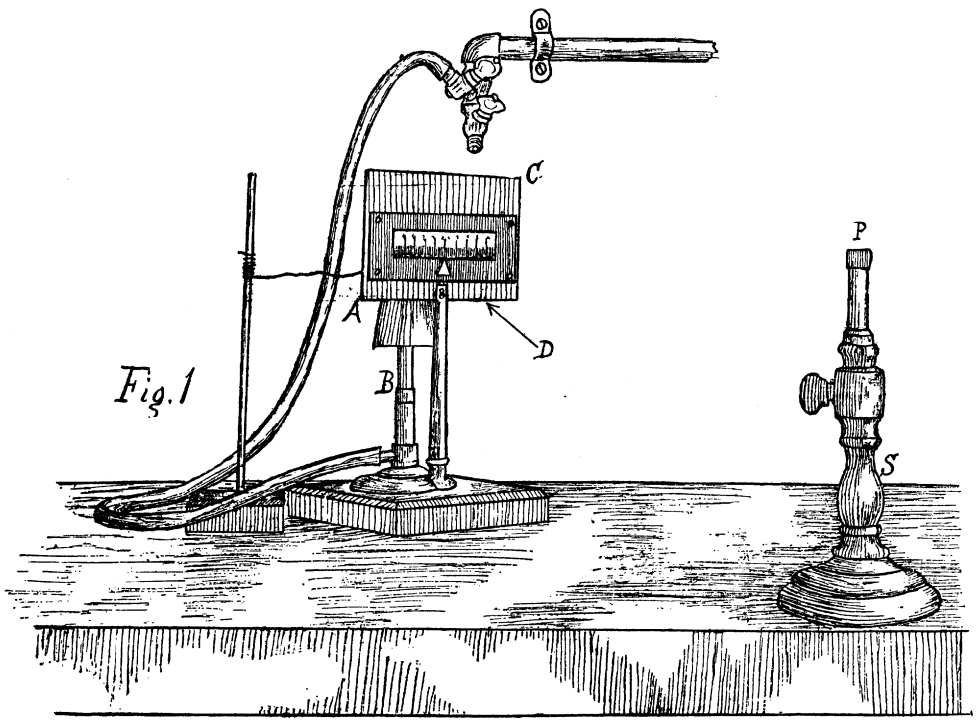

Fig. 1

some position as at A′ C′. If, for example, strontium is introduced into the flame the observer will see a red triangle appear under the scale A′ C′ at some such place as D″, Figs. 2 and 3. If thallium is used a green triangle will appear as at D‴. In other words one can read the positions of the points of the colored triangles at the bottom of the scale, just as the positions of the colored lines are read on the scale in an ordinary spectroscope. A little practice and care will enable one to read the positions of the triangles to 0.1 mm, and thus to obtain about as good results as with the customary more elaborate and more expensive form. This little piece of apparatus has proved a great help in making the principles of the spectroscope thoroughly clear to students doing laboratory work. Of course it is desirable to have a black screen to prevent light from entering the eye from the direction of A′ C′. In fact it is very convenient to blacken the wall for a considerable space behind this apparatus.

Columbia College, December 10, 1895.

THE GEOLOGICAL SOCIETY OF AMERICA.

The Geological Society of America held its eighth annual meeting in the main building of the University of Pennsylvania, at Philadelphia, December 26, 27 and 28. The first session of the Council took place at the Hotel Lafayette at eleven o'clock on the 26th. The ballot for officers was canvassed with the following result:

President, Joseph Le Conte, Berkeley, Cal.; First Vice-President, Charles H. Hitchcock, Hanover, N. H.; Second Vice-President, Edward Orton, Columbus, O.; Secretary, H. L. Fairchild, Rochester, N. Y.; Treasurer, I. C. White, Morgantown, W. Va.; Editor, J. Stanley-Brown, Wash-

Fig. 3.

Fig. 2.

ington, D. C.; Councillors, B. K. Emerson, Amherst, Mass., and J. M. Safford, Nashville, Tenn.

The newly elected Councillors replace E. A. Smith and C. D. Walcott who retire under the rules. The other members are F. D. Adams, I. C. Russell, R. W. Ells and C. R. Van Hise. The following fellows were also announced as elected:

Harry Foster Bain, B. S., M. S., Des Moines, Iowa, assistant geologist, Iowa Geological Survey.

