THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE thirty-ninth annual meeting of this body was held on August 20–26 at Indianapolis, which is the capital and largest city of the State of Indiana, and is the largest inland city of the United States, being a railroad centre without navigable water of any kind, and having, with its suburbs, a population of about 140,000.

Near the city is located the greatest region of natural gas in the world. The manufacturing business of this whole region has received a wonderful stimulus from the discovery of natural gas, which has caused a rapid increase in population and manufacturing within the past three years. The gas is found in the Trenton limestone at a depth of nearly a thousand feet over a large area north and east of the city, and, besides being used *in situ*, is brought to the city in pipes for use there, where it has displaced other fuel in the large factories. One of the most instructive object-lessons the Association has ever had was the excursion on Saturday through this gas belt, stopping at Noblesville (whence the supply for Indianopolis is drawn), Kokomo, Marion, Muncie, and Anderson. At the latter place a remarkable exhibition was made of gas forced through the river and ignited upon the surface. President Goodale warned the citizens in an address of the necessity of economizing this resource, since it is not inexhaustible.

The sessions of the Association were held in the new Capitol, a fine building completed only two or three years ago at the cost of about 2,000,000 dollars, and decidedly the most sumptuous quarters ever offered to the Association, being also spacious enough to accommodate all the eight Sections under one roof.

A number of affiliated associations meet at or about the time of the principal one. Of these the Society for the Promotion of Agricultural Science, and the Society of American Geologists preceded the main meeting, while the Botanical, Entomological, and, this year for the first time, the Ornithological Club, met at intervals between meetings of the parent Association.

On Wednesday morning the retiring president, Prof. T. C. Mendenhall, called the Association to order, and resigned the chair to Prof. George L. Goodale, President-Elect. The morning was devoted to addresses of welcome and responses, and to the organization of the several sections. Among the speakers were Mayor Sullivan and Lieutenant-Governor Chase. An invitation was received from the Australasian Association for the Advancement of Science to attend the meeting at Christ Church, New Zealand, in January 1891, and President Goodale was deputed, and will attend as a delegate.

In the afternoon the eight Vice-Presidents read their several annual addresses before their respective Sections. These addresses were generally ably written.

Section A (Mathematics and Astronomy) was addressed by Prof. S. C. Chandler, of Harvard, on the variable stars. The number of these discernible with an ordinary field-glass is two thousand, while our largest telescopes reveal, perhaps, hundreds of thousands. The cycle of change, commonly called the period, ranges from less than eight hours in the wonderful variable recently found by Paul, up to two years. Between these limits is a highly significant deviation from uniformity of distribution. At least five-sixths of the variables are reddish, and the redness of the variable stars is, in general, a function of the length of their period of light variation. The redder the tint, the longer the period. An examination of fluctuations in brightness, or light curves, enables us to distinguish a number of types, of which the most remarkable is that of Algol. The cause of variability is still problematic, except for the ten stars of the Algol type, which seem to be explained by the theory of an occulting satellite, somewhat modified however. For the other types we may perhaps seek an explanation in certain consequences of rotation of the stars upon their axes, or by introducing modifying suppositions of unequally illuminated surfaces, irregular forms, tidal action upon light-absorbing atmospheres, spontaneous and intermittent explosions, meteor swarms, and the like.

Section B (Physics) was addressed by Prof. Cleveland, Abbé of Washington, colloquially designated throughout the United States "Old Probs," for the reason that he is in charge of the weather bureau, and makes up the daily weather report, with indications, formerly called probabilities. His theme was terrestrial physics. There are two kinds of physics—molecular and terrestrial. The latter he names, following the German nomenclature, geo-physics. It relates to the earth as a whole, including all phenomena relating to earthquakes, volcanoes, gravitation, and the variations in its intensity on land and sea, mountain, plain, and valley, magnetism of the earth, tidal motion and tidal stress of the earth's crust as well as of the ocean, and in general the study of the entire interior of the earth, of the earth's crust, both land and water, meteorology, auroras, &c. He deplores the lack of laboratories for such researches, and deems a good geo-physical laboratory a great desideratum. He urges that some such institution should be founded and endowed, rather than to continue the founding of laboratories for research in chemistry or molecular physics of which so many are already in existence, or the establishment and endowment of universities to teach only what is already known.

