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THE SIXTEENTH INTERNATIONAL GEOLOGICAL CONGRESS

By Dr. W. C. MENDENHALL

DIRECTOR OF THE U. S. GEOLOGICAL SURVEY AND GENERAL SECRETARY OF THE CONGRESS

THE Sixteenth International Geological Congress met in Washington, D. C., the week of July 22 to 29. A total of 1,181 geologists and organizations enrolled as members of the congress, and of these about 165 foreign and 500 American geologists attended the session in Washington. Thirty-four foreign countries were represented by official delegates.

The Geological Congress meets every three or four years. Each congress includes council meetings and general meetings for the transaction of business, reports of international commissions and sectional meetings at which scientific papers are presented. In connection with the congress a series of excursions designed to show visitors the major features of the geology of the host country is arranged.

The Sixteenth Congress was opened on July 22 with an address by A. L. Hall, general secretary of the Fifteenth Congress, held in South Africa in 1929. The Honorable Harold L. Ickes, Secretary of the Interior of the United States, welcomed the members on behalf of the government. Waldemar Lindgren, president of the Sixteenth Congress, C. K. Leith, president of the Geological Society of America, which generously financed the congress, and W. C. Mendenhall, general secretary of the Sixteenth Congress, made brief addresses.

A number of topics were selected by the organization committee as especially important at this time, and papers and discussions on these topics were invited.

(1) *Fossil man and contemporary faunas.* Sir Arthur Smith Woodward,[1] in the opening paper of the section, reviewed the distribution of early man in the Old World and presented the thesis that human remains found in Tanganyika Territory, indistinguish-

[1] SCIENCE, vol. 78, pp. 89–92, Aug. 4, 1933.

able from *Homo sapiens* but associated with an early Pleistocene fauna, indicate the general center in which the human race developed. The contemporary primitive types, such as *Eoanthropus* in England, *Pithecanthropus* in Java, and *Sinanthropus* in China, all of early Pleistocene age, represent the marginal remnants of an earlier wave or waves of migration from the African center, still enduring with but little change, whereas in the African center the advance had gone on to the stage of *Homo sapiens.* The variability of *Homo neanderthalensis* of the middle Pleistocene in Europe, it was suggested, means that the species was dying out, not that it was giving rise to *Homo sapiens. Homo neanderthalensis* and *Homo sapiens* are both to be viewed as representing waves of migration, the former perhaps replacing the primitive types and then itself being replaced.

Davidson Black presented a summary of the latest work on *Sinanthropus,* the recently discovered fossil man of China, and the rich fauna associated with his remains. A special publication presenting more fully the results of this work had been prepared for distribution at the congress. S. K. Sanford spoke of the migrations of earlier man in the southern Libyan Desert, where at times a relatively large population managed to subsist. Progressive desiccation eventually drove these people to the scarps bordering the desert and to the Nile Valley, though there were variations of climate that permitted some abandoned areas to be reoccupied for a while.

A group of papers presenting the latest knowledge on fossil man in America was brought together for the congress by John C. Merriam. Chester Stock described recent finds from caves in various parts of the Southwest, and Barnum Brown those from Folsom, New Mexico. Dr. Merriam summarized the evidence from finds in different parts of the country. In all, the human remains or artifacts are associated with many extinct vertebrates, but the authors seem to be agreed that it is more probable that certain animals which have been generally believed to have become extinct at the end of the Pleistocene survived into post-Pleistocene time than that the remains of man hitherto found in this country are of Pleistocene age.

E. C. Eckel and Junea W. Kelly offered the thesis that the occurrence in Pleistocene deposits of the Appalachian region as far south as Georgia of remains of the tamarack larch, now found only in the north, shows a great migration of living things far southward in Pleistocene time. As there is an abandoned shore line at the present 250-foot level, the authors believe that the Appalachian region was isolated by ice on the north and by the sea on the other sides, thus restricting a possible habitat for early man to that region.

