swallowed up by the lake, but when one of the great downfalls referred to occurred, it would not immediately sink, but would float off across the lake, a great floating island of rock. At about three o'clock an is land of this character was formed estimated to be about 125 feet long, 25 feet wide, and rising 10 to 15 feet above the surface of the lake. Shortly after, another great fall took place, the rock plunging out of sight beneath the lava. Within a few moments, however, a portion of it, approximately 30 feet in diameter, rose up to an elevation of from 5 to 10 feet above the surface of the lake, the molten lava streaming from its surface, quickly cooling, and looking like a great rose-coloured robe, changing to black. These two islands, in the course of an hour, floated out to the centre, and then to the opposite bank. At eight in the evening they had changed their appearance but slightly, but the next morning they had disappeared." It was observed that, as the falls occurred, the exposed surface, sometimes more than 100 feet across, was left red-hot. Sometimes a great mass would fall forward like a wall; at others it would simply collapse and slide down, and again enormous boulders, as big as a house, singly and in groups, would break from their fastenings, and, all aglow, leap far out into the lake. It is believed that this is the first break-down of Kilauea that has taken place in the presence of observers, those prior to 1868 being before the establishment of the Volcano House, and those of 1868, 1886, and 1891, and several minor ones, all having occurred at night when no one was present.

THE additions to the Zoological Society's Gardens during the past week include a Slender Loris (*Loris gracilis*) from Ceylon, presented by Miss Grace Thomson; two Wild Swine (*Sus* sp. ?) from Turkish Arabia, presented by Mr. F. G. Beville, H.B.M. Consul; three Agoutis (*Dasyprocta* sp. ?) and two Orange-winged Amazons (*Chrysotis amazonica*) from the Island of Tobago, presented by the Hon. W. Low; a Raven (*Corvus corax*), European, presented by Mr. Ogilvie Grant; a Green Turtle (*Chelone viridis*) from the West Indies, presented by Mr. E. Leach; a Japanese Teal (*Querquedula formosa*) from North-eastern Asia, purchased; a collection of Marine Fishes, purchased; two Shamas (*Cittocincla macrura*) from India, received in exchange; a Brazilian Blue Grosbeak (*Guiraca cyanea*), and a Red-headed Marsh Bird (*Angelæus ruficapillus*) from Brazil, received in exchange; and a Diana Monkey (*Cercopithecus diana*) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN.

THE HARVEST MOON.—This year's Harvest Moon will be exceptionally conspicuous. On the day of full moon, September 14, the ascending node of our satellite's orbit will be only 1° 35′ from the vernal equinox. The inclination of the orbit to the horizon will therefore be very nearly the same as if the node were exactly at the equinox. Owing to this, the moon is longer above the horizon than she is at other times of the year. On the average, the moon rises fifty-one minutes later every night; but for a few evenings before and after the coming full moon, the average interval is only about ten minutes.

ECLIPSE OF THE MOON.—A partial eclipse of the moon, partly visible at Greenwich, will occur early on Saturday morning. The first contact with the penumbra takes place at two o'clock in the morning, the first contact with the shadow at 3h. 36m., and the middle of the eclipse happens at 4h. 32m. The last contact with the shadow will occur at 5h. 27m. As the moon sets shortly after, the last contact with the penumbra will not be observable. Taking the moon's apparent diameter as equal to 1, the magnitude of the eclipse = 0 225.

M. TISSERAND ON SATELLITE-ORBITS.—M. Tisserand's recent investigations on the satellite of Neptune have already been referred to in these columns (vol. xlix. p. 543). He has shown that the equatorial protuberance of Neptune causes the direction of the major axis of the orbit of the satellite to change, and that the reaction of the satellite itself modifies the position of the plane of the planet's equator. As the mass of the satellite is comparatively small, the latter effect can be neglected for a considerable period of time. But when the difference of mass between a primary and its companion is not great, the case is altered. In the *Bulletin Astronomique* for August, M. Tisserand investigates the various conditions affecting the secular displacements of the equator of a planet and the satellite-orbit. He cites the Algol system as a case in which the two members—that is, the luminous star and the dark companion revolving round it—have comparable masses. The distance separating the pair is also commensurate with their dimensions. Under these conditions, the variations of the equator and those of the orbit of the satellite, can be treated at the same time. The secular inequalities undergone by the equator and the orbit doubtless cause the proportion of the bright star's disc eclipsed by the dark companion to vary with the lapse of ages. A secular change in the range of variability must result from this. Observations extending over a long interval of time should also show changes in the periods of variables like Algol. M. Tisserand considers cases of this kind and develops the formulæ relating to them. The discussion of the formulæ is reserved for a future communication.