William Keith Brooks, Ph. D., Baltimore, Md., professor of zoölogy in Johns Hopkins University.

Charles Rochester Eastman, A. B., A. M., Ph. D., Cambridge, Mass., assistant in paleontology in Museum of Comparative Zoölogy and in Harvard University.

Henry Barnard Kümmel, A. B., A. M., Ph. D., Trenton, N. J., assistant on the State Geological Survey of New Jersey.

William Harmon Norton, M. A., Mt. Vernon, Iowa, professor of geology in Cornell College, special assistant on the Geological Survey of Iowa.

Frank Bursey Taylor, Fort Wayne, Ind. Accountant, engaged in pleistocene geology.

Jay Backus Woodworth, B. S. Cambridge, Mass., instructor in Harvard University

and assistant geologist on U. S. Geological Survey, engaged in general and glacial geology.

The Council also distributed a printed report containing the resumé of the year. The last printed roll contains the names of 223 living and 13 deceased fellows of the Society. Four have died during the year. The financial affairs of the Society are in good condition. After a few announcements, memorials of deceased members were presented as follows: of James D. Dana, written by Joseph Le Conte and read by H. S. Williams; of Henry B. Nason, written by T. C. Chamberlin and read by Bailey Willis; of Albert E. Foote, written by G. F. Kunz and read by J. F. Kemp; of Antonio del Castillo, written by Ezequiel Ordonez and read by the Secretary.

The reading of scientific papers was then taken up with the usual rule that papers whose authors were not present in person were passed and transferred to the end. The papers actually read came in the following order.

Illustrations of the Dynamic Metamorphism of Anorthosites and related Rocks in the Adirondacks. J. F. Kemp, New York, N. Y.

The high, central peaks of the Adirondacks and the larger outlying ridges consist of anorthosite,. a coarsely crystalline rock that is nearly pure labradorite. Though described as norite in earlier reports, it is noticeably poor or entirely lacking in ferro-magnesian silicates. In the course of a fairly extensive reconnoissance of the principle portion of the mountains, the writer has met but limited exposures of the anorthosites in an uncrushed condition. Specimens of such were shown, and beginning with these as a starting point the gradual development of crushed rims was shown, which at first barely discernible, increased until the original crystals of labradorite were but small nuclei. The extreme is a 'pulp-anorthosite' with no nuclei. The passage into gneissoid forms, through augen-gneisses, and with a rich development of garnets, was also illustrated. The final result is a thinly laminated gneiss. Comments on the areal distribution of these types were added. The speaker then took up a series of basic gabbros and illustrated, by specimens, their passage into gneissoid types in the same exposure. Acknowledgments are to be made to Prof. James Hall, State Geologist of New York, under whose direction a part of the material used for illustration was gathered. The paper was discussed by A. C. Lane and C. H. Hitchcock, bringing out the facts that in the gabbros the change to gneiss was generally marked by a passage of pyroxene to hornblende, and that the igneous series, though called Upper Laurentian by the speaker in following the Canadian usage, was doubtless later than the crystalline limestones of the region, that would be called Algonkian by many American geologists.

The Importance of Volcanic Dust and Pumice in Marine Deposits. N. S. Shaler, Cambridge, Mass.

Considerations based on volcanic action in the Java district make it probable that the extrusions of rock matter in the form of dust and pumice may exceed that which is carried to the sea by the rivers and possibly equals that which is conveyed to the ocean by all other actions. Observations on the shores of the United States afford evidence that there is a noticeable contribution of pumice to the deposits forming along that coast line. The facts warrant the supposition that the value of these volcanic contributions to sedimentation has not been properly appreciated.

The paper elicited an extended and interesting discussion. C. H. Hitchcock, apropos of the recorded discoveries of pumice along the southern coast line of the United

States, stated that in his travels in the West Indies he had found no pumiceous rocks among the volcanoes, and suggested the possibility of remoter sources. C. W. Hayes remarked upon a vast formation of volcanic tuffs met by him in eastern Alaska, extending over many hundreds of square miles and up to 75 feet thick. Its bulk he estimated at over 100 cubic miles. He also referred to the top layer of the Devonian rocks of the southern Appalachians, which 8 inches to 18 inches thick, extends from eastern Tennessee and Georgia to Arkansas and Missouri, and which is regarded as a volcanic tuff. L. V. Pirsson mentioned the wide area over which the fine ejectments of Krakatoa had spread and gave a brief sketch of Bäckstrom's observations on the presence of volcanic dust in the sea beaches of Norway. Much of this is demonstrably from Iceland, but other samples agree with the products of no volcano in the Atlantic basin. Caution is needed not to be misled by artificial slags and cinders. M. E. Wadsworth cited the tuffs collected by S. Garman, G. P. Merrill and J. S. Diller in Nebraska, and by Diller in Massachusetts. Persifor Fraser called to mind the dust that was gathered by Joseph Wharton in Philadelphia on the first snowfall, December, 1883, Krakatoa having been active in August of the same year. Its microscopic characters agreed entirely with samples from Krakatoa.