The address of Prof. R. B. Warder, of Washington, to Section C (Chemistry), on geometrical isomerism, was decidedly the most abstruse of the series, but to one able to follow him, it was of unusual interest, giving the latest results of study into the subject of the relative positions of atoms in a molecule, including a careful study of the right-handed and left-handed carbon molecules. Most of this material is very recent, the prominent workers, such as Wislicenus and Wunderlich, having made more progress within two or three years than in any previous period. Besides the speculative interest of these studies they have a very important practical application in the physiological and pathological action of isomers, many of which, while identical in chemical constitution, affect living organisms very differently, whether administered as food or as medicine.

Prof. James E. Denton, of Hoboken, addressed Section D (Mechanical Science and Engineering) on mechanical tests of lubricants. Experiments to determine the co-efficient of friction between lubricated rubbing surfaces have been prosecuted for two hundred years, and have resulted in the existence of many forms of satisfactory apparatus for such measurement, which are now known as oil-testing machines. The overheating of bearings is due, however, to accidental abrasion of rubbing surfaces, which generates an intense heat at some points, and tends to vaporize some oils more than others. Oil-testing machines are inadequate to reveal these differences, and moreover the supply of oil is artificially abundant, instead of feeding through practical forms of oil-cups. It is concluded, therefore, that each oil must be tested with a series of conditions of the rubbing surfaces, and practical feeding devices which involve opportunities for abrasion and overheating. Explanation was given of the paradoxical fact that overheating is often remedied by supplying sand or emery to bearings. The sand grains make grooves around the wearing parts, and as a result the oil is uniformly distributed, and the hot-box cools down to the limit of safety.

Prof. John C. Branner, State Geologist of Arkansas, addressed Section E (Geology and Geography) on relations of the state and the national geological surveys to each other. He thus recapitulates the benefits to be derived from voluntary cordial co-operation between all geologists and all geological organizations in this country.

"(1) Geologic research being under the nominal direction of the leading investigators would be so conducted as to be of the greatest utility to the greatest number.

"(2) When a piece of work was done by one it would be done for all, and duplication by state surveys and by individuals, and the consequent waste of energy, time, and money would cease.

"(3) The functions and fields of official organizations being better defined, state and national surveys and individuals could so direct their efforts as to serve the purposes of others without neglecting their own immediate aims, and without infringing upon each other's ground.

"(4) National and state surveys would be strengthened, and local organizations and individual effort encouraged.

"(5) It would give us a better geologic literature, better instruction, better geologists, and more thorough specialists.

"(6) And finally, we trust it would put a stop to those oracles of science who are so ready to prophesy in its name."

Dr. Charles S. Minot, of Boston, addressed Section F (Biology) on certain phenomena of growing old. The loss of vital power commences from birth; the older an organism is the more time it takes to produce a given change, and this indicates a progressive loss of vitality. Anatomical peculiarities can be found correlated with this progressive loss of vitality. Considering in detail the various tissues of the body in the order of

their development, in each of the principal tissues and organs of inner, middle and outer layer of the body, the cells composing them show the same peculiarity, namely, that in their young condition they contain only a small amount of protoplasm, and in the adult condition a very much larger amount, so that the proportion of protoplasm to nucleus increases with the age of the organism. The conclusion is that development of protoplasm is associated with loss of vitality. So that instead of speaking of protoplasm as the physical basis of life, we might term it the physical basis of advancing decrepitude, or in other words, the physical basis of death. The reverse development is seen in generation, where the first process which the fecundated ovum undergoes is segmentation into numerous nuclei, with attendant decrease in the proportion of protoplasm to nucleus, and precisely the same phenomenon is noted in animals which multiply by fissure, the tissues at the point of fissure becoming greatly segmented.

Dr. Frank Baker, of Washington, addressed Section H (Anthropology) on the ascent of man, in which he traced with much detail the modifications which the body has undergone in ages of development, the more striking modifications being those connected with the limbs, the change from quadrupedal to erect posture and the segmentation of the body, and indications of change being left as vestigial organs. The erect position is gradually acquired, and the difficulty that an infant experiences in learning to walk erect is strong evidence that it is an accomplishment acquired by the race late in its history. The human body gives evidence of a previous semi-erect position. The special changes of structure which secure the erect position are less marked in children and in the lower races. In the course of evolution of these changes, there is a period of struggle before the body becomes thoroughly adapted to them. Such struggle is still going on, the adaptation being far from complete. Hence the liability of man to certain deformities and diseases, to which quadrupeds are not so much disposed. It is in just this line that is to be found the explanation of the greater difficulty and dangers of parturition in the human family, and of the fact that woman in her entire organism has suffered more than man in the upward struggle. The increased influence of gravity also explains the greater tendency to certain disturbances of the circulatory organs. Study of the bony skeleton gives, in man, evidence of his relationship, in origin to the lower animals, as in the persistence of relics of ribs, and in unmistakable signs that the skull is composed of segmented pieces like the vertebræ. The evidence of such relationship has come, and is coming from all sides, from the study of comparative brain weight and structure, of the facial angle, the face bones and teeth, with their resulting changes in expression from brute or brutal man to the highest types, in which the brain shows its rulership in the countenance.