THE DISTRIBUTION OF NEBULÆ AND STAR-CLUSTERS.—Mr. Sidney Waters has mapped the positions of the nebulæ and star-clusters—7840, in all—contained in the New General Catalogue, and two excellent lithographed charts, given in the number of *Monthly Notices*, R.A.S., just issued (vol. liv. No. 8), show the results of his labours. The Milky Way is drawn upon the charts, the portion for the northern heavens being taken from Dr. Boeddicker's fine maps, while that in the southern heavens is copied from the *Uranometria Argentina*. Mr. Waters designed the maps with two objects. First, to study the distribution of nebulæ and clusters of stars, and, secondly, to guide astronomers engaged upon the observation of nebulæ to fields of research. Clusters are shown upon the charts by means of red crosses, resolvable nebulæ by red dots, and irresolvable ones by black dots. The distribution of these objects is thus taken in at a glance. Whether, in the light of recent research, it was desirable to continue to recognise this difference between nebulæ is a matter of opinion; one point in favour of the distinction is that it was followed in similar maps drawn by Mr. Waters and laid before the Royal Astronomical Society in 1873, so that the two sets are easily comparable. The present charts show very clearly the peculiarities of the distribution of clusters and nebulæ. Referring to the former, Mr. Waters says: "It is striking to note the fidelity with which they follow not only the main track of the Milky Way but also its convolutions and streams. They appear in many parts to seek out the denser regions, and to avoid with an equal persistence the dark spaces." As to nebulæ, we read (and the maps bear out the remarks): "A proportionate scattering of resolvable nebulæ follow the others throughout the charts, showing that they are probably intermixed, and that the resolvability of many of them must not necessarily be regarded as a criterion of their distance. The remarkable avoidance of the nebulæ of the galaxy, although in some points reaching up to and encroaching upon its edges, is equally significant with the coincidence of the clusters with its main track." It is pointed out that the exceeding nearness to one another of very many of the nebulæ suggests the probability of physical connection analogous to that of double stars, hence long-continued observations may lead to the detection of similar orbital motions. Other fields of research are suggested by the charts, and by exploring them new light will certainly be thrown upon the structure of the sidereal universe.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

A GENERAL account of the recent meeting of the American Association for the Advancement of Science was contributed to our last issue by Dr. W. H. Hale. We are now able to give a few extracts from presidential addresses, together with descriptions of some of the papers read before the different sections.

In the course of his reply to the address of welcome to

Brooklyn, Dr. Daniel G. Brinton, the President, thus expounded the aims of the Association.

"The influence of our Association is in the highest and best sense of the word educational. Its discussions are aimed to present the correct methods of scientific investigation and to be guided by the true spirit of scientific inquiry.

"The goal which we endeavour to attain is scientific truth, the one test of which is that it will bear untrammelled and unlimited investigation. Such truth must be not only verified, but always verifiable. It must welcome every test, it must recoil from no criticism, higher or lower, from no analysis and no scepticism. It challenges them all. It asks for no aid from faith; it appeals to no authority; it relies on the dictum of no master.

"The evidence, and the only evidence, to which it appeals or which it admits is that which it is in the power of every one to judge, that which is furnished directly by the senses. It deals with the actual world about us, its objective realities and present activities, and does not relegate the inquirer to dusty precedents or the mouldy maxims of commentators. The only conditions that it enjoins are that the imperfections of the senses shall be corrected as far as possible, and that their observations shall be interpreted by the laws of logical induction.

"Scientific truth has likewise this trait of its own: it is absolutely open to the world; it is as free as air, as visible as light. There is no such thing about it as an inner secret, a mysterious gnosis, shared by the favoured few, the select *illuminati*, concealed from the vulgar horde or masked to them under ambiguous terms. Wherever you find mystery, concealment, occultism, you may be sure that the spirit of science does not dwell, and what is more, that it would be an unwelcome intruder. Such pretensions belong to pseudo-science, to science falsely so called, shutting itself out of the light because it is afraid of the light.