(2) *Batholiths and related intrusives.* In the section on "Batholiths and related intrusives" many stimulating papers were read. F. F. Grout presented evidence, chiefly on the relations between the orientation of minerals in the Saganaga granite mass of Minnesota-Ontario and the attitude of the unconformably overlying Ogishke conglomerate, strongly suggesting that the granite mass has been tilted about 70° since its consolidation. Some horizons now exposed were once, he thought, 20 miles below the surface. The suggestion was made that these deepest parts were rootlike feeders of the main mass. These feeders strikingly resemble petrographically the main mass and top of the granite.

Papers on the origin of granite magmas were offered by W. H. Collins, Pentti Eskola and J. J. Sederholm.

Hans Cloos, in a general paper, pointed out the similarity in the movements of liquid plutonic masses and of their walls, and the continued tectonic influence of the masses after they become solid and "dead."

The anorthosites of Norway were discussed by C. F. Kolderup, who argued for their normal intrusive origin, and by T. F. W. Barth, who interpreted them as the crystal residue from the filter-pressing of a more complex magma.

N. L. Bowen and J. F. Schairer, having worked out the melting relations in the olivine group, found that the melting-point of intermediate members was not, as supposed by J. H. L. Vogt, much below that of the pure magnesia olivine forsterite. In view of the absence of evidence of high-temperature effects around bodies of the olivine rock dunite, they questioned whether these bodies were ever wholly liquid and suggested their emplacement as loose masses of crystals.

The small lenticular intrusive bodies called phacoliths received attention in two of the most suggestive papers. A. F. Buddington described gravity-stratified sills in the northwestern Adirondacks, emphasizing the fact that the linear parallelism in these masses was a later metamorphic feature, independent of their emplacement. Similar conclusions were reached by H. B. Stenzel from a study of a granite mass near Llano, Texas. Attention was directed by F. E. Suess to the necessity of demonstrating the magmatic origin of linear parallelism in igneous masses before drawing conclusions as to their mode of emplacement, and James Gilluly pointed out the valuable tool in discriminating magmatic and postmagmatic structures now available in statistical studies of mineral orientation by Sander's method.

(3) *Orogenesis.* The problems of structural geology considered by the congress ranged widely over the field, including questions of ultimate causes of crustal disturbance, regional correlations and classifications of rock structures.

The energy sources of crustal disturbance were attributed by Arnold Heim to cosmic impulses, which altered both the position of the earth's axis and the rate of rotation of the earth in geologic time. The stresses thus set up he regards as adequate for all mountain building and as important factors in magmatic development.

Correlations of the structural history of Europe and North America were presented by Hans Stille, who considered them closely related. F. E. Suess, on the other hand, emphasized the differences in the structural development of the two continents. Axel Born concluded, from regional correlations, that broad continental uplifts and subsidences (epeirogeny) and mountain building (orogeny) both occur in rhythmic cycles, but he believes that the rhythms are independent. W. J. Arkell, in an analysis of the Mesozoic and Cenozoic folding in England, showed that the Triassic depression was independent of the grain of the Paleozoic foundation. Minor onsets of compression resulted in rejuvenation of the axes of the Paleozoic basement, but the powerful Alpine orogeny was controlled by the Jurassic troughs of sediments. Hellmut de Terra offered a correlation of the structural evolution of the Alps with that of the Himalayas. A. Demay pointed out the analogous structures at different places along the Hercynian mountain systems of Europe.

Bruno Sander presented his method of study of "petrofabrics" (Gefügekunde der Gesteine). By studying and charting the orientation of mineral grains and structures of deformed rocks he is able to analyze the movements in the rocks and to determine the superposition of one deformation upon another. His analysis shows that there are two varieties of mineral parallelism (linear schistosity) in rocks, one parallel, the other normal to the movements in the rocks.

Mountain (and island) arcs are regarded by T. Tokuda as caused by continental drifting.