Prof. J. R. Dodge, of Washington, addressed Section I (Economic Science and Statistics) on the standard of living in America. Prof. Dodge is chief of the agricultural bureau of statistics of the United States, and his report of the condition of growing crops on the 10th of every month is always eagerly awaited, and has a great effect on market prices of agricultural produce of all kinds. The American standard of living is the highest known. To maintain it, wages are and should remain high. Production is not thereby diminished because of the brain power of the American people and our utilization of labour-saving machinery, so that in many articles exportation increases enormously despite high wages. Our woods are tougher than those of Europe, and we would not accept European tools if given to us.

His most important conclusions are: The question arises, Shall the present standard of living be maintained? It is a point upon which hangs "the future education, enterprise, independence, and prosperity of the people" of the United States. It depends on the industry of the producing classes, and wisdom in the distribution of their labour for a production that shall meet their wants. If idleness shall be encouraged, production limited, importation enlarged, and dependence on foreign countries fostered, wages will be reduced, and the ability to purchase as well as the volume of production will decline. If the advice of public and private teachers of repressive economy to buy everything abroad, and sit down in the enjoyment of the luxury of idleness at home, shall become the law of the land, short rations will follow, and high prices will only be abated by the inability of our people to purchase for consumption.

Unless the largest variety of production shall be encouraged, and the highest skill shall be stimulated in the endeavour to meet all the wants of our people by the results of our own labour, it will be impossible for us to have a surplus for export. It is a matter of time, of determined effort, of high endeavour to render high wages consistent with large exportations of surplus, but the future will accomplish it, if the present scale of living and rate of wages of the American people shall be maintained.

Wednesday evening was taken up with the address of the retiring president, Prof. T. C. Mendenhall, chief of the United States Geodetic and Coast Survey, who spoke on the relation between men of science and the community. He began by calling attention to the fact that this association is the outgrowth of the Association of American Geologists and Naturalists organized just fifty years ago. He spoke of the duty assigned the retiring president to present an address as giving an opportunity to dismiss the relationship between members of the Association and the general public whose interest is often born of curiosity rather than intelligent appreciation. The meetings of this Association have been the means of disseminating proper methods of investigation and study throughout the land. He considered various elements of weakness in scientific men such as assumption of superior knowledge in lines of investigation outside of their own specialties, lack of a proper amount of utilitarianism, as well as lack of interest in political affairs, contrasting this spirit with the distinguished service rendered to mankind by such scientific men as Newton, Watt, and Franklin. The ideal of duty which ought to be present in the mind of every man of science may well be higher than that growing out of mere selfish pleasure in the acquisition and possession of knowledge.

The remaining days of the session—Thursday, Friday, Monday and Tuesday—were devoted to general business and the reading of papers in the sections. On Friday evening Dr. H. C. Hovey lectured on Mammoth, Marengo, and Wyandotte caves, and on Monday evening Prof. C. Leo Mees lectured on electricity.

The general business included an appropriation of 250 dollars to Prof. E. W. Morley for the further prosecution of his researches in the velocity of light in a magnetic field; resolution of thanks to two Brazilian gentlemen for removing to the museum at Rio the largest meteor ever found, weighing five tons; resolution requesting Congress to provide fire-proof quarters for the botanical collection at Washington, and another urging protection of the forests; resolution favouring the use of the metric system at Custom houses in the United States.

It was decided to hold the next annual meeting at Washington, and invitations were sent to other governments on the American continent to send delegates, thus giving to this meeting, which is the only one held at Washington in recent times, an international character.

The Association adopted the report of the committee of anatomical nomenclature, which recommends the following changes, with special reference to the brain: "That the adjectives dorsal and ventral be employed in place of posterior and anterior, as commonly used in human anatomy; and, in place of upper and lower as sometimes used in comparative anatomy; that the cornua of the spinal cord and spinal nerve roots be designated dorsal and ventral rather than posterior and anterior; that the costiferous vertebræ be called thoracic rather than dorsal; that the hippocampus minor be called calcar; that the hippocampus major be called hippocampus; the pons variolii, pons; the insula Reilii, insula; pia mater, pia; dura mater, dura."