"Again, that spirit of science which we cultivate and represent is at once modest in its own claims and liberal to the claims of others. The first lesson which every sound student learns is to follow his facts and not to lead them. New facts teach him new conclusions. His opinions of to-day must be modified by the learning of the morrow. He is at all times ready and willing to abandon a position when further investigation shows that it is probably incorrectly taken. He is in this the reverse of the opinionated man, the hobby rider and the dogmatist. The despair of a scientific assemblage is the member with a pet theory, with a fixed idea, which he is bound to obtrude and defend in the face of facts. Yet even towards him we are called upon to exercise our toleration and our charity, for the history of learning has repeatedly shown that from just such wayward enthusiasts solid knowledge has derived some of its richest contributions.

"All this prying into the objective, external aspect of things, this minute, painstaking study of phenomena, this reiterated revision and rejection of results, are with the single aim of discovering those absolute laws of motion and life and mind which are ubiquitous and eternal, which bear unimpeachable witness to the unity and the simplicity of the plan of the universe, and which reveal with sun-clear distinctness that unchangeable order which presides over all natural processes.

"This is the mission of science—noble, inspiring, consolatory, lifting the mind above the gross contacts of life, presenting aims which are at once practical, humanitarian, and spiritually elevating."

Mathematics and Astronomy.

The address of the vice-president of Section A (all the sectional presidents are termed vice-presidents) was summarised in our last number. In this section Prof. George E. Hale gave an interesting paper on "Some Attempts to Photograph the Solar Corona without an Eclipse."

C. W. Hough presented a method of control of the equatorial driving clock, based on a description published in the Transactions of the Albany Institute in 1871.

W. R. Warner, on "Requisites for Governing the Motion of Equatorial Telescopes," told of the differing resistance produced by weather, oil, or the lack of it, &c., which a driving clock must overcome in order to run accurately.

Prof. Doolittle exhibited a large diagram showing the results of the recent latitude determinations at the Sayre Observatory, of South Bethlehem, Pa. The Chandler theory and these observations differ so much that one can hardly be called an approximation of the other. Prof. Doolittle finds a dimunition in the mean value of the latitude which is entirely unaccounted for.

Physics.

The subject of the presidential address to this section was "Obscure Heat as an Agent in producing Expansion in Metals under Air Contact." The address contained the results of a study of the forces under which the expansion and contraction of metals take place, under the conditions in which they are used in every-day experience. Among the papers communicated to the section was one by Miss Mary Noyes, on the influence of heat and electricity upon Young's modulus for a piano wire. It appears that the effect of heat is to make the modulus less. Magnetism has no effect. The passage of a current of electricity through the wire causes the modulus to diminish more than can be accounted for by the heating effect.

W. Hallock, of Columbia College, who has photographed sensitive flames, exhibited specimens.

Dr. Bedell presented a paper by Prof. Nichols and Miss Crehore, of Cornell University, giving studies of the lime-light. They have examined the light from the lime cylinder of the Drummond light, by means of a spectro-photometer.

In a paper upon aluminium violins, Mr. Springer discussed their merits. He said that soundboards made of aluminium differed from those made from other metals, and were analogous to those of wood. They did not produce secondary tones which were not in harmony with the prime tones. There were many difficultities to be overcome in the manufacture of violins from aluminium. The material could not be soldered satisfactorily, and had to be rivetted. As uneven thicknesses could not be secured for the belly and back, it was necessary to rib and arch the metal. In conclusion, he said: "My experiments incline me to believe that the real cause of the superiority of old wooden instruments over new ones is not so much in the elasticity of the wood or in the composition of the varnish, but in the peculiar warping of the wood to a higher arch, a buckling caused by the position of the F holes and sound-post. I have never seen a good old instrument which was not thus warped. Moreover, I believe if a new wooden instrument were immediately so constructed, while good at first, would deteriorate because further arching would produce rigidity and consequent veiling of tone. Time has no such effect on aluminium violins, as they remain practically unaltered; one which has been used daily for the last two years shows no signs of crystallisation. A perfect instrument would consequently retain all of its good qualities, and could easily be duplicated."

Two papers of considerable interest were read, one by A. McAdie, on some peculiar lightning flashes, and the other on a phonographic method of recording the change in alternating electric current, by C. J. Rollesson.

Mr. McAdie said that in the month of June, 1894, there were one hundred persons killed by lightning in the United States. It is, therefore, important to get accurate knowledge about lightning discharges, especially in reference to the length and form of the path of lightning, so as to discover its energy. Mr. McAdie has three cameras pointed at the top of the Washington Monument, in the city of Washington; one at the Capitol, a second at Fort Myer, and the third at the Weather Bureau. He wishes to obtain three simultaneous photographs of a lightning discharge, but though he has watched since May, he has not been successful.

