PROCEEDINGS OF THE AMERICAN ASSOCIATION.

THE work accomplished in the various sections of the American Association for the Advancement of Science is very satisfactory if considered as a whole. The number of members attending the meeting was comparatively small; while many leading scientists took part in the discussions, and brought important problems before the sections, thus inducing many of the most able students to co-operate in their solution.

Section B (Physics) did very good work in discussing fully the report of the committee on the teaching of physics. Section A (Mathematics) joined on the first day in these discussions, and did not hold any meeting in its own hall. The report of the committee was made by Prof. T. C. Mendenhall. In substance it is as follows: —

The publication in the English language within a few years, of several excellent text-books of physics and a few laboratory guides of a high order of merit, together with a considerable advance in real scholarship among teachers, makes it possible to use the phrases 'text-book work,' 'lecture-work,' and 'laboratory practice,' with a fair chance of being understood; yet it may be well to remark, that, where the latter is referred to, something very different from mere illustrative experimentation is meant; it being the opinion of the committee that the work in the laboratory should be quantitative rather than qualitative, and always of as high a degree of precision as is possible with the appliances available.

In order to give definiteness to its conclusions, the committee undertook to answer the following questions: —

1. In what grade of the public school should physics-teaching begin? 2. What should be the character of this first instruction, — oral, by text-book, by laboratory methods, etc.? 3. What should be the character of the physics-teaching in the high school, — text-book, laboratory, text-book followed by laboratory, laboratory followed by text-book, or laboratory and text-book combined? 4. What knowledge of physics should be required for admission to college? 5. What should be the minimum course in physics for undergraduate students, and what should be the nature of this course?

The answers are as follows: —

1. In answer to the first question, it is the opinion of the committee that instructions in physics may begin, with profit, in what is generally known as the 'grammar school.' At the same time it is decidedly opposed to any general recommendation that it must begin there or in the primary school. Here, perhaps more than anywhere else, nearly every thing depends upon the teacher. One who has a strong liking for and a good knowledge of physics will be tolerably certain to succeed, while another not thus equipped for the work is equally certain to fail.

2. When taught in the grammar school and by a competent teacher, it should be done mainly by and through illustrative experiments. These may be of the simplest character, involving and exhibiting some of the fundamental principles of science; and they should generally be made by the teacher, the pupils being encouraged to repeat, to vary, and to extend.

3. In any discussion of the character of instruction in physics in the high school, one fact of the utmost importance must not be lost sight of. It is that a large majority of the young people who are educated in the public schools receive their final scholastic training in the high school. Its course of study must be in harmony with this fact, such provision as may be made for those who continue their studies in college or university being merely incidental. It is important that the student should be made acquainted, if only to a limited extent, with the methods of physical investigation, and that he should be able himself to plan and carry out an attack upon some of the simpler problems of the science. It is believed that the two very desirable ends can be reached without giving an undue share of the time and energy of the pupil to the subject. Assuming the high-school course to consist of four years of three terms each, it is recommended that the study of physics should begin not earlier than the third year; that it should continue through one year, three hours a week being devoted to it, not including the time necessary for the preparation of the lesson; and that during the first two terms the work should be text-book work, accompanied by illustrative experiments performed by the instructor, and made as complete as his facilities will allow, while the last term should be devoted to simple laboratory exercises.

4. As to the requirements in physics for admission to college, it is sufficient to say that the course indicated above should be required for admission to any and all courses in the college.

5. In reference to the minimum course in physics for undergraduate students in the college, it seems important to avoid the mistake of asking too much. In many institutions, and especially where the elective system largely prevails, it is possible at present for students to receive a degree and yet be almost absolutely ignorant of the principles of physics. It is the judgment of the committee that a knowledge of this subject constitutes one of the necessary and essential elements of a liberal education, and a minimum course of three hours per week for one year is recommended. What is usually known as the junior year is most desirable for this work, as at that time the student is sufficiently mature and has acquired the necessary training in mathematics to enable him to make the best of what he does. It is recommended that this course consist entirely of text-book and recitation work, with lectures fully and completely illustrated on the professor's table.

The report is signed by T. C. Mendenhall, William A. Anthony, H. S. Corbait, and F. H. Smith.

The very large attendance of members at the session when the report was read, and the continued discussions, show that the importance of the question at issue is well appreciated. The last day of the meeting was exclusively devoted to this subject. The report was very favorably received and unanimously indorsed. It was the opinion of the section that there should be a wide distribution of the report in the educational journals of the country.

The Physical Section did a considerable amount of valuable work besides that of the committee. On the first day W. LeConte Stevens read a very interesting paper on 'The Quality of Musical Sounds.' It contained a sketch giving the method adopted by Helmholtz in his investigation on musical quality, which resulted in the conclusion that "differences in musical quality of tone depend solely on the presence and strength of partial tones, and in no respect on the differences of phase under which these partial tones enter into composition."

In a paper on the 'Beats of Imperfect Harmonies,' read in 1878 before the Royal Society of Edinburgh, Sir William Thomson expressed conclusions inconsistent with those previously reached by Helmholtz, and the question was subsequently studied by means of the wave siren, invented by Rudolph Koenig of Paris, for the purpose of testing the effect of change of phase in quality of tone. This instrument was brought to America a few years ago, but was injured in transit so that it could not be operated. It has since been further improved. Mr. Stevens has had an opportunity to test its action in company with M. Koenig, and believes that through the instrument the truth has been established that variation in phase among the components of a composed sound is a distinct element in determining musical quality.

