this head are as follows: In addition to boiling the water, it should be analyzed to determine the exact quantity of hydrate of lime (or common quick lime) to add to the water to precipitate the whole of the bicarbonate, and the amount of carbonate of soda (or common washing soda) to decompose and precipitate the sulphate of lime and magnesia.

The best installation found in the camp was that of the 12th New York. The boilers were placed in a row over a wood fire, and the water was carried boiling into four casks, from which it fell through wooden spigots into four asbestos filters. From the filters the water passed to four other casks in which the ice was introduced. It is suggested that if the 12th New York had put a little lime and soda into the boiling water in the casks, they would have had a drinking water which would have been perfect, being both softened and sterilized.

The 14th New York, under the enterprising command of Col. Wilder, erected a distilling apparatus of sufficient capacity for the whole regiment, which, of course, settled the question of mineral soils and microbes at a stroke.

As a conclusion of the investigation, the report says that the terrible increase of sickness which has caused the camp to be abandoned has had the water supply for the main if not the exclusive cause. The July rains washed the microbe-laden atmosphere and the polluted soil and carried the morbid material into the pockets of water struck by the pumps. The spring water was polluted by the canvas bags and the muddy bottoms of pails. These causes account for the malarial and typhoid cases, while the loss of vitality, the lumbago, rheumatism, and stomach disorders are due, for the most part, to the hard water of the pumps and springs.

In concluding his report, Mr. Maignan states that by taking the precautions as outlined above there is no reason why the National Park at some future time, after suitable disinfection and proper sanitary arrangements for the disposal of excretæ and other waste, should not be a first-rate camping ground.

GEOLOGY AT THE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY E. O. HOVEY.

The numerous receptions and excursions given and arranged for through the hospitality of the citizens of Boston reduced the time for the actual reading of papers to about two days and a half for Section E, which is the department of the association devoted especially to geology and geography. In this time eighteen papers were presented by the Geological Society of America, eight by the National Geographic Society, and twenty-nine by Section E proper. As usual, the geological papers covered a wide range of topics, from the oldest to the newest strata, and included discussions in petrography and mineralogy as well. Before the regular business of the section was taken up, tributes were paid to the memory of Prof. James Hall, the veteran geologist and paleontologist of New York, who died suddenly at Bethlehem, N. H., August 7, of this year, at the age of 87. The speakers on the occasion of the memorial were H. L. Fairchild, B. K. Emerson, W. H. Niles, and H. C. Hovey, all of whom testified to the eminence and high scientific attainments of this the last of the famous coterie of founders of the science of geology in America.

The chairman of the section this year was Prof. H. L. Fairchild, of Rochester, N. Y. He chose for the subject of his set address "Glacial Geology in America." (See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 1183, 1184, 1185), and presented a concise review of the history of the progress made in this department of geology.

Fifteen other papers dealt more or less directly with glacial geology, some of which aroused much discussion. The first was entitled "Some Features of the Drift on Staten Island, N. Y.," by Arthur Hollick, of Columbia University. He said, in part: The terminal moraine crosses Staten Island from Fort Wadsworth, at the Narrows, to Tottenville, opposite Perth Amboy, N. J. Its front rests partly upon the serpentine ridge and partly upon the plain region to the south. In the former locality it consists of true morainic material derived from foreign sources. In the latter it consists of a ridge or core of Cretaceous and Tertiary clays, sands, and gravels shoved forward and upward from their original positions on the island, on top of which is the morainal till and gravel. At two localities there are well defined indications of extra-morainic drift, south of the terminal moraine. The direction of glacial movement is indicated by the striæ on rock outcrops to be from about N. 17° W. The most abundantly represented bowlders are those derived from the Triassic, of New Jersey, but others have come from nearly all the outcrops between Staten Island and the Adirondacks. About 120 species of Paleozoic fossils have been obtained from the transported bowlders, and about 35 Cretaceous and Tertiary species, mostly plants, have been found in the drift which were derived from the disturbed Staten Island strata.

