sociology, but the approach is anthropological. A series called *Publications of the Institute of Social Anthropology* has been established, in which the results of the field studies appear. These monographs contribute to a broader knowledge of the social sciences and furnish material, comparable in scope and purpose to studies made in other parts of the world, that may be used in arriving at generalizations concerning culture processes and culture changes. They also provide information that may be of help to administrators whose duty it is to carry out practical programs among peoples whose basic cultures are being greatly affected by the growth and changes in present-day civilization.

Since its organization, the Institute has had members of its staff in Mexico, cooperating with the Escuela Nacional de Antropología; in Peru, working with the Instituto de Estudios Etnológicos and the Ministry of Education; and in Brazil, assisting the Escola Livre de Sociología e Politica de São Paulo. The contemplated expansion of the general cooperative program to the Eastern Hemisphere suggests the possibility of the Institute's eventually having projects in the Near East, China, and Russia.

During the war period members of the various anthropological staffs in the Institution devoted much of their time to searching out and preparing information about native peoples and little-known parts of the world and to writing pamphlets and handbooks for various branches of the armed services. This work was coördinated by the Ethnogeographic Board, an organization set up as a joint project of the Smithsonian Institution, the National Research Council, and the American Council of Learned Societies. The offices of the Board, which went out of existence on 30 June 1946, were in the Smithsonian Building.

Throughout the history of the Bureau of American Ethnology, the Department of Anthropology, and the recent Institute of Social Anthropology, there has been no duplication of effort. The researches and other work have been planned and carried on as an integrated whole. The activities of each unit supplement those of the others, and in conjunction the three comprise the Smithsonian program for anthropology.

The Smithsonian: Pioneer in American Geology

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ROCKS, MINERALS, AND FOSSILS are popularly regarded as the sole objects of the geologist's study. The rocks do, indeed, furnish basic ideas of the earth's composition and history; the minerals are their expressions in chemical form or their artistic representations as gems; and the fossils reveal the story of prehistoric life, its environment, and its development. The natural science geology is, however, a broader subject, because it records the entire history of the earth and its inhabitants from our planet's origin in the sun to the present. Thus, geology is a composite science in which astronomy, biology, physics, and chemistry, contribute toward unraveling this complicated history. Furthermore, its findings lead directly to the modern sciences of economics, history, geophysics, and other subjects. It is in this larger sense that some of the pioneer researches of the Smithsonian Institution are here outlined. Since 1846, geologic research in many of its phases has been fostered and encouraged by the Institution and in some instances has been personally cultivated by its secretaries. This broad conception of the science is illustrated in Elliot's large mural painting, "Diana of the Tides," overlooking the dinosaur hall of the Natural History Building. Although primarily intended to represent the story of mythology, "Diana" does in fact picture astronomy, physical geology, petrology, sedimentation, fossils, glaciation, and other subjects of geological inquiry.

Progress in the earliest days of American geology was made largely by men engaged in the "learned" professions who pursued its study as a hobby. At that time there were no maps and no railroad cuts where the rocks were exposed to view; in fact, the country was largely a wilderness. It was logical, therefore, that certain gigantic fossil bones found weathered out at the surface in western Virginia (now West Virginia) should be investigated first. These were described by Thomas Jefferson as *Megalonyx,* which later was found to be not a lionlike animal, as he thought, but a giant sloth. When Jefferson became President, he continued his paleontological studies and had in the White House more than 300 fossil bones, chiefly from Big Bone Lick, Kentucky.

The James Smithson bequest came at an opportune period in the history of American geology. During this very year or shortly afterward New York and 12 other states inaugurated state geological surveys, being preceded only by North Carolina in 1824 and Tennessee in 1831. These early surveys were primarily charged with such essential projects as preliminary mapping, soil and mineral analyses, and other requirements of an undeveloped country, so that practically not even a beginning could be made on research problems. The need for a research institution, as visualized by Smithson, was paramount.

