6. The following officers were elected for the year 1912: *President,* Robert Morris Ogden, University of Tennessee; *vice-president,* H. J. Pearce, Brenau College, Gainesville, Ga.; *secretary-treasurer,* William Carl Ruediger, The George Washington University; *councilors,* Shepherd Ivory Franz, John Brodus Watson (for 3 years) and W. B. Lane (for 1 year).

7. The following persons were elected to membership: Samuel Claman, Howard University; H. E. Cunningham, Lookout Mountain, Tenn.; Gardner C. Basset, Johns Hopkins University; Williston S. Hough, George Washington University; Edmund B. Huey, Johns Hopkins University; Herbert Charles Sanborn, Vanderbilt University.

8. Votes of thanks were extended to Dean W. C. Borden for the use of the George Washington University Medical School and to Professors Franz and Ruediger for the smoker.

THE GEOLOGICAL SOCIETY OF AMERICA

THE twenty-fourth annual meeting of the Geological Society of America was held at the new National Museum at Washington, D. C., from Wednesday to Saturday, inclusive, of Christmas week, and was the largest in the history of the organization, there being a registered attendance of 140 fellows and 14 fellows-elect, besides many visitors. Professor William Morris Davis, president for the year, presided, having made a special trip for the purpose to America from Paris, where he is serving as Harvard exchange professor at the Sorbonne. The first session of the society was occupied with matters of business. The secretary reported the election of twenty-nine new fellows, making the present active membership of the society 351.

During the past year, there were lost by death Samuel Calvin, for many years state geologist of Iowa; Samuel F. Emmons, a noted mining engineer who was connected with the United States Geological Survey from its organization and was a member of the National Academy of Sciences; Christopher W. Hall, professor of geology at the University of Minnesota; Edwin E. Howell, of Washington, D. C., and Amos O. Osborn, of Waterville, N. Y. One foreign correspondent, Professor A. Michel-Lévy, a famous French geologist, died. An indication of the activity of the society was the publication during the year of a volume of its *Bulletin,* consisting of 738 pages of text and 31 plates, and including part of the papers read at the last preceding annual meeting, which was held at Pittsburgh a year ago. A large part of the volume was devoted to E. O. Ulrich's contribution, "A Revision of the Paleozoic Systems."

In the course of the meeting the following papers were offered:

New Evidence on the Taconic Question: ARTHUR KEITH.

The reasons were given in this paper for reopening the old controversy and for selecting the north end of the Taconic Mountain as the crucial place. The principal views regarding the rocks of the Taconic Mountains were briefly outlined and the geology of the region summed up. Five subdivisions of the Stockbridge limestone around the north end of the Taconics were described and attention called to the extreme folding and metamorphism of the rocks. The slates of the mountains are sharply outlined from the Stockbridge limestone and the contact follows a rude semicircle around the end of the mountains. The characters of this plane of separation were discussed and the conclusion reached that they can only be due to faulting. The bearing of this conclusion was briefly considered.

Some Features in the Grand Canyon of Colorado River: N. H. DARTON.

Several years ago, the author measured sections at a number of points along the Grand Canyon to determine the stratigraphy of the Arizona Plateau. These sections were presented, and there was exhibited a colored preliminary geologic map of the Vishnu, Bright Angel and Shinumo quadrangles similar to one now in the corridor of El Tovar hotel at Grand Canyon.

Covey Hill Revisited: J. W. SPENCER.

This remarkable hill terminates the northeastern point of the Adirondack plateau (1,030 feet above tide). It is capped with Potsdam sandstone thinly covered with drift. This hill is separated from the main plateau by a broad depression from which the drift has been swept away. Its removal is commonly attributed to the broad trough being a spill-way for a glacial lake. This question is not raised except that it may have belonged to an epoch before the Iroquois period. The broad trough is incised by a deep gorge—the Gulf. Its character has not been fully described. This heads in a small channel such as is being formed to-day, with the increase in size due to the undermining of the walls of jointed sandstone where the blocks are forced off by frost action. Thus the gorge can not be taken as evidence of a greater drainage

than at the present time. The gorge is post-Glacial for this reason, and does not represent the outflow from a glacial lake. A beach on the northern flank of the hill at 450 feet above tide has been supposed to be marine without the showing of any evidence. Upon revisiting the hill no evidence of the marine character was found.

Dr. Spencer's paper was discussed by J. B. Woodworth and H. L. Fairchild, and reply was made by the author.

Pre-Cambrian Formations in South-central British Columbia: REGINALD A. DALY.

A reconnaissance along the Canadian Pacific Railway line has established the following conclusions: (1) Dawson's "Nisconlith series" occurring in the Selkirk Mountains is not Cambrian, but represents the northern continuation of the "Beltian" (Belt terrane) rocks at the International Boundary. (2) Dawson's "Nisconlith series" of the Shuswap Lakes area (west of the Selkirks) is an entirely different pre-Cambrian and pre-Beltian group of sediments, which unconformably underlie the "Nisconlith series" of the Selkirk section. (3) The Adams Lake volcanic series conformably overlies the thick limestones of the "Nisconlith series" in the Shuswap Lakes area and is of pre-Beltian age. (4) The "Shuswap series" of the Shuswap Lakes is not a distinct gneissic group unconformably underlying the "Nisconlith series," but is the facies of the "Nisconlith series" produced where that series was thermally metamorphosed by batholiths. (5) Though these pre-Cambrian rocks are typical crystalline schists, their metamorphism of the regional type was not due to dynamic action; it was "static" metamorphism (Belastungsmetamorphismus of Milch). (6) The pre-Cambrian rocks are much less deformed (upturned) than the overlying Carboniferous or Triassic rocks, illustrating the small depth of the earth-shell which underwent strong folding in post-Cambrian time. (7) The petrography of this pre-Cambrian and pre-Beltian terrane strongly suggests that it furnished the greater part of the clastic material of the Rocky Mountain geosynclinal prism.

