

PROCEEDINGS OF THE TWELFTH SUMMER MEETING, HELD
AT NEW YORK CITY, JUNE 26, 1900

HERMAN LE ROY FAIRCHILD, *Secretary*

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SESSION OF TUESDAY, JUNE 26

The Society was called to order at 11.45 o'clock a m, in room 401, Schermerhorn Hall, Columbia University. The President, Dr George M. Dawson, occupied the chair throughout the meeting.

ELECTION OF FELLOWS

The Secretary announced that the three candidates for fellowship had received a nearly unanimous vote of the ballots transmitted, and that they were elected, as follows:

Fellows Elected

LEONIDAS CHALMERS GLENN, Ph. D., Columbia, South Carolina. Professor of Geology, South Carolina College.

THOMAS LEONARD WATSON, Ph. D., Atlanta, Georgia. Assistant State Geologist, Georgia State Geological Survey.

STUART WELLER, B S., Walker Museum, University of Chicago. Instructor in University of Chicago.

The announcement was also made by the Secretary that the next Winter meeting would probably be held at Albany, New York.

The reading of papers was declared in order. The first paper of the program was

GEOLOGY OF THE SILVER PEAK RANGE, NEVADA

BY H. W. TURNER

In absence of the author the next paper was read by J. F. Kemp:

NATIVE COPPER NEAR ENID, OKLAHOMA

BY ERASMUS HAWORTH AND JOHN BENNETT

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DISCOVERY AND LOCATION OF THE COPPER

About two years ago an unknown person sent to the University of Kansas for identification a sample of material which proved to be unusually interesting. It consisted mainly of a piece of the well known Red Beds clay shale so common in southern Kansas and northern Oklahoma, but in small crevices or fissures within the mass were numerous thin sheets of metallic copper, from a half inch to two inches in width, so thin that they could be rolled between thumb and finger almost as readily as tinfoil.

For two years persistent efforts were made to learn the location of this find and information regarding it. Last autumn these efforts were successful. The location is about 18 miles northwest from Enid, on the farm of Mr O. P. Barnes, near the northwest part of Garfield county, Oklahoma.

Oklahoma was opened for homesteading as agricultural lands, and Mr Barnes and neighbors feared that the finding of this native copper would cause the land to be classed as mining land and thereby interfere with their homesteads, and hence the difficulty in learning details concerning the discovery.

The farm of Mr Barnes occupies a portion of the watershed between the Cimarron river on the south and a tributary of the Arkansas on the north. It is well within the Red Beds area, but just where on the vertical scale is not yet determined.

SECTION OF WELL IN WHICH DISCOVERY WAS MADE

The copper was found in a six-inch stratum at the bottom of the well 32 feet

deep, dug to obtain water for domestic use. A section of the well, as obtained by Bennett, is as follows, numbering from the top :

1. Ten feet of alluvial material.
2. Five feet of dark red clay shale.
3. Six inches of light colored clay shale.
4. Two feet of light red clay shale.
5. Three feet six inches of mottled dark red and light clay shale.
6. One foot ten inches of red clay shale.
7. One foot three inches of light clay shale.
8. One foot six inches of dark red clay shale.
9. Five feet three inches of mottled red and light clay shale with red greatly predominating.
10. Six inches of mottled red and light clay shale, the copper-bearer.
11. A hole was dug in the bottom of the well about two feet deeper into the red clay shale, but no more copper was found.

NATURE OF THE COPPER DEPOSIT

The six-inch copper-bearing horizon is not materially different from that above and below excepting that the little fissures within it are filled with the metallic copper. From the small exposure in the well it seems that near the middle of the layer the copper films approach a horizontal position, but both above and below they are inclined at almost every angle, showing a total lack of regularity. From an examination of the surrounding country it was learned that the bedding planes of the clay shales are practically horizontal. Wherever good exposures were found many small fracture seams were noticed, as is so common in the Red beds elsewhere—seams likely produced by the contraction of the sediments upon drying. The copper films occupy these fissures, and therefore have been deposited since the fissures were formed.