In addition to his vice-presidential address, Prof. Fairchild presented two papers on glacial geology. The first pertained to the Finger Lake region of central New York, and supplemented an earlier paper of his on the same subject, detailing many new observations. He has now traced out the beaches which determine the limits of the ponded glacial waters in these curious valleys, and indicate their halt at at least four levels for long periods. The work is much complicated by the post-glacial elevation of the land, which has raised the northern beaches above their original relation to the southern.

In his other paper, Prof. Fairchild described a great "kettle hole" in the gravel plateau above the village of Potter. The explanation of the phenomenon is that an isolated block of ice was left here by the receding glacier, and that the delta sands and gravels were piled around it. The subsequent melting of the ice block produced the cavity.

Warren Upham, of St. Paul, Minn., discussed the evidences of continental elevation and depression immediately preceding and following the ice age. He stated that recent mapping and investigation showed that the pre-glacial elevation in different parts of the world was greater than was supposed forty years ago, and was sufficient to account for the glacial climate. This elevation for the northern half of North America amounted to from 3,000 to 5,000 feet above the present level.

The question as to whether the summits of the White and Green Mountains were covered by the great ice sheet has been much discussed. Fresh evidence in support of the glacier having covered these summits was discovered by Prof. C. H. Hitchcock, of Hanover, N. H., during the past year, who ascended Mount Orford, 5,000 feet high, near Lake Memphremagog, and found it glaciated from bottom to top. The movement of the glacier was from the northwest. A twenty pound bowlder was found on the summit and submitted to Prof. F. D. Adams, of McGill College, Montreal, who determined it to be Laurentian gneiss from the north side of the St. Lawrence River. Previously, Prof. Hitchcock has found similar bowlders on the summits of other of the high peaks of the White Mountains, including Mount Washington. The movement of the Hudson River lobe of the Laurentide ice sheet was to the southeast, over the tops of the White and Green Mountains, to the southwest over the Adirondacks (though Mount Marcy seems to have kept its head above the ice) and due south along the low-lying valley.

The gorge of the Niagara River, from the falls to the escarpment at Lewiston, has always been a region of the highest interest to the geologist as well as to the tourist, hence the importance attached to a paper by Prof. G. F. Wright on "The Age of Niagara Falls as Indicated by the Width of the Gorge at Lewiston." The late Prof. James Hall early noted the significant fact that "the outlet of the chasm below Niagara Falls is scarcely wider than elsewhere along its course." This is certainly important evidence of the late date of its origin, and has been used by the author and others in support of the short estimates which have been made concerning the length of time which has passed since the glacial period. A close examination made by Prof. Wright the past summer greatly strengthens the force of the argument, since he found that the disintegrating forces tending to enlarge the outlet and give it a V-shape are more rapid than have been supposed. Somewhat more than forty years ago a railroad was built along the face of the eastern side of the gorge. Where a vertical exposure was then made, the shale has since crumbled away to an extent of several feet and in some places to that of twenty feet. A conservative estimate of the rate of disintegration for the seventy feet of Niagara shale supporting the Niagara limestone would be one inch a year, with a probable rate twice as great. At the lowest estimate, only 12,000 years would be required for widening the upper part of the mouth of the gorge 1,000 feet on each side, which is largely in excess of the actual amount of enlargement. Some of the recent estimates, therefore, which would make the gorge from 30,000 to 40,000 years old, are evidently extravagant and must incorporate some error in their premises. The gorge cannot be much more than 10,000 years old, and is probably considerably less.

"Another Episode in the History of Niagara River" was the title of a paper by Dr. J. W. Spencer, in which he announced the discovery that, while the falls were receding from Foster's Flats to the point of the railway bridges, the fall of the river reached its maximum height of 420 feet by the retreat of the Ontario waters toward the north. The return to the present height of 326 feet was interrupted by the subsequent rising of the level of the lake in the gorge to a height of 75 feet, thus reducing the actual fall of the river to 250 feet. The evidence of this is preserved in the remains of a terrace deposit opposite the foot of Foster's Flats and a corresponding terrace just outside the mouth of the gorge. The paper was really a sequel to one by the same author presented to the association four years ago on "The Duration of Niagara Falls."