Origin of the Sediments and Coloring Matter of the Eastern Oklahoma Red Beds: J. W. BEEDE.

Recent investigations seem to show that the sediments of the lower red beds of Oklahoma were derived from the Arbuckle-Wichita Permian land mass. The conclusion is based on the amount of material removed and the geographic distribution of sediments bordering the mountains. Coarse limestone conglomerate of great thickness and conglomerates of crystalline rocks—both possibly of subaerial origin—dovetail into red beds. Belts of sandstone have been found extending into the area of finer sediments farther away from the mountains, apparently indicating the location stream debouchures at the margin of the shoal sea. The extreme shallowness of the water is clearly indicated in the structure of the beds. The coloring matter is thought to have been derived from the solution of the 8,000 or 10,000 feet of pre-Carboniferous limestone which formerly covered the Arbuckle-Wichita Mountains and much of the surrounding region. The solution of the limestone furnished optimum conditions for the oxidation of its iron content, as it does at the present time in the limestone regions of the Mississippi Valley, southern Europe, West Indies, etc. Moreover, the solution of the pre-Carboniferous limestones and the conglomerates of the Arbuckle-Wichita region now in progress produces a red residuum practically indistinguishable from red beds sediments. The red granites, red porphyries and other crystalline rocks of the region under discussion contributed their share of material to the red beds. Other factors may have entered largely into the formation of the red beds of western Oklahoma.

The paper was discussed by I. C. White.

Correlation of Rocks in the Isolated Coal Fields around the Southern End of the Rocky Mountains in New Mexico: WILLIS THOMAS LEE.

Several isolated coal fields in New Mexico, near the southern end of the Rocky Mountains, were visited, notably those near Cerrillos east of the Rio Grande and those on the Rio Puerco. Stratigraphic studies were made and fossil leaves and shells collected from the coal-bearing rocks and those stratigraphically near them, with two objects in view: first, of fixing the age of the coal beds, and second, of correlating the formations of the great coal fields on opposite sides of the mountains by means of the data from these small fields intervening between them.

Monument Creek Group and its Relations to the Denver and Arapahoe Formations: G. B. RICHARDSON.

The Monument Creek Group, Hayden's name for several thousand feet of arkosic deposits on the Platte-Arkansas divide in Colorado, is separated into two parts on the basis of a well-marked unconformity. The rocks above the break carry titanotherium bones of Oligocene age, and the rocks below contain leaves of Eocene age. The

lower parts of these lower deposits strike into the Arapahoe and Denver formations of the Denver Basin, and it appears that those formations are equivalent to part of the lower division of the "Monument Creek."

Dark Scale of Hardness: ALFRED C. LANE.

The hardness of a mineral is its resistance to shearing stress. Like other properties of minerals, it may differ in different directions. When two similar surfaces are rubbed together, the softer mineral leaves a powder (streak) on the other. In order to be sure which mineral gives the streak, it is at times convenient to have besides the common Mohs scale of hardness, composed of light minerals, a "dark scale of hardness" of minerals whose color and streak is dark, especially in teaching. For such minerals, the following properties are desirable: quickly recognizable, easily obtainable, hardness uniform. The following minerals have been used by the writer: (1) graphite, with 1 good cleavage, at one extreme in the white scale, at the other extreme in the black; (2) stibnite (Sb_2S_3), with 2 good cleavages, bladed; (3) galenite (PbS_3), with 3 good cleavages; (4) iron (use soft wire nail), magnetic, ductile; (5) niccolite (NiAs), characteristic color, no cleavage; (6) magnetite (Fe_3O_4), magnetic, brittle. The minerals mentioned seem fairly satisfactory. Above six, the author does not know whether spinel or some other mineral would be more desirable, but as there are comparatively few minerals concerned, it is not important.

Demonstration of Relative Refraction: ALFRED C. LANE.

The method of determining relative index of refraction developed by Exner, Becker and Schroeder van der Kolk[1] may be demonstrated to a class as follows: A large beaker of water placed just a little to one side of a window or other source of light will show a bright streak on the farther side, having a higher index than the surrounding medium. A test tube full of air placed in the beaker will show a bright streak of total reflection on the nearer side, the air within having a smaller index than the surrounding medium.

A Stratigraphic Study of the Appalachian and Central States with Reference to the Occurrence of Oil and Gas: GEO. H. ASHLEY.

It has always been supposed by the oil and gas men that the Appalachian region, extending from Pennsylvania to Alabama, was a stratigraphic unit, and it has been a mystery that eastern Kentucky, Tennessee and Alabama should not yield as much oil and gas as Pennsylvania or West Virginia. The mystery largely disappears when a comparative study is made of the stratigraphy of the Appalachians as a whole. The paper compares graphically the stratigraphy of the southern and northern Appalachians and the central states with reference to the occurrence of oil and gas.

The paper was discussed by H. B. Kümmel.

Granularity Limits in Petrographic-microscopic Work: FRED E. WRIGHT.

In this paper the petrographic microscope is treated as a measuring device for the exact determination of the optical properties of crystal plates, especially of minute crystal fragments and of crystallites. The methods now available for the purpose are considered briefly with special reference to their accuracy and applicability to the investigation of fine-grained silicate preparations. Attention is directed in particular to the lower granularity limits at which satisfactory measurements of the different optical properties of a mineral grain can still be made.

The Arkansas Diamond-bearing Peridotite Area: L. C. GLENN.