Mr. Rollesson said that two operations were necessary to produce the alternating current curve by the aid of the phonograph: first, a record of the curve must be produced on the wax cylinder of the phonograph; second, the record produced in the second operation must be magnified by means of a suitable multiplying arrangement. The method described was especially adapted for the study of harmonics in the alternating current.

Chemistry.

The subject of Prof. T. H. Norton's address was "The Battle with Fire, or the Contributions of Chemistry to the Problem of Preventing Conflagration." We hope to be able to print this address in full in a future issue.

Among the papers read before the section was one upon observations regarding certain European water supplies, by William P. Mason. It was shown that the difference in the death-rate of various towns and cities in Europe, caused by improvement in the water supplies, varied from 2 to 13 per cent. "Fallacies of Post-mortem Tests for Morphine" was the title of a paper by David L. Davoll. Other papers before this

section were on the behaviour of allylmalonic, allylacetic, and æthylidenpropionic acids when boiled with caustic soda solutions, John G. Spenzer; camphoric acid, W. A. Noyes; double halides of antimony and potassium, Charles H. Herty; some peculiar forms of iron, T. H. Norton; on the existence of ortho-silicic acid, T. H. Norton; volatility of certain salts, T. H. Norton; a new formula for specific and molecular refraction, W. F. Edwards; action of nitric acid upon the chlorides of zinc, bismuth, and cadmium, O. C. Johnson; and a convenient milk sampling tube, M. A. Scovell.

Mechanical Science and Engineering.

Dr. Mansfield Merriman delivered an address before Section D, on "the resistance of materials under impact." He pointed out that the science of the resistance of materials, as taught in text-books and used in the daily practice of every engineer, was mainly that of static conditions where external force is resisted by internal stress. The question of resistance to the impact of falling bodies, likely to occur in machinery, on bridges, and to a certain degree also in buildings, is recognised as important, but it is seldom reduced to computation or made the occasion of careful experiment. Even the fundamental principles and laws regarding it seem often not clearly understood. Dr. Merriman's address was an attempt to set forth the present state of knowledge concerning impact, and to reconcile some of the apparent paradoxes that often arise in the discussion and application of its principles.

The first paper before the section was on the crank curve, by J. H. Kinealy, secretary of the section. In this paper a simple graphical method was given for determining the velocity of the piston of a steam engine for a given positon of the crank. The next paper was on preliminary experiments on a new air pyrometer for measuring temperatures as high as the melting point of steel, by D. S. Jacobus. Experiments made at the Stearns Institute show that three pyrometers gave concordant results in measuring extremely high temperatures.

Another paper, by Prof Jacobus, was on improvements in methods of testing automatic fire sprinkler heads. Automatic fire heads for extinguishing fires have now come into common use. In these a valve is opened automatically in case of fire, by the melting of a fusible solder piece, and the water from this valve puts out the fire. The method of making tests on such heads was described in detail. A paper, by Prof J. E. Denton, was read on the ratio of the expansion of steam in multiple expansion marine engines for maximum economy in East River steamers. This was followed by a paper by Samuel Marsden, on experiments on the transverse strength of long-leaf yellow pine. The results of numerous experiments were presented. The last paper was by Elmo G. Harris, on the air-lift pump.

Geology and Geography.

The president of this section, Samuel Calvin, took for his subject "Niobrara Chalk." The Niobrara stage of the Upper Cretaceous is well represented along the Missouri, from the mouth of the Niobrara River to the mouth of the Big Sioux. East of the Sioux, beds of the same stage are found at various points in Iowa as far eastward as Auburn in Sac country, while fossils distributed through the drift indicate the former existence of cretaceous strata at points many miles farther east than any locality where they are not known to occur in place. The general distribution of the Niobrara deposits covers an area reaching from Western Iowa to the Rocky Mountains, while north and south it stretches from Texas to Manitoba, and probably northward to the Arctic Ocean. The address was limited, however, to a description of some of the characteristics of the Niobrara chalk exhibited in the somewhat restricted region lying between the mouth of the river from which the formation takes its name, and the most eastern exposure of the beds at present known, near Auburn, Iowa.

Major J. W. Powell read a paper on the water resources of the United States. Mr. Powell said that the ultimate development of the United States rested largely upon the most thorough utilisation of the water resources. This was conspicuously true of the vast arid and sub-humid regions extending from the great plains to the Pacific coast. There the almost boundless extent of fertile land could not be utilised for agriculture without the artificial application of water. In all cases, whether in arid or in humid regions, the proper solution of the problem rested upon the correct knowledge of the distribution and fluctuation of the available water. This study had been begun by the United States Geological Survey, and was now being carried on.