It is reported that copper was also found in a well about a mile distant from the one described, but this was not examined. Careful search along neighboring canyon walls failed to reveal any copper; but the search was not sufficiently extended to have an important bearing on the question of extent of the deposit. Further developments will be awaited with interest.

ORIGIN OF THE COPPER

NATURE OF THE RED BEDS

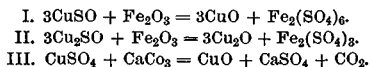
It is interesting to inquire into the methods by which this native copper may have originated. With our limited knowledge of the environments, it must be admitted that any theorizing on the subject may lead to error. It is generally admitted that the Red beds are a mass of clay shales, sometimes quite arenaceous, accumulated beneath ocean water so strongly concentrated that no life could exist within it, and that therefore they are highly colored with red iron oxide.

The copper-bearing stratum shows no sign of having been reduced by surface agencies. Under such circumstances it would seem that organic matter could have had no part in the reduction of the copper. If the copper were held in solution as a sulphate it may have been associated with ferrous sulphate and a trace of free sulphuric acid, products generally formed by the weathering of copper and iron

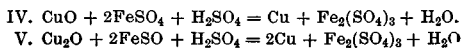
sulphides. The shales contain large quantities of iron oxides and perhaps small quantities of calcium carbonate, although not in the form of limestone.

CHEMICAL REACTIONS

We can write out chemical equations showing how metallic copper might have been formed from such associations, thus:



The copper oxides produced by one or more of the above equations could readily be reduced to metallic copper by the action of ferrous sulphate in the presence of traces of free sulphuric acid, thus:



ORIGINAL SOURCE OF THE COPPER

The original source of the copper is difficult to determine. The nearest known copper beds are to the south more than a hundred miles. If the source were the Red beds themselves, then the copper must have been gathered from the immediate surface, or possibly from material already removed by erosion, for it could not have been leached from the surrounding shales without the leaching process having made a greater change than has occurred. At present the surface waters, of course, are charged with organic matter, the same as other surface waters where vegetation is abundant, but the iron oxide of the shales oxidize such matter while yet near the surface, as is shown by the red color for 20 feet above the copper bed.

Remarks upon the subject of the paper were made by W. H. Hobbs, J. F. Kemp, and the President.

The third paper was read by title:

ANDESITIC ROCKS NEAR SILVERTON, COLORADO

BY FRANK R. VAN HORN

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INTRODUCTION

In the summer of 1898, while spending a few weeks at Silverton, San Juan county, Colorado, in the study of the mines and economic geology of the region, the rocks which are the subject of this paper were collected. The fundamental rocks of the neighborhood seem to be granites and granito-diorites associated with gneisses and schists. Over these follow several lava flows, probably of Tertiary age, in succession, accompanied in some localities by considerable tuff, which has

become consolidated into breccia-like masses. No attempt was made to trace the different flows from one place to another, and the specimens were simply taken at random in the different localities. However, in view of the fact that most of them were collected at altitudes of from 12,000 to 14,000 feet, it seems very probable that the younger flows were gathered. Most specimens were collected on King Solomon, Galena, and Boulder mountains, which lie in a northerly direction from Silverton, covering a triangular area. However, while there I had neither map nor instrument with me and my points of the compass may not be very accurate.

The rocks of this locality, although apparently all of the same kind, differ considerably in appearance and texture. The specimen which was least altered, and therefore most typical, was found at the summit of the southeast spur of Galena mountain, above the Big Ten claim, which at that time was being exploited by Mr A. M. Campbell and associates. It is this rock which will serve as the basis of the description for all the rocks of the region. Nevertheless, various characteristics not found in this specimen but observed on others will be incorporated into the description of this rock, in order that a general account may be given without taking too much time and space.