Dr. E. P. Howland described the most recent methods of instantaneous photography, and during his lecture showed a very interesting specimen of such work, — the photograph of a mule whose head had just been blown off with dynamite. It was taken before the animal fell. The paper was illustrated by experiments and projections.

E. L. Nichols and W. S. Franklin reported on some of their recent experiments on the direction and velocity of the electric current. A coil of wire of 390 turns was driven at a very high rate of speed, the axis of the coil being the axis of rotation. When the coil reached 338 revolutions per second, the linear velocity of the wire in the direction of its own length amounted to 8,000 centimetres per second. By means of two brush contacts at the axis, a current was sent through the coil while the latter was in motion. The magnetic moment of the coil was determined by means of a very sensitive astatic pair of magnets carrying a mirror.

Readings were taken with the coil at rest and in revolution, the motion of the coil and the direction of the current being repeatedly reversed. If the electric current result from the flow of a fluid through the wire, in other words, if it may be considered as possessing direction and finite velocity, the influence of a motion of the conductor with or against the current should produce an appre-

ciable influence upon the deflection of the magnet-needle, even though the velocity of the current were very large as compared with that of the conductor. In order to render the detection of this presumably very small effect less difficult, the direct influence of the coil was eliminated by differential winding. Under these circumstances, when the coil was carrying as large a current as it could be made to do without injurious heating, the rotation of the coil was found to be without appreciable effect upon the magnetic moment of the same. The best results were obtained by sending 4.6 ampères of alternating current of 40,000 alternations per minute through the coil.

At a velocity of the wire equal to 8,000 centimetres per second, they produced no effect upon the needle amounting to 0.2 millimetre deflection. The figure of merit of the coil and needle was determined by substituting a coil of continuous winding, its position with respect to the needle being the same as that of the rotating coil, and determining the current necessary to produce one centimetre deflection. The sensitiveness of the apparatus was found to be such that a current having direction and a velocity of 1,000,000,000 metres per second would have shown a change in its action upon the needle (when the motion of the coil was 380 revolutions, 8,000 centimetres per second) amounting to 0.1 centimetre deflection, — an effect which could not have escaped observation. It follows from the above negative result, that, if the electric current consists in the flow of a medium or fluid through the conductor, the velocity of the same must be greater than the exceedingly high rate just mentioned. Fopl, who in some recent experiments used an apparatus in most essential particulars similar to their own, but one by means of which only relatively very low velocities could have been detected, has reached the same negative conclusion.

Monday was almost exclusively devoted to electrical matters, while only few papers on the subject were read on the preceding days. While the interest of the section was concentrated in theoretical questions, a few problems of practical import were discussed. A new form of electro-magnetic telephone was described by R. B. Fulton, and the efficiency of incandescent lamps was treated by E. Merritt. Messrs. E. L. Nichols and W. S. Franklin gave the interesting results of their spectro-photometric comparison of sources of artificial illumination, which have an eminently practical bearing. C. J. H. Woodbury discussed the protection of watches against magnetism, — a problem that has become of importance since the increased use of electricity for industrial purposes.

The programme of the Mathematical Section embraced many problems of geophysics and astronomy, as well as discussions on the theory of physical instruments. Among twenty-one papers read, six were purely mathematical, while the greater number of the rest referred to astronomy. One of the most interesting of the latter class was Prof. A. Hall's paper on 'The Appearance of Mars in June, 1888.' It will be remembered that recently remarkable changes in its surface were observed which it is difficult to account for. Professor Hall has recently paid considerable attention to this subject, and has observed the planet on eighteen nights, from June 1 to July 2 inclusive.

While observing satellites in April, attempts were made on several nights to see the canals of Mars, but without success; and Professor Hall determined to make the trial in twilight, when he had been able to see more detail on the surface of planets. However, he was not able to see any thing like the regular canals drawn by European observers, although the usual reddish and dark spots and markings were visible nearly every night. The only remarkable change which he noticed during June was the diminution in the size of the white spot at the south pole of the planet. On June 1 the spots at the poles were a good deal extended, but on July 2 the one at the south pole had become very small and round.

The color and brightness of the sky, and the methods of exact measurements, were treated in the Mathematical and Physical Sections. While in the latter Prof. F. P. Whitman reported on certain photographic experiments, in the former Henry M. Parkhurst of New York City read a paper upon 'The Effect of the Brightness of the Sky in extinguishing the Light of Stars' with special reference to photometric observations with a wedge of neutral-tint glass. The presence of moonlight, of twilight, and even of ordinary starlight, diminishes the effect of the wedge according to the aperture of the telescope and the magnifying-power employed. By observations during the day he had ascertained that the effect of the wedge in extinguishing stars was reduced to less than one-tenth what it was in the evening. He also presented formulæ by which the effective value of the wedge can be ascertained under different degrees of illumination.