Prof. W. J. McGee read a paper by F. H. Newell, on the Geological Atlas Folio issued by the United States Geological Survey. These folios are the final maps of the survey showing the topography, geology, and the mines of the areas covered by the sheets. Accompanying the maps are the descriptions of the same in popular rather than technical language, for the benefit of the people. The folios have involved a great expense, and represent probably the finest specimens of geological lithography that are known.

Mr. Joseph H. Hunt described briefly the minerals from Paterson, Upper Montclaire, N.J., and the Palisades, and exhibited excellent specimens, some of which showed in a beautiful manner the process of alteration of one mineral into another.

Dr. W. H. Dale, in a paper, entitled "Notes on the Atlantic Miocene," showed that the vast deposits of phosphate rock of South Carolina, which have yielded millions of dollars, are of Miocene age, like those of Florida.

Prof. Spencer read an interesting paper upon the age of Niagara Falls. He said that the first conjecture as to the age of Niagara Falls was made by Andrew Ellicott in 1790, who supposed the Falls to be 55,000 years old. About 1841 Lyall estimated the age of the Falls as 35,000 years. According to Prof. Spencer, the evolution of the Falls was as follows: A little stream draining the Erie basin only fell about 200 feet over the brow of the Niagara escarpment, and in magnitude was just about the size of the American Falls. This stream was not over one-fourth the present volume of the great cataract, and, consequently, was able to excavate the gorge at a much lower rate than at present. During this early history of the river the waters of the three upper lakes emptied through the Huron basin by way of the Ottawa River. The height of the Falls has advanced several times, and, owing to this change and the variation in the discharge of the water, retreat of the Falls has varied greatly during changing episodes. The computations of the age have been based upon these changing conditions of elevation and downfall of the river. The first episode, as before stated, represented a small river, with a total fall of 200 feet. This lasted about 11,000 years. Then fell another episode, where the height of the Falls was increased from 200 to 400 feet, succeeded by the entire drainage of all the upper Great Lakes. At the same time there were series of three cascades, the lower gaining on the upper, until finally they were all united in one great cataract, much higher than that of the present time. Subsequently the waters were raised at the head of Lake Ontario so as to bring about the present conditions after a lapse of 17,000 years from the end of the first episode. The last or modern episode has lasted 3000 years under nearly the present conditions. Thus we see that the age of the Falls is about 31,000 years, with another 1000 years added for an earlier condition not given. It is now 8000 years since Lake Huron emptied into Lake Erie for the first time. The land has risen about the outlet of Lake Erie, and if the present rate continues, in 5000 or 6000 years the waters of the four upper lakes will be turned into the Mississippi River drainage at Chicago.

Zoology and Botany.

Among the papers read before the section of Zoology were the question of spider bites, L. O. Howard; the pulmonary structures of the Ophidia, Edward D. Cope; photographing fishes and other aquatic animals under water by means of a vertical camera, Simon H. Gage; a migration of cockroaches, L. O. Howard; sexual characters in Scolytidæ, A. D. Hopkins; notes on the genus *Perigoninus*, Sars, Charles W. Hargett; the transformations of the lake and of the sea lamprey, S. H. Gage; on the above-ground buildings of the seventeenth year Cicada, J. A. Lintner.

Prof. L. O. Howard described an extraordinary migration of Croton bugs or German cockroaches, witnessed by him on the streets of Washington on a very dark day last summer. He found that the migrating army, which was composed of many thousands of individuals, consisted almost entirely of females carrying egg-sacs.

At a joint meeting of the sections of Botany and Zoology, Dr. Manly Miles read a paper on the limits of biological experiments. Among other things the speaker pointed out the futility of most feeding experiments. During the discussion which followed, Prof. Edward Cope remarked: "If Weissmann

had been a better botanist he would never have promulgated his theory of the isolation of the germ plasm."

Prof. L. H. Bailey discussed the relation of the age of type to variability. He called attention to the wide range in variability of cultivated types, some of which, he said, vary so much and so quickly that specific types may be lost, yet the difference was not due to age or period, nor to geography or diversity of cultivation. Continuing, he said:

"Variability under cultivation must be ascribed to some original elasticity of the species, and this elasticity or flexibility is no doubt intimately associated with the phylogeny of the type. The common notion that man can modify any plant in given directions is not true. The newer the type the more readily does it vary. All this establishes an intimate relationship between development under cultivation and evolution under natural conditions. They are not two, but one, and the agriculture (*sic*) of man is but an extension of the agriculture of nature."