Evidence will be offered of the circulation of presumably thermal waters about the margin of the original pipe described by Branner. A supposed extension of the peridotite area proves to consist of disintegrated peridotite mixed intimately with well-rounded quartz sand and occasional water-worn chert pebbles and was evidently water-laid. Indications of the age of this material will be given, narrowing down the period within which the extrusion of the peridotite must have occurred.

The paper was discussed by A. H. Purdue.

Resins in Paleozoic Coals: DAVID WHITE.

Resins are present in most coals, except possibly those of the highest grades, the amount depending in general on the degree of concentration (residual) resulting from the decay and reduction of the attending plant structures. Interesting examples of megascopic resins in coals from the Carboniferous of the Mississippi Valley and Montana indicate the presence of resin in the Paleozoic coals in proportions probably as large as in the coals of the Mesozoic and Tertiary.

Onyx Deposits in East Tennessee: C. H. GORDON.

The existence of onyx deposits in east Tennessee has been known for a long time, and attempts have been made at recurrent intervals to utilize the

[1] Report Michigan Geological Survey, Vol. VI., p. 154.

material. Thus far no success has attended these efforts, but with persistent frequency hopes are aroused over some new "find" and glowing announcements are made of the possibilities of this industry. The onyx found is of cave formation and for the most part represents the remnants of vanished caves. The character and extent of the deposits was discussed and the possibilities of their commercial development.

Variation of the Optic Angle of Gypsum with Temperature: EDWARD H. KRAUS.

By using an oil bath to determine the variation of the angle of the optic axes of gypsum at different temperatures it is found that gypsum is optically uniaxial at approximately 90° C. for sodium light. Although Mitscherlich observed in 1826 that this change takes place at about 92°, the values given later by Des Cloizeaux, and more recently by Tutton, both of whom used air baths, are from 15° to 26° too high. Neverthless, Des Cloizeaux's value of 116° C. for red light is the one commonly quoted. By plotting the values of the apparent angles of the optic axes at various temperatures up to 132.5° C., it is easily seen that the angle changes most rapidly in the vicinity of the uniaxial point, that is, between 80° and 100°, and further, that one axis, as was pointed out by Naumann, changes its position more rapidly than the other.

Notes on the Paragenesis of the Zeolites: J. VOLNEY LEWIS.

Zeolites and other secondary minerals occur in the Newark igneous rocks of New Jersey: (1) in cavernous spaces in the ropy pahoehoe of the extrusive Watchung basalts; (2) in fault fissures and fault-breccia of both the basalts and the great intrusive sill (Palisades, Rocky Hill and Sourland Mountain); (3) less commonly in the ordinary joint cracks of both the extrusive and the intrusive types. The rocks are essentially the same in both chemical and mineral composition, consisting essentially of pyroxene and plagioclase feldspars, with quartz-bearing and olivine-bearing facies. The zeolites and related silicates are essentially combinations of the feldspathic elements and water, with the addition of fluorine in apophyllite and boron in datolite; the accompanying amphibole, biotite, chlorite, epidote, serpentine and talc are derivatives of the pyroxenes. Hypotheses of origin dependent on the action of meteoric waters are inapplicable on account of difficulties of circulation, deoxygenation and sources of fluorine and boron; on the other hand, contact metamorphism by the intrusives has produced in the adjacent shales minerals into which fluorine and boron enter, presumably by emanation from the magma. Hence magmatic waters are regarded as the most probable agent in the formation of the zeolites and accompanying minerals.

The paper was discussed by A. C. Lane and F. R. Van Horn.

Peculiar Iron Ore from the Dunham Mine, Pennsylvania: W. S. BAYLEY.

No abstract received.

Glacial Deposits of the Continental Type in Alaska: R. S. TARR and LAWRENCE MARTIN.

The glaciation of the interior of Alaska forms a striking contrast with the coast, where glacial erosion forms predominate, the deposits being largely under water, except for (1) 1,600 square miles east of Yakutat Bay, (2) 16,000 square miles in the Cook Inlet-Susitna Valley region, and smaller areas. The interior, between the coast ranges and the Endicott-Rocky Mountain system, where the National Geographic Society's party made some studies in 1911, has extensive glacial deposits of the continental type, previously described in part by Russell, Brooks and others and similar to those of the United States. These include at least (*a*) 15,000 square miles in the Copper River basin, (*b*) 27,000 square miles in the Tanana and Kuskokwim valleys, (*c*) 17,000 square miles in the Yukon Flats, (*d*) several thousand square miles on the Upper Yukon region in Canada and smaller areas. The dominant material is outwash and this extends long distances outside the country actually glaciated. In places there is wind-blown loess associated with this. In some localities it is still being deposited, and in the Copper River basin it has been accumulating during the time required for the growth of six or seven generations of trees. There is also some till, but this is largely buried beneath outwash. Lake deposits, eskers, kames and buried vegetation are also found, but thus far no one has found drumlins. In thickness, some of these deposits rival those of the middle west, one instance being known of probably 800 feet of gravel, sand, etc., grading out from the mountains to less than 100 feet fifty miles away. The presence or absence of these drift deposits seems to be chiefly a matter of favorable topography and existing deglaciation, a process much like that formerly in progress in northeastern and central United States.

The paper was discussed by W. M. Davis, C. A. Davis and H. M. Eakin.

Glaciation in Northwestern Alaska: Philip S. Smith.

In northwestern Alaska there are small existing glaciers and evidence of much greater alpine glaciers in the geologic past. The present communication aims to set forth some of the observations made by parties from the U. S. Geological Survey during the field season of 1910 and 1911 in the Kobuk and Noatak regions of northwestern Alaska, which bear on the glacial phenomena.

