calculated therefrom equals the known velocity of the air; (4) the differential pressure varies exactly as the square of the velocity, as required by theory. The air velocities employed ranged from five to thirty miles an hour, and the pressure gauge was graduated to millionths of an atmosphere. The experiments were conducted in a tunnel through which air was drawn with uniform velocity and direction, its velocity being measured simultaneously by the pressure-tube anemometer and by a balloon anemometer. In the latter device a toy balloon drifting through the tunnel cuts two pencils of light thrown squarely across its path at an interval of ten feet, the time between the cutting of the sheets of light being determined photographically. The average wind-speed determined by means of the pressure-tube anemometer agrees with the average determined by the standard, or balloon anemometer, accurately to less than one per cent. Examples are also given of the use of the pressure-gauge for measuring static pressures from one millionth of an atmosphere upwards.

Hydrographic Work of the U. S. Geological Survey: H. A. PRESSEY, Washington, D. C.

The work of the Survey in measuring the flow of all the important streams in the country is described, and the great value of the results to industrial projects pointed out.

Friction in Ball-bearings: M. J. GOLDEN, Purdue University, Lafayette, Ind.

The paper describes an apparatus used to determine the friction of ball-bearings of different sizes at different speeds. It was shown that at high speeds ball-bearings fail entirely. Ball-bearings for ordinary pressures and speeds give a loss by friction less than that of an ordinary bearing poorly lubricated, but not much less than a finely polished and thoroughly lubricated bearing.

Errors in Analyses of Furnace Gases Shown by Computation: WILLIAM KENT, Passaic, N. J.

It is shown by arithmetical computation based on the analyses of a certain coal that the analysis of the gas from the chimney, as reported by the chemist, must be in error. With such an analysis it is impossible to compute a heat balance in a boiler test with any approach to accuracy.

Heat Exchanges Within the Steam-engine: R. H. THURSTON, Cornell University, Ithaca, N. Y. (Not read.)

The method of heat exchange in the steam-engine cylinder, which results in serious wastes of heat and proportional reduction of the efficiency of the machine, has been considered an obscure phenomenon. The experiments made by Professor Dwelshauvers-Dery and by M. Duchesne indicate that the cylinder wall takes the temperature of the steam as long as it is covered with moisture; but when the wall is dry it may hold a temperature considerably in excess of that of the steam in contact with it. During expansion and compression of steam in the cylinder there is a constant interchange of heat, which accounts for the varying efficiency of the steam as a motor. Experiments conducted at Sibley College of Cornell University sustain these deductions. The experiment is described and results shown graphically.

ELWOOD MEAD,
Secretary.

SECTION E, GEOLOGY AND GEOGRAPHY.

SOME forty-five papers were offered to Section E for reading at the Washington meeting. On account, however, of the conflict with the meeting of the Geological Society of America, all the papers of the Section E program were accepted by the

Geological Society for reading before that body as a part of its program, with the exception of five which were read before Section E Monday afternoon (there being no vice-presidential address this year), and the papers dealing with the Lesser Antilles and the recent eruptions there, which were read before the same body Friday morning, the Geological Society adjourning at that time for the purpose of attending the meeting of Section E.

The Shifting of Faunas as a Problem of Stratigraphic Geology: Henry S. Williams, Yale University.

A comparison of sections through the Upper and Middle Devonian rocks of the New York-Pennsylvania province discloses marked differences in the faunas which occur at corresponding levels. The explanation of the facts is found in the shifting of faunas during the time represented. The paper discussed at length the nature, extent and mode of recognition of faunal shifting in studying stratigraphy, and modifications were suggested in the customary practice of correlating formations by their fossils.

Some Relations of Tertiary Formations of the Northern Great Plains: N. H. Darton, U. S. Geological Survey.

For several field seasons, the author has given a portion of his attention to the formations from Oligocene to Pliocene in age of Nebraska, South Dakota and eastern Wyoming and Colorado. Structural and stratigraphic relations have been determined, and the origin and geologic history of the formations have been considered. In studying the Black Hills, Big Horn Mountains and Laramie range, it has been found that there are extensive overlaps of the White River Oligocene beds to high altitudes where there are old shore lines which define some of the physiographic conditions. The materials of the formations have been deposited principally by streams, but at some points fine-grained materials have been laid down in widespread overflows or in local lakes and bayous.

The Economic Geology of Michigan: Alfred C. Lane, Lansing, Mich.