Papers by Ramiro Fabiani on Sicily and by D. C. Barton on the structural basin of southern Bavaria represent attempts, in a direction that holds much promise for the future, to interpret large geologic structures on the basis of geophysical observations.

Interesting local orogenic studies were presented by H. D. Miser (Ouachita geosyncline), Robert Balk, (southern New York), Thorolf Vogt (Scandinavia and Spitzbergen), H. A. Brouwer (Celebes), R. H. Dott (Arbuckle Mountains), and several others.

(4) *Measurement of geologic time.* Many methods for measuring geologic time have been suggested in the last few years. In a discussion of these methods two seemed to be in most general use at present for measuring the number of years since geologic events —the ratio of radium G(Pb 206) to uranium, and the number of "varves" (annual layers of sediment deposited in quiet bodies of water) providing a very accurate chronology similar to tree rings. The variations in the thickness of varves, corresponding to variations in the character of the seasons, has permitted Gerard De Geer to correlate sequences from different localities without direct tracing. By the use of synchronous varves and tree rings Mrs. Ebba De Geer believes she has made it possible to carry our calendar back into glacial times. Ernst Antevs announced that by study of varves he had been able to determine periods of highest summer temperature in the late Quaternary, thus providing a possible means of long-distance correlation of these deposits. The use of summer temperature for correlation, he said, has received a decided impetus through its probable astronomical explanation by Rudolf Spitaler, who believes that warm summers in the northern hemisphere occur when the earth is nearest the sun during the northern summer and the eccentricity of the earth's orbit is fairly large.

(5) *Geomorphogenic processes in arid regions.* The land forms of desert regions are so different from those of humid regions and there is so much difference of opinion as to their origin that processes of land sculpture in arid regions was selected as one of the main topics for discussion.

K. S. Sandford analyzed the stages in development of the Libyan Desert. Arid conditions apparently began in certain areas, each unit area being controlled in its development by local base-levels. These desert peneplains gradually expanded and eventually merged into a vast desert.

Fritz Jaeger attributed the depressions known as lime pans, in arid Southwest Africa, to deposition of lime on vegetation growing near the shores of small ponds—mostly remnants of old stream channels—toward the end of a wet period preceding the present arid period.

Papers and discussion by N. G. Hörner, Eliot Blackwelder and G. W. Grabham emphasized the fact that heating by day and cooling by night is a negligible factor in the disintegration of rocks in deserts, and that it is only where the rocks are occasionally wet and where salts crystallize between their grains that they disintegrate notably. Hörner believes that denudation in the desert is very slow. His study of wind action convinced him that on rock and gravel surfaces it is almost negligible, but on waterlaid silt and fine sand it is of regional importance as an erosive agent. The finest particles come to rest as loess where, outside the arid region, moisture causes slight cementation. The coarser material forms extensive dune areas. The main loess formation probably coincides with the drying of great ancient lakes.

According to G. B. Barbour's analysis, there were two epochs in which a large amount of loess was deposited in North China—the Sanmen (Plio-Pleistocene) and the Malan (upper Pleistocene). In the Malan epoch loess deposition was uninterrupted. The Sanmen epoch was longer and was interrupted at times when mature soil profiles were developed, giving superimposed "fossil" soil surfaces which can be dated by fossil evidence. V. K. Ting, however, contended that there is but one loess formation in that region.

The greater part of the basin deposits in the arid Southwest, according to Kirk Bryan, are not receiving additions now but are deformed middle and late Tertiary beds laid down in basins which in general coincide with existing down-faulted blocks. The present fault-block mountains are hence the product of several periods of faulting. Ephemeral streams in early Pleistocene time graded pediments across softer late Tertiary beds of the depressed blocks to local base-levels.