Smithson himself was interested in geology, for among his 27 publications in science several deal with the origin of the earth and with analyses of minerals and chemicals. His studies of zinc minerals indicated a new species, a carbonate, to which the name "smithsonite" was applied by subsequent investigators. His personal collection of minerals came with the bequest as the first geological donation to this Institution.

Several friendships of this early period are of interest in foreshadowing the future progress of geologic science in America. Just previous to Smithson's gift there appeared in the geological field a man of untiring energy, Amos Eaton, who at the age of 40 abandoned his law practice to study geology. Subsequently he traveled several thousand miles on foot through New England and New York, delivering short lectures on natural history. While Eaton was teaching at Rensselaer Polytechnic Institute at Troy, New York, a young man, an amateur collector, fell under his spell. Thus started the distinguished career of the first state geologist of New York, James Hall, who for more than half a century was the predominating figure in American geology and invertebrate paleontology. Eaton's lectures had a similar effect upon another young man, Joseph Henry, who had dreamed of a life devoted to poetry and drama but who now changed his aspirations to the fields of science. Eaton, when commissioned in 1820 to conduct an agricultural and geological survey of Albany County, New York, chose as his assistant the same Joseph Henry, the future first secretary of the Smithsonian. Henry was therefore a geologist first, as evidenced by his collections made on this soil survey and still preserved at the New York State Museum. Hall and Henry became close friends and remained so throughout life to the benefit of American science. In the conduct of his New York survey Hall owed much to Henry's wise counsel, while Henry similarly benefited from Hall's experience as a geologist.

Geography

Geography deals with the most recent period of earth history and thus is present-day geology. So much of the land areas was practically unknown in 1846 that the Institution early decided to foster geographic explorations to the extent of its ability. Financially it was unable to equip large expeditions, but the service rendered by the loan of its personnel and by the preparation and publication of the results caused it to play a more important part than is popularly believed—indeed, to contribute a real service to mankind at this time. The natural-history specimens, rocks, fossils, animals, and plants derived from these expeditions were fertile sources of increase to the collections and, through their study, to scientific knowledge. Since the greater part of the United States west of the Mississippi River was unknown at this time, it was natural that these explorations were usually organized under the branches of the general Government. Earliest of these were the expeditions conducted by the War Department to discover practical railroad routes to the West. These were accompanied by geologists, biologists, and ethnologists, who received their instructions from the Institution. Maj. J. W. Powell's famed exploration of the Colorado River, partly at the Smithsonian's expense, was undertaken at this time. In these pioneer days experts of the Smithsonian were also engaged in cave investigations on the Island of Anguilla to throw light on the life and the geography of the West Indies in prehistoric times. Later, parts of Asia were explored, particularly by Raphael Pumpelly, one of the first Americans to travel extensively through China and Mongolia. In the researches published by the Smithsonian, Pumpelly described the geological features of large parts of this vast area. Parts of Africa too were visited at this early date by Americans associated with the Smithsonian, which in many cases published the results of their explorations.

Paleogeography

From geography one passes to paleogeography, the science of mapping the ever-changing lands and seas of geologic times. The inauguration of this branch of learning in America can be attributed to Smithsonian scientists. Just as modern animals and plants are classified according to definite areas of geographic distribution, so the ancient assemblages of life, the fossil faunas and floras, can also be so delimited. Sea animals and the sediments in which their remains were buried were certainly not deposited on dry land. Consequently, it can usually be safely assumed that the ancient shore line has been reached when a rock layer with marine fossils has been traced to the point where it thins out and disappears. Thus, by plotting the distribution over wide areas of sedimentary rocks of a particular age, as determined by their contained fossils, the arrangement of land and water of that time—in other words, the ancient geography or paleogeography—can be ascertained. Phosphate deposits formed along old shore lines, salts representing the evaporation product of ancient lagoons, bog iron ores, and indeed many other mineral deposits depended for their formation upon ancient geographic conditions.

