Most of the specimens obtained were kindly identified for me by Dr. Stejneger, of the U. S. National Museum.

H. A. Allard

Bureau of Plant Industry,
Washington, D. C.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 220th meeting of the society was held at the Cosmos Club on Wednesday evening, May 12.

Regular Program

Significant Time-breaks in Coal Deposition: Mr. Geo. H. Ashley.

In a study of the results which were recently published in *Economic Geology*, it was found that one foot of bituminous coal, if deposited under present-day conditions, would require at least three hundred years for its laying down.

Considering the known variation in the thickness of single coal beds, the question arises as to whether it may not prove possible to use a coal bed as a measuring rod for the time of deposition of other beds in the coal measures. Thus, in the case of a bed 15 feet thick in one district and 18 inches in another, if the coal in each case were deposited at the same rate, the 15-foot bed required *at least* four thousand years longer than the 18-inch bed. Study was made to see if where the coal was thin there was a compensating thickening of the adjoining rocks. As far as the study was carried no such compensating thickening could be found. It was therefore assumed that in the cases examined the thin bed of coal represents approximately all of the deposit made at that point during the time required for the deposition of the thick bed near by. This resulted from either slow growth or time-breaks either in or just preceding or following the thin coal bed itself.

A study of the rate of deposition of certain peats in Europe leads to the conviction that in many cases the difference in thickness is due to difference in rate of deposition, while in other cases the difference would seem to be due to time-breaks or periods of non-deposition.

The evidence of these time-breaks may consist of "smooth partings," which, as in the Lower Block coal of Indiana, may locally show as unconformities between the under- and overlying beds, or of smooth partings which are represented in other districts by up to 40 feet of shale and sandstone, as in Coal IV. of Indiana. In other cases one or two inches of cannel coal or bone may be represented in an adjoining district by a thick parting, as in the Moshannon bed, west of Houtzdale. In some beds partings of clay, shale or sandstone, where they are known, are uniformly thin and regular. In other beds they will vary from one fourth inch up to 40 or 50 feet. In such cases the great thickness of the parting often suggests, even though it does not prove, a considerable time interval.

A study of the problem seems to indicate clearly that the elements of slow growth and of temporary non-deposition can not be eliminated from it, and that it would be scarcely right to say that the rocks forming a parting in the coal, or that a certain thickness of rocks above or below the coal, may have taken a certain number of years for their deposition, equivalent to the time represented by the difference in the thickness of the coal at that point and at the point of greatest thickness, multiplied by an assumed rate of deposition of the coal.

Cretaceous Geology of the Carolinas and Georgia: L. W. Stephenson.

The belt of Cretaceous deposits which, with certain interruptions, extends along the inner margin of the coastal plain from Marthas Vineyard, Mass., to Cairo, Ill., has its widest areal development in the region of southeastern North Carolina and northeastern South Carolina.

In North Carolina three Cretaceous divisions are recognized. The oldest of these is of lower Cretaceous age, and consists of about 275 feet of light-colored, coarse, generally compact or partially indurated, feldspathic, cross-bedded sands with inter-stratified lenses of massive more or less sandy clays. So far as known these materials are non-fossiliferous. The beds are separated from the overlying Cretaceous strata by an unconformity. Employing physical criteria, the division has been correlated approximately with the Patuxent formation of Virginia and Maryland. The name Cape Fear formation was proposed for this terrane by the writer in a paper entitled "Some Facts Relating to the Mesozoic Deposits of the Coastal Plain of North Carolina," which appeared in 1907.

The next younger division, which is of upper Cretaceous age, consists of 500 to 600 feet of dark to black lignitic, irregularly bedded and for the most part laminated, sands and clays, with interbedded marine lenses in the upper portion. As regards their structural relations the beds rest

unconformably upon the Cape Fear formation and are overlain conformably by strata of the next younger Cretaceous division and by non-conformable post-Cretaceous deposits. Fossil plants occur from the base to the top of the division, and towards the top invertebrates occur in marine lenses interbedded with the plant-bearing beds. Both the physical and paleontologic characters point to the approximate equivalency of the formation with the Magothy-Matawan series of New Jersey and with the combined plant-bearing Tuscaloosa beds, the Eutaw formation and the lower portion of the Ripley formation of Alabama. As regards more distant correlations the plants seem to indicate equivalency with the Woodbine division of Texas, the Dakota formation of the western interior, and the upper Cenomanian or Turonian of Europe, while the invertebrates, which show a close faunal relationship with the overlying younger division in North Carolina, point perhaps even more strongly to equivalency with the Taylor-Navarro series of Texas and the Montana series in the western interior, both of which occupy positions not only above the Woodbine and Dakota formations, respectively, but also above the still higher Colorado group representatives. There exists, therefore, a difference of opinion which with the present array of facts is irreconcilable; and the question of the correlation of the division with deposits outside of the Atlantic coast and eastern gulf regions must remain an open one until additional data are procured. In the paper previously mentioned the writer proposed the name Bladen formation to designate these beds.