The discussion then took up the length of time, during which such dust might remain suspended in the atmosphere. W. M. Davis stated that the peculiar red sunsets following the Krakatoa outbreak lasted through 1884, and that the so-called Bishop's ring was visible around the sun for fully two years. N. S. Shaler mentioned the observations of the Germans on shining clouds that were at first 80 miles in the air and that were later noted at 140 miles before they disappeared. He also reminded the Society that the same red sunsets followed the great eruption of Skaptar Jokul in 1783. C. H. Hitchcock raised the point that red glows from aqueous vapor should not be confused with colors from volcanic dust, as the latter are chiefly greenish, but in reply it was brought out that the colors were due to diffraction and that the reds might also be caused by fine particles of mineral matter.

A needed term in Petrography. L. V. PIRSSON, New Haven, Conn.

The speaker adopted the definition of a crystal that is based upon its outer plane faces, rejecting thus the tendency of some authors to make it dependent on internal, physical and optical properties. He then spoke of the inaccuracy of using the word crystal for the mineral components of a rock, which, in most cases, have no plane faces, illustrating his point by the augites of augitic rocks. For such the terms crystal fragment and crystalloid had been used, but were both objectionable. Therefore, after consultation with E. S. Dana, he proposed the name anhedrine for them, the word meaning without planes. In a brief discussion that followed, the term was on the whole well received, although the general feeling was strong against the introduction of further new terms into the over-burdened nomenclature of petrography and other branches.

Note on the Outline of Cape Cod. W. M. DAVIS, Cambridge, Mass.

The speaker described the topography of the Cape from a point some distance south of Highland Lighthouse, to the north, and made a distinction between the 'mainland outline' or the original glacial drift hills of the highlands, and the 'constructional outline' by which was meant the later added sandspit to the north. The argument was then made that the 'mainland' had once extended some miles to the southeast, that it had been worn away at first to a some-

what northwesterly coast line, now indicated by an inshore sandspit, in the constructional area, and later to a more northerly line as shown by the building of the present spit from the 'point of attachment' in sympathetic conformity to the cliff line on the south. The migration of the sediment worn from the cliff around the end of the point, the features of Race Point and Long Point and the crescentic scouring of the inner side of the cape, were all commented on. G. K. Gilbert asked if there is any evidence of the elevation or depression of the cape area *en bloc*, to which the speaker replied that there is none. C. H. Hitchcock recalled the idea of Louis Agassiz that there had once been a continuous line of drift from Cape Ann to the 'mainland' of Cape Cod, but the speaker said it had been long disproved, and referred also to historic records of islands off to the southeast of Highland Lighthouse. In closing the discussion President Shaler stated that the 'mainland' of the cape was formed by a deposit of drift on an old preglacial divide of Tertiary and Cretaceous strata, and that the former river systems could be traced with entire accuracy southward through Vineyard sound. He dwelt also on the fear of the Provincetown people lest the cape to the east of them should be breached and their harbor be filled with sand. The value of jetties north of the 'point of attachment' referred to above was emphasized.

The Society then adjourned until the following day at 10 A. M. Thursday evening many of the Fellows attended the interesting lecture of Prof. Wm. B. Scott on the Tertiary Lake Basins of the West, at the Philadelphia Academy of Sciences, and all who are accustomed to arc-light stereopticons were strengthened in their faith in them, as the lime light provided did not do Prof. Scott's slides justice. Nearly all the Fellows also attended and enjoyed the reception which was most hospitably extended to the visiting societies by Dr. Horace Jayne, to whom an expression of thanks is due.