In the Chemical Section a report of the committee on water-analysis was read, from which we learn, that, so far, the propositions of the committee have not met with much encouragement in England. The question of water and water-supply was treated by Albert W. Smith with special reference to Cleveland and the water of Lake Erie, while E. H. S. Bailey spoke on the significance of the presence of ammonia in water. Prof. Frank H. Morgan of Cornell University also discussed the progress in chemical methods of water-analysis, and gave a preliminary notice upon iodine as a reagent in the analysis of drinking-water. The last day of the meeting was devoted to the presentation and discussion of laboratory methods.

On account of the absence of the vice-president, Prof. C. M. Woodward of St. Louis, Section D (Mechanical Science) did not organize until the second day of the meeting, and work was not begun until the third day. Lieutenant Peary's paper, on 'Surveys for the Nicaragua Canal,' is mentioned below. In connection with this may be mentioned W. Nelson's paper on 'The Panama Canal,' which was illustrated by stereopticon views. As these subjects are pretty well kept before the eyes of the public, we refrain from a detailed report on the papers.

Considerable interest was excited by W. J. Keep's, C. F. Mabery's, and L. D. Vorce's statement on the influence of aluminium upon cast iron, in which it was shown that the addition of aluminium materially increases the strength of iron, that it causes the carbon to be changed from the combined to the graphitic state, and secures many other advantages.

If we turn to the proceedings of Section E (Geology and Geography, or, more properly Geology, as no geographical papers were read), we find ourselves somewhat embarrassed by the great number of valuable papers that were presented, and by the important facts and theories contained in many of them. We can therefore do no more than point out a few of the most important features of these lectures. Geologists from numerous States were present; but, Cleveland being situated on the Great Lakes, the theory of their origin and the glacial period in general chiefly attracted the attention of the meeting. This was principally the case on Friday, when J. W. Spencer read his interesting series of papers on 'Lake Warren and its Later History.'

Lake Warren is the first chapter in the history of the Great Lakes, and is subsequent to the deposit of the upper bowlder clay, and therefore the lakes are all very new in point of geological time. By the movements of the warpings of the earth's crust, as shown in the beaches, — after the deposit of the later bowlder clay, — the lake region was reduced to sea-level, and there were no Canadian highlands northward of the Great Lakes. Upon the subsequent elevations of the continent, beaches were made around the rising islands. With the rising of the land, barriers were brought up about this lake region, producing Lake Warren, — a name given to the sheet of water covering the basin of all the Great Lakes. A succession of beaches of this lake have been partially worked out in Canada, Michigan, Ohio, Pennsylvania, and New York, covering almost thousands of miles. Everywhere the differential uplift has increased from almost zero about the western end of the Erie basin, to three, five, and in the higher beaches to from five to nine, feet per mile. With the successive elevations of the land, this lake became dismembered, and the present lakes had their birth. The idea that these beaches in Ohio and Michigan were held in by glacial dams to the northward is disproven by the occurrence of open water and beaches to the north, which belong to the same series, and by the fact that outlets existed where placid dams are required.

With the continental rise described above, owing to the land rising more rapidly to the north-east, Lake Warren became dismembered, and Huron, Michigan, and Superior formed one lake; the Erie really was lifted out of the bed of Lake Warren, and be-

came drained; and Ontario remained at a lower level. The outlet of this lake was south-east of Georgian Bay by way of the Trent valley into Lake Ontario at about sixty miles west of the present outlet of this lake. The waters of this upper lake were twenty-six feet over this outlet into the Trent valley, and long continued to flow through a channel from one to two miles wide; and it has cut across a drift ridge to a depth of five hundred feet, as the whole area has been rising. With the continued continental uplift to the north-east (which has raised the old beach at the outlet about three hundred feet above the present surface of Lake Huron), the waters were backed southward, and overflowed into the Michigan basin and into the Erie, thus making the Erie outlet of the upper lakes to be of recent date. This is proven by the fact that the Georgian beach, which marked the old surface plain of the upper great lake, descends to the present water-level at the southern end of Lake Huron, and is beneath the surface of the water upon its north-western side, as the uplift, which has been measured, was to the north-east.

The Erie basin is very shallow, and, upon the dismemberment of Lake Warren, was drained by the newly constructed Niagara River. Subsequently the north-eastward warping eventually lifted up the rocky outlet, and formed Erie into a lake in recent times, thus making it the youngest of all the lakes.

Previous investigations have shown that there was a former river draining the Erie basin, and flowing into the extreme western end of Lake Ontario, and thence to the east of Oswego, but no further traceable, as the lake-bottom rose to the north-east. Upon the southern side there were a series of escarpments, some of which are now submerged. By recent studies of the elevated beaches, it is demonstrated that the disappearance of this valley is due to subsequent warpings of the earth's crust, and that the valley of the St. Lawrence was one with that of Lake Ontario. Recent discoveries show that the ancient St. Lawrence, during the period of high continental elevation, rose in Lake Michigan, flowed across Lake Huron and down Georgian Bay, and a drift filled the channel to Lake Ontario, thence by the present water to the sea, receiving on its way the ancient drainage of the Erie basin and other valleys.