The author defines economic geology as the science of raw materials. The effect of the presence of these materials upon industry and the effect of geological conditions upon their development were illustrated by reference to several Michigan products. Such factors were considered as the position of the state in the center of the Great Lake distributing system, the tilting of the Great Lake basin and its effects, the mutual relations of coal and iron and the development of the iron-ore business, the peculiarities of lake copper as compared with that of the far west. Salt, limestone and lumber and their mutual relations, the coal basin and the causes of its retarded development, were considered.

Some Results of the Lake Minnesota Geological Survey: N. H. Winchell, Minneapolis, Minn.

This paper mentioned: (1) Some of the scientific conclusions, and (2) some of the known economic results of the Survey presented in the final report. (1) Scientific: (*a*) The identification of the parts of the Upper Cambrian, (*b*) the definition of the Lower Silurian, (*c*) the determination of the extent of the Cretaceous toward the east, (*d*) the definite determination of the duality of the ice epochs, (*e*) the determination of the duality and alternation of the ice lobes and the resultant glacial lakes, (*f*) the discovery of the duality and later of the triple character of the iron horizons of the Lake Superior region, (*g*) the separation of the Archæan into two non-conformable parts, (*h*) the discovery

that the Animikie overlies both parts of the Archæan non-conformably, (*i*) the recognition of the igneous origin of the green-sand of the Animikie, (*j*) the determination of the igneous origin of the jaspilytes of the Mesabi and Vermilion ages, (*k*) the addition of numerous minerals to the geographic area of the state, (*l*) the determination of the metamorphic origin of gabbro from Archæan greenstone, and (*m*) of granite from Archæan sediments. (2) Economic and educational: (*a*) Determination of the cause of foul waters in the prairie region, (*b*) the demonstration of the excellence of the Hinckley sandstone and its consequent wide adoption, (*c*) the discovery and announcement of the Mesabi iron ores, (*d*) the distinction of the gabbro (igneous) ores from the Mesabi iron range, (*e*) the delineation of the Mesabi belt as distinct from the Vermilion, which has facilitated search and exploitation, and (*f*) the demonstration of the utility of intrusting geological surveys to the state universities.

Current Work in Paleontology in New York State: JOHN M. CLARKE, Albany, N. Y.

(*a*) The Guelph reefs and their faunas. Recent investigations have shown an excellent development of the Guelph fauna at at least two stages in the Upper Siluric dolomites of New York, and an analysis of the character of the species and the nature of the enclosing rock indicates that the fauna flourished on and about coral reefs in the shrinking sea. (*b*) The faunistic provinces of Portage time. In addition to the provinces already established during this stage in New York, viz., the eastern or Oneonta, the central or Ithaca, the third or Naples (= true Portage). The last proves to be divisible into sub-provinces, depending upon the degree to which this fauna, advancing from the west, penetrated eastward. The migration path of the fauna is from the northwest. (*c*) The causes of depauperation in pyrite faunas. Investigation of the organic contents of the sheet of pyrite lying in the horizon of Tully limestone for a distance of one hundred miles in western New York gives some clue to the causes which have effected like results in similar occurrences of other age. (*d*) The determination of the uppermost Cambric in eastern New York. This pertains to the discovery of the horizon of *Dictyonema* and *Clonograptus* in Rensselaer County.

On an Important but not Well-known Locality Furnishing Cretaceous Fishes: O. P. HAY, American Museum of Natural History.

The paper called the attention of geologists and collectors to a locality in the region about Yankton, South Dakota, from which Dr. F. V. Hayden obtained several species of fossil fish for Professor E. D. Cope. Most of the genera are related to or identical with genera from Mount Lebanon, Syria.

Quantitative Chemical-mineralogical Classification of Igneous Rocks: WHITMAN CROSS, J. P. IDDINGS, L. V. PIRSSON and H. S. WASHINGTON.

The presentation of the subject embraced a statement of the needs and the occasion for such a classification of igneous rocks; the principles on which it is based; the method of procedure employed to produce quantitative subdivisions of rock magmas; the method of expressing the actual mineral development (composition) and texture of the rocks; the nomenclature proposed; the proposition to establish a classification and nomenclature for use in field work, and for general geological purposes. The presentation closed with a correlation of the quantitative classification with the one in use at present.

Dikes in the Oklahoma Panhandle: C. A. Waldo.

In this paper the author referred to the discovery of mineral dikes in the extreme northwest townships of Oklahoma Territory. This section has not been carefully mapped by the U. S. Geological Survey, and it is a region about which little has been written. The discovery of the dikes resulted from an attempt to explain the existence of extensive mineral deposits in that locality, and was accomplished after the failure in this particular of several experts and hundreds of professional mineral prospectors.

The Geographic Development of Western Pennsylvania and Southern New York: Marius R. Campbell, U. S. Geological Survey.