MEGASCOPIC DESCRIPTION OF THE ROCK

Megascopically the rock in question is of gray color, with numerous phenocrysts of plagioclase feldspar, hornblende, and magnetite in an aphanitic groundmass. The phenocrysts are arranged in some instances in roughly parallel directions as a result of flowing. This rock effervesces but slightly with acids, while others do so very strongly. The prevailing color of the rocks is grayish green, but at times a brownish to reddish gray was noted. Sometimes the phenocrysts are very numerous and give the rock almost a plutonic appearance, while again they are nearly absent, and the mass has an aphanitic character. Often the plagioclase crystals are from 3 to 5 millimeters long and 2 to 5 millimeters across. However, in the rock from Dives tunnel, given in the analyses, the feldspars are at times 19 millimeters long and from 6 to 13 millimeters wide. When unaltered the cleavage faces have pearly luster, but they are quite commonly dull. The hornblende is black, with smooth glistening cleavage planes, and is not found in very large amounts. Magnetite is plentiful and is generally titaniferous, as is shown by microscopic examination.

MICROSCOPIC OBSERVATIONS

Microscopically, the rocks are found to be distinctly holocrystalline porphyritic, although at times the groundmass is so intensely fine as to be almost cryptocrystalline.

Plagioclase phenocrysts occur in various forms, but are probably generally tabular parallel to the brachypinacoid (010), being bounded by the prisms (110) ($\bar{1}\bar{1}0$), brachypinacoid (010), base (001), and a macrodome. The crystals are generally twinned after the Albite law, and very frequently compound twins after Albite and Karlsbad laws are found. Pericline twins occur more rarely. Zonal structure is frequently observed, and at times is very common. When such structure is noticed, the extinction angles of the center are always found to be considerably greater than those of the periphery, which indicates isomorphous growths of the

various plagioclase. Cleavage is good after both (001) and (010). The rock given under analysis I was pulverized by stamping and the minerals isolated by means of the Klein solution. A small portion of feldspar had the specific gravity 2.69-2.684 at 22 degrees centigrade. Extinction angles on P (001) were found to range about 8-10 degrees, while on untwinned pieces, evidently after M (010), values of 20-23 degrees were found. Most of the feldspar has a specific gravity of 2.684-2.64 at 22 degrees centigrade, in which angles on P (001) were found from 0-7 degrees, while a few angles of 12-17 degrees were observed on particles evidently cleaved after M (010). The latter gave in convergent light an axial figure intermediate between that of oligoclase and labradorite. Another considerable portion ranges from 2.64-2.604 at 22 degrees centigrade, but it was found to consist mainly of groundmass; in fact, the portion from 2.684-2.64 had considerable groundmass mixed with it.

The foregoing observations, together with the maximum symmetrical extinction angles given in sections normal to M (010), indicate that the phenocrysts are members of the andesine and acid labradorite series. The successive occurrence of these, with even other plagioclase not mentioned, is not to be wondered at in view of the frequent zonal structure; since particles belonging to the same crystal may give extinction angles ranging from those of labradorite to oligoclase, as was observed in a few cases. It is extremely probable that the plagioclase phenocrysts of the majority of the rocks are more basic than in the present instance, which is the most acid rock of the series. Symmetrical extinction angles of 25-27 degrees in the zone normal to (010) with Albite twins and Karlsbad twins with differences in the two sides of 12-15 degrees would seem to point out that the more basic labradorites play an important part in many of the rocks under investigation. The plagioclase decompose first along cleavage and twinning directions, except perhaps when zonal structure is present, in which case the alteration begins at the center of the crystal. The secondary minerals resulting from the feldspars were found to be calcite, mica, kaolin, epidote, and possibly chlorite, as the result of mutual reaction of solutions originating from plagioclase and the dark minerals. Quartz was at times present in small amounts, but whether it resulted from the feldspars or other minerals could not be stated. Of these alteration products calcite was probably most common, then come mica, either paragonite or muscovite, and, finally, epidote, the remainder of the decomposition products being rarer.