The Council of the Society met at 9 A. M. Friday and transacted routine business. At 10 the Society assembled and devoted a few minutes to executive business. The auditing committee and the committee on photographs reported. The latter placed on exhibition the collection which now amounts to 1283 pictures, many of which are of more than ordinary interest. 205 new ones were added during the year. Great credit is due the efficient chairman of the committee, Dr. Geo. P. Merrill, of the United States National Museum, for his efforts in its behalf. The committee solicits donations which may be sent to Dr. Merrill and which will be duly acknowledged in the publications of the Society. The Society also voted not to have a session separate from Section E of the American Association at the summer meeting, but only one for executive business and for the reading of papers by title. Attention will also be given to arranging excursions as heretofore. Fellows of the Society are urged to read their papers in Section E, while publishing as before in the *Bulletin*. It was announced that a group photograph would be taken at the noon recess. This was afterward done, with a quite successful result, by Herbert Hoffman, of 914 Arch street, Philadelphia. The business finished, the Society listened to the annual presidential address. It was delivered by retiring President Shaler, and will appear in full in an early number of Science. The subject was 'The Relations of Geologic Science to Education,' and it was followed by some discussion by Messrs. Gilbert, H. S. Williams and Wadsworth. The regular papers were then taken up as follows:

Plains of Marine and Subaërial Denudation.
W. M. Davis, Cambridge, Mass.

Ramsey's explanation of plains of abrasion as the product of marine denudation

(1847) found general acceptance, and in England to this day hardly any serious consideration is given to any other explanation. The production of plains of abrasion at the completion of a cycle of subaërial denudation, advocated by Powell in connection with the idea of the baselevel of erosion (1875), has found wide acceptance in this country, but it is less approved abroad. The paper considered the criteria by which plains of abrasion of one origin or the other may be distinguished. When such plains are uplifted and maturely dissected in a second cycle of denudation the difficulty of determining their origin increases. It is suggested that plains of subaërial denudation may be recognized, even when uplifted and dissected, by the degree of adjustment of their streams to their structures; thorough adjustment requires a longer time of stream action than has passed since uplift; much of the adjustment must be referred to a previous cycle of denudation, which is thus shown to have been a subaërial cycle.

Considerable discussion followed by Messrs. Willis, Reid, Hayes, Van Hise and Gilbert, the speakers giving instances from different parts of the continent, which illustrated one or the other interpretation cited, or which emphasized the large part played by the character of the rocks concerned or by isostatic adjustments.

Cuspate Fore-lands. F. P. GULLIVER, Cambridge, Mass.

1. Action of waves, tides and currents. Waves attack the whole coast, but erode more rapidly on headlands than at bay heads. Tides are less effective agents of transportation along shore on exposed coasts than currents, but they are the important agents in sounds, channels and inlets.

2. Current cusps. Type, Cape Hatteras. The cusp is formed in the dead water between two eddy currents.

3. Tidal cusps. Type, West Point, Puget Sound, Washington. The cusp is formed between eddies of in- and out-flowing tides.

4. Delta cusps. Type, Tiber delta, Italy. The mouth of the river forms the point of the cusp, on either side of which the along shore currents arrange the detritus.

The paper was illustrated by pilot charts, which somewhat unfortunately were not all used, as space for display was limited. Bailey Willis remarked on the applications of the views advanced to localities in the Puget sound region.

Drainage Modifications and their Interpretation. M. R. CAMPBELL, Washington, D. C.

This paper opened with a discussion of the subject of stream modification under the influence of slow elevation or depression of the earth's surface. From this was derived the Law of the Migration of Divides which control, to a greater or less extent, the alignment of all drainage systems. The Law of the Migration of Divides is in brief that divides migrate toward a region of uplift and away from a region of depression. The relations of divides may therefore be significant indicators of the lines of upheaval or depression even when these are comparatively slight. Criteria were given by which these modifications may be recognized and the character of the crustal movement determined.

A brief description followed of some of the drainage systems of the Appalachian province, south of the glaciated region, to show that similar modifications of the drainage are of common occurrence, not only in the regions of horizontal rocks, but also occur in the highly complicated geologic structure of the Appalachian valley. It was shown that some of these changes are of recent occurrence, whereas some probably date back to the time of the Jura-Trias depression.

The principal object of this paper was to show that the drainage of the Appalachians constitutes a record of Mesozoic history, and that this record is to the physiographer of equal importance with that contained in the forms sculptured from the surface of the land.