The Huron and Ontario basins are thus sections of the former great St. Lawrence valley, which was bounded, especially upon the southern side, by high and precipitous escarpments, some of which are submerged. But upon their northern sides there are also lesser vertical escarpments, now submerged, with walls facing the old valley. The valley was excavated when the continent was at high altitude, for the eastern portion stood at least two hundred feet higher than at present, as shown by the channels in the lower St. Lawrence, in Hudson Strait, and in the New York and Chesapeake Bays. The valley was obstructed in part by drift, and in part by a north and north-eastward differential elevation of the earth's surface, due to internal movements. The measurable amount of warping defied investigation until recently, but now it is measured by the amount of uplift of beaches and sea-cliffs. Only one other explanation of the origin of the basins has been given, — the "erosion by glaciers." The foundation of this theory is that the glaciers are considered (by some) to erode. A theory of this kind was a necessity, so long as the terrestrial warping was not known.

Living glaciers, however, abrade but do not erode hard rocks; and both modern and extinct glaciers are known to have flowed over even loose morasses and gravels. Again, even although glaciers were capable of great ploughing action, they did not affect the lake valleys, as the glaciation of the surface rocks shows the movement to have been at angles (from 15° to 90°) to the direction of the side of the vertical escarpments against which the movement occurred; also the vertical faces of the escarpments are not smoothed off as are the faces of Alpine valleys, down which glaciers have passed. Lastly, the warping of the earth's surface in the lake region since the beach episode after the deposit of the drift proper is sufficient to account for all rocky barriers which may obstruct the basins.

These papers were followed by an interesting discussion, in which many prominent geologists took part.

A considerable number of papers treated of phenomena similar to those referred to in Mr. Spencer's papers, particular attention being paid to the study of ancient river-beds. A study of wide scope was A. Winchell's report on systematic results of a field-study of the archæan rocks of the North-west. It is not yet agreed what main divisions of the archæan should be recognized, nor whether any divisions exist in nature. The author's study in the region north-west of Lake Superior showed that this region is peculiarly adapted to the working-out of the order of succession of the various formations. He discovered certain stratigraphic discordances which indicate that the archaic rocks embrace three geological systems, which he designates as the equivalent to the Huronian, the Marquettian, and the equivalent to the Laurentian.

Prof. J. S. Newberry reported on the oil-field of Colorado, while E. Orton described recently discovered sources of oil and gas in Ohio, Indiana, and Kentucky. We merely mention the interesting paleontological papers by Professors Newberry and Ward.

Mr. J. T. B. Ives exhibited one of his interesting geological maps in the section, which consists of a series of colored pasteboards, each representing a geological system. The most recent rocks form the highest layer. Wherever they do not exist, the pasteboard is cut out; and the deeper layers, which represent the more ancient formations, are exposed to view, as they are on the earth's surface. By this effective system the distribution of rocks is very clearly shown. The only objection to such a map is, that those regions which are highest in nature appear to be lowest on the map.

We turn with some reluctance from the proceedings of this section, as so much that is of more than passing interest remains that has not been mentioned in these brief remarks.

While the meetings of Section F were not as good as in recent years, those of the Section of Anthropology showed a marked advance; the number of papers handed in being more than sufficient to secure a full programme, and their value being almost without exception very high. The culminating point of the meetings of this section was the discussion following Dr. Brinton's paper on 'The Alleged Mongolian Affinities of the American Race,' in which Major J. W. Powell, Prof. Horatio Hale, Prof. Otis T. Mason, and Prof. Frank Baker took part. Dr. Brinton gave a terse review of the arguments advanced in favor of the theory of the unity of the American and Mongolian races, and tried to refute them one by one. The discussion turned very soon to the question of races and the principles of classification. Major Powell upheld his frequently expressed views, that language is the only means of classifying peoples, although it also is imperfect. He rejected altogether any division founded on physical characteristics found in the relative proportions and in the peculiarities of the parts of the body, on the ground that every attempt in this line has failed. Prof. Horatio Hale agreed with Major Powell in that respect, that he also considered language the fundamental principle of classification. After Frank Baker had defended the methods based on the physical characteristics of peoples, Otis T. Mason was the first to make the discussion clearer by separating the points of view, which had so far been treated promiscuously, — the linguistic and the genealogical standpoints, or, as Dr. Brinton formulated it later on, the historical and genealogical standpoints. While the study of the former is well advanced in North America, the importance of the latter has hardly yet been fully recognized. The interesting discussion, the salient features of which we have here recorded, will, it is hoped, lead to an increased interest in the study of the physical characteristics of the American race.

Dr. Brinton read two papers more, which were as suggestive, and excited as much interest, as the former. He reported on 'Early Man in Spain,' and availed himself of this opportunity to throw open to discussion the question of an early North Atlantic connection between Europe and America, which was taken up by Thomas Wilson. The second paper was on 'Traits of Primitive Speech,' in which the author maintained that interchanging phonetic elements is a characteristic of such languages, and in which he concurred with C. Abel's theory of a root having the meaning of a certain idea, and of its negation at the same time. Unfortunately the limited time at the disposal of the section did not permit this suggestive paper to be adequately discussed. The basis of the inquiry was one that ought to be kept in mind by all philologists. He maintained that when inquiring into the origin of language we ought to know whether there is any language that can claim to be

more primitive than another, and thus he was led to the question, 'What are the characteristics of primitive language?' His conclusions may or may not be correct. It is of great importance to have emphasized the necessity of solving this preliminary question.