Hornblende is the next most important constituent after the plagioclase. It is pleochroic with ϵ and η = brown, α = yellow with a tinge of brown. The crystals are generally idiomorphic, being bounded by the prism (110), clinopinacoid (010), and terminated evidently by pyramid and dome faces. At times, however, the mineral occurs in bizarre forms, which are due to resorption. Twins were observed after the orthopinacoid (100). Cleavage is good after the prism (110) and cleavage fragments gave an extinction of 11-13 degrees, which would probably yield values of 14-16 degrees on (010). Indications of zonal structure were also observed. All of these facts indicate a typical basaltic hornblende. Through decomposition the mineral loses its color and the pleochroism becomes weaker, but the double refraction does not change. Along the outer parts of the mineral a mass of fine dark grains of iron oxide, which at times is hematite, accumulates, giving the hornblende at first glance an appearance of zonal structure, or perhaps of resorption rims. This could not be the fact, however, as the rims increase in width with growing decomposition. In some cases the alteration does not pro-

ceed farther than this stage, but at other times complete alteration to chlorite and calcite is found. Hematite is also seen deposited on the cleavage cracks, and epidote occasionally is a secondary product.

Augite in small colorless or pale green crystals occurs at times. The amount, however, never seems to be great. The mineral is bounded by (110), (010), and (100) in the prismatic zone, as usual. Cleavage after (110) is present, but not well developed. Twins after (100), sometimes polysynthetic, are found. Extinction in sections near (010) is 42 degrees. The augite seems to alter more readily than hornblende to chlorite, calcite, and epidote, so that the maximum amount of augite can never be ascertained. It seems certain, however, that this mineral plays a less important part in these rocks than the hornblende.

Magnetite is always present in considerable quantity in both phenocrysts and groundmass. It occurs in well defined octahedrons, sometimes twinned after the Spinel law. The mineral decomposes to hematite and limonite. In advanced stages of alteration the presence of leucoxene rims around the surfaces, as well as along the parting planes, proves that the mineral is titaniferous. Occasionally the shape of the crystals and amount of leucoxene is such as to indicate ilmenite, but the fact that the substance is so strongly magnetic bespeaks magnetite.

Apatite in short hexagonal prisms, terminated evidently by base and pyramid, is generally present in and near the magnetite.

A mineral having the properties of zircon is found very sparingly.

The groundmass, which megascopically is always aphanitic, is, so far as could be observed, holocrystalline. It consists mainly of plagioclase microlites, both twinned and untwinned, often woven into a felt-like or pilotaxitish structure, but sometimes possessing a parallel arrangement due to flowing. In rock number I, which was separated by means of the Klein solution, a quantity of the groundmass was found in the portion having the specific gravity 2.684-2.64 at 22 degrees centigrade. However, most of the groundmass seems to be included in the quantity having the specific gravity 2.64-2.604 at 22 degrees, while a very small portion ranges from 2.604-2.578 at 22 degrees, which was the lightest portion found in the rock. Although these masses were not pure, still a good idea is given of the limits within which the groundmass is confined. Extinction angles in sections normal to (010) and angles measured with reference to the long directions of the microlites gave values from 0 degrees up to 7-9 degrees. It seems safe, even from the specific gravities, to conclude that the groundmass consists of oligoclase-andesine, perhaps with some albite, in contradistinction to the andesine-labradorite of the phenocrysts. The specific gravity 2.578, at which all particles of the rock had slowly fallen, shows that there could be no glass present in the groundmass. Besides plagioclase, the groundmass contains innumerable specks of what seem to be magnetite, together with a few other minerals in small amounts, which are largely secondary products, like calcite, epidote, and chlorite.

CHEMICAL COMPOSITION *

The analyses were made in the chemical laboratory of Case School of Applied Science, under the direction of Doctor A. W. Smith, by the students of the college.