Two hundred and fifty-nine papers were read, of which the largest number, fifty-one, were in the section of physics, and the next largest, forty-eight, in biology. It is difficult to attempt a selection without doing injustice, but a few of the papers deserve mention, while perhaps others, equally meritorious, may be overlooked. Prof. Cleveland Abbé read papers by himself on kinematic methods of determining the altitudes and motion of the clouds, and, by Frank N. Bigelow, on further study of the solar corona, and on terrestrial magnetism. The corona is deemed to consist of matter streaming out from the sun in zones about 32° distant from the poles, and falling back into the region of sun-spots, which are, probably, thus caused. It is regarded as similar to the earth's aurora, though of denser matter.

Prof. T. C. Mendenhall, in his paper on the use of the magnetograph as a seismoscope, showed that earthquakes are caused by the tidal stress of sun and moon upon the earth's

crust, and are accompanied by magnetic currents which serve as indices of their approach.

Prof. E. W. Morley's report on the velocity of light in a magnetic field shows an increase in velocity in such a field amounting to seven parts in one thousand million. These investigations are to be continued.

Prof. Morley also read a paper on the determination of the volumetric composition of water, and one on the ratio of the density of oxygen and hydrogen. In twenty determinations the minimum value of combination in water was 2·0005, the maximum was 2·00047, mean 2·00023, with a probable error of one part in 30,000. The value two to one, which every schoolboy learned is the ratio of hydrogen and oxygen in water, must be increased about one nine-thousandth. In two determinations of density, Morley reaches the same result as Rayleigh, viz. 15,884, giving 15,882 as the atomic weight of oxygen. Prof. W. A. Noyes read a paper on the atomic weight of oxygen, giving the results of four series of six determinations with apparatus devised by himself. The value found is 15,896, or about seven one-hundredths less than the usually accepted one.

The series of papers on distribution of North American plants, prepared on topics assigned last year, was pronounced by the presiding officer the most remarkable ever presented to the biological section. They were on the distribution of the North American umbelliferæ, by John M. Coulter; the distribution of hepaticæ of North America, by Lucien M. Underwood; geographical distribution of North American grasses, by W. J. Beal; geographical distribution of North American cornaceæ, by John M. Coulter; and the general distribution of North American plants, by N. L. Bulton. The following assignments were made for next year:—The absorption of gases, J. C. Arthur; the aëration of aquatic plants, W. P. Wilson; the absorption of fluids, L. H. Pammel; the movement of fluids in plants, W. J. Beal; transpiration, C. E. Bessey.

The exhibition of apparatus included some delicate seismoscopes and seismometers. Prof. Mendenhall exhibited some of the metric standards recently distributed by the International Congress, in the manufacture of which to distribute to all nations, two-thirds of all the iridium in the world was used. Prof. W. A. Rogers exhibited a precision screw 8 feet long, with a variation of only 1/8000 of an inch in its entire length.

Officers elected for the Washington meeting were: President, Albert B. Prescott, of Ann Arbor, Mich.; Vice-presidents, Section A, E. W. Hyde, of Cincinnati, O.; Section B, F. E. Nipher, St. Louis, Mo.; Section C, R. C. Kedzie, Agricultural College, Mich.; Section D, Thomas Gray, Oene Haute, Ind.; Section E, J. J. Stevenson, New York; Section F, J. M. Coulter, Crawfordeville, Ind.; Section H, Joseph Jastrow, Madison, Wis.; Section I, Edmund J. James, Philadelphia, Pa.; Permanent Secretary, F. W. Putnam, Cambridge, Mass. (holds over); General Secretary, Harvey W. Wiley, Washington, D.C.; Secretary of the Council, Amos W. Butler, Brookville, Ind.; Treasurer, William Lilly, Manch Chunk. Secretaries of the sections: Section A, E. D. Preston, Washington, D.C.; Section B, A. McFarlane, Austin, Texas; Section C, T. H. Norton, Cincinnati, O.; Section D, William Kent, New York; Section E, W. J. McGee, Washington, D.C.; Section F, A. J. Cook, Agricultural College, Mich.; Section H, W. H. Holmes, Washington, D.C.; Section I, B. E. Vernon, Washington, D.C.