(6) *Major divisions of the Paleozoic era.* One of the most interesting features of the section was the discussion of methods used for determining the relative ages of rocks of different continents. Papers by E. O. Ulrich and others emphasized the use of unconformities, the physical evidence of longer interruptions of deposition between rocks, and other types of physical evidence, for correlating distant beds and drawing boundaries between the rocks of different geologic periods; whereas most of the papers given by European authors and discussions by some American geologists argued that fossils are the most practical means of correlating widely separated rocks. Advocates of the use of fossils considered that, even though in some localities index fossils had to be arbitrarily selected, they are more practical for this purpose, because, as shown by several papers, large areas are known where there was no interruption of sedimentation from one period to another and also because in other areas it is impossible to distinguish which of several unconformities is the most significant.

An interesting proposal was that of A. W. Grabau and V. K. Ting, to increase the thickness of the Permian system greatly by adding to it rocks generally included in the Carboniferous of Europe and Asia under the epoch name Uralian. This proposal would also greatly increase the length of Permian time. It was especially interesting as contrasted with a paper by R. C. Moore, which would absorb the whole Permian period into the Pennsylvania period. According to another proposal made by Moore the Pennsylvania and Mississippian periods would replace the widely used and long established Carboniferous period. These proposals constitute a renewal of previous attacks on the Permian period and a renewed attempt by an American geologist to induce geologists of other continents to use the American terms Mississippian and Pennsylvanian. They provoked considerable discussion. Several objections were made to them, and considerable disagreement arose over the location of the boundary between the Mississippian and Pennsylvanian rocks in the south-central part of the United States. The use of the term Carboniferous in most papers given at the congress by European geologists suggests that, although a considerable number of American geologists have discarded it in favor of the two American terms, these terms have not made much headway in Europe.

A significant contribution to the Permian problem was made by David White, who discussed the evidence of fossil plants in fixing the Permian boundaries in North America and indicating the climatic changes of the early Permian in this country. A. L. du Toit gave evidence to show that the ancient (late Paleozoic) glacial deposits, now known to be wide-spread over the entire southern hemisphere, were not, as has been suggested, confined to a short time range in the Permian but were formed at several different times during both the Carboniferous and Permian periods.

Another interesting feature was the discussion of the validity of the Ozarkian, proposed some years ago by E. O. Ulrich as a new geologic period and named from rocks exposed in the Ozark region of the central United States. A special evening meeting was devoted to continuing the discussion of this question. Papers presented on the lower Paleozoic rocks of Great Britain and on the Cambrian and Ordovician systems of Asia implied that the Ozarkian was not recognized as a valid period in those areas.

(7) *Geology of petroleum.* In a symposium on the geology of petroleum great interest was shown in the origin and accumulation of oil. Two points of view appeared—one that oil migrates long distances (because of hydrostatic pressure) until it is finally trapped on the flanks of folds or by other structural barriers; the other that oil is formed in approximately the place where it is found.

F. R. Clark suggested that the rich accumulations of organic matter which are the source material of oil were deposited in restricted areas near or in contact with the reservoirs that trap the oil because conditions in most oil pools indicate that free oil has not migrated over long distances.

A. I. Levorsen[2] showed that study of the ancient geology of petroliferous regions may aid in explain-

[2] A. I. Levorsen, "Studies in Paleogeology." Am. Assoc. Petroleum Geologists *Bull.*, vol. 17, no. 9, September, 1933.

ing unusual occurrences of petroleum. By geologic maps showing the areal geology and regional structure of the United States in late Paleozoic and early Cretaceous time, he was able to determine the history of the migrations of petroleum in a stratum and to select those geologic structures which are likely to contain oil. His maps indicate that many areas which now contain well-developed anticlines were not favorably situated in the earlier geologic history of the reservoir stratum and, as is frequently proved by drilling, have therefore not trapped petroleum. Other areas furnishing only a small trap for oil have been more advantageously situated in the past and are found to be richly petroliferous.