Pre-Wisconsin Glacial Drift in the Region of Glacier Park, Montana: Wm. C. Alden.

Along the east front of the Rocky Mountains from Two Medicine Lake northward to the International Boundary, valleys of most of the streams issuing from the mountains are bordered on either side by high, flat-topped ridges, whose crests stand 800 to 1,600 feet above the adjacent valley bottoms with maximum elevations ranging from 5,800 to 6,400 feet above sea level. These high flat-topped ridges taken together have the appearance of being remnants of a continuous high-level plain bordering the base of the bold mountain front and they have been so interpreted by Salisbury, Calhoun, Willis and Finley. Examination of nine of these ridges, those adjacent to Two Medicine, Cut Bank, Boulder, Swift Current and Kennedy creeks, and St. Marys and Belly rivers, and of high benches at corresponding levels on the west side of Belly River, shows the massive ridges to be composed of Cretaceous shales and sandstones with a capping of glacial drift ranging in thickness from 100 to several hundred feet. Fresh scarps resulting from recent slumping afford excellent exposures of the typical glacial till containing abundant striated boulders. In several places much of the till is cemented to a hard tillite conglomerate. In some places, as in the type exposure of Willis's "Kennedy gravels," the material is coarse, sub-angular to rounded cobble-stone gravel composed principally of quartzite, but even here careful search yielded numerous striated pebbles. Striated pebbles and boulders were found on the extensive flat top of Milk River Ridge eight miles from the mountain front. The component material in all cases is derived from the mountains. During the last great epoch of glaciation, the glaciers extended down nearly all the intervening valleys, in some cases nearly filling them. Cut Bank Glacier spilled through sags in the crest of Milk River Ridge, and St. Marys Glacier laid its lateral moraine along the upper slope and lower part of the crest of St. Marys Ridge, but in some places the high level drift rises above that of these valley glaciers and is quite distinct therefrom, though of similar lithological composition. The topographic relations, cementation and considerable amount of modification due to weathering indicate that the high level drift is much older than that in the valleys, and represents a distinct and earlier stage of glaciation separated from the Wisconsin by a long interval during which much erosion was accomplished. Although the relations have not yet been carefully studied, it appears that this older drift includes some at least of the "quartzite gravels" described by the authors cited above, and regarded as pre-Glacial and possibly, but not certainly, some of those described by Dawson and McConnell in southern Alberta and denominated "Albertian Drift."

The paper was discussed by W. W. Atwood and A. P. Coleman.

Some Glacial Deposits East of Cody, Wyoming, and their Relation to the Pleistocene Erosional History of the Rocky Mountain Region: Wm. J. Sinclair.

Twelve miles east of Cody, Wyoming, in the Eocene badlands in the vicinity of McCulloch Peak, angular blocks of Paleozoic limestone occur at elevations of 6,000 feet above sea, either on the crests of narrow ridges separating deep valleys cut in the badland clays or on terraces several hundred feet above the Shoshone River. No other rocks than limestone have been seen in these high level deposits, but at lower levels abundant pebbles and boulders of andesite may be found, all of which are water worn, while the high level material is highly angular, the only sign of abrasion being the pitted surface produced by the solvent action of rain water. Corals and bryozoa frequently appear in relief on the rain-etched surfaces. Individual fragments vary in size from a few inches or less to blocks $6 \times 8 \times 4$ or 5 feet. The source of the limestone is, undoubtedly, the Paleozoic formations of the mountains to the west of Cody. Glacial ice is the only known agent capable of transporting blocks of the size indicated. If they have been transported by ice, 1,200 feet or more of canyon cutting has intervened since their deposition, for they are stranded on narrow divides and comb ridges at least that high above the Shoshone River. If they are to be correlated with the first glacial advance in the Rocky Mountain region, much of the deep dissection of such intermontane troughs as the Bighorn Basin

must be regarded as an event of Pleistocene time.

The paper was discussed by W. W. Atwood and Wm. M. Davis.

Fossils of Lower Limestone of the Steep Rock Series: C. D. WALCOTT.

The paper described a new genus and two species of sponges found by Dr. A. C. Lawson in the limestone of the Steep Rock Series of Canada.

The paper was discussed by A. P. Coleman.

Evidence of Three Distinct Glacial Epochs in the San Juan Mountains of Colorado: WALLACE W. ATWOOD and KIRTLEY F. MATHER.

Abundant evidence of two distinct Glacial epochs has been reported by several investigators from various mountain ranges in the western portion of the continent. During the past season glacial deposits have been examined and mapped about the margin of the San Juan Mountains, which deposits have been interpreted to indicate an epoch of glaciation distinct from the two later epochs that have been clearly recognized in the history of the range.

For convenience, the three distinct epochs are referred to, beginning with the oldest as "San Juan," "Big Horn" and "Uinta."

The composition, distribution and topographic relations of the San Juan glacial drift indicate that this earliest known epoch was separated from the Big Horn Glacial epoch by a much longer time than the Big Horn was separated from the Uinta. The two later epochs appear to have been separated by a much longer time than has elapsed since the last disappearance of glacial ice from the range. The San Juan Glacial epoch is so far removed from the present time that the glacial deposits of that epoch are found at but a few places, where conditions were most favorable for their preservation.

There are reasons for believing that the San Juan Glacial epoch may have been characterized by small ice caps among the western ranges rather than by Alpine glaciers, which were the prevailing type during the Big Horn and Uinta epochs.

There are good reasons for believing that the San Juan epoch preceded the development of the great canyons among the mountains, and, therefore, that much of the sculpturing which has given form to the scenic features of the range is inter- and post-Glacial in origin. The time relation of the epochs of glaciation to other events in the physiographic history of the range were also suggested.