Prof. Bailey also read a paper on the struggle for existence under cultivation, and during the course of his remarks he said—

"It is commonly supposed that struggle for existence ceases under cultivation, and that man's endeavours and nature's are two. Here we have statistics. There are enough seeds in the United States to stock the world. It is observed that in cultivation there is less waste than in nature. Struggle is more intense than in nature. Not more than one in twenty or more which actually germinate are allowed to mature. But it is a struggle of few against few, rather than a struggle of few against many. This struggle, therefore, instead of fixing the specific type in a warfare against outsiders, sets up a divergence among individuals of the species itself. This, to my mind, is one of the reasons for the rapid development of garden plants."

Other papers read before the joint meeting were:—The numerical intensity of faunas, L. P. Gratacap; the growth of radishes as affected by the size and weight of the seed, B. T. Galloway; the work of the Indiana Biological Survey, A. W. Butler; the movement of gases in rhizomes, Katherine E. Golden; some interesting conditions in wood resulting from the attacks of insects and woodpeckers, A. D. Hopkins.

A paper on evidence as to the former existence of large trees on Nantucket Island, by Dr. Burt G. Wilder, was read before the section of Botany.

Dr. Byron D. Halstead, in a paper upon a root rot of beets, before the section of Botany, described a new disease of those plants.

Major J. Hotchkiss showed specimens of wood cut from trees that had been marked by surveyors 107 years ago. The presence of the injury was still manifest upon the surface of the trees. The growth per year was about one-twentieth of an inch.

Dr. E. F. Smith read a paper on watermelon disease in the south. Other papers read were:—The sugar maples of Central Michigan, W. J. Beal; some affinities among Cactaceæ, John M. Coulter; simplification and degeneration, Charles E. Bessey; regulatory growth of mechanical tissue, Frederick C. Newcombe; further studies in the relationship and arrangement of the flowering plants, Charles E. Bessey.

Anthropology.

Dr. Franz Boaz's address to this section was on human faculty as determined by race. He traced the history of civilisation from its dawn in the far East until now, showing how ideas and inventions were carried from one nation to another. He referred to the civilisations in ancient Peru and Central America, and showed that the general advancement was the same as in Asia and Europe. The only difference was one of time. One reached a certain stage 3000 or 4000 years earlier than the other. But this difference was insignificant compared with the age of the human race. Man had existed for a period to be measured by geological standards only. He showed that, in the past, nations brought into contact with civilisation easily assimilated it, and now they dwindled away before its approach. This was due to the fact that formerly races did not differ so widely as at present, and now disease devastated regions newly opened to white people. The conditions for assimilation in ancient Europe were much more favourable than in countries where primitive people now came in contact with civilisation. This conclusion was confirmed by other facts from the history of civilisation—Northern Africa and in China.

Dr. Boaz remarked: "Several races have developed a civilisation of a similar type to the one from which our own had its origin. A number of favourable conditions facilitated the rapid spread of this civilisation in Europe. Among these common physical appearances, contiguity of habitat and moderate differences in the modes of manufacture were the most potent. When, later on, civilisation began to spread over other continents the races with which the modern civilisation came into contact were not equally favourably situated. In short, historical factors appear to have been much more potent in leading races to civilisation than their faculty, and it follows that achievements of races do not warrant us to assume that one race is more highly gifted than another."

He also said: "After going over the field of anatomical differences, between races, so far as they have a bearing upon our question, our conclusion is that there are differences between the physical characters of races which make it probable that there may be differences of faculty. No unquestionable fact, however, has been found yet which would prove beyond a doubt that it will be impossible for certain races to attain a higher civilisation."

Dr. Boaz expressed the opinion that the probable effect of civilisation upon an evolution of human faculty has been much over-estimated. The psychical changes which are the immediate consequence of civilisation may be considerable. They are changes due to the influence of environment. It is doubtful, however, if any progressive changes or such as are transmitted by heredity have taken place. The number of generations subjected to this influence seems altogether too small. Besides, the tendency of human multiplication is such that the most highly cultured families tend to disappear, while others, who have been less subjected to the influences regulating the life of the most cultured classes, take their place. Therefore, it is much less likely that advance is hereditary than that it is transmitted by means of education.