His study of the upland features of western Pennsylvania and southern New York has satisfied the author that this plateau is not as old as the deeply dissected upland of the bituminous coal field of West Virginia and Kentucky. The latter is generally regarded as of Cretaceous age; therefore, the former must date back only to some part of the Tertiary. In reviewing the work of Professor Davis in the eastern part of the state, the author finds evidence of a peneplain intermediate in position and age between the Schooley (Cretaceous) and the Somerville (Tertiary) peneplain. This newly-recognized feature is called the Harrisburg peneplain, from its extensive development in the belt of shale hills back of that city. It appears that from whatever point this peneplain is traced it rises toward the New York line, and the author has provisionally correlated it with the general upland tops already mentioned in the plateau region of northern Pennsylvania and southern New York. If this correlation is correct, the peneplain has been deformed into an ellipsoidal, dome-shaped structure whose major axis extends in a northeast-southwest direction, and whose maximum development is attained in Potter and McKean Counties, Pennsylvania.

The Blue Ridge of North Carolina: William Morris Davis, Harvard University.

The Blue Ridge in northern North Carolina and southern Virginia is not properly a ridge with strong slopes descending on either side of its crest line, but it is an escarpment separating an uneven and often mountainous upland on the northwest from a rolling and occasionally mountainous lower land on the southeast. The escarpment is not determined by variation of structure in the disordered schists in which it is carved, but by the unequal length of the rivers which drain the upland back of it in the northwest and the lower land in front of it on the southeast. The high level head-waters of the northwestern rivers, which discharge *via* the Mississippi into the Gulf of Mexico, are constantly losing length by the retreat of the escarpment through the retrogressive erosion of the low level head-waters of the shorter Atlantic stream. There is no local indication that the sea has had any share in producing the escarpment.

The Fresh-water Tertiaries at Green River, Wyoming: William Morris Davis, Harvard University.

This paper gave an account of some detailed observations on the stratigraphy of the Tertiary strata at Green River, showing the occurrence of variable deposits, including frequent cardboard shales, alternating with cross-bedded, ripple-marked sandstones and with occasional shale-pebble beds. An inquiry into the nature of strata deposited in large lakes and on the stream-washed surface of interior basins

leads to the conclusion that the Green River Tertiaries are not simply the continuous deposits of a single large lake, but that they are the deposits of many successive shallow and fluctuating lakes of moderate area combined with the deposits of numerous aggrading streams.

A Highly Viscous Eruption of Rhyolite: G. K. GILBERT, U. S. Geological Survey.

A butte of rhyolite in western Utah illustrates the viscosity of acid lavas, and thus helps to sustain the theory of Dutton for the dynamics of eruption.

Physiographic Belts in Western New York: G. K. GILBERT, U. S. Geological Survey.

The physiographic belts recognized by Lincoln can now be studied in part with the aid of contour maps. South of the drumlin belt is a zone of great glacial erosion in which the aspect of the land was revolutionized by ice sculpture. It is limited southward by a great moraine, beyond which the upland drainage is pre-glacial, and in which the glacial modification of hill forms diminishes rapidly to the glacial boundary.

Some Shore Features of Lake Huron: M. S. W. JEFFERSON, Ypsilanti, Mich.

This paper reviewed the shore features, such as dunes, beaches old and new, town sites and river erosions, at Kincardine, Ontario, with regard to Kincardine's position nearly 100 miles north of Gilbert's isobase line. Comparison was made with points to the south of the same line, as Muskegon. Kincardine is regarded as possessing a lake and bar separating it from Lake Huron, modified in a manner appropriate to an uplift of the smaller lake bed to a height of about 70 feet above the great lake, with resulting elevated beaches, deeply cut stream valleys, limited dune sand and increased river sediments.

The Topographic Work of the Geological Survey in Northern Canada: ROBERT BELL, M.D., Acting Director Geological Survey Department, Ottawa.

Previous to the confederation of the Canadian provinces in 1867, and the subsequent acquisition by the Dominion of the other British possessions in North America, including British Columbia, the territories of the Hudson Bay Company, the Labrador peninsula and all the islands lying north of the mainland of North America, the operations of the Canadian Geological Survey were confined to the southern parts of the areas which now constitute the provinces of Ontario and Quebec. Since confederation, however, the attention of the department has been directed to surveying these vast, newly acquired territories and the regions which have been added to Ontario and Quebec. These tracts were entirely unsurveyed and only partially explored, the main geographical features alone being roughly indicated on the maps. The subdividing of the fertile lands of Manitoba and the Northwest Territories was performed by a different department, and its work added little to the knowledge of the topography of the country. The fieldmen of the Geological Survey have been the pioneer surveyors of the natural features of the vast regions which constitute half the continent. In order to map out the rock formations, the geologists found it necessary to make topographical and geological surveys simultaneously. From their long experience in these operations, they have been able to do this work rapidly and well, and the object of this paper was to show the astonishing amount of accurate geographical work which has been accomplished by a small number of devoted men with very limited means at their disposal.