Hydrogenation—an increase in the hydrogen-carbon ratio—appears, according to W. E. Pratt, to take place during the evolution of petroleum deposits in a manner analogous to the commercial process of hydrogenation. The source of the hydrogen may be the methane that usually occurs with petroleum in nature, and the saturation may be accomplished by the incorporation of methane into the unsaturated molecules by methylation.

Studies by Taisia Stadnichenko show that oil and gas are formed from the different organic constituents of such rocks as oil shales, carbonaceous shales, bogheads and cannels, at different temperature points or zones, indicating that the petroleum found in our oil fields may contain products generated at several stages in the long course of the devolatilization of the organic matter in the sediments.

Zonal relations of metalliferous deposits. Most of the papers in this section, especially those by Svitalsky, Ahnert, and Behre and his co-authors, dealt with variations in areas of mineralization rather than with variations in individual veins—the latter, as noted by Behrend, being uncommon in many regions, although, as shown for southern Virginia by Brown, they may exist in such form as to be evident only as a result of quantitative studies. Among the obscuring factors mentioned are separation in time and space of different pulsations of mineralization in a genetically homogeneous metalliferous province, such as the Freiberg district (Schumacher); mutual interference of zones surrounding closely spaced centers of mineralization, as in Colorado (Behre and associates); the effects of different wall rocks (Bruet and others); and the possible effect of regional tilting in changing the vertical relations of lodes deposited prior to the tilting, as in the Triassic areas of the eastern United States (Newhouse).

INTERNATIONAL COMMISSIONS

Of the international commissions appointed by the congress, those to which is assigned the task of producing a definite publication—a map or a book—always face the problem of procuring funds, as the congress itself has no continuing funds. The most successful commissions of this kind have been the two which are charged with producing a geologic map of the earth and one of Europe. The direction of these two enterprises has been in the hands of the Geological Survey of Prussia, which has itself contributed much of the work and succeeded in raising additional funds by subscription and sales. The commission for the geologic map of the world is next to take up North America, where it will doubtless be greatly aided by the new geologic map of the United States prepared for the congress by the United States Geological Survey.

Less successful hitherto has been the commission charged with the republication, on standard-sized cards, of illustrations and descriptions of type fossils, but there are prospects that an enterprising group of French geologists may find a publisher willing to issue the cards on a commercial basis.

The commission engaged in preparing a lexicon in which the names given to strata or groups of strata in different parts of the world are defined, although it has a large amount of material ready, has not yet succeeded in obtaining funds for publication.

Other commissions, such as that dealing with fossil man and that dealing with the deposits of the Gondwana system, the peculiar deposits of the southern hemisphere which include the ancient glacial deposits of Permian time, submitted valuable scientific reports for publication in the general report of the congress.

The commission which at each congress awards to some particularly promising young geologist of the country in which the congress is held a prize given to the congress by a Russian, Spendiaroff, in memory of his son, this year selected Thomas B. Nolan, of the United States Geological Survey.

As science becomes more specialized and the number of special associations increases, overlaps of activities are inevitable. To avoid wasteful duplication that might result from such an overlap, the congress voted to transfer to a commission on glaciers of the International Geophysical Union the functions and records of a commission of its own which had been dealing with studies of the movement of glaciers.

Problems created by this multiplication of special associations came before the congress in another form when Arnold Heim, of Switzerland, proposed that the Geological Congress meet every five years instead of every three years, as has been traditional. He pointed out that there are now twelve such international gatherings in zoology, botany, geography, physics, etc. If each of these met every three years there would be four such meetings a year, and the cost of sending delegates to each of them would be too great for a small country like Switzerland. Decision on the question had to be deferred to the next congress.

This congress, however, tended to add to the number of these international associations by the efforts made by some of its members, led by B. F. Howell, of Princeton, to form an International Paleontological Union; by approving the expansion of the Association for the Study of the Quaternary Period of Europe into a world-wide association; and by the formation, by some of its members, under the leadership of J. J. Sederholm, of Finland, of an association for the study of the Precambrian rocks, the oldest known rocks of the earth, whose complicated relations are only slowly being unraveled.