The paper was discussed by H. E. Gregory.

Glacial Investigations in Minnesota in 1911: FRANK LEVERETT.

A sheet of old calcareous drift deposited by an ice sheet radiating from central Canada covers nearly all of Minnesota and extends into western Wisconsin. The prominent moraines of western Minnesota, named by Upham, Itasca, Leaf Hills and Fergus Falls, were formed in the order named, as is shown by the glacial drainage from them. The rock constituents of these moraines show remarkable disintegration that suggests a possible pre-Wisconsin age. After these moraines were formed by the ice radiating from central Canada, there followed an ice movement radiating from the high tableland northeast of Rainy Lake. This moved across the northern ends of the above-named moraines and extended a few miles beyond the portion of the Mississippi above St. Paul. This produced the so-called "red drift." After this ice movement waned there followed a re-advance of the ice sheet radiating from central Canada which had its main axial movement through the Red-Minnesota-Des Moines Valley; but which also extended southeastward across the portion of the Mesabi Range west from Hibbing, Minnesota, and spread to the left and right in a basin which divides its drainage between the St. Louis and Mississippi Rivers. This ice movement deposited the so-called "gray drift" of the Minnesota Reports. It forms only a thin veneer on the portions of the Leaf Hills and Fergus Falls moraines which it overrode, and it failed to cover all of the Leaf Hills moraine. The correlative position of the Lake Superior Lobe is found to have been but little beyond the western end of the present lake, in Carleton County, Minnesota. A large glacial drainage line opened a great valley along the St. Louis between Floodwood and Carleton, but was there turned southwestward because of the presence of the Superior Lobe. The relations of this latest ice movement from central Canada to the Glacial Lake Agassiz are such as to make necessary a radically different interpretation from that given by Upham in his monograph on Lake Agassiz.

The paper was discussed by Lawrence Martin and J. B. Tyrrell.

Recent Studies of the Moraines of Ontario and Western New York: FRANK B. TAYLOR.

The paper was entirely descriptive of moraines recently mapped in the areas of Ontario and western New York.

Remarks were made by W. M. Davis and H. L. Fairchild.

A Grooved and Striated Contact Plane between the Nebraskan and Kansan Drifts: J. ERNEST CARMAN. (Introduced by George F. Kay.)

The paper described the unique feature of a grooved and striated contact plane between the Nebraskan (pre-Kansan) and Kansan drifts. Both sides of the contact plane are striated. Neither side is the mold of the other. The possible explanations are considered and the conclusion reached that glaciation produced the feature.

The Nebraskan Drift of the Little Sioux Valley in Northwest Iowa: J. ERNEST CARMAN. (Introduced by George F. Kay.)

The paper traced a farther extension of the Nebraskan drift and compared the Nebraskan and Aftonian deposits of this region with those along the Missouri River.

Dr. Carman's two papers were discussed by J. W. Spencer, F. Leverett and W. M. Davis.

Hanging Valleys and their pre-Glacial Equivalents in New York: J. W. SPENCER.

Visiting that most beautiful gorge, Watkins Glen, at the head of Seneca Lake, it would seem that the stream is entirely post-Glacial; but above the railway bridge a great cove, like that of the Whirlpool Basin at Niagara, is developed, with its northern side and end composed of drift. Its continuing channel to the lake has been discovered by boring. The same is true of other falls in this locality. Taughannock, on the western side of Cayuga Lake, is of little less importance. Its pre-Glacial channel, as observed by Hall in 1842, is situated immediately to the north.

Equally important are hanging valleys in northern New York. Between Carthage and Boonville is a plateau at 1,400 feet above sea level, overlooking the Black River and the much lower country east of it. The plain is bounded on the west by an escarpment 500 feet high, surmounted by another plateau. The Black River shales here are easily incised. Here the finest hanging valley with waterfalls is Whetstone Gulf, two miles north of Housie P. O., while the great pre-Glacial valley occurs at this hamlet, with the drift partly removed from it.

It seems that wherever an important drainage basin occurs with modern waterfalls, equivalent pre-Glacial valleys may be found, although more or less filled with drift. Accordingly, in New York State hanging valleys of themselves are no evidence whatsoever of the over-deepening of the trunk valleys or plains in front of them by glacial erosion.

Closing Phase of Glaciation in New York: H. L. FAIRCHILD.

As the Labradorian ice sheet melted away from the north border of New York State, it allowed the water of the ice-bound Lake Iroquois to escape at Covey Hill Gulf and to pass around the northeast slope of the Adirondack highland. Being confined and directed by the ice border, this stream flow produced the extensive areas of bare rock in the towns of Mooers, Altona and Beekmantown, formerly described by Woodworth (N. Y. State Museum Bulls., 83, 84). The later stream flow, along the Altona rocks, determined the level of a narrow lake lying northwestward, into which Lake Iroquois was lowered by the waning of the ice front on Covey Hill, and for a time this lake succeeded Iroquois in the Ontario basin. It is proposed to call this water Lake Emmons (after Ebenezer Emmons, whose district in the first geologic survey of the state covered this area). The further weakening of the ice border finally allowed Lake Vermont (named by Woodworth), which had previously been confined to the Champlain Valley, to succeed Lake Emmons and in turn to occupy the Ontario basin. It is proposed to call this expanded water Lake Vermont-New York. These two water planes in the Ontario basin, inferior to Iroquois, are represented chiefly by delta sand-plains on the larger streams. Eventually the waning of the ice east of the Champlain embayment allowed the glacial waters to become confluent with the sea, and the sea level waters were thus established in both the Champlain and Ontario basins at the same time. The height of the marine beaches about Covey Hill is 525 feet, which definitely gives the amount of land uplift on the international boundary since the ocean transgressed that area. Maps exhibit the glacial drainage channels, the deltas and the shore lines of the three water planes in the Champlain district and the four planes in the Ontario district.