The Saddle-back Topography of the Boone Chert Region, Arkansas: A. H. Purdue, University of Arkansas.

The rocks exposed in northern Arkansas are those from the Silurian to the Upper Carboniferous inclusive. The position of the rocks is essentially horizontal. In the western part of the region north of the Boston Mountains, the prevailing surface rock is the Boone chert; but in central northern Arkansas erosion has continued far below the Boone chert, exposing the Silurian rocks, except where there are monadnocks. These monadnocks are of necessity greatly dissected by small mountain streams which are cutting their way headward into them. The spurs between these streams are frequently surmounted by one or more knobs, which produce the saddle-back topography so common in the region. These knobs are always capped by fragmentary Boone chert, which in some cases is partly water-worn. That the water-worn material is not due to submarine action is proved by the fact that it is found only locally. It follows that it must be of stream origin.

The knobs owe their existence to the formation of alluvial cones by former streams at the time when the stream beds were on the level of the present knobs. The cones of the fragmentary chert obstructed the streams, causing them to shift laterally, and at the same time protected the subjacent rocks from erosion. If conditions were favorable, two or more cones were formed by the same stream at different stages in its history, a knob resulting from each cone, and a series of knobs indicating the former course of the stream. The paucity of the water-worn material in these old cones is explained by the streams that formed them having been short and of a torrential nature. The present drainage of the region is like that at the time the Boone chert was the prevailing surface rock only as regards the master streams; and the change is due in a large measure to the shifting of the streams brought about by their own obstructions.

Scientific Relief Maps: George Carroll Curtis, Boston, Mass.

For years past the scientific bureaus of the United States have deemed it advisable to construct relief maps. The Paris Exposition of 1900 afforded a just international comparison; and it was found that America was exhibiting work which fell far behind that of some of the European countries, because of the lack of scientific methods.

A perfect topographic relief map is a perfect miniature or model of nature; and, unless natural laws and principles are employed in its construction, no progress beyond the old relief map will be attained. Truthful topographic modeling is an exact art requiring accurate, rational and systematic methods throughout the gathering of data upon the field, and the application and reproduction of the facts of nature in other dimensions. Modern scientific inventions, including contour maps and dry-plate photography, are aiding in bringing this work toward perfection and into recognition.

Lunar Calderas: E. Hayes, Wellesley College.

Every topographic feature of the moon is invested with mystery and difficulty. Some forms, however, invite study and discussion, because of their likeness to certain earth forms. Among these are the so-called 'ring-plains.' They consist of a circular wall, composed often of lofty mountains enclosing an approximately horizontal floor which is generally broken by a central cone. The prevailing theories of their formation are untenable, for both dynamic and topographic reasons. On

comparing such a ring-plain as Theophilus, for example, with the Hawaiian calderas studied by Dutton, we are led to assign to these lunar rings an origin similar to that of terrestrial calderas.

Evidences of Post-Newark Normal Faulting in the Crystalline Rocks of Southwestern New England: WILLIAM H. HOBBS, University of Wisconsin.

The study, in 1899, of the Newark area of the Pomperaug valley in Connecticut disclosed conditions of deformation which have made it possible to work out, in part at least, the structure of the crystalline rocks surrounding the Newark basin. The key to the structure has been sought and, it is believed, found in these areas where the areal relations seem most complex, or where, in other words, a large number of formations are found in small masses within a very limited area. Such areas of complex areal relations have generally been regarded as ill-adapted for structural studies. They have also been generally neglected for the reason that the determination of their structure would be time-consuming, and, when once determined, could hardly be represented upon geological maps of the ordinary scale. The studies here under consideration have shown that, complex though they may be, the very complexity of these areas will generally allow of but one theory of their structure, provided the data collected are sufficiently complete. On the other hand, areas of the crystalline rocks in which formations are represented at the surface by large masses are apt to allow of a number of theories of interpretation, any one of which may furnish an adequate explanation of the facts observed. It has been by the detailed study of a number of widely separated areas of excessively complex areal relations that the conclusions here stated have been reached.

It was shown that the area of southwestern New England is one of complexly jointed and faulted, as well as of complexly folded, rocks. The system of faults affecting the area is found to be oriented like the system of joints. The throws along fault planes, while generally small, are, owing to the great number of faults involved, by their cumulative effect of great importance. Methods have been developed by which the *fault system* of an area may, under favorable circumstances, be determined from observation in the field.