Workers in other branches of science may be interested in the resolution submitted by O. T. Jones, of Cambridge, England, and passed by the congress, petitioning the governments represented at the congress to permit the importation, duty-free, of geophysical instruments borrowed for a limited period.

The congress voted unanimously to accept the invitation for the next session presented by the Union of Soviet Socialistic Republics.

At the closing meeting delegates from the guest nations made addresses of thanks and appreciation, and a letter of greeting and good wishes from President Roosevelt was read.

ENTERTAINMENT

The evenings during the sessions were given over to less technical talks and to social events. On the first night of the session the Geological Society of Washington entertained the members of the congress at a smoker at which Douglas Johnson gave an account of some of the representative geomorphic features of the United States.

On Sunday afternoon Dr. Whitman Cross, who had been assistant secretary of the International Geological Congress held in Washington in 1891, and Mrs. Cross entertained the Congress in their lovely garden in the suburbs. The foreign guests were much interested in the singing of American Indian songs and Negro spirituals by members of those races. That evening Hellmut de Terra gave an account, illustrated with motion pictures, of his explorations in the Himalayas.

On Monday evening the Bureau of Mines presented its motion picture dramatizing the evolution of the oil industry. On Tuesday evening Frank Adams,[3] in commemoration of the completion of Lyell's "Principles of Geology" in 1833, reviewed the life and work of that founder of modern geology. On behalf of the scientists of the nation, the National Academy held a reception for the members of the congress on Thursday evening.

[3] SCIENCE, 78: 178–183, September 1, 1933.

EXCURSIONS

One of the most important features of each International Geological Congress is the program of excursions offered to members. These give visiting geologists an opportunity to study the geology of the host country and give universities and museums the opportunity to round out their collections by having their representatives collect specimens.

In preparation for the excursions in the United States in connection with the Sixteenth Congress, held at Washington in July, a set of 31 guide-books was prepared, covering to a large extent the regional geology of the entire country. Those geologists, in all about 170, most familiar with the different areas undertook the authorship of parts of the guide-books. All the guide-books were published by the Geological Survey except two, the manuscripts of which were received after the appropriation had lapsed. In addition special guide-books were prepared for the scientific institutions of New York and Washington.

Although each excursion was generally in charge of a single leader, a large number of geologists assisted, so that, in general, for each day's work the members had the benefit of guidance by the American geologist most familiar with the particular area visited on that day.

In addition to the more formal excursions of the type ordinarily given for the International Geological Congress, the fact that most of the foreign visitors landed in New York made it appropriate to offer a special series of short excursions in the vicinity of that city. These were arranged by a committee of New York geologists under the chairmanship of C. P. Berkey and included both trips of general interest —such as orientation trips, visits to the principal scientific institutions of New York and an exposition of the geologic features of New York—and trips designed for specialists, such as those emphasizing glaciology, stratigraphy, mineralogy and engineering geology.

Similarly during the session at Washington it was possible to arrange short field trips to near-by points of interest, including Appalachian stratigraphy and structure in Virginia and Pennsylvania, the Precambrian of Maryland and Pennsylvania, the Coastal Plain of Maryland, the titanium and soapstone deposits of Virginia and the Cornwall iron mines of Pennsylvania. Short afternoon trips were made to the scientific institutions of Washington.

The longer excursions before the session were chiefly in the eastern and southern states, and those after the session in the western and central states.

Except for the two transcontinental trips, which were necessarily more general in nature, these were arranged to be of interest to specialists in various branches of the science. The unfavorable economic conditions reduced participation below earlier estimates, but, on the other hand, the generosity of the Geological Society of America, by making it possible to offer the excursions at a considerable reduction below actual cost, allowed a larger attendance than would otherwise have been possible.

Of the shorter excursions, eight before and two after the session, three primarily featured stratigraphy, four economic geology, one petrology and structural geology, one geomorphology and one glacial geology.