The paper was discussed by F. B. Taylor, J. W. Spencer and H. L. Fairchild.

Post-Glacial Erosion and Oxidation: GEORGE FREDERICK WRIGHT.

(1) Opportunities for observation in Ohio. (2) Small amount of erosion by the streams north of the watershed entering Lake Erie. (3) Esker terraces in the valleys of the Styx and Killbuck on the south side of the watershed. (4) Comparison of calculations from these sources with those from Niagara and other post-Glacial gorges. (5) Ex-

tent of pre-Glacial oxidation. (6) Evidence of small amount of oxidation since the Wisconsin epoch. (7) Evidence that the till of the earlier Glacial epoch consists largely of material oxidized during pre-Glacial times. (8) Evidence of unoxidized material mingled with the highly oxidized material of the earlier epoch. (9) Evidence indicates that the date of the Wisconsin epoch is to be reckoned by thousands, rather than by tens of thousands of years, and the earlier epochs by tens of thousands rather than by hundreds of thousands of years.

The paper was discussed by F. Leverett, J. W. Spencer, H. L. Fairchild and the author.

The Intermingling of Pleistocene Formations: B. SHIMEK.

The paper discussed the effect produced by ice-sheets passing over older Pleistocene formations. Special illustrations are found in the mingling of fossiliferous loess and Wisconsin drift at Des Moines, Iowa, fossiliferous silts at Sioux Falls, S. D., and in other places.

Loess a Lithological Term: B. SHIMEK.

The term "loess" has commonly been understood as implying a more or less distinct division of time. The fact is set forth that there are several loesses deposited at different periods and that loess does not designate a distinct period of time, but indicates rather a condition of deposition, as do such terms as "sandstone," "limestone" and "drift."

Professor Shimek's two papers were discussed by W. C. Alden, F. V. Emerson, Frank Leverett, G. F. Wright and the author.

Criteria for the Recognition of Ancient Delta Deposits: JOSEPH BARRELL.

Previous to the discussion of criteria, definitions were given and an analysis of the parts of a delta. The criteria naturally are different for each part. Variations in the proportions of the parts, the ratios in which these may enter into ancient formations and the intergradations of parts were next considered. Where the conditions of delta growth were such as to give gradations between parts, the criteria become overlapped and tend to result in confusion. It is concluded that deltas of previous geologic ages have commonly developed under quite different conditions from those taken as typical in modern deltas. The principle of a delta cycle is next developed, showing the theoretic stages of rivers building outward and upward against the sea, followed in a later stage by marine dominance and plantation. Where the larger features of an ancient deposit are known, the principle of the delta cycle may be of value as a criterion of origin. Illustration is made by application to the late Mesozoic formations of the Atlantic Coastal Plain. The evaluation of stratigraphic criteria is next taken up with the view first of separating the subaerial delta beds—those periodically exposed to the air, from the subaqueous—those permanently covered with water. Secondly, however, the criteria record also physiographic and climatic conditions controlling the character of the beds. The stratigraphic criteria are taken up in order, and the degree of significance attaching to each is discussed. Two chief conclusions are reached. First, the need of extended study of the stratigraphic characters of present sedimentation. Second, most individual criteria are to some degree indeterminate and a conclusion in regard to the mode of origin of a formation or part of a formation should, in order to obtain acceptance, be based on the convergence of several lines of evidence.

Stratigraphic and Paleontologic Features of Ancient Delta Deposits: A. W. GRABAU.

After a brief reference to the pre-Cambric or early Cambric delta fan of the Pacific Province and the Torridon of Scotland, the author discussed the late Ordovicic and early Siluric fans of the Appalachian region, the Schawangunk dry delta fan and its relationship to the Salina desert, the Esopus delta and its relation to the Oriskany deposits, the Early Devonic talus breccia of Michigan and western Ontario, the Old Red of Scotland and the Catskill group, the Pocono, Mauch Chunk and Pottsville and the Triassic fans of America and western Europe, with special reference to their stratigraphic and paleontologic characters and their bearing on paleogeography.

A Mississippian Delta in the Northern New River District of Virginia: E. B. BRANSON.

A delta started in the Devonian in the New River district and continued through most of the Mississippian. The thickness of the Mississippian part is more than 5,000 feet and consists of varicolored shales and sandstones that thin out in all directions excepting southeast from this region. The Mississippian rocks are known as the Pulaski formation and are to be correlated with the Pulaski, Greenbrier, Bluefield and Hinton formations fifteen miles farther north.

Discussion of the last three papers was participated in by J. M. Clarke, David White, G. W.

Stose, A. Keith, G. I. Adams, E. T. Wherry, H. B. Kümmel and W. C. Alden, with replies by Joseph Barrell and A. W. Grabau.

Differential Erosion and Equiplanation in Portions of Yukon and Alaska: DELORNE D. CAIRNES. (Introduced by Percy E. Raymond.)

Certain limestones and dolomites have been found to offer much greater resistance to ordinary sub-aerial erosive agencies than most other types of sediments, although many of these may be considerably harder and apparently better adapted to withstand the destructive forces to which rocks are exposed. In portions of the Yukon plateau province, the original peneplanated upland surface has been almost entirely destroyed in areas in which the bed rock is chiefly highly metamorphosed slate and quartzite, but is well preserved in adjoining tracts where limestones and dolomites predominate.