This ticket was elected as reported from the nominating committee, except that a substitution was made in the Vice-President for Section I, which is notable as the first instance in the history of the Association in which any change was ever made in the list of nominees reported.

WM. H. HALE.

CHEMISTRY AT THE BRITISH ASSOCIATION

MANY of the papers read in Section B this year were of considerable theoretical importance. Additional interest was also given to the proceedings by the presence of several distinguished foreign guests.

After the President's Address, Prof. Dunstan read the third Report of the Committee on the present methods of teaching chemistry. During the past year the Committee has been principally engaged in collecting and comparing the regulations issued by the more important of the examining bodies in the kingdom, in order to discover how far their requirements were in harmony with such a course of instruction as that suggested by the Committee in their second Report, presented at the Newcastle-on-Tyne meeting. The Committee direct special attention to the following points:—

It is of great importance that natural science should be sufficiently represented on the board which issues the regulations and is responsible for the proper conduct of the examination.

In addition to examinations, periodical inspection of the teaching seems desirable, the reports of the inspectors as well as the students' own record of work testified to by the teacher being taken into account in awarding prizes, certificates and grants, in addition to the results of an examination.

With respect to the schedules and examination papers, for the most part they do not aim at an educational training of the kind suggested in the Committee's last report, being on the other hand more suitable for those who wish to make a special and detailed study of chemistry as a science. The obvious conclusion is that the necessary reforms can only be brought about by the active co-operation of examiners and teachers.

Sir Henry Roscoe introduced a discussion on recent legislation for facilitating the teaching of science. He drew attention to the powers given by the Technical Instruction Act of 1889, to County Councils and other local authorities, and assured his hearers that the Education Department and the Science and Art Department were extremely anxious to give local authorities a free scope, and free choice of subjects. Referring to the action of the Chancellor of the Exchequer, which placed in the hands of the County Councils this year the sum of £743,000 to be devoted, whole or in part, to the purpose of technical education, he urged upon these bodies the importance of taking full advantage of this grant. In the discussion which followed hopes were expressed that the money would not go simply towards the relief of the rates. It was also remarked that for the success of these provisions it is necessary that more attention should be given to primary education.

Dr. J. H. Gladstone and G. Gladstone read a paper on the refraction and dispersion of fluorbenzene and allied compounds. Fluorine behaves quite differently to chlorine, bromine, and iodine, as it exerts scarcely any refractive action upon the light rays, and it has the property of reversing the dispersion produced by other substances.

Dr. G. H. Bailey and J. C. Cain gave a paper on a method of quantitative analysis by weighing precipitates suspended in liquids. The object of the method is to do away with the operations of filtering and washing. The specific gravity of the precipitate having been determined once for all, it is weighed together with the supernatent liquid in a specially constructed measuring flask. The specific gravity of the supernatent liquid can be readily determined, and hence the weight of the precipitate calculated. The method is found to be rapid, and to give results of sufficient accuracy for many technical purposes.

Dr. G. H. Bailey and A. A. Read gave a paper on the behaviour of different metallic oxides when exposed to high temperatures. This is a continuation of work previously published in the Journ. Chem. Soc. on oxide of copper. The following oxides were subjected to high temperatures in an oxidizing atmosphere:—SnO_2, Bi_2O_3, V_2O_5, PbO WO_3, MoO_3. The following results were obtained:—V_2O_5 was converted into V_2O_3, SnO_2 lost weight slightly, and MoO_3 lost oxygen, and was transformed into the blue oxide of molybdenum, the others were unchanged. It was suggested that some light might be thrown by the experiments on the formation of minerals in nature.

A paper was then read by Dr. G. H. Bailey on the spectrum of the haloid salts of didymium. The influence of dilution and of various reagents on the intensity of the different bands was studied. It was found that the addition of nitric acid to the solution of didymium chloride influenced some bands quite differently to others. Again the variation of the halogen element, in combination with the didymium, brought about differences in the relative positions of the bands. In addition to these, observations were also made on the effect of polarised light. Each of these different conditions influenced the bands sometimes in intensity, sometimes in position, and this in a selective manner. The connection was pointed out between these results and the experiments of Welsbach on the fractionation of didymium.

Prof. Armstrong read the fifth Report of the Committee on isomeric naphthalene derivatives. A complete set of reference compounds has now been prepared in the disubstituted series. It is found that although 13 dichlor naphthalenes have been