochemical Field Services Section,
5950 McIntyre St.

2—Public Inquiries Office,
1012 Federal Bldg., 1961 Stout St.

3—Denver Federal Center,
(see map inside front cover)



As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.