In the discussion President Shaler took up the relations of the drainage systems of Kentucky and emphasized the value of the paper in helping to clear away points that were previously obscure. Remarks by Messrs. Davis and Gilbert followed, and the latter in reply to a question alluded to the part played by the rotation of the earth in determining lines of drainage. He described it as slight, if at all present, and as requiring almost unattainable delicacy of tests for its detection.

Some Fine Examples of Stream Robbing in the Catskill Mountains. N. H. Darton, Washington, D. C.

By means of a large topographical chart the speaker showed how the Kaaterskill and Plaaterskill Creeks flowing eastward into the Hudson, had pushed their divides backward until they had robbed the headwaters of Schoharie creek. Other small ones along Esopus creek were also cited.

Movement of Rocks Under Deformation. C R. Van Hise, Madison, Wis.

The paper was a general discussion of the behavior of rock when subjected to deforming stresses, and is preliminary to the discussions which the author gave last summer on the analysis of folds and upon the relations of primary and secondary structures in rocks.

Three zones in the earth's crust were cited: 1, an outer one of fracture during rock movement; 2, an inner one of mixed fracture and flowage; 3, an inmost one of flowage. In elaborating these, the effects of pressure on rocks were analyzed. It was shown that a quick application of pressure might fracture where a slow one would cause flowage, and that the possible depth at which cavities might exist was greater than had been assumed by Heim (5000 m.). Mathematical deductions by Prof. Hoskins, of Stanford University, made for this paper, have shown that where the walls of a cavity are subjected to three equal stresses at right angles with one another, the cavity will be closed up in case the stresses equal two-thirds the ultimate strength of the rock. With a single stress the full crushing pressure is needed. Assuming the strongest rock for these conditions in order to get a certain maximum depth below which cavities would be an impossibility, and taking the specific gravity of the crust at 2.7, from which in the calculation we must subtract 1, for the water that penetrates all fissures, we obtain for the first relation of forces 6670 metres and for the second 10,000 metres as this depth. Under these conditions the water is understood to be free to escape. Instances of quartz pebbles were cited, one being rolled out without fracture in the Marquette region. The effects upon heterogeneous rocks were discussed and their relations to folding. The zone of mixed crushing and folding was next taken up, after which the paper concluded. In the discussion A. C. Lane spoke of the bearing of the paper on the conceptions advanced by him at a previous meeting regarding the escape of the earth's internal gases. J. F. Kemp referred to its important bearing on the origin and possible depth of formation of mineral veins. B. K. Emerson cited the case of the Cambrian gneisses of Massachusetts, in which quartz crystals are rolled out as thin as paper, but with their optical properties unimpaired, and emphasized the possibility of chemical recrystallization. J. P. Iddings brought up the interesting experiments of O. Mügge on ice crystals as recently set forth in the Neues Jahrbuch, showing that ice sheared

in small blocks along gliding planes across the optic axis without altering its direction. Prof. Van Hise in closing admitted the possibility of chemical recrystallization, citing in illustration some marbles which exhibited it, but mentioned others that are full of strained and crushed crystals. The paper was one of the most important of the meetings and is indispensable to all students of metamorphic districts.

Proofs of the Rising of the Land around Hudson Bay. ROBERT BELL, Ottawa, Canada.

The speaker cited well preserved sea margins and grand terraces, especially on the eastern coast; lines of driftwood above highest tides; debris along old shore lines in the woods on the west side at a distance from the highest tides; islands near shore becoming peninsulas within the human period; drying of salt water marshes; the character of the lower parts of streams showing recession of the sea; shoaling of mouths of rivers and formation of new islands and bars in historic times; other historic evidence; successive growth of marsh plants, bushes, poplars, spruces, etc., as the land rises; beach dwellings and other shore works of the Eskimos now elevated to considerable heights; fresh character of fossil shells, etc., in clays and sands; deep water deposits elevated above the sea level at comparatively recent periods; similar phenomena on the eastern coast of the Labrador peninsula; bones of whales, etc., on elevated ground in Hudson Strait; raised terraces and beaches in the northwestern part of Hudson Bay; general shoaling of the water, extension of shores and enlargement of islands.

The paper was discussed by one or two speakers without, however, bringing out material points.

Possible Depth of Mining and Boring. ALFRED C. LANE, Houghton, Mich.