A Record of Post-Newark Depression and Subsequent Elevation within the Area of Southwestern New England: WILLIAM H. HOBBS, University of Wisconsin.

Within a belt some twelve miles in length, lying between Sheffield, Mass., and Falls Village, Conn., there are revealed some peculiar conditions of the impregnation of dolomite by silica. The trunk lines for the introduction of the silica are shown to be a system of joint- and fault-planes clearly connected with the Post-Newark deformation of the area. Evidence is not lacking that surface conditions widened the joint fissures previous to the infiltration and cementation by silica. A measure of time is thus secured within which the cycle of subsidence, cementation and elevation, must have been included.

Criteria Requisite for the Reference of Relics to a Glacial Age: T. C. CHAMBERLIN, Chicago University.

What constitutes good grounds for referring relics (human, in particular) to a glacial age, and the chief sources of error in making such reference were discussed under the following sub-topics: Evidence to be sought in the glacial formations themselves; evidence from the bowlder clays; evidence from assorted drift included in till and moraines; evidence from

kames and eskers; confirmatory evidence in these cases; combined evidences; the cumulative value of repetition; the interpretation of imbedded and striated relics; evidences from the interglacial deposits; evidences from assorted drift lying upon or outside of the true glacial series, river deposits especially; scour-and-fill; unequal effect on aggrading and degrading rivers; breadth of action in the great streams of the glacial area; adjustment plains as sources of deception; amount of the errors; flood-plain deposits; bluff-border accumulations; derivative formations; decomposed secondaries; the meaning of a principal river as a cause of alternate erosion and deposition in the mouth of its tributary valleys, and association with certain extinct animals not a criterion.

Glacial Cirques and Rock-terraces on Mount Toby, Massachusetts: B. K. Emerson, Amherst College.

Mount Toby is composed of coarse Triassic conglomerates, and, being placed in the lee of the great ridge of the Deerfield trap-sheet, has been especially protected from the erosive action of the inland ice of the glacial period. The mountain is now cut into deep amphitheaters with strong, often vertical walls which head against an extremely narrow ridge, and are separated by ridges which are crossed by many vertical rock-terraces from ten to a hundred feet high, most of which seem to be formed by the plucking action of the ice. They do not cross the cirques, which are deeply filled with foreign glacial material. They seem to have been formed by small glaciers, and then overridden and filled by the main ice-sheet.

Protection of Terraces in the Upper Connecticut River: C. H. Hitchcock, Dartmouth College.

Recent papers by Professor W. M. Davis propose the theory that many alluvial terraces are kept in place by underlying ledges. First, the high flood-plain was deposited by the river, enormously developed through melting of the ice-sheet. Next, as the waters diminished in volume, a large excavation was made in the high plain, and the steep slopes resulting are the escarpments of terraces. These terraces are variable in bulk and number, and it has been a difficult matter to explain these variations. As the river swings back and forth over the low ground, it meets ledges which it is unable to remove; neither can it remove the earth superimposed upon them. In other words, the ledges protect the terraces behind them from destruction. It is common to see a ledge at the extreme pointed end of a terrace, and the terrace broadens as you follow it back. The outer edge below the ledge will ordinarily be curved. The localities described by Professor Davis are at Westfield, Mass., and Bellows Falls, Vt. I have extended the observations above that point, especially between White River Junction and Wells River.

Glacial Features of Lower Michigan: Frank Leverett, Ann Arbor, Mich.

The paper was illustrated by maps and diagrams setting forth the relation of the Michigan, Saginaw and Huron-Erie ice-lobes in lower Michigan during the Wisconsin stage of glaciation, and represents three years of field work for the United States Geological Survey. Especial attention was given to eskers, and their bearing upon the question of superglacial or subglacial origin is discussed. An extensive drumlin area was briefly described in its relation to ice movements and moraines. The paper closed with reciting the evidences of earlier ice invasions than the Wisconsin which have been found within the limits of the Wisconsin drift.

Studies in the Glaciation of the Berkshire Hills, Massachusetts: FRANK B. TAYLOR, Fort Wayne, Ind.