Paleogeographic maps can be prepared in such detail as to be of service in the search for such mineral and other economic deposits provided the fossils have been studied in advance. The paleontologist is naturally the best person to prepare accurate paleogeographic maps. Although various generalized maps were outlined in Europe and America some years before, it was not until 1902, when Charles Schuchert, then assistant curator in the National Museum, and E. O. Ulrich, honorary associate in paleontology, combined their knowledge and experience with Paleozoic fossils and produced the first set of detailed maps of that era. This pioneering work has been followed by others to such an extent that paleogeography is now a firmly established and very useful division of geology.

Glacial Geology

The weather, operating through the cold climates of high altitudes and arctic latitudes with the formation of vast areas of glacier-covered country at various times in geologic history, has had much to do with the formation and distribution of rich areas of soil as well as barren, boulder-strewn regions and outcrops of bare rocks exposing their mineral contents. Louis Agassiz in 1834 observed that the boulder and clay beds of the plains of Switzerland were identical in character with the deposits made by the present-day Swiss glaciers. With the promulgation of Agassiz's glacial theory the science of glaciology was inaugurated, but the proof of the theory had to be established. Secretary Henry, realizing the importance of glacial studies to the widespread drift and terrace deposits of the United States, was soon interested in sponsoring and publishing researches upon the subject. It was thus that in 1857 Edward Hitchcock's "Illustrations of surface geology" and in 1866 Charles Whittlesey's "On the fresh-water glacial drift of the northwestern states," as well as various succeeding papers published by the Institution, had their part in the proof of the theory. Today glaciology is such an important science that separate divisions for its study have been established in the Federal and State Geological Surveys and in many universities.

Chemical Geology

In the act establishing the Institution provision was made for a chemical laboratory. This was frequently occupied by students engaged in the "chemical analyses of soils and plants," researches mentioned in the plan of organization as a means "to increase knowledge." Results from this laboratory often formed the subjects of lectures delivered in the Smithsonian hall, commencing as early as 1848. In 1853 the laboratory was being used for the examination of American minerals by the early American mineralogist, J. Lawrence Smith, who followed his researches with a series of analyses of meteorites, among which were 14 belonging to the cabinet of James Smithson. This pioneer work anticipated the classic studies in chemical geology of George P. Merrill, head curator of Geology in the latter part of the century, and his volumes of research on meteorites, building and ornamental stones, and rock weathering and soils.

Paleontology

The facts of paleontology provide a standard for the subdivision of geologic time, which in turn permits an application to many practical affairs. The physical phenomena, such as rainfall, weathering of the rocks, and deposition of sediments under water and on the land, have operated essentially the same throughout the earth's history, but species of animals and plants, although remaining stable for centuries, do change in various ways, through evolution, as time goes on. Thus, only the simplest forms of life are found as fossils in the oldest stratified rocks, and increasingly complex species occur in the sediments of more and more recent periods. It follows that if sedimentary rocks in widely separated areas contain the same species of fossils, these were deposited more or less contemporaneously. Knowledge of these species, therefore, helps to identify or correlate rocks of the same age in different parts of the world. Such knowledge is useful also in the search for economic products and is required in the identification of the faults, folds, and other dislocations of the strata encountered in structural geology. The paleontologist is primarily concerned with the description and correct naming of these ancient animals and plants in anticipation of their use in other branches of geology.

The Smithsonian has been active in paleontologic studies ever since the explorations undertaken in its earliest days. This work was conducted primarily for the advancement of knowledge, but today the successful paleontologist must be more practical. He must also be a stratigrapher and a structural geologist, first to correlate the strata and then to determine their underground relationships. Charles D. Walcott, the fourth secretary of the Smithsonian, was an outstanding example of this rare combination of talents. Starting in 1876 as assistant in paleontology to James Hall, Walcott soon advanced to the position of assistant geologist on the newly organized U. S. Geological Survey. Then in 1883 he became, in addition, an honorary curator of the National Museum, where he continued his work of research and upbuilding of the geological collections until his appointment as director of the Survey in 1894, and as secretary of the Smithsonian in 1907. Walcott pioneered in structural geology with his studies and publications in 1890 on the faulting and folding of the Grand Canyon area. His studies of the stratigraphy and paleontology of the oldest rocks of the earth's crust and of the succeeding Cambrian period brought him worldwide recognition as well as renown to the Smithsonian for his association with it. Younger members of his staff, working under his inspiration, have carried on investigations more intensively in the paleontology and stratigraphy of the succeeding periods of time and the Smithsonian publications now give a fair review of the entire geological column.