Another fundamental problem was brought before the section by Horatio Hale. Since the European origin of the Aryan race has been maintained by many authors, the champions of the old doctrine of their Asiatic origin have taken a firm stand, and looked for new arguments to defend their position. Max Müller's 'Biographies of Words' was written for this purpose, and Professor Hale seconded his friend in his paper 'The Aryan Race, its Origin and Character.' His main argument is that the race must have sprung from one household, that, according to his theory of the origin of language, must have lived in a favorable climate. Its language was originally complex and highly inflected, but in course of time, by mixture of races, became more simple in form. By this mixture he explains the numerous languages and various races of Europe. Next he dwelt upon the character of the original Aryan or his descendants. He believed that the Iranians were pure Aryans, and showed that certain of their traits may be discovered in European races, while others he ascribes to the aborigines they conquered. The paper was listened to with much interest, but did not excite as much discussion as might have been expected.

Horatio Hale's second paper, 'On an International Language,' engrossed at once the attention of the large audience that listened to it. He took up the argument of the American Philosophical Society, and indorsed its action in discussing the value of existing international languages and of the requisites of such a language. He showed the insufficiency of Volapük; and, in consequence of this interesting paper, a motion was brought before the council of the association, and adopted in the concluding meeting, to this effect: —

"Resolved, That, in the event of a congress being convened for considering the subject of an international language for scientific and other purposes, the council be authorized to appoint three members of this association as delegates, with two others as substitutes, to attend, at their own expense, the congress on behalf of the association, it being understood that no decision of the congress shall be binding on the association until it has been accepted in general session."

The committee appointed by the chair consists of Prof. Horatio Hale, Mr. Henshaw, and Professor McFarland.

We will mention in this place that the committee to memorialize Congress for the preservation of archæologic remains upon the public domain made a voluminous report. It was agreed that it would be well if the following remains of early America could be preserved: Chaco Cañon, Cañon De Chelly, Cañon Del Muerto, and Walnut Cañon, the ruin on Fossil Creek, ruins in Mancas Cañon, the round towers situated on the flat valleys of the lower Mancas, and the Cavate Lodges in the cinder cone, about eight miles east of Flagstaff, A.T. The report continues: "Besides these groups of ruins and dwellings, there are isolated remains in the Territories of New Mexico, Arizona, and Utah, numbering over forty, which demand preservation; the pueblos which are not on treaty reservations or grants, and the old Mandan and Arickaree village on the Fort Berthold Indian reservation in Dakota, to be preserved when they cease to be inhabited by the Indians, also certain burial and village sites in Alaska."

The committee in charge of this work — Miss Alice C. Fletcher and Mrs. T. E. Stevenson — have caused a bill to be introduced in Congress providing for a reservation in New Mexico for the purpose of archæologic study.

The important question of paleolithic man in America, which C. C. Abbott had made the subject of his vice-presidential address, was ably treated by Thomas Wilson, who is so thoroughly acquainted with the paleolithic age of Europe and America.

Attractive features of the meetings of this section were Prof. F. W. Putnam's illustrated paper on the 'Serpent Mound,' and the work done there during the last year; Prof. Otis T. Mason's lecture on 'Woman's Share in Primitive Industry,' which was also illustrated by lantern projections; and Col. G. Mallery's report on 'Algonkin Pictographs.' Professor Putnam's energetic action in preserving the Serpent Mound has roused the citizens of Ohio out of their inactivity, and a short time since a committee of ladies has been formed in Cleveland to preserve the interesting remains on Fort Hill. Referring to this matter, the following resolution was passed by the association: —

"Resolved, That we heartily commend the effort of the ladies of the Western Reserve to secure Fort Hill to the people of Ohio; that we appreciate highly the importance of preserving to all time, in perfect condition, one of the wonderful remains of antiquity so fast disappearing, and recommend to the citizens of Ohio the work already begun at the Serpent Mound in that State by the citizens of Massachusetts."

Professor Mason tried to show that there are two branches of civilization, one belonging to each sex, — hunting and procuring food, that of man; arts and industries, that of woman. In a very instructive way he traced the influence of the latter in all branches of life. Colonel Mallery's former work in the line of the study of pictographs has won him so well-deserved renown, that all his communications bearing upon this subject are listened to with the greatest interest, as they must form the basis of all studies on the development of the art of writing.

Among ethnological and archæological subjects which were brought before the meeting of the society, we will mention the important finds of paleolithic implements by Hilborne T. Cresson; the interesting exhibit of a gold ornament from Columbia, and a jadeite tablet from Guatemala, by George F. Kunz; and Stephen D. Peet's papers, in which he once more recapitulated his views on the archæology of America.

In the Section of Biology the theory of evolution occupied a prominent place. The number of leading biologists present was, however, not very large, and consequently the meetings of the section came to an end on Monday. Dr. E. L. Sturtevant read a paper which dealt principally with the limitations of evolution as influenced by human control. He demonstrated, in the case of the dandelion, the variability of the wild species and the practical identity between the wild forms and cultivated varieties. Prof. N. L. Britton called the attention of the section to the discrepancies in biological nomenclature, and urged a method to secure uniformity.