The Berkshire Hills lie within the area covered by the retreating Hudson Valley lobe of the Labrador ice-sheet. The retreat of the ice-front across Berkshire County was from southeast to northwest and the trend of the front was northeast and southwest, the apex of the lobe resting on the central axis of the Hudson Valley. In the lower, less mountainous region near the Hudson River, the moraines and border drainage features, though faint, are continuous, so that the positions of the ice-front at its several halts are traceable continuously. In Berkshire County continuous tracing is not possible, the borders there being marked by fragmentary terminal and lateral moraines, mostly very slender, and by remains of border drainage. The extremely serrate character of the ice margin at each halt, coupled with the frequency of the halts, makes interpretation difficult. The average interval between successive recessional moraines is about three and one half miles. The paper was devoted mainly to a discussion of the method of interpretation, showing, first, that, by the circumstances of the recession across this county, the moraine marking each halt of the ice-front may be safely regarded as an individual, separate and distinct from the moraines of earlier and later halts; and, second, that interpretation on this assumption unifies and explains the morainic phenomena of Berkshire County satisfactorily.

The Geological Age of the West Indian Volcanic Foundation: J. W. SPENCER, Toronto.

From personal explorations the author has found that the whole Caribbean plateau is underlain by an igneous basement of pre-Tertiary age. This foundation occurs not merely beneath the older Tertiary limestone, but also on those islands where such have not accumulated, or have been removed by denudation, and are now surmounted by volcanic ridges. The igneous formations have been analyzed, and their relationship to the later fossiliferous deposits show that the volcanic activity was renewed about the close of the Pliocene period, and has continued intermittently since that time. And it also seems probable that there was a long quiescence during the greater part of the Tertiary period.

The Geologic and Physiographic History of the Lesser Antilles: ROBERT T. HILL, U. S. Geological Survey.

The author stated that the Windward chain of islands from the Anegada Passage to the South American coast consisted of three distinct types of islands: (1) Those of the Virgin chain, which were Antillean in their relationships; (2) those of the Caribbee chain, which were constructional volcanic forms; and (3) islands of the Trinidad type, which were detached portions of the South American continent. Besides these types there is the semblance of an outer circle of islands, including Antigua, Grande Terre (Guadeloupe) and Maria Galante, consisting of marine sedimentaries veneered upon old volcanic piles. Barbados is in a class by itself, with probably South American relations. Vulcanism has prevailed in the Caribbean islands since Cretaceous time, and the volcanic ejecta have consisted essentially of horneblende-andesites throughout. Physiographically the islands are of several distinct types. The Caribbee Islands proper are strictly constructional forms modified somewhat by rainfall erosion, and truncated around the edges by marine erosion. The changes of level have been more or less epeirogenic, but never, at least since Jurassic times, has there been any connec-

tion between the Windward Islands and the mainlands. There is absolutely no topographic or geologic proof that the volcanic Caribbees are of other than progressive constructional origin, or that any continent or semblance of a continent ever prevailed on their present site.

Mont Pelée—the Eruptions of August 24 and 30, 1902: Angelo Heilprin, Philadelphia, Pa.

The paper described the author's experiences during the great eruptions of these dates, being actually high upon the eastern slope of the volcano during the outburst of August 30, when Morne Rouge was destroyed. Morne Rouge was destroyed by a volcanic blast from the crater similar to that which devastated St. Pierre early in May. Lantern slides from the author's negatives showed the inner cone overtopping the rim of the ancient great crater.

The Principal Causes of Death during the Eruptions of Mont Pelée and La Soufrière: Israel C. Russell, University of Michigan.

A review was presented of the evidences bearing on the question mentioned in the title, and arguments brought forward to show that the chief agent of death was highly heated, dust-laden steam.

Secondary Volcanic Phenomena of the West Indian Eruptions of 1902: George Carroll Curtis, Boston, Mass.

Fresh evidences of geologic work, which could not be credited to the main phenomena of eruption alone, were found by those early upon the field after the West Indian eruptions in 1902. Over the area lay a large amount of volcanic ejecta upon which erosion forces were rapidly working. An excellent opportunity was thus afforded for the study of stream development upon an initial cover. Portions of the coastal plain had subsided; other deposits had undergone elevation; tidal waves had swept the marginal slopes; and marine erosion was rapidly altering new deposits. Flows of mud-like detritus had filled valleys, extended their deltas seaward, entombing villages and inhabitants. From the valley floors minor eruptions were taking place, giving rise to early reports that lateral craters connected with the main source of volcanic energy had played important parts in the great eruptions. Detailed study of these eruptions on the actual ground indicates that they were not from a primary volcanic source, but that they formed a series of secondary manifestations with origin, process of outburst and topography developed peculiar to themselves.

Some Erosion Phenomena on Mont Pelée and Soufrière: Edmund Otis Hovey, American Museum of Natural History.

The stripping of the volcanoes Pelée and Soufrière of all vegetation by the eruptions, and the deposit of fresh fragmental material over the whole, gave excellent and unusual opportunity for observation of the development of new erosion forms (particularly dendritic drainage) on old surfaces.