The third and youngest division, also of upper Cretaceous age, consists of 700 to 900 feet of dark gray, more or less argillaceous and calcareous, marine sands and clays, conformably overlying the Bladen formation, and unconformably overlain by Tertiary and later deposits. The beds carry marine invertebrates indicating approximate equivalency with the Monmouth formation of New Jersey and with the upper Ripley beds of Alabama. Employing the same criteria, the division is correlated with the Navarro formation of Texas, the Montana series in the western interior, and the Senonian of Europe. The name Ripley formation was applied to this division by the writer in 1907, but owing to uncertainty which has arisen regarding the exact meaning of this term as employed in the gulf region it will probably have to be dropped, in which case the name Burches Ferry formation applied by Sloan to the southward continuation of the terrane can appropriately be employed in North Carolina.

In both South Carolina and Georgia equivalents of all three of the divisions occurring in North Carolina have been recognized, and their approximate areal distribution determined.

The Santa Maria Graphite Mines, Sonora, Mexico: FRANK L. HESS.

The Santa Maria graphite mines which are owned by the United States Graphite Company, of Saginaw, Mich., are situated about twenty miles south and a little east of La Colorado, in central Sonora. The country rock is a metamorphosed sandstone, ranging in fineness from shaley material to conglomerates containing pebbles one and one half inch in diameter. Considerable andalusite in small crystals is developed in the sandstones. The rocks are probably of upper Triassic (Richmond) age. They are intruded by graphite which has been the metamorphosing agent. Intercalated with the sandstones are at least seven beds of graphite ranging in thickness up to 24 feet and standing at high angles. The rocks are considerably folded and the graphite beds show the effect of movement more than the enclosing sandstones, so that they are in places almost cut off through squeezing, while in other places they show thickening. The graphite beds are also intruded by granite dikes and in places granite forms the walls. The graphite is undoubtedly formed through the metamorphism of coal beds, which in other parts of the state are to be found in the form of coke, anthracite and bituminous coal. The graphite of the Santa Maria deposits is entirely amorphous and from the main vein averages 85 to 86 per cent. graphitic carbon. Specimens may be picked which carry 95 per cent. graphitic carbon.

The material is shipped to Saginaw, Michigan, for refining. A large part of the best pencils are made from this graphite. It is also used for a lubricant, foundry facings, etc.

AT the 221st meeting of the society, held at the Cosmos Club on Wednesday evening, May 26, Mr. S. F. Emmons spoke informally on the Cobalt mining region.

Regular Program

Diopside and its Related Minerals: ARTHUR L. DAY.

The formation of pure wollastonite from its component oxides, lime and silica, and its combination with magnesium metasilicate to form diopside, together with a record of the character

and stability of all the mixtures which result when one of the components is present in excess of the exact proportion required to form the mineral, establishes the practicability and effectiveness of physico-chemical methods in solving such questions as the order of crystallization from the magma and the stability of the crystalline products formed during the cooling to present temperatures. The relations between these minerals are nearly all eutectic, and when considered in connection with previous work on isomorphous mixtures, serve to illustrate the certainty with which such measurements upon rock-making minerals can be made and interpreted, their freedom from dependence on the personal judgment of the observer, the comprehensive way in which characteristic differences of physical form, as well as those of chemical composition, are taken into account, and the ready adaptability of the system to provide a more comprehensive classification of the mineral relations whenever a sufficient body of such measured data shall have been gathered.

The scope of the laboratory problem, that is, the immense domain within which these methods have now been successfully applied, is shown by the fact that these minerals were studied not only through all percentages of the components, but over the entire range of temperatures in which stable forms occur, either in the mineral compounds or their components—in all, a range of about 2,100 centigrade degrees.

Pure silica was found to possess three stable crystal forms: (1) α-quartz—stable at ordinary temperatures and up to 575° C.; (2) β-quartz—stable from 575° to 800°; (3) tridymite (cristobalite)—stable from 800° to the melting temperature (1,600°).

Pure lime has but one form which melts in the electric arc but is out of reach of accurate pyrometry.

Lime and silica combine to form two compounds: (1) The metasilicate—which exists in two stable crystal forms: (*a*) Wollastonite, stable at ordinary temperatures and up to 1,190° C.; (*b*) pseudo-wollastonite, stable from 1,190° to its melting point, 1,512°. (2) The orthosilicate—with three stable crystal forms which were designated for convenience: α, stable from 1,410° to the melting temperature, 2,080°; β, stable from 675° to 1,410°; γ, stable at ordinary temperatures and up to 675°.