The paper of Thomas Meehan, on 'Adaptation in the Honeysuckle and Insect Visitor,' excited considerable discussion among the members of the section. The views of the author on the dependence of cross-fertilization upon the adaptation of the plant to the insect were not shared generally by the other speakers.

Mr. Burrill contended that the general fact of mutual adaptation was thoroughly established, and that the adaptation to other insects than the honey-bee in the honeysuckle might exist. Creative design or evolutionary development might form a point of discussion.

It was doubted by Professor Riley whether observations upon plants outside of their native habitat could be adduced for proving or disproving the existence of adaptations between plants and insects, the latter likely existing only in the native habitat of the plant.

The botany of Michigan was the subject of several papers by W. J. Beal, who gave a report on very interesting observations on the succession of forests in northern Michigan, and compared the flora of the east and west sides of that State, showing that the west side contained plants of more southern distribution, while the east side showed many northern plants not found on the west side.

The Botanical Club met formally on Wednesday morning, Judge David F. Day presiding, and the Rev. W. M. Beauchamp acting as secretary in Prof. V. Spaulding's absence. Judge Day's address included a memorial of the lamented Asa Gray, and a committee was appointed to draft resolutions on this. Steps were also taken for preserving and publishing the proceedings. It was found inexpedient to change the club into a section. On Friday the following resolutions on Prof. Asa Gray were adopted by a rising vote: —

"Resolved, That the Botanical Club of the American Association for the Advancement of Science sincerely regrets, that, meeting but once a year, it should be among the last of similar associations to place on record its sense of the great loss which the whole range of science suffers by the death of Prof. Asa Gray.

"Resolved, That, though among the last to contribute to the wreath of sorrow with which science is everywhere crowning the memory of Dr. Gray, this body takes a mournful pride in remembering that he was one of its honored members, and that it was as

a botanist he won such eminent renown. We feel that we have a right to be among the chief mourners at his departure from the field of labor he loved so well, and in a special degree to unite in sympathy with the many thousands who miss him everywhere.

"Resolved, That copies of these resolutions be forwarded to the family of our deceased friend, and given to the botanical and other scientific serials for publication."

Mr. S. M. Tracy read an interesting paper by Prof. George Vasey, which was finely illustrated by lantern-slides of the vegetation of the great American desert. A pleasant botanical excursion occupied the afternoon.

Prof. T. J. Burrill of Champaign, Ill., was elected president for the next meeting; B. D. Holsted of Ames, Io., vice-president; and D. H. Campbell of Detroit, Mich., secretary.

The report of the committee on the Botanical Exchange Club was accepted, with the thanks of the club for the valuable work accomplished.

The papers throughout the sessions were both valuable and interesting. Prof. J. F. James presented specimens of remarkable variations in *Dentoria multifida* and *Asclepias tuberosa*. Prof. F. L. Scribner's 'Observations on Nomenclature' brought up the question of who shall have credit for a name. Prof. B. E. Fernow's subject, 'What is a Tree?' called forth lively discussion. The question has come to be of considerable importance to the United States Land Office. Rev. Dr. Beauchamp's paper on 'The Names given to Some Plants by the Onondagas,' was listened to with great interest.

The first paper in the Section for Economic Science was read by B. E. Fernow, and treated of the necessity of a forest administration in the United States, in which he called attention to the vast extent of American forests and the wasteful practices by which this valuable property is being destroyed. He estimated the annual loss to the amount of from ten to twenty million dollars. These forests are situated mainly on the western mountain-ranges, which supply the surrounding semi-arid plains with water for irrigation, necessary for the agricultural development of the soil. The equalizing influence of the forest-cover upon waterflow makes their preservation as continuous forests an absolute necessity. Mr. Fernow recommended that an administrative bureau be formed which should have exclusive charge of the timber-lands of the government. Mrs. Laura Talbot of Washington distinguished herself by bringing the subject of industrial education, which has lately excited so much interest, to the attention of the section. Her paper was a vigorous plea for the establishment of industrial schools for children who are now placed in public orphan-asylums and reformatory institutions. Mrs. Talbot denounced the present system of caring for the waifs of the great cities of the country, asserting that it was educating these unfortunates to idleness and crime. She favored manual training in connection with these industrial institutions, as well as farming in all its branches. In the discussion that followed, a number of well-known educators took part, who expressed themselves in favor of manual training in connection with these schools.

Professor Atkinson's valuable paper on 'The Use and Abuse of Statistics' elicited a spirited reply from Col. E. Daniels on the question of currency on which Atkinson had touched, maintaining that a strictly metallic currency would greatly benefit the country. Daniels, on the other hand, said that coined legal-tender money, whatever its material, is of precisely the same purchasing-power, whether of paper, gold, or silver. It will pay precisely the same amount of debt. Coins are nothing else than tools of exchange. They vary in price or exchangeable value according to the number of them offered in the market. Daniels set forth his favorite views more fully on another day, when reading a paper on 'Our Monetary System.'

Discussion in the same line followed Edward N. Ammidown's paper, 'Suggestions for Legislation on the Currency.' He summarized his views in the demand that financial legislation in the United States should aim to increase the use for gold and silver money throughout the country, and to expand its volume in proportion to the growth of population and business. It should encourage the free issue of national bank currency under similar rules which now prevail to secure the easy and rapid expansion and contraction in harmony with the fluctuating requirements of trade. Such a policy would give the country a broad, substantial basis of metallic legal tender, and, through the national bank currency, furnish the means to maintain easily that equilibrium between demand and supply of money which is essential to continuous national prosperity.