The Inner Cone of the Mont Pelée Crater and its Relation to the Destruction of Morne Rouge: Edmund Otis Hovey, American Museum of Natural History.

The growth of the inner cone of eruption above the western opening beside Étang Sec caused the partial closing of the great gash in the side of Mont Pelée, and finally lifted the main vent above the rim of the great crater, to a point where there ceased to be any hindrance to the radial expansion of the explosions.

Origin of the Sandhill Topography of the Carolinas: Collier Cobb, University of North Carolina.

Many of the sandhills show the structural features of æolian cross-bedding seen on Hatteras. Unlike most dune sands,

those of the Carolina coast contain many fragments of potash feldspar, being essentially the same in composition as the beach sands, which may account for the presence of the potash in the coastal plain soils, while explaining the origin of some of the topographic features.

Recent Changes in the North Carolina Coast, with Special Reference to Hatteras Island: COLLIER COBB, University of North Carolina.

Hatteras Island is being added to on the sound side and taken from on the ocean side north of the cape, and a new inlet is being made between the cape and Kinnakeet. South of Cape Hatteras the island is growing on both sides, but is extending in a southeasterly direction. The rate of change has been noted by the planting of cedar posts, and noting the changes of shore line with relation to posts, trees and various natural objects through the years 1892–1902.

The Hanging Valleys of Georgetown, Col.: W. O. CROSBY, Massachusetts Institute of Technology.

The paper describes chiefly the break of several hundred feet between the floor of the valley of Clear Creek and that of Leavenworth Creek, one of its principal tributaries, and explains it as due, not to fluvial or glacial erosion, but to faulting, of which abundant independent evidence is afforded by mining developments. Other and similar features in the vicinity were correlated with this, and it was shown that the part of the main valley occupied by Georgetown is a depressed fault-block or graben, and that the valley is, therefore, due in part to displacement and not wholly to erosion, suggesting comparison with Yosemite Valley. The idea was also advanced that the elevation of this oldest of the Colorado ranges has been recently, and may be still, in progress, and that while in the past the movement has been chiefly massive, developing the great fault-scarp overlooking the plains, it has in later times affected the axis more than the axis of the orographic block, leading to a marked tilting of the Cretaceous peneplain; and in part, at least, it is very locally differential, and in the Georgetown instance in a degree to accelerate the topography.

Further Notes on Lake Arickaree: J. E. TODD, Vermilion, S. D.

Lake Arickaree was a glacial lake formed in the valley of Moreau and Grand Rivers, South Dakota, with its axis corresponding with the Missouri River in that region. The region was first visited by the author in 1890, and a description of its peculiar southern margin preserved as a bowldery ridge above the north side of Fox Ridge, reported in 'Bulletin 144' United States Geological Survey. He visited the region again this past summer, discovered another outlet, and traced the margin more definitely.

The Problem of the Loess in the Missouri Valley Compared with that in Europe and Asia: G. FREDERICK WRIGHT, Oberlin College.

The physical resemblances between the loess deposited in the Missouri Valley and that in southern Russia and in Turkestan and northern China are perfect; but in general distribution there is great diversity. In China the deposits occur in vast wind-blown masses near the summits of the mountain-border on the east coast of Mongolia, up to five thousand feet above the sea. Elsewhere, however, only in the lower areas are they distributed over level areas, evidently by water action; while at the head of the plain extending west from Peking, near the Nankau Pass, there are evident deltas six hundred feet above the sea, consisting of loess mingled with large transported blocks of rock. Along the

northern base of the Ala Tan Mountains in Turkestan, and along the western base of the Thian Shan Mountains, the delta-like characteristics of the distribution are evident, maintaining a pretty general level of twenty-five hundred feet above the sea. Over the southern plains of Russia the deposit maintains a pretty general level of six hundred feet, having a scope of from fifty to a hundred feet over everything, though the rivers have cut channels three hundred feet deep in the more southern portions.

In the Missouri Valley there is also a definite relation to the streams. On both sides of the Missouri the deposit is developed from Yankton to Kansas City in almost equal degree, having a depth of a hundred feet or more. Both in the Missouri Valley and in the lower levels in China there are also frequent indications of water action in more or less obscure lines of bedding, while in both areas fossils are scarce, and are mostly of land species which love moist places. In China the source of material is certainly not from a glaciated area, while in the Missouri Valley it is probably both from the adjacent glaciated area and from the arid plains to the west. In both areas the distribution by water is best accounted for on the theory of an extensive subsidence of land over the entire northern hemisphere. In the Missouri Valley the following order of earth movements seems best to fit the facts:

1. Pre-Glacial elevation of two thousand or three thousand feet. This continued until the close of the Kansas stage.

2. Depression increasing toward the north until the level was considerably below present level. This closed the Iowan stage, and was accomplished by the main loess deposits, while the gradient of the river was reduced to a few inches per mile and the water action increased from ten to twenty feet during the late summer melting of the ice, covering all the adjoining land for a few weeks, and then leaving it bare for the rest of the year. Thus the peculiar fossils may be accounted for.