This paper discussed some of the difficulties in deep mining, especially the rise in temperature, and considered what the most favorable circumstances are and the most effective way of overcoming the difficulties, and how far we may expect that the earth's crust will be penetrated. The expenses were plotted as the abscissas of a curve of which the depths furnished the ordinates. Ten thousand feet appeared to be approximately the limit. The depths of some of the shafts in the copper country of Lake Superior were cited, and the hope was expressed that, when the ultimate practical depth has been reached, a purely scientific bore hole be started at the bottom, before the shaft is abandoned, and sent down several thousand feet further. In the discussion that followed special attention was paid to the rate of the increase of temperature as we go down. One speaker cited the recent results published by Alexander Agassiz in the American Journal of Science, December, 1895, p. 503, as 1° F. for each 223.7 feet down to 4,580. For this result a mean rock temperature at 105 feet of 59° F. is used, whereas the mean annual temperature of Calumet is about 40°, and practically this temperature of 40° has been determined at slight depths in other neighboring mines. A mean annual temperature of 59° F. is not met north of Kentucky and this fact makes corroboration desirable before important inferences are based on the later and excessively low gradients.

Notes on Glaciers. HARRY FIELDING REID, Baltimore, Md.

Dr. Reid referred, in opening the paper, to his recent efforts to get reliable data on the variations of American glaciers. Mr. Willis reports that the Pyallup glacier on Mt. Rainier had retreated 200–300 yards and the Carbon glacier 100–200 feet. In British Columbia the Illiciliwaet was observed to recede in 1890 and 1894. Dr. Reid then gave a most interest-

ing analysis of the accumulation and motion of glaciers. He distinguished the region of accumulation of snow in excess of melting as the reservoir, and the region of melting in excess of accumulation as the dissipator; the border line is the nêvé line. By assuming cross-sections at various points, the relative velocities of movement were worked out on the basis of mechanics. The same was done for a glacier which spreads from a center in all directions. The progress of the same layer of snow was then traced from reservoir to dissipator and parallel lines of motion for the individual parts were established, the névé line furnishing a middle line. It was then shown that the original stratification plane as indicated by debris would at the end of the journey cut these lines of motion and would emerge with a high dip, a fact already observed on some glaciers. The topic of the variation in the advance and retreat of glaciers was discussed and the several explanations were analyzed in detail. The paper was discussed by G. Frederick Wright and R. D. Salisbury, the latter mentioning that the thin fronts of Greenland glaciers showed the upward tendency of stratification planes, but that thick fronts lacked it. The Society then adjourned until the following day.

In the evening about sixty Fellows dined together, with President Shaler and Professor Emerson acting jointly as toastmasters, and listened to some amusing speeches by several members.

On reassembling Saturday morning the reading of papers was at once resumed.

The Relation between Ice Lobes South from the Wisconsin Driftless Area. FRANK LEVERETT, Denmark, Iowa.

Instead of a coalescence of ice lobes from the east and the west sides of the Driftless Area in the drift-covered district to the south there was an invasion and withdrawal of one lobe (the western) before the other reached its culmination. The eastern lobe encroached upon territory previously glaciated by the western, depositing a distinct sheet of drift and forming at its western limits a well-defined morainic ridge. There appears to have been a period of considerable length between the withdrawal of the western lobe and the culmination of the eastern.

Subsequently, however, there was a readvance of the lobe on the west into northeastern Iowa, and this readvance appears to have been contemporaneous with the nearly complete occupancy of northwestern Illinois by the eastern ice lobe. It seems not improbable that the ice lobes were then for a brief period coalesced for a short distance about the south border of the Driftless Area. Evidence of complete coalescence, however, is not decisive so far as yet discovered.

These developments serve to throw light upon the cause for the scarcity of lacustrine deposits in the Driftless Area. They show that there was at most but a brief period in which the southward drainage of the Driftless Area was completely obstructed by the ice sheet.

By means of maps it was brought out that there were probably two centers of accumulation—one, the earlier, toward the northwest; and the other, the later, in the Labradorian heights. In the discussion R. D. Salisbury remarked the great complexity of the glacial period, and G. Frederick Wright, while admitting the minor complexity, emphasized its essential grand unity. President Shaler called attention to the importance of demonstrating the progress of glaciation from west to east, because if we can establish the sequence of events, we have advanced a long way toward discovering their cause.

The Loess of Western Illinois and Southeastern Iowa. FRANK LEVERETT, Denmark, Iowa.