In conclusion Dr. Boaz said: "The average faculty of the white race is found to the same degree in a large proportion of individuals of all other races, and although it is probable that some of these races may not produce as large a proportion of great men as our own race, there is no reason to suppose that they are unable to reach the level of civilisation represented by the bulk of our own people."

In the Anthropological Section, Dr. Daniel G. Brinton read a paper entitled "Variations in the human skeleton and their causes." The speaker called attention to a number of peculiarities in the human skeleton which had attracted the notice of anatomists, and which had frequently been interpreted as signs of reversion to an ape-like ancestry. He said that most of these variations can be explained by mechanical function, or excess or deficiency of nutrition; and when they can be so explained, this is the only interpretation they should receive. They could no longer be offered as evidence of the theory of evolution, nor considered as criteria or marks of the human races.

Mr. M. H. Saville read a paper on a comparative study of the Glyphs of Copan and Quirigua, in which he presented his conclusions on the hieroglyph "pax." In the discussion of Mr. Saville's paper, Dr. Brinton presented his conclusions, which he announced for the first time, based upon studies of vases in the museum of Pennsylvania, that the symbol pax was a representation of the sacred drum of the Aztecs, and that the hieroglyph stood in the codices for paxahs, "It is finished."

"Iroquois migration" was the subject of a brief paper by the Rev. Dr. Beauchamp, who said that one at least of the three great divisions of the Iroquois family had its centre near the south-western border of Lake Erie.

Mr. Frank Hamilton Cushing, ethnologist for the Bureau of American Ethnology at Washington, read a paper entitled "Salt in Savagery." He referred tot he universal liking for salt among the Indians of North America. The Zuni Indians believed that the first salt came from the sun. According to Indian mythology, there is a salt goddess who is the daughter of the ocean. Mr. Cushing related her genealogy, and then proceeded to discuss the influence of salt upon the culture of the Indians in the south-west. He stated that he believed that nothing led the cliff-dwellers down from their inaccessible dwellings to live in villages more than their desire for salt. Men's dispersion over the world, said Mr. Cushing, is largely influenced by salt. Coming down from his arboreal retreat, where he lived on nuts and fruit, he found the seashore and acquired a taste for a substance now universally used.

Mr. R. G. Haliburton read a paper on the dwarf races of the New World.

Rev. W. H. Beauchamp described the southern visit of the Eskimo, in which he declared that evidence of Eskimo contact with the Indians of Northern New York were to be found in certain stone knives found among them, specimens of which he exhibited.

Mr. Dorsey read a paper by William Sturtevant, in which Mr. Sturtevant described three ears of corn from prehistoric grains from localities in Peru, collected by Mr. Dorsey, the especial point of interest being that from a grave of undoubted antiquity in Iquique was found a kind of corn which was commonly supposed to be of a recent cultivated variety. Mr. Dorsey called attention to the great importance of collecting and preserving all varieties of corn from all prehistoric sources as a means of determining the original habitat of the maize, as well as furnishing an index of civilisation.

THE DISPLACEMENTS OF THE ROTATIONAL AXIS OF THE EARTH.[1]

DISPLACEMENTS of the rotational axis of the earth with reference to fixed directions in space have been observed since the earliest ages of astronomical measurement; for such displacements, visible in wanderings of the pole of the apparent diurnal rotation of the celestial sphere among the constellations of fixed stars, exist in such enormous amplitudes, that in their main features they could be detected by the aid of very simple apparatus and observations.

The true law and explanation of these wanderings of the pole remained, nevertheless, a deep mystery till Copernicus lifted the veil by showing that they were only the celestial image of real displacements of the rotational axis of the earth in space, and until Newton came and, combining his discovery of universal gravitation with his deduction of the ellipsoidal figure of the earth, proved that these displacements are due to the actions of the moon and the sun on the earth.

The mathematicians of the eighteenth century completed this explanation by profound researches embracing the full theory of free rotation of a solid system of masses, under the action of various disturbing influences, not only those acting from outwards on the rotating body (as in the case of the sun's and the moon's attractions on the earth), but also those depending upon the condition or changes within the rotating system itself.

Among several interesting results, these investigations pointed out an essential difference between the development of the disturbed rotation in the first and in the second case.

Upon the supposition, corresponding to the real terrestrial conditions of the problem, namely, that all the disturbing influences are relatively small in comparison with the amount of energy represented by the primary rotation of the earth itself, the following distinctions were demonstrated.