* Messrs E. W. Gebhardt and W. G. Haldane, who made analyses II, III, IV, V, VI, VIII, and IX, chose the chemical study of these rocks as a subject for the degree of bachelor of science. Analysis I was executed by Mr E. O. Cross, while VII was analyzed by Mr E. B. Willard. To all of these gentlemen my thanks are due for their work.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
SiO ₂	61.36	58.36	57.38	57.29	56.93	56.36	55.77	55.68	54.22
TiO ₂	Undet.	1.49	2.22	1.42	.98	.83	.34	1.45	1.65
Al ₂ O ₃	16.56	16.13	16.30	19.93	17.61	15.46	16.38	17.09	16.69
Fe ₂ O ₃	3.44	3.85	3.70	2.95	3.04	5.00	4.27	5.26	3.63
FeO.....	2.93	3.25	2.66	3.39	3.24	1.85	4.17	1.98	3.39
MnO.....	Undet.	.66	1.70	.75	2.23	1.49	Undet.	1.56	1.43
MgO.....	.85	2.91	1.61	1.55	1.77	2.00	3.10	2.23	2.72
CaO.....	4.56	3.57	5.12	5.67	5.03	5.28	6.66	5.05	5.86
Na ₂ O.....	6.86	4.51	3.58	3.34	3.97	4.91	3.65	2.83	4.82
K ₂ O.....	1.30	2.41	2.29	1.92	2.93	2.73	2.37	1.95	2.20
H ₂ O.....	1.55	1.61	1.08	1.53	.74	1.34	2.36	1.50	1.55
CO ₂	traces.	1.54	2.66	none.	1.45	1.92	1.58	2.97	2.53
	99.41	100.29	100.30	99.94	99.72	99.17	100.65	99.55	100.69
Specific gravity.....	2.63	2.655	2.745	2.66	2.70	2.735	2.745	2.725	2.695

I. Hornblende-andesite, summit of southeast spur of Galena mountain, above Big 10 claim, near Silverton, Colorado.

II. Hornblende-andesite, tunnel of Dives claim, upper level, King Solomon mountain, near Silverton, Colorado.

III. Hornblende-andesite, west slope of Boulder mountain, 1½ miles north of Silverton.

IV. Hornblende-andesite, from Middleton, 6 miles northeast of Silverton, on east side of road.

V. Hornblende-andesite, 30 feet from hanging wall of Big 10 vein, Galena mountain.

VI. Hornblende-andesite, country rocks of Dives claim, upper level of King Solomon mountain.

VII. Hornblende-andesite, Little Giant peak of King Solomon, slightly below summit toward Cunningham gulch.

VIII. Hornblende-andesite, summit of Little Giant peak of King Solomon mountain, about 14,000 feet above sealevel.

IX. Hornblende-andesite, hanging wall of Big 10 vein (east side), Galena mountain, near Silverton, Colorado.

The analyses show at first glance that the rocks are of andesitic character, and also that they are badly decomposed. All the rocks have a similar character, with a tendency to form a series, ranging from acid to basic members. However, if the CO₂ were calculated to the remaining constituents, the basic end of the series would not be so low. Nevertheless these rocks belong to the basic rather than to the acid andesites. In the analyses the constant presence of considerable TiO₂ and MnO is to be noted. The TiO₂, as before mentioned, is probably to be found in the magnetite. The fact that the microscope shows the presence of apatite in small quantities will partially explain the fact that some of the analyses are too low, as P₂O₅ was not determined. The advanced stage of alteration of these rocks will also explain other seeming irregularities in the analyses. In many cases the rocks have undoubtedly been altered by the ore-bearing solutions which have deposited most of their material in the veins of the district.