Where remnants of the original plateau-surface remain, agencies, including nivation, frost and chemical action are at work on the upland tending to remove all inequalities of the surface by transporting material from the upper to the adjoining lower levels; for this process the term "equiplanation" is proposed. This name has suggested itself as its results tend to make the elevation of all points equal in the area affected. Equiplanation is the reverse of peneplanation, as by isoplanation there is but a slight if any loss of material within the planated areas, but in peneplanated tracts all crustal matter above sea-level tends to become transported to the ocean. Equiplanation thus includes all planating activities, even wind action, whereby a plain-like surface tends to be produced, and by which there is no perceptible loss of material to the planated tract; all ordinary stream action, which is the main factor in peneplanation, is thus excluded.

The paper was discussed by W. W. Atwood, W. M. Davis, H. M. Eakin and the author.

The Cenozoic History of the Wind River Mountains, Wyoming: L. G. WESTGATE and E. B. BRANSON.

A preliminary account of the successive peneplanes, partial peneplanes and terraces of the southern part of the Wind River Mountains, the pre-Glacial gravels capping some of the terraces and the relation of the terraces to deposits of an earlier and a later glaciation.

The Stability of the Atlantic Coast: DOUGLAS WILSON JOHNSON.

The results of the Shaler Memorial investigation of shoreline changes along the Atlantic coast indicate that there has been no appreciable subsidence of this coast within the last few thousand years. The phenomena which seem to indicate recent subsidence appear to fall into three groups: (1) Fictitious appearances of subsidence which are produced by wave action on a retrograding shore line without any change in the level of land or sea; to this group belong many instances of submerged stumps, peat exposed at low water on the seaward side of barrier beaches, erect trees recently killed by the invasion of salt water, etc. (2) Phenomena produced by a local rise in the high tide surface, due to a local change in the form of the shoreline, unaccompanied by any general change in the relative level of land and sea; in this group may be found examples of practically all phenomena ordinarily attributed to a recent subsidence of the land. (3) Phenomena produced by an actual subsidence of the land or rise of the sea level which occurred some thousands of years ago; in this group belong many of the deeply buried peat deposits and submerged stumps. The evidence of coastal stability consists of (1) the form and position of successive beach ridges the oldest of which were built by the waves thousands of years ago, yet later than the deeply buried peat deposits; (2) the position of abandoned marine cliffs on which the waves can not have worked in recent time; and (3) the absence of a fringe of dead trees on those portions of the coast which are exposed neither to direct wave attack nor to local fluctuations of the high tide surface. It is concluded, with reference to the Atlantic coast, that the land can not have subsided as much as a foot within the last century; that there can have been no long-continued progressive subsidence at so high a rate as one foot per century, within the last few thousand years; and that no evidence thus far available can be regarded as satisfactory proof of any degree of recent subsidence, either spasmodic or progressive.

The paper was discussed by C. A. Davis, H. B. Kümmel, J. W. Spencer and A. C. Lane.

Physiography of the East African Plateau: GEORGE L. COLLIE.

Four physiographic regions may be recognized in British East Africa. First, the coastal plain; second, the foot plateau; third, the gneiss plateau; fourth, the lava plateau, which includes within its boundaries the great Rift Valley. The coastal plain is generally but two or three miles wide. It is composed of recent coral rock, and it is a true degradation plain; the agent is probably marine

erosion. Rising rather abruptly from the coastal plain is the great plateau which extends to the basin of Victoria Nyanza. The frontal portion, called by Gregory the foot plateau, is underlain by sedimentaries of Mesozoic age. The main portion of the plateau is gneiss, but toward its western border there have been great extravasations of lava, which have completely covered the original gneiss surfaces over a belt 100 miles wide and extending north and south indefinitely. The lava flows are connected with the rifting processes that have formed the rift valley. The underlying rocks have some bearing upon the minor features of the different regions, but this is a matter of detail. The plateau as a whole from ocean to the Victoria Nyanza basin should be considered as a unit in its larger aspects. The plateau is a very ancient feature; it has been thoroughly peneplaned, though great residual masses of gneiss remain, especially in the region between Voi and Kiu. These mound rocks in some cases rise to the dignity of mountain ranges. The most remarkable feature of the plateau is the constant, uniform rise of the peneplaned surface from sea level to a height of nearly 10,000 feet at the Man or western escarpment of the Rift Valley. The plateau surface is really a great beveled slope which rises on the average about 20 feet to the mile for 500 miles. The plateau is typical of those that lie in the monsoon region, in that only the higher portions and those that lie near sea level are being acted upon by normal erosion. The intermediate and by far the greater area is being degraded by deflation and sheet-flood erosion, chiefly. There are two brief and widely separated rainy seasons. The conditions are such that, in the main, there is a large intake of ground water and relatively little run off, and hence very little dissection. In the interim between rainy seasons the ground becomes parched and dry, so that deflation becomes of importance and offsets dissection. The plateau confirms the truth of observations made in South Africa and elsewhere that one type of peneplanation may go on at any altitude above sea level. This type of peneplanation does not require desert conditions, as is sometimes said. Thirty inches of water fall annually over much of this plateau, but it does not require monsoon conditions where rainfall is concentrated in widely separated rainy seasons with arid or semi-arid conditions in between.

On the Nomenclature of Faults: HARRY FIELDING REID.

This was a preliminary report by the chairman of the committee appointed by the society at the Baltimore meeting (1908) and was submitted for discussion and criticism in advance of making a final report at the next meeting of the society.

Boulder Beds of the Caney Shale at Talahina, Oklahoma: J. B. WOODWORTH.