The question of gold and silver was also the subject of a paper by S. Dana Horton, which was read on Monday, in which he considered the opinion established that parity of metals can be maintained by concurrent laws of nations. The question is only a political one whether the European nations will pass these laws.

E. Atkinson's paper, which was mentioned above, covered a wide range of facts. He dwelt upon the abuse of statistics in the separate comparisons of rates of wages and prices of goods, and emphasized the necessity of careful training in this branch of science in order to avoid false deductions and conclusions. His prime object was to show, that, unless statistics are made use of as a basis of economic reasoning by persons competently trained, they become a mere snare and pitfall, working more harm than good through the false deductions that may be made from them; while, on the other hand, the economist who attempts to reason on the condition of men in their relation to each other without regard to the statistics of prices, wages, volume of currency, and other elements by which the exchange of services is contrasted or measured, will, of necessity, be a mere theorist whose unsustained hypotheses may not come near the mark.

On the following day W. O. Atwater subjected the doctrine of Malthus, and his views on the food-supply of the future, to a critical study, and found that the prospects for a greatly increased supply by the use of the discoveries of modern science are very hopeful, and that we do not need to fear the ultimate starvation of mankind. Mr. Charles S. Hill, in his paper on 'Ship-Building and Shipping,' reviewed the history of the decline of American shipping. He vigorously denounced the action of Congress in withdrawing that national aid from American shipping which enabled it to compete with the British. He demanded that ship-building and shipping should be revived in this country by all possible means, and showed how many industries and trades would thus receive a new impulse. The most important paper of this day was a report on the progress made in the work of surveying the Nicaragua Canal route. It will be remembered that at the New York meeting a general sketch of the work done up to that date was given, and the Nicaragua Canal Association did not lose its opportunity at the present meeting of again calling the attention of the public to its enterprise. A photographic reproduction of a bird's-eye view of Nicaragua, and a map (on Mercator's projection) showing the routes around Cape Horn and through the projected canal, were exhibited. Commander Taylor's general report on this subject went materially over the same ground as many of his former lectures on the same subject, but he added a report of the proceedings of the association during the past year. He stated that the contract of 1887 with the republic of Nicaragua had been supplemented recently by one of similar tenor with Costa Rica, perfecting the exclusive title of the Canal Association. A bill to incorporate the Maritime Canal Company of Nicaragua has passed the United States Senate, and now awaits action by the House of Representatives, having been favorably reported by its committee on commerce, with the expression of the committee's full satisfaction as to the financial standing of the Canal Association. Next, Lieut. R. S. Peary gave a sketch of the history of surveys, and of the work done during the present spring. The methods of work were as follows: The expedition being divided into parties and the work into sections, the locations of 1880 in the western division, and of 1872–73 and 1885 in the eastern, were taken as bases, and a main transit and level line run, and bench-marks established about every thousand or two thousand feet. These benches were then checked. From this transit-line, compass, chain, and aneroid offsets were run from one thousand to two thousand feet on both sides; adjacent streams, valleys, and hills reconnoitred; and the work plotted. With this chart in hand, the entire line was then gone over in the field by the engineer in charge, accompanied by the chief of the section, and the location decided upon. The location was then run in and levelled, checking upon the benches of the preliminary line, and cross-sections run and levelled from one hundred to four hundred feet apart, along the

main line, as the topography demanded. Sometimes portions of this location were modified and re-run. Streams were then surveyed and gauged, neighboring elevations beyond the limits of the canal taken with the aneroid, and the entire work plotted on a four-hundred-foot scale with a ten-foot contour. The boring party then went over the line, boring on all summits and in all depressions, and penetrating to the level of the canal-bottom unless rock was encountered sooner. Borings were also made on the sites of all locks, dams, and embankments.

Two perfectly practicable routes of about equal cost were found, either of which is far superior to any other route across the isthmus; and when the day comes, as it surely will, when one canal cannot accommodate the traffic seeking it, then the other can be built, and give one canal for eastward and one for westward bound vessels. The computations of the notes of the surveys being yet incomplete, precise quantities and estimates cannot now be given. In general terms the quantities in the sections where no modifications are made will be the same as those of 1885, while the saving from modifications will be from ten million to fifteen million dollars. The item of earth excavation, with its varied plant of excavators, cars, locomotives, etc., and its attendant expense of maintaining and shifting tracks and handling material in rainy weather, is reduced to a minimum, and the construction of the canal provided for practically under the three heads of hydraulic mining, rock-excavation, and dredging, all independent of drainage and rains. The work can be prosecuted day and night without interruption. Numerous borings have made an end of the bottomless swamps, semi-liquid quicksands, and numerous other subterranean bugbears which have been conjured up against this route, and have shown that in no portion of either line is there any trouble about foundations. In the worst swamps the boring implement, after sinking with its own weight perhaps ten or at most fifteen feet, reached a stratum of firm red clay extending to bed-rock. The experience of the expedition is worth volumes as evidence concerning the effects of the climate of Nicaragua. During the seven months it was in the field, not a man out of nearly two hundred was lost, and there was not a single case of serious illness. The size and capacity of the canal will not vary materially from the plans of 1885. The number of locks will be reduced to six, and possibly five, and the time of lockage to thirty minutes. The general dimensions and methods of construction of the locks are not changed, but the double lock at La Flor is a new feature.