The study of the history of drainage systems is one feature of the border region between geology and physical geography. Prof. W. G. Tight, of Granville, O., read a paper on "The Development of the Ohio River," in which he said in substance:

"A brief review of the literature shows that the generally accepted view is that the Ohio River is a very ancient stream. The work of certain geologists in New York and Pennsylvania indicated the recent origin of the Ohio above New Martinsville. In papers already published by the author the existence of a very ancient erosion basin extending in general from east to west through the central part of Ohio and Indiana is established by the restoration of many tributary drainage lines and by deep wells. Further evidence is presented to show that the Ohio in its present location has been established by the appropriation of sections of numerous north and northwestward flowing streams and their tributaries by the cutting of the ancient cols and the broadening and deepening of the valleys. The explanation for the modifications is found in the position and action of the glacial ice sheet in the various sections, thus determining also the relative age of the Ohio valley to be glacial or post-glacial. The lines of discharge of the glacial waters determined the present lines of southward flowing tributaries of the Ohio. The theory is proposed that the reason for the development of the Ohio River entirely beyond the greatest extent of the ice sheet on the eastern side of the Mississippi and the Missouri almost entirely within the limits of the ice, west of the Mississippi, is due to the different angle which the tributary streams made with the advancing ice front and their gradients; thus forcing the water over distant cols in the former case and retaining the water next to the ice front, thus wearing back the ice at the time of final recession, before the establishment of the channel by down cutting in the latter."

"The Oldest Known Rock," by N. H. Winchell, State geologist of Minnesota, was a communication in which, after a brief description of the other members of the Archean system, the author dwelt more at length on the so-called greenstones of Minnesota, which he considers the bottom of the geological scale and the representative of the original crust of the earth formed from the molten mass by the earliest consolidation. The greenstones, as such, are divisible into two parts, one igneous and the other sedimentary, the latter succeeding the former in point of time, with a confused and sometimes apparently non-conformable superposition, somewhat in the manner that a lot of surface rocks might be superposed in presence of oceanic action on a massive stone of the same nature at the same place. The sedimentary portions of the greenstones vary to more siliceous rocks, constituting great thicknesses of graywackes, phyllytes, and conglomerates, and as such have been converted by widespread metamorphism into mica schists and gneisses, the alteration, coming on by degrees, increasing in intensity toward centers of granitic intrusion and toward the great areas of granite and igneous gneiss which extend over large tracts. The Canadian Laurentian, as a whole, appears to be of later date than the greenstones of Minnesota, since the igneous portions cut them; hence these greenstones must be considered to be the oldest known rock.

The second paper by Prof. Winchell discussed the "Origin of the Archean Igneous Rocks," a topic of great difficulty, but of great interest to all students of the earth's history. The greenstones, which are spoken of in the preceding paper, are supposed to represent the original crust of the earth, and the author denies the possibility of the derivation of the alkaline granitic magma from this ferromagnesian greenstone magma by any of the methods of lixiviation or of differentiation which are currently proposed by geologists who have lately discussed the origin of the igneous rocks. The author holds that the potash resided in the ocean itself, which immediately followed the consolidation of the first crust. Such an alkaline ocean, especially if heated, would hold in solution much silica. Hence followed precipitation of alkaline silicates and of excess of silica. Hence the alkaline character of the schists and gneisses when its sediments were formed into rock and metamorphosed, and hence, when fused, the alkaline magma. The author does not attempt to account for this potassic ocean. He only throws out the suggestion that potassium, from its chemical characteristics, might have remained in the atmosphere until the consolidation of the first crust and the subsequent condensation of the moisture and less volatile vapors formed the ocean.

Our brief review has included only a few of the more popular papers presented before Section E. Although the section is intended to embrace geography as well as geology, only one paper that could be called geographic was presented before it, and it is to be hoped that there will be a marked change in this regard in the future. The value of the meeting was much enhanced to some members of the section by the impromptu geological excursions which were taken to various points of interest in the vicinity of Boston under the guidance of Prof. W. O. Crosby and Mr. J. H. Sears.

The chief officers of the section this year were Prof. H. L. Fairchild, vice-president, and Warren Upham, secretary. For next year the offices are held by J. F. Whiteaves, of Ottawa, Canada, and Arthur Hollick, of New York city, respectively.