The Caney shales of Mississippian age in southeastern Oklahoma carry grooved and striated stones and large boulders, all of which phenomena have been described by Mr. J. A. Taff, of the Geological Survey. The writer describes the best known locality near Talahina, Okla., and ascribes the markings on the stones and boulders to internal rock movements accompanying the faulting of the beds. It is thought with Mr. Taff that the distribution of the boulders, aside from the nature of their striated surfaces, demands transportation by ice. Other evidence is briefly cited in support of the idea that the Permian Glacial period was preceded by signs of widely distributed ice action of one kind or another in the Carboniferous period in the northern hemisphere.

Some Coastal Marshes South of Cape Cod: CHARLES A. DAVIS.

A report on a continuation of the work on salt marshes in the vicinity of Boston, the results of which were reported at the Boston meeting of 1909. The structure of salt and brackish marshes on the south side of Cape Cod and on Long Island was described and the bearing of this on the problem of recent coastal subsidence was discussed.

The paper was discussed by J. B. Woodworth, A. W. Grabau and the author.

Structure of the Helderberg Front: A. W. GRABAU.

The Helderberg Front is the northern extension of the westernmost belt of the Appalachian folded area, left after extensive erosion. The former extent east of the Hudson is partly indicated by Becraft Mountain and Mt. Ida. The basal part is of folded Hudson strata unconformably succeeded by late Siluric showing various phases of overlap. The Appalachian folds are of the usual asymmetric type, while the range from near Rosendale to Catskill and beyond is complicated by one or more pronounced overthrusts. The first of these was described by the author from Kingston and subsequently more fully discussed by Van Ingen and Clark. Chadwick has described a part of the thrust at Saugerties, and the author has determined its character near Catskill. Several new sections from this last region were presented.

The paper was discussed by J. B. Woodworth.

Some Relations between Gravity Anomalies and the Geologic Formation in the United States: William Bowie. (Introduced by A. H. Brooks.)

A report of an investigation of topography and its isostatic compensation upon the intensity of gravity will soon appear as a Coast and Geodetic publication. This and a subsequent investigation, involving 124 gravity stations, show the gravity anomalies in the United States are very small as a rule and that there is no apparent relation between the size and sign of the anomalies and the character of the topography. There is, however, a relation between the sign of the anomalies and the geologic formation. The stations in the older formations tend to have anomalies of the positive sign, indicating an excess of mass, and the stations in the most recent formations tend to have anomalies with the negative sign. It is probable that the anomalies are caused by erroneous assumptions regarding the surface density of the material at a station, and to a departure of the crust of the earth near the station from a state of complete isostatic compensation.

The paper was discussed by H. F. Reid and the author.

The following papers were presented by title:

Geological Reconnaissance in Northeastern Nicaragua: Oscar H. Hershey.

The Geology of Steep Rock Lake: Andrew C. Lawson.

The Mesozoic Stratigraphy of Alaska: G. C. Martin.

Color Scheme for Crystal Models: George H. Chadwick.

Occurrence of Petroleum Associated with Faults and Dikes: Frederick G. Clapp.

New Minerals from the Favas of Brazil: Oliver C. Farrington.

Progress of Opinion as to the Origin of the Iron Ores of the Lake Superior Region: N. H. Winchell.

Saponite, Thalite, Greenalite and Greenstone: N. H. Winchell.

Pre-Wisconsin Channels in Southeastern South Dakota and Northeastern Nebraska: J. E. Todd.

Geographic Cycle in an Arid Climate: Should its Development be by Wind or Water? Charles R. Keyes.

The Effect of Rapid Off-shore Deepening on Lake Shore Deposits: Rufus Mather Bagg, Jr.

List of Underground Temperatures in the United States: N. H. Darton.

A Bibliography of the Mammoth Cave: Horace C. Hovey and R. Ellsworth Call.

The following officers were elected for 1912:

President—Herman LeRoy Fairchild, Rochester, N. Y.

First Vice-president—Israel C. White, Morgantown, W. Va.

Second Vice-president—David White, Washington, D. C.

Secretary—Edmund Otis Hovey, New York, N. Y.

Treasurer—William Bullock Clark, Baltimore, Md.

Editor—J. Stanley-Brown, Cold Spring Harbor, N. Y.

Librarian—H. P. Cushing, Cleveland, Ohio.

Councilors (1912–14)—S. W. Beyer, Ames, Iowa, and Arthur Keith, Washington, D. C.

Fellows elected December 28, 1911: R. C. Allen, Robert Van Vleck Anderson, Manley Benson Baker, Edwin Bayer Branson, Durdon Montague Butler, Stephen Reid Capps, Jr., George Halcott Chadwick, Clarence Norman Fenner, James H. Gardner, Walter Granger, John Sharshall Grasty, William Otis Hotchkiss, Cyril Workman Knight, Adolph Knopf, Lawrence Morris Lambe, Elwood S. Moore, Daniel Webster Ohern, Sidney Paige, Joseph E. Pogue, William Frederick Prouty, Elmer S. Riggs, Jesse Perry Rowe, John Joseph Rutledge, Joseph Theophilus Singewald, Jr., Burnett Smith, Frank Springer, Clinton Raymond Stauffer, Lloyd William Stephenson and Mayville William Twitchell.

Wednesday evening the Geological Society of America joined with other affiliated societies and the general American Association for the Advancement of Science in listening to the address of welcome by President Taft. Thursday afternoon was devoted to visiting the Geophysical Laboratory of the Carnegie Institution, while the evening was occupied with the annual dinner of the society followed by much speech making under the leadership of Dr. J. M. Clarke, of Albany, N. Y. On Friday evening, the presidential address of Professor Davis was followed by a smoker at the Cosmos Club tendered by the Geological Society of Washington to the Geological Society of America, the Paleontological Society and the Association of American Geographers.

The next meeting of the society will be held at Yale University, New Haven, Conn., a year hence.

Edmund Otis Hovey,
Secretary