One of the stratigraphic excursions, A–4, under the leadership of D. H. Newland, covered the classic early Paleozoic section of New York between Albany and Buffalo. A–3, led by Charles Butts, G. W. Stose and Josiah Bridge, covered the Paleozoic stratigraphy of the southern Appalachians between Washington and Bristol, Tennessee, studying not only the stratigraphy of the region but the recent structural interpretations of this complex area. The stratigraphy of the Coastal Plain was studied in excursion A–5, which traveled by yacht under the direction of L. W. Stephenson through the Potomac estuary and up Chesapeake Bay, visiting the well-known fossil localities of the region.

Of the four excursions grouped as primarily of economic interest, one, C–4, led by W. O. Hotchkiss and C. K. Leith, was in large part devoted to a study of the Precambrian stratigraphy of the Lake Superior region between Marquette and the Mesabi range. The excursion not only gave opportunity for the study of the iron and copper deposits, but the Lake Superior geologists who acted as leaders and guides were able to explain in this field the intricacies of the inter-range correlation of the Precambrian formations and the complexities of the regional geology.

The many and varied mineral deposits, both metallic and non-metallic, of the eastern and central states were covered by two excursions—A–8, led by C. P. Berkey, and A–2, led by J. T. Singewald, Jr. Excursion A–8 covered the territory between New York and Washington, visiting Franklin Furnace, New Jersey, the slate, cement and anthracite districts of eastern Pennsylvania and the Cornwall iron deposits of Pennsylvania. Excursion A–2 was the principal mining excursion of the congress and covered a much wider territory. A coal mine and steel plant of the Pittsburgh district were first visited, then the fluorspar mines of southern Illinois, the iron and lead deposits of southeastern Missouri, the Tri-State zinc-lead region, the Arkansas bauxite deposits, the petrologically interesting Magnet Cove locality in Arkansas, the iron and coal mines of Birmingham, the Ducktown copper deposits and the zinc deposits of Mascot and Jefferson, Tennessee. The third economic excursion, A–6, under the direction of W. E. Wrather, emphasized oil geology, including oil fields in Oklahoma and Texas, a trip across Paleozoic formations of the Arbuckle Mountains, the Fort Worth Cretaceous section, the east Texas oil field, and the oil and sulfur-producing salt domes of Texas, returning to Washington by way of New Orleans.

Excursion A–1, under the direction of C. R. Longwell, covered the varied geology of eastern New York and western New England, including the Adirondack anorthosite area, the structurally complex regions of Vermont and western Massachusetts and the Triassic basin of southern New England.

While geomorphology was to some extent a feature of all the excursions, it was particularly the object of excursion A–8, which was conducted by Douglas Johnson from New York to Harrisburg and thence to Washington.

The glacial geology of the central states, including parts of Illinois, Iowa and Wisconsin, was covered by excursion C–3, under the direction of M. M. Leighton.

The two transcontinental excursions, C–1 and C–2, each had equipment consisting of two Pullmans (the well-known "Princeton" with C–2) and, through the courtesy of the Baltimore and Ohio Railroad Company, a baggage car fitted with shower baths, racks for specimens and work tables. Although it was not possible in such long and varied excursions to cater entirely to specialists, C–2 stressed particularly stratigraphy and structural geology, and C–1 offered opportunities for a rapid study of the major mining districts of the West, with optional excursions for those to whom economic geology had less appeal.

Excursion C–2, led by R. M. Field on the way west visited the Grand Canyon by way of Meteor Crater and Canyon Diablo and spent a day in the Los Angeles region and a day on the San Francisco Peninsula. A motor trip was made to Crater Lake from Klamath Falls and a two-day trip from Eugene, Oregon, across the John Day Basin to Wishram, Washington. After stops at the Grand Coulee, near Spokane, and at Butte, came the principal feature of the excursion, a six-day motor trip through the Yellowstone National Park and the Big Horn, Beartooth and Pryor Mountains, with study of the structural and stratigraphic features. The party then spent two days in the Black Hills.