The metasilicate of lime combines with the metasilicate of magnesia—possessing two stable and three unstable crystal forms, of which one (unstable) corresponds to enstatite—to form only one mineral, diopside, stable at all temperatures up to its melting point, 1,395°.

The measurements were made at constant (atmospheric) pressure and in the absence of water.

The measurements themselves depend upon: (1) the chemical purity of the component minerals; (2) the ability to establish equilibrium between them at the temperatures where the characteristic changes occur within the time available for a laboratory experiment; (3) sufficiently sensitive and accurate temperature measuring devices to locate with certainty every characteristic change in the energy content of the system.

The Slumgullion Mud Flow: Mr. Whitman Cross.

The Slumgullion mud flow is a landslide of unusual character, which took place many years ago in an eastern tributary of the Lake Fork of Gunnison River a few miles above Lake City, Colo. The damming of the Lake Fork by this flow caused Lake San Cristobal, a sheet of water two miles long.

The flow originated at the south end of a high ridge at the head of a minor branch of the Slumgullion drainage. From this point, with an elevation of about 11,500 feet, the flow descended 2,500 feet to the valley of the Lake Fork, four miles distant from the source. The material of the flow now fills the valleys in which it lies to a probable elevation of 150 to 300 feet above the original bottom.

The topographic features of the flow are very pronounced. It is bounded for nearly its entire length by two moraine-like lateral ridges of very sharp outline. Between these the flow is usually lower and characterized by furrows and trenches, knolls and hollows of confused relations resembling those of modified landslide areas or of some glacial deposits.

The material of the flow is mainly a soft, light yellow or nearly white decomposition product of pyroxene andesitic lava and irregular fragments of the same rocks, some of which are fresh, while more are partly altered. The origin of the flow is intimately connected with this decomposed condition of the andesite at its head. It appears that at the end of the ridge mentioned a large mass of andesite belonging to a complex of flows was extensively decomposed, the product consisting principally of opaline silica, hydroxides of iron and alumina and gypsum, forming a soft mealy mass which on saturation with water became a liquid mud. On this mass rested less altered beds of andesite.

It is believed that at a certain time unusual softening of the mass by water caused it to give way, and that the greater part of the visible flow descended at one time, in the manner illustrated by mixtures of soil and rock waste which, on a much smaller scale, frequently flow down ravines or mountain slopes as a result of cloudbursts.

The Slumgullion flow took place before the beginning of the present heavy forest growth and after the glaciation which produced the morainal deposits on the adjacent slopes.

FRANCOIS E. MATTHES,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

THE academy met at the academy building, 3817 Olive St., Monday evening, May 17, 1909.

Professor W. E. McCourt, of the department of geology of Washington University, presented an illustrated paper on "Diamonds in Arkansas."

Professor McCourt first gave a general account of the properties of the diamond, and an account of some of the famous diamonds of history. Then the general commercial occurrences of the diamond were considered—namely, India, Brazil and Africa, whence the world's supply of diamonds has largely come. Diamonds have also occurred in the United States, some of them to a size of fifteen carats, but nowhere in very large quantities.

In 1906, however, diamonds were found derived from a parent rock in Pike County, Arkansas, near the town of Murfreesboro. The presence of the rock in this region, similar to rock in which diamonds were found in Africa, has been known for some time, and the state survey has mapped one of the areas. The igneous rock is a peridotite which has been pushed up through the Carboniferous and Cretaceous quartzites and sandstones, and in places is covered by beds of Post-Tertiary and Quaternary formations. But there does not seem to have been any metamorphism accompanying the intrusion of this material. This peridotite is dark colored, basic igneous rock which contains olivine, augite, magnetite, mica and perofskite. In some places the rock is exceedingly hard and dense, but in others it has weathered to a yellowish and greenish soft material to a depth of from twenty to twenty-five feet. Covering the region to a depth of a foot or so is a black gumbo soil which contains fragments of the hard peridotite and the country rock.

The work in this region has not been very extensive, but bore holes have been made in several places, one reaching to a depth of 205 feet in the hard rock; several companies have located on the area; and stones to the number of about 600 have already been found. The largest stone is six and a half carats. Some have been cut and are valued at $104 a carat. The colors vary, most of them being white, brown and yellow, though one blue diamond has been found and several black ones.

From these indications this area seems to contain a mass of rock similar to the rock in South Africa. But as to the number of diamonds which may be found deeper in the peridotite, that, said Professor McCourt, is a question which can only be settled by actual mining and testing. The results which have been shown by the more or less spasmodic exploitation, however, seem to indicate a good promise.