The north border of the loess both in

western Illinois and eastern Iowa appears to have been determined by the ice sheet. The loess is apparently an apron of silt spread out to the south by water issuing from the ice sheet. It is loose textured at the north and becomes finer textured toward the south, showing a decrease in the strength of depositing currents. The wide extent of loess over the uplands has led to a consideration of the influence of wind as well as water in its distribution. It is thought that wind-deposited loess may be distinguished from that which is water deposited. The wide extent, however, appears to be due to water distribution rather than wind. Wind action apparently came into force subsequent to the water distribution and is of minor importance.

G. K. Gilbert in discussion expressed his gratification at hearing of 'loess' the rock, instead of exclusively of 'the loess,' the peculiar geological formation. He cited a case in eastern Colorado, along the Missouri Pacific Railroad, where loess had gathered on the leeward side of sand dunes. B. K. Emerson spoke of the aqueous loess of the Hadley meadows in Massachusetts from the annual floods of the Connecticut river, and the eolian loess on the neighboring hills.

High-level Terraces of the Middle Ohio and its Tributaries. G. FREDERICK WRIGHT, Oberlin, O.

This paper embodies the results of the writer's personal observations during the summer and autumn of 1895 on the terraces of the Ohio river, between Steubenville and Marietta, and on the Kentucky river, between High Bridge and Boonetown. The presence of beds of granitic gravel and of isolated boulders of this rock, *i. e.*, of a rock that must have reached its resting place by the agency of ice from the north, in the country adjacent to the Ohio was remarked. An elevated and extensive bed of sand on the southwest end of a large island between St. Mary's and Newport was instanced as indicating peculiar and as yet not well explained conditions of high water and of a change in the river channel.

I. C. White in discussion explained the large island as in large part caused by a preglacial channel of Middle Island creek, which enters the Ohio at St. Mary's, directly athwart its course and through a gorge that is continued in the abandoned channel that now forms the island's northwest side. He also stated that pebbles often reached exceptional heights on the hills because the farmers use sand with some contained gravel for bedding in their stables and consequently scatter it over their fields at all altitudes. President Shaler also cited the custom among the Indians of cooking with heated boulders, and as the local limestones and sandstones were of no value for this purpose they often brought granitic boulders from a distance. Prof. Wright, however, cited boulders of 4,000 pounds, which manifestly could not be explained in these ways. A. Heilprin then mentioned the polished and grooved rocks of South Africa which had been regarded as glaciated. More careful investigation however has shown that the polishing is due to the habit of elephants to formerly resort to them and roll and scrape on them, and that the grooves are due to the rubbing of their tusks. F. Leverett corroborated the observations of Prof. Wright in the northern part of the area.

Four Great Kame Areas of Western New York. H. L. FAIRCHILD, Rochester, N. Y.

This paper described three kame areas south of Irondequoit bay and one south of Sodus bay. These are remarkable for extent and quantity of material, as well as for location and altitude; one of them having gravel hills 400 feet high and furnishing the highest altitude of ground in western New

York, north of the Devonian plateau. The geographical location and extent of the kames were shown by a large map and the first three were named, the Irondequoit, the Mendon and the Victor; the last was called the Junius. Excellent photographs were passed around in further illustration.

Paleozoic Terranes in the Connecticut Valley. C. H. Hitchcock, Hanover, N. H.

The author has made occasional studies of the rocks along the upper Connecticut valley since his official connection with state surveys, and thinks there are good reasons for revising some of the conclusions of the New Hampshire report. Some of the points are: 1. The existence of two bands of argillite; one below and the other above the calciferous mica schist. 2. The hornblende schist of the neighborhood of Hanover is a laccolite. 3. The protogene gniesses of Hanover and of North Lisbon are igneous. 4. With the views now entertained of the igneous origin of the protogene, hornblende schist, foliated diorites and diabases, a new arrangement of the stratified fossiliferous rocks of Littleton, N. H., is suggested. The points were illustrated by geological maps. The older argillite cited under 1, above, was referred to the Upper Silurian, and the later one to a subsequent but not definitely determined period. The discovery of contact effects along the junction of the hornblende schist of 2, with the argillites and mica schists is additional ground for the later conclusion. In support of 3, it was shown that the gneiss contains inclusions of the schists. Under 4 the metamorphic rocks, in association with fossiliferous Niagara limestone at Littleton, are now regarded as post-Niagara, not Cambrian. B. K. Emerson, in discussion, remarked that this revision placed the geological structure in harmony with the results now attained in Massachusetts on the south.