CONCLUSION

The rocks in the neighborhood of Silverton, Colorado, comprised in the triangular area bounded by Galena, King Solomon, and Boulder mountains are horn-

blende-andesites of rather basic character, having a holocrystalline porphyritic texture with phenocrysts of andesine-labradorite, basaltic hornblende, augite, magnetite, and apatite in a pilotaxitic groundmass of oligoclase-andesine and magnetite. These rocks are rarely fresh, but generally very much altered—a fact which renders them difficult as well as unsatisfactory material for investigation. In many cases the decomposition has been caused largely by the action of ore-bearing solutions, an example of which is especially noticeable in analyses V and IX.

The fourth paper presented was

EVIDENCES OF INTERGLACIAL DEPOSITS IN THE CONNECTICUT VALLEY

BY CHARLES H. HITCHCOCK

[Abstract]

The evidences of interglacial deposits in the Connecticut valley are derived from the study of the eskers, notably the one passing through Hanover, New Hampshire, which has been followed for thirty miles between Thetford and Windsor, Vermont. The esker was formed in caves or open gorges while the ice was still moving down the valleys, and it represents glacial action. Hence the underlying deposits represent what was earlier or interglacial. In searching for the base of this esker I found it to be modified drift. It is mainly a compact clay containing the curious massive concretions described in the "Geology of Vermont" as coming from Sharon. This I find at several localities in the village of Hanover, revealed by recent excavations. There is a later widely disseminated clay not indurated and passing into silt, besides containing tubular ferruginous concretions, which belongs to a later period. Besides the clay I discover a thick sand higher up, and hence intermediate between the lateral terraces and the till, which seems to represent an older deposit. Dunes blown from this were described by Upham* in Lebanon, Plainfield, Cornish, Charlestown, etcetera, always on the east side of the valley. The dunes are absent from the west side of the valley, but the deposit is present, sometimes associated with a tough clay.

This lower clay has been tilted and contorted, as in the vale of Tempe, where the wrinkling is comparable with the minute corrugation of crystalline schists. The combined induration and folding are regarded as effects of pressure induced by the overlying glacier.

For two miles along the east bank of the Connecticut this esker is continuous at a uniform height, cut across by Mink brook, Tempe brook, and at length by the main river. I find valleys of drainage pointing across this ridge at two points where artificial excavations have been made—one for a road to cross the Ledyard bridge and the other for a sewer a mile north. The drainage must have taken this direction before the formation of the esker and through modified drift.

These facts confirm the correctness of my contention of the existence of a local Connecticut glacier subsequent to the general southeasterly movement of the ice. The presence of what appears to me to be this same glacial lobe is predicated by the observations of Professor B. K. Emerson in Monograph XXIX of the United

* Geology of New Hampshire, part iii, page 41 et passim.

States Geological Survey, 1899. Upon the four sheets, plate xxxv, A, B, C, D, thirteen ice barriers obstructing tributary valleys and thereby producing high level sands are represented upon the east side and fifteen upon the west side. Most of them extend northerly and southerly, because the obstructing ice occupied the main valley. Other ice-tongues seem to have similarly occupied the Deerfield and Millers river valleys.

It has been objected to the existence of local glaciers that the flow of the lower ice was influenced locally by the topography. This fact is conceded for the time of excessive ice accumulation, and then it will be the valley rocks which will be transported downward; but the esker is characterized by the presence of the valley rocks, and they must have been transported even after the accumulation of some modified drift. I refer to the fragments of white mountain porphyries which are common in the esker, but have not yet been discovered in the neighboring till. These fragments increase in number and rise as one ascends the valley of the Ammonoosuc, and constitute there an upper till overlying the ground moraine.

The presence of this lobe of ice may confirm the contention of Mr Upham, that certain tributary deltas are higher than the normal principal terrace of the Connecticut. The side stream may occasionally discharge an abnormal amount of water which would pile up an unusual amount of sediment.

Following the reading of Professor Hitchcock's paper the Society adjourned, at 12.40 o'clock, for the noon recess. At 2.10 o'clock the Society reconvened and listened to a second paper by the same author.

VOLCANIC PHENOMENA ON HAWAII

BY CHARLES H. HITCHCOCK

Remarks were made by W. H. Hobbs and by visitors. The paper is printed in full in this volume.