Exterior disturbing influences will mainly produce displacements of the axis in space, and corresponding wanderings of the pole among the stars, whilst the simultaneous displacements of the axis in the earth itself, in consequence of the particular conditions of their evolution, remain insensible.

On the contrary, interior conditions and disturbing influences, as those contained in the configurations of the masses, or in changes of the distribution of the masses composing the rotating system, will mainly produce displacements of the rotational axis in the rotating body itself, whilst in this case the simultaneous displacements of this axis in space and the corresponding variations of the position of the pole among the stars remain insensible.

Very soon after these deductions had been made from the theory, astronomers began to inquire if also effects of the latter type, that is to say, displacements of the rotational axis in the earth, really existed.

According to the theory, such displacements ought even then to exist when the distribution of the masses composing the earth is not in the slightest degree variable.

It is sufficient for producing such displacements that the position of the rotational axis of the earth is actually not in perfect coincidence with one of its principal axes of inertia, known as the principal axis.

[1] A paper read by Prof. W. Foerster, Director of the Royal Observatory of Berlin, before the British Association.

The slightest deviation of the rotational axis from the principal axis has the consequence that the pole of the rotational axis begins and continues to describe a small circle around the pole of the principal axis.

The velocity of this movement depends upon the law of the figure and of the distribution of the masses composing the earth, and the best numerical data for this dependence had given the result that the displacement in question would probably have a period of nearly ten months.

Now all such displacements, possibly measurable with reference to fixed directions in the earth, and insensible with reference to fixed directions in space, could be found in the most favourable way by measuring as exactly and continuously as possible the distance of the pole from the zenith of the observer's station; in other words, by repeated determinations of the geographical latitudes. But, notwithstanding very long and refined determinations of the geographical latitudes at some of the principal observatories, beginning shortly before the middle of the present century, only very uncertain and discordant traces of the phenomena in question were found.

The reason for this want of success is now very clear. Astronomers had limited their researches too narrowly to the last-mentioned type, namely, to the supposed regular ten-monthly periodical movement of the pole of the rotational axis around the pole of the principal axis. Too easily it had been admitted that all the existing variations of the distribution of terrestrial masses were by far too small for altering sensibly the position of this principal axis itself.

It was Lord Kelvin, at the Glasgow meeting of the British Association (1874), who at first drew the attention of the scientific world to the consideration of the great natural transports of masses of air and water and various masses by the water, going on continuously and periodically in the form of currents and circulations of different kind, as well in the atmosphere as in oceans and rivers, for instance the enormous periodical sediments of snow and ice. He showed that these very considerable variations of the distribution of masses on the earth could not only produce sensible displacements of the principal axis of inertia, but that such displacements of this axis could have an amplifying effect on the total amount of displacements of the rotational axis.

For if the principal axis were itself not in a constant position, the theoretically required movement of the rotational axis around the principal axis would become a very complicated movement, differing entirely from the simple form which to that epoch had appeared in the researches of astronomers.

This epicyclic character of the movement of the pole of the rotational axis could considerably modify not only the length of the period, but also the whole geometrical character and amplitude of the curve in such a way, that in longer periods epochs of very small variations of latitude could alternate with epochs of considerably increased variations of latitudes. Possibly, as a further consequence of this complication of the displacements of the two axes, and as a consequence of the still existing plastic state of certain parts of the earth, as well as by the damping effects of the fluid parts, even *progressive*—though very slow and unsteady progressive—displacements of the rotational axis in the earth could still result.

The field of this research was thus decisively cleared by the veritably releasing ideas of Lord Kelvin. Finally, about four years ago, by the co-operation of some observatories with the International Geodetic Union, clear evidence was obtained, and in the last three years, with the aid of an expedition sent by the International Union to Honolulu, decisive proofs of such displacements have been found. I consider it a special honour and pleasure to be enabled to submit some of the newest results of this international co-operation to a meeting of the same Association which, twenty years ago, had been witness of the almost prophetic assertions of one of its most illustrious members regarding the real conditions of this important phenomenon.

I have prepared a diagram (Fig. 1, p. 489) showing these newest results. You see in this diagram a representation of the wanderings of the pole of the rotational axis of the earth on the surface of the latter during the last twenty months, from October 1892 to May 1894.

This sketch is founded on nearly 6000 single determinations of latitude made in the Observatory of Kasan (Eastern Russia), Strassburg (Elsass), and Bethlehem (Pennsylvania). The observations are condensed in twenty monthly mean results,