The next paper was by C. Willard Hayes on 'The Devonian Formations of the Southern Appalachians.' Mr. Hayes gave a generalized section of the Devonian as follows: An upper and very persistent layer, 8 inches to 24 inches thick, of a green sandstone, with phosphatic nodules and shreds of volcanic glass, feldspars, etc., such as to indicate a volcanic tuff. Below this comes black shale, 0–12 ft., and not always present. The bottom stratum is a ferruginous conglomerate or sandstone 0–6 ft., and contains the recently discovered phosphate beds of Tennessee. Attempts to explain the thin character or actual absence of the Devonian over great areas have been made as follows.

1. The region was a deep sea bottom, lacking sediments.

2. It was a region of shallow waters whose entering streams were without sediments.

3. It was a land area.

4. It was a shallow sea without sediments and with swift but clear currents, like the Gulf stream region of the West Indies.

The speaker believed, however, that such sediment as was distributed came in large part in currents from the northeast, and that another current came from the southeast and moved northwest, rounding the Cincinnati arch. D. W. Langdon raised the point of the relations of the Devonian to the Helderberg limestones in southwest Virginia, and the same point was discussed by the author and by J. J. Stevenson. Messrs. Keith, Van Hise and H. S. Williams also took part in the discussion.

Notes on the Relations of the Lower Members of the Coastal Plain Series in South Carolina. N. H. Darton, Washington, D. C.

The formations below the Eocene buhrstone which were included in the Eocene by Tuomey have been found to be Potomac. Some of their features and their relations to the marine Cretaceous were described.

Resumé of General Stratigraphic Relations in the Atlantic Coastal Plain from New Jersey to South Carolina. N. H. DARTON, Washington, D. C.

A series of sections were exhibited to show the distribution and variations of the principal coastal plain formations, and there were pointed out some bearings of the features on the geologic history. The data are based largely on the author's studies, but they also combine a resumé of some observations of others.

Both these papers were read together and were illustrated by figured geological sections based on the recently acquired records of artesian wells. There were five, viz: Philadelphia to Wildwood, N. J.; Washington to Crisfield, Md.; Richmond to Norfolk; Orangeburg to Charleston; Aikin to Beaufort, S. C. They illustrated the relations of the granitic Archean rocks to the Jurassic Potomac formation, the Cretaceous Magothy and Severn, the Eocene Pamunkey and the Miocene Chesapeake. Paleontologic details would have made the first paper clearer. An interesting and important point is the discovery of Newark sandstone in a deep well at Florence, S. C., far south of our previously recorded locations. D. W. Langdon, in discussion, raised the paleontologic point referred to above.

The last paper read was by Arthur Keith, '*Some Stages of Appalachian Erosion.*' The paper was a general review of the drainage systems of the area in question, and of the factors which had contributed to develop its present topography.

C. H. Hitchcock then presented a resolution of thanks to the local committee and to the authorities of the University of Pennsylvania for their hospitality and many courtesies. It was unanimously passed and then the eighth annual meeting of the Society adjourned.

The following papers, although announced in the program, were not read either because their authors were absent from the meeting, or because they were not present when the papers were reached in regular order:

The Natchez Formations. T. C. CHAMBERLIN.

Disintegration and Decomposition of Diabase at Medford, Mass. GEORGE P. MERRILL, Washington D. C.

On the Geographic Relations of the Granites and Porphyries in the Eastern Part of the Ozarks. CHARLES R. KEYES, Jefferson City, Mo.

The Cerrillos Coal Field of New Mexico. JOHN J. STEVENSON, New York, N. Y.

Pre-glacial and Post-glacial Channels of the Cuyahoga and Rocky Rivers. WARREN UPHAM, St. Paul, Minn.

J. F. KEMP.

COLUMBIA COLLEGE.

AMERICAN MORPHOLOGICAL SOCIETY.

OF the three sessions held by the Morphological Society the first was mainly devoted to business questions, of which the most important related to the plan of affiliation with the Society of Naturalists brought forward at the meeting of 1894. This plan was rejected on the ground that most of the other societies had taken action adverse to it. It was, however, recommended that coöperative action by all the societies should be urged in order to assure a common place and time of meeting. A resolution was adopted endorsing the action of the Smithsonian Institution in maintaining an American table at the Zoölogical Station at Naples, and expressing the earnest hope of the Society that the table may be continued in order that the unrivalled facilities of the Station may be open to American investigators in the future as in the past.