Excursion C–1, under the leadership of Waldemar Lindgren, went west by a more southerly route, making El Paso its first stop. Here the party divided, one group visiting the Marathon Basin and Carlsbad Caverns, while the other studied the ore deposits of the Santa Rita and Bisbee districts. In the Los Angeles area the program included a short trip along the San Andreas fault and two days of study of the stratigraphy, structure and oil fields of the region. After a day spent on the San Francisco Peninsula and Berkeley Hills, the party moved to the Yosemite National Park and again divided, one group going by bus across the Tioga Pass to Mono Lake, Lake Truckee and Reno, and the other visiting the mines of the Mother Lode. At Salt Lake likewise two sets of excursions were available. Some preferred to visit Zion and Bryce Canyons and the north rim of the Grand Canyon. For those who remained in Salt Lake there were visits to the principal mines of the Bingham, Park City and Tintic districts and trips to localities of structural and general geologic interest. In Colorado there was a choice of three options; the most popular excursion visited the mining districts of Gilman, Leadville, Alma and Cripple Creek; another trip crossed the San Juan Mountains, and the third allowed study of the stratigraphy and structure of the Front Range between Minturn and Colorado Springs.

The success of all the excursions was, of course, due in great measure to the volunteer assistance rendered, often at considerable personal inconvenience, by all geologists and mining engineers whose fields of work lay within the regions visited. To a great extent, moreover, the officers of the congress are indebted to the hearty cooperation and cordial hospitality offered by all residents of the regions traversed. In particular, most cordial cooperation was afforded by the officers of the National Park and Forest Services and all civic organizations.

A HISTORY OF THE NATIONAL RESEARCH COUNCIL, 1919-1933

X. THE DIVISIONS OF GENERAL RELATIONS[1]

By ALBERT L. BARROWS
ASSISTANT SECRETARY

IN addition to its divisions of science and technology established for the direct encouragement of scientific research, the National Research Council has maintained four divisions of general relationships. These divisions are concerned with the relations of the Council to the Federal Government, to international scientific organizations, to conditions of research in scientific agencies of state governments and to research interests in educational institutions.

Division of Federal Relations: During the World War special contacts were maintained between the National Research Council and the War and Navy Departments of the Government through a Military Committee of the Research Council, composed of representatives of these two departments and of various scientific bureaus of the Government. The Executive Order of President Wilson of May 11, 1918, requested the National Academy of Sciences to perpetuate the National Research Council for the stimulation of research "with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare," and specifies that the duties of the Council shall be, among other functions:

> To serve as a means of bringing American and foreign investigators into active cooperation with the scientific and technical services of the War and Navy Departments and with those of the civil branches of the Government.
>
> To direct the attention of scientific and technical investigators to the present importance of military and industrial problems in connection with the War, and to aid in the solution of these problems by organizing specific researches.

This Executive Order further directs that "the cordial collaboration of the scientific and technical branches of the Government, both military and civil" be given to the Council, and that "to this end representatives of the Government, upon the nomination of the President of the National Academy of Sciences, will be designated by the President as members of the Council, as heretofore, and the heads of the departments immediately concerned will continue to cooperate in every way that may be required."

In order to carry out these instructions the National Research Council includes a Division of Federal Relations, composed of representatives designated in accordance with the Executive Order. This division now contains 43 members, representing the ten departments of the Federal Government or the scientific bureaus of these departments, and also three independent establishments of the Government. Through this division a medium is provided for the discussion of matters relating to the general function of research in government and a mechanism is furnished by means of which formal cooperation between governmental agencies and the Council may be effected whenever occasion for doing so arises.

Division of Foreign Relations: The Council also

[1] This is the last of a series of ten articles prepared to describe briefly the nature of the activities upon which the National Research Council has been engaged during the past fourteen years.