C. K. Remington's plea for cremation was very much contested by various members of the section. The paper was illustrated with diagrams on the blackboard, and the process of incinerating a body was fully explained. The description of the construction of a crematory was especially interesting. In answer to questions propounded, Mr. Remington stated that cremation was necessary as a sanitary measure. He also contended that the land used for cemeteries was needed. He thought it much better that a body should be reduced to dust in an hour than for it to lie in the ground for years.

Mr. Henry Farquhar gave, under the title 'Economic Value of Binary Arithmetic,' a paper that was more interesting from a theoretical point of view than from a practical. He explained the advantages that would accrue from the substitution of two for ten as a basis for counting. Instead of having to commit sums of figures to memory, we would perform addition by simply counting the marks of similar shape. There would be no multiplication table to learn, all multiplication being resolved into displacement of symbols on a regular plan. This would bring a considerable degree of arithmetical skill within reach of many who cannot possibly attain it at present.

On Tuesday J. R. Dodge read an interesting paper on 'The Agricultural Surplus.' He pointed out that the United States have a surplus of agricultural products very large in proportion to the total volume. He considered this fact an element of strength and of weakness, and at the same time a subject of congratulation and regret. "The congratulation," he said, "is found in the ability to relieve the deficiencies of needy nations, while swelling the plethora of domestic wealth: the regret is for the tendency to over-production of certain crops, and its inevitable result. This is the reduction of prices for the benefit of the foreign purchaser, without any advantage to the producer. Very few people know the extent of our net surplus in agriculture. Almost every one exaggerates it." Mr. Dodge continued to show that the value of the exported product at farm prices is less than $400,000,000. The value of the deficiency supplied by import very nearly reaches $350,000,000. Thus we have a surplus sufficient to pay for our deficiency, and little more. This is the net result of our boast of feeding the nations. We feed them just a little more than they feed us. The lesson we learn from these facts is, that no nation can afford to have a deficiency of the raw products of agriculture; and, as a rule, nations do not. There is one notable exception, and that is apparent more than real. Great Britain seems to have a large deficiency. Really it is largely made good by shipments from her own colonies, of the dividends of her own capital, under the technical name of 'imports.' Our agriculture, therefore, should seek to supply deficiencies rather than to swell surplus crops; to meet the present wants of domestic markets, and create new wants by a greater variety of edible products, especially the fruits; and afterwards supply any deficiency of foreign nations that is practicable or possible.

Last of all we mention W. F. Switzler's sketch of the history of statistics, in which he showed that at the earliest stages of civilization attempts to ascertain statistical data were made, and in which he traced the gradual development of that science. He dwelt upon the importance of statistics to the statesman, whose art is thus made "to rest on the solid masonry of well attested and accomplished facts, the granite pedestal of recorded history. It is no longer a speculation: it has become a mathematical demonstration. It is no longer a prophecy: it is a revelation." The paper closed with an interesting history of the methods of gathering statistical data.

The meetings of this section were well attended, and there was sufficient material on hand to keep the section busy until the end of the meeting.

EVIDENCES OF THE ANTIQUITY OF MAN IN EASTERN NORTH AMERICA.[1]

IN studying the history of man we have to adopt the same methods and draw the same inferences as have been done in tracing the evolution of animals. This, strangely enough, seems repugnant to very many, who feel that any relationship, however remote, with less intelligent creatures, is a reflection upon their own intelligence.

To determine at what precise point in geological time man appeared upon the earth, is, it seems to me, obviously impracticable, from the fact that the dividing-line separating humanity from the non-human cannot be drawn. It were as easy to name the moment when the gloaming merges into night, or shout with confidence, 'Now!' as the dawn brightens into day. Nor is it demonstrable, with our present knowledge, to point to that country where the momentous change first took place, if it occurred but once. At present, however, we can safely say that miocene man is extremely problematical, and pliocene man a question as yet unsettled; the auriferous gravels of California being pronounced late tertiary by Whitney, and by LeConte as representing "the beginning of the glacial epoch."

At all events, we have neolithic man as far back as the glacial epoch, and possibly in the pliocene. Man in the tertiaries, therefore, championed by my honored predecessor, Professor Morse, becomes something more tangible than a hypothetical creature. Professor Putnam has arrived at the conclusion that the western coast of our continent was inhabited by man in earlier geological times than the eastern half.

Mr. Warren Upham has examined the drift formation of Little Falls, Minn., where Miss Babbitt found those extremely rude but unquestionably worked quartzes, and describes it as the flood-plain of a river of the glacial epoch.

In 1883, as the result of exhaustive studies of glacial deposits, from New Jersey westward, across Ohio, Rev. G. Frederick Wright predicted that traces of paleolithic man would be found in the latter State.

[1] Abstract of an address before the Section of Anthropology of the American Association for the Advancement of Science, at Cleveland, O., Aug. 15–22, 1888, by Charles C. Abbott, vice-president of the section.