3. An elevation increasing to the north with an east and west axis near the latitude of Omaha, culminating in the Wisconsin stage. The once waste grounds from the Wisconsin moraines down the Big Sioux River are a mile and a half wide and only ten feet above the present flood plain. These continue for a little distance down the Missouri after reaching Omaha. Below Omaha there has been filling, instead of erosion, since the Wisconsin stage. This would give to the loess deposits of undoubted Iowan age.

A New Meteorite ('Bath Furnace') from Kentucky: A. M. Miller, Lexington, Ky.

The meteorite exhibited was the one which occasioned the brilliant display seen at 6.45 P.M. of November 15 by many persons in the states of Ohio, Kentucky, Tennessee, Louisiana, Mississippi, Alabama and Georgia. Its detonations, associated with the checking of its orbital velocity by the resistance of the air, startled the inhabitants of Bath County, Kentucky. It actually struck the earth in the road in front of the house of Mr. Bluford Staten. The latter, an eye-witness of the event, picked the stone up on the following morning. It passed next into the hands of Mr. W. H. Daugherty, of Owingsville, Ky., from whom it has been purchased by Professor Henry A. Ward for the Ward-Coonley collection, New York City. The meteorite is an aerolite containing, among other substances, disseminated nickeliferous iron, and it exhibits the usual black crust with pittings. Before chips were removed for analysis the specimen weighed nearly thirteen pounds. Specific gravity, 3.48.

Science at the World's Fair, St. Louis, 1904: J. A. HOLMES, St. Louis, Mo.

The exhibits at the approaching Universal Exposition to be held in St. Louis, from April 30 to December 1, 1904, will endeavor to show the applications of science in all the great industries of the country; and in some of these departments, notably that of mines and metallurgy, it is proposed to show the equipment and methods of geological surveys and similar institutions for geologic, geographic and metallurgic research; in fisheries will be shown methods and equipment for biologic research; in liberal arts, laboratory research equipment in many branches of science; in education, equipment and methods of instruction and research at the institutions of learning; in the department of electricity will be shown modern equipment and methods of electrical research. In addition to the above, arrangements are being made for holding, under the auspices of the exposition, a number of scientific congresses for the discussion of methods and equipment, and general plans for research, in all departments of knowledge.

EDMUND OTIS HOVEY,
Secretary.

OPENING EXERCISES OF THE WASHINGTON POST-GRADUATE MEDICAL SCHOOL.

THE opening exercises of the Washington Post-Graduate Medical School were held in the presence of a distinguished audience on Monday evening, January 12, 1903, at 8 o'clock in the lecture hall of the Columbian University.

Addresses were delivered by Professor Wm. H. Welch, M.D., of Johns Hopkins University, and by the president of Columbian University on behalf of the educational institutions. The rector of Georgetown University was unable to be present, but sent words of welcome and encouragement to the new school.

Professor Welch emphasized especially the many advantages of the National capital as an educational center, and spoke in the most appreciative terms of the work performed in the government laboratories, by men who are also connected with the teaching staff of the graduate school. The speaker expressed great gratification that the department of preventive medicine had been given deserved prominence, and in this respect characterized the attempt as unique, in this country at least, and one which could not fail to be appreciated by all interested in scientific medicine. He referred to the advantages which must accrue to the students by the utilization of the hygienic laboratory of the public health service, the laboratories of the Army and Navy Medical School, the biochemic laboratories of the Department of Agriculture and the demonstrations which are possible in the Army Medical Museum and the Museum of Hygiene. He stated that the advantages for securing a thorough training in preventive medicine and in the study of tropical diseases are unexcelled anywhere, and predicted a useful future for the school, in the training of men who desire to become health officers, medical officers of the army, navy, marine hospital or the colonial service.

Dr. Needham welcomed the school among the educational institutions, and expressed satisfaction that the leading medical schools of the city had united in placing their laboratory and teaching facilities at the disposal of the graduate school, thus insuring a hearty cooperation in the promotion of higher medical education.

General Sternberg, the president of the faculty, in behalf of the school, returned thanks to the medical departments of Columbian and Georgetown universities and all hospitals in the city, government, private and municipal, for their