Micropaleontology

The Smithsonian Institution is a conspicuous example of a research organization devoted primarily to pure science which has seen its results applied to the most practical things. For example, the petroleum industry has particularly benefited from the activities of Smithsonian scientists through their intensive study of micropaleontology, the science comprising the various groups of fossil microscopic organisms, Foraminifera, ostracods, conodonts, bryozoans, and diatoms. Joseph A. Cushman, distinguished collaborator of the Smithsonian since his earliest studies of the Foraminifera, was the first to demonstrate their practical value in commercial work. Now the petroleum geologists particularly desire publications treating in a comprehensive way of the fossils from widely scattered areas and various periods of geological time. Fossils of all sizes, from microscopic forms to the huge dinosaurs, are useful as guides to the age and structure of sedimentary rocks, but in the petroleum industry the minute species are most important. The reason for this is that, in drilling, the larger species encountered in the well are generally churned to pieces.

The Foraminifera, minute one-celled animals enclosed in porous shells, have long been considered the best of such guide fossils in oil geology, mainly because they have so far received the most study and have thus produced the best results. However, well drillings are often crowded with Ostracoda, minute bivalved Crustacea, and other classes of microscopic fossils that are found in stratified rocks of all kinds and ages from early geologic time to the present. Some types of rock, such as shale and sandstone, were deposited under conditions unfavorable to the development or preservation of Foraminifera and Ostracoda. Here the paleontologists may be fortunate in finding toothlike organisms called conodonts, which, although usually a millimeter or less in diameter, have great resemblance to sharks' teeth. The conodonts, however, became extinct many millions of years ago. A class that persisted throughout most of geologic time and is still abundantly represented includes the moss animals, or Bryozoa, which, although forming large colonies, can be identified by thin sections of minute fragments. The classification of the Bryozoa and Ostracoda and then the conodonts was placed on a firm foundation by Smithsonian students, whereupon interest in these groups was so stimulated that now scores of investigators carry on their study.

Vertebrate Paleontology

The Division of Vertebrate Paleontology has had a long and distinguished record of service in the Smithsonian's history. Beginning with the transfer of the National Cabinet of Curiosities in 1846, the fossil vertebrate collection showed a steady growth for several decades through the exploring expeditions of the General Land Office, Pacific railroads, the Army, and the early U. S. Geological and Geographical Surveys. In 1850, Joseph Leidy was commissioned as a collaborator of the Institution to study these collections, a task which occupied him for the next 20 years. Leidy's works, published in part in *Smithsonian Contributions to Knowledge,* were pioneer for the science and covered various fields, as evidenced by their titles: "Memoir on the extinct species of American ox" (1852), "Cretaceous reptiles of the United States" (1865), and many others. In the early 1870's commenced the contributions of E. D. Cope, following his appointment as collaborator in vertebrate paleontology with the Hayden Geological Survey. Cope's exploration of the western fossil fields and the many volumes and reports on vertebrate fossils published by various branches of the Government attest to his great activity, which is equally reflected in the enrichment of the National Museum collections. Cope was succeeded in 1882 by O. C. Marsh, who, in addition to his position as vertebrate paleontologist for the U. S. Geological Survey, was curator of the Department of Vertebrate Fossils at the Museum. During the next 10 years, with the aid of a large staff of assistants provided by the Survey, he was able to collect, prepare, and describe one of the most notable assemblages of fossil vertebrates ever made in the history of the science.

In spite of all this aid, great collections of vertebrate fossils remained for preparation and study at the time of Prof. Marsh's death in 1899. That this was carried on successfully by succeeding curators—Charles W. Gilmore for fossil reptiles, and J. W. Gidley and, more recently, C. L. Gazin for fossil mammals—is attested in the present exhibition halls and great study collections.