Professor Nipher stated that he had been unable to finish his work on electrical discharges on account of recent developments. He has found that the electric corpuscles can be focused by means of a fiber of red glass lying on the film of the photographic plate. When the positive and negative terminals of the influence machine are grounded at different points, he finds evidence that the corpuscles are discharging from the negative line to surrounding bodies. They are also moving from surrounding bodies to the positive line. This refracting device seems to furnish a way of making further studies on electric fields.

The following memorial was adopted in memory of Dr. H. Aug. Hunicke, corresponding secretary of the academy at the time of his death:

Dr. Henry August Hunicke, at the time of his death on April 5, 1909, had been a member of the Academy of Science of St. Louis for rather more than twelve years, during five of which he held the office of corresponding secretary.

His active interest in everything appertaining to the labors of the academy is indicated, not only by his contributions to its scientific proceedings, but also, to an even greater degree, by his active participation in the business of the council, in matters of organization, in the discussion of questions of policy and in the promotion of measures designed to broaden the scope or to increase the usefulness of the academy.

He was an effective speaker, because his outlook and his sympathies were both broad and deep. Although a keen debater, he was uniformly considerate of the feelings of others and never permitted himself to treat his opponent of the moment with anything less than the most perfect courtesy. His spirit was ever helpful, encour-

aging, warmly appreciative of merit or good intent, but he was, nevertheless, quick to detect and to comment upon faults in logic or on errors of any sort. Such criticisms were always without rancor and were delivered with a touch of humor and with so delicate a tact, that, while they enlivened debate, they rarely or never gave offense.

As a councillor, his advice was highly valued, because he looked to the end, being not easily diverted from the main objective nor disposed to waste time over side-issues or trifles, and because he neither underestimated the adverse view nor overstated his own.

In his various capacities, as adjunct professor at Washington University, as a resourceful and able technologist, and as a close student of certain strictly scientific applications of the theory of thermodynamics, Dr. Hunicke enjoyed in full measure the respect of those who were in a position to judge his work, and so achieved his reputation; but in the minds of his colleagues of the university and of the academy, his truest claim to distinction lies in the exceptional qualities of heart and character, which endeared him to his friends, which were a constant inspiration to all who came within the sphere of his influence and of which the memory constitutes a living monument in his honor.

The Academy of Science of St. Louis places this record in its archives as a brief token of respect and as an expression of its sense of the severe loss which the academy and the world have sustained in his death.

Launcelot W. Andrews,
Chas. D. Stevens,
H. A. Wheeler

The academy met at the academy building, 3817 Olive St., Monday, June 7, 1909.

Professor W. E. McCourt, of Washington University, exhibited a number of photographs taken in Onondago Cave, near Leesburg, Mo., and described the formations found there.

Professor F. E. Nipher, of Washington University, gave a verbal account of some of his recent work on electric discharge, stating that his paper on the subject has not yet been completed.

He has recently obtained what have the appearance of shadow images of glass fibers laid across the film of a photographic plate enclosed in a hard-rubber holder, although the fibers were not present. They had been laid across the film of another plate previously exposed in the same holder. When the fibers were present they gave black focal lines on the negative. The after images formed on the next plate were white shadow images. The electrons which came from a highly charged line wire from the negative terminal of a plate glass machine were on the second plate deflected away from the lines upon which they had been converged in the first plate. This indicates that the effect is due to electrons and not to ether waves or ultra-violet light.

Experiments of the same kind with X-rays have given negative results. Previous exposures of plate holders to electrical radiations do not appear to affect X-ray images, although this matter is still under examination.

Later experiments to determine momentum effects around an angle in a wire have been made by placing the angle flat upon a sheet of glass. It is held in place by means of a fine silk thread doubled around the wire at the angle and attached to a helical spring. A photographic plate may be slipped under the wire at the angle. A sheet of black paper is inserted between the film and the wire, and a larger sheet is laid down upon the glass plate. These sheets of paper cut off luminous effects due to the discharge. If these sheets of paper are used a second time during the day, images of the wire due to previous exposures are formed on the plate. The momentum effects previously observed and reported are less marked by this method, and can only be obtained by placing a grounded and laminated condenser plate below the sheet of glass upon which the plate is supported. This deflects the negative particles downward upon the film.

It has also been found that the smooth aluminum wire lying flat upon the sheet of black paper in contact with the film, produces under some conditions an image which shows a sharp system of wave forms. The breadth of the image is about 3 or 4 mm. at the widest part and inappreciably small at the nodal points. The wavelength and position seem to be affected by the angle in the wire and the local geometry of the circuit around the angle. The wave-length is about 2×3.75 cm. The wave forms reverse their positions in a symmetrical way when the direction of the discharge is reversed. It is suspected that the tension on the wire has something to do with these wave forms. When the tension is small they are not observed. There is, however, much remaining to be done in the study of these phenomena.

W. E. McCourt,
Recording Secretary