The next paper was

A THEORY OF ORIGIN OF SYSTEMS OF NEARLY VERTICAL FAULTS

BY WILLIAM H. HOBBS

[*Abstract*]

The point is first emphasized that joints and faults probably differ in degree of displacement chiefly, and that prismatic fault systems formed of two parallel and intersecting series may be explained by simple compression of a section of crust in the same way that prismatic systems of joints have been accounted for by Becker and others. The conditions of rupture under compression are discussed (*a*) for a homogeneous crustal block without preexisting structure planes, and (*b*) for a crustal block possessed of a network of vertical fault planes. Stress is laid upon the fact, too often overlooked, that an isotropic block during compression is in the anisotropic condition of a non-isometric crystal.

The relative depression of a crustal block along vertical rupture planes due to inadequate support of its load receives an independent discussion. In every area where relative depression occurs there is a closed line, which may be termed the

margin of the area of no vertical stress, or for brevity the line of no vertical stress, along which and without which there is no vertical component of the stress due to load, but about which act the moments of the load within the overloaded area. The convergence of vertical planes downward imposes a restraint upon the depression of a crustal block within vertical walls, and tends to form new rupture planes if the thickness of the crustal block be small in comparison with its area.

The principles discussed are applied to explain the observed faults within the valley of the Pomperaug river, Connecticut.

The following paper was read by the author, who was introduced by J. M. Clarke :

HUDSON RIVER BEDS NEAR ALBANY AND THEIR TAXONOMIC EQUIVALENTS

BY RUDOLF RUEDEMANN

[Abstract]

This paper is the first installment of an investigation of the belt of so-called Hudson River beds, extending on both sides of the Hudson river in eastern New York. It gives the results obtained between the mouths of the Mohawk river and Coeymans Kill.

The uniform mass of shales and sandstones with conformable easterly dip, which hitherto, as "Hudson River beds," has been considered as representing the time interval between the Utica and Oneida ages, can, by means of the entombed faunas, be separated into Lower, Middle, and probably Upper Trenton beds, Utica shale, and Lorraine beds. All of these stages are represented by belts of similar rocks, extending from west-northeast to south-southeast with the general strike of the rocks. The whole series is overturned, being the underturned wing of an overturned fold of Appalachian type.

Remarks were made by J. M. Clarke.

The three following papers were read by title:

FAUNA OF THE ARENACEOUS LOWER DEVONIC OF AROOSTOOK COUNTY, MAINE

BY JOHN M. CLARKE

GIANTS' KETTLES ERODED BY MOULIN TORRENTS

BY WARREN UPHAM

This paper is printed in full in this volume.

PLEISTOCENE ICE AND RIVER EROSION IN THE SAINT CROIX VALLEY OF MINNESOTA AND WISCONSIN

BY WARREN UPHAM

This paper is printed in full in this volume.

After announcement of excursions under the guidance of Professor J. F. Kemp, the Society adjourned.

REGISTER OF THE NEW YORK MEETING, 1900

The following Fellows were in attendance upon the session of the Society:

J. M. CLARKE.	E. O. HOVEY.
G. M. DAWSON.	A. A. JULIEN.
H. L. FAIRCHILD.	J. F. KEMP.
G. K. GILBERT.	W J MCGEE.
ERASMUS HAWORTH.	E. B. MATHEWS.
R. T. HILL.	F. H. NEWELL.
C. H. HITCHCOCK.	R. D. SALISBURY.
W. H. HOBBS.	H. W. TURNER.
ARTHUR HOLLICK.	T. G. WHITE.
J. A. HOLMES.	S. W. WILLISTON.

Present at the meeting of the Society, 20.

The following Fellows were in attendance upon the meeting of Section E, American Association for the Advancement of Science:

W. B. CLARK.	J. E. TODD.
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Fellows-elect

L. C. GLENN.	STUART WELLER.
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Total attendance, 24.