Paleobotany

The ground work of the science of fossil plants was laid in Europe as early as 1804, but it was not until the latter half of the century that this study was inaugurated in America. Pioneers in the United States were Leo Lesquereux, with his studies on Alaskan fossil plants, and J. S. Newberry, with his studies of Tertiary plants from western United States, both sponsored and published by the Smithsonian Institution. They were followed by Lester F. Ward, curator of Paleobotany for many years and a great organizer and bibliographer whose researches for the Institution continued to enrich the science. Ward was fortunate in bringing to Washington two outstanding paleobotanists, David White and F. H. Knowlton, both then in their twenties, to carry on research as associate curators of the U. S. National Museum for the rest of their lives. White's work on the Coal Measures plants, especially of the eastern United States, is classic, while Knowlton's studies, first of the Fossil Forest and continuing with the Cretaceous and Tertiary floras of the western United States and Canada, resulted in many monographs forming the basis for subsequent researches in the present century.

TAXONOMY

Finally, the Smithsonian has pioneered and has been active throughout its first century in its publications on taxonomy, a branch of learning little appreciated by the general public but a necessary adjunct in all branches of natural science. Rocks and minerals, animals, and plants have received special scientific names which necessarily must remain the same in all languages if they are to be useful as guides for students of all nationalities. Unfortunately, through lack of knowledge or other reasons the same species of rock or animal, for example, has often been described over and over again under different names, a proceeding that impairs its use in scientific work. Taxonomy, the science of systematic classification, remedies these defects in nomenclature. The student with access to an extensive library and a keen interest in reducing the duplicate names or "synonyms" to the original valid one will prepare catalogues, bibliographies, or indexes, whichever they may be called, a task requiring a comprehensive knowledge of the subject under study as well as extreme patience in searching the literature. Secretary Henry, the physicist, probably because of his association with paleontologist James Hall and with Prof. Baird, the naturalist who succeeded him, so appreciated the need for taxonomic research that the Smithsonian commenced publication on the subject as early as 1864 with F. B. Meek's check list of North American invertebrates. Within two years Conrad's work on Eocene fossils was issued, followed by a comprehensive catalogue of the Museum's Mesozoic and Cenozoic types. By 1876 studies in paleobotany had progressed to the point that a catalogue of Cretaceous and Tertiary plants by Lesquereux and later a similar but expanded work by Associate Curator Knowlton became necessary for proper bookkeeping in this study.

Invertebrate paleontology requires the largest number of publications to solve taxonomic problems. Scudder's "Nomenclator Zoologicus" (Museum Bulletin 19, 1882) dealt entirely with the proper classification of fossil and Recent genera. Assistant Curator Schuchert's bibliography of American fossil brachiopods (1897) was the last of such publications in the 19th century. Since 1900, however, more than 3,000 printed pages of synonymic bibliographies on Paleozoic invertebrate fossils alone, particularly echinoderms, Bryozoa, and Ostracoda, by members of the Museum staff, have been published and distributed to the libraries and interested students of the world.

Pioneers in a nation or an organization invariably bring its early days to mind. In a scientific institution such as the Smithsonian, even with its varied early interests, the term pioneer cannot be so restricted because of the new endeavors assumed as time passed. Accordingly, the Smithsonian has pioneered in quite recent years and expects to do so in the future, following Secretary Henry's original admonition always to cooperate to the fullest extent but not to compete with any organization doing the same type of work equally well.

Centennial Notes—

***The first hundred years of the Smithsonian Institution* is the title of a finely illustrated, 64-page book by W. P. True, chief of the Editorial Division. This book, which is being published for wide distribution by the Institution, should prove of interest to the readers of *Science*.**

***A new three-cent postage stamp* commemorating the Centennial of the Smithsonian Institution is being issued on 10 August.**

***A Centennial Exhibit* is to open on 10 August in the foyer of the National Museum Building, Washington, D. C. The exhibit will continue through the month of September.**

—1846-1946