subject. My contention seems so plausible that I venture to appeal to you to allow me to give the following brief exposition of my view, in the hope that I may be able to elicit some authoritative reply.

The amount of solar radiation is at present, for all intents and purposes, expressed in terms of melting ice. In other words, the sun is supposed to be giving forth as much heat as he would do were he surrounded, close to the photosphere, by a constantly renewed shell of ice, or never-failing ocean of water. My conception is, that, judging from what we know of hot bodies cooling upon the earth, it is impossible to believe that the sun could be pouring forth so much heat under existing conditions, as he would do were he continually to radiate to ice or water close to all parts of his surface.

The velocity, and the rapidity of vibration of the waves of light and heat can be accurately measured. This is the sum of motion—known as radiant heat—which the sun imparts to his surrounding medium. Absorbed heat is a very different thing (Balfour Stewart), and could not exist without the particles of matter. Now I fail to perceive what grounds the authorities have for calculating, as they do, that the sun's radiation amounts to something over a million calories per minute for each square metre of his surface. This means a million times the quantity of heat which will raise the temperature of a kilogramme of water 1° C. No doubt if the sun were surrounded by water the above would represent a correct estimate of the outflow of heat. But the men of science ignore, it appears to me, the marvellous virtue of the "if" in this case. The communication of heat consists in forcing the molecules and atoms of matter asunder against the attractions of cohesion and affinity, and causing the particles to vibrate; and there is no proof, but the evidence is all the other way, that the sum of motion imparted by the sun to the ether of space would represent anything like the expenditure of energy as would do the raising of water to an enormous temperature. If a red-hot globe of iron or copper were caused close to the surface to radiate to ice, the metal would cool much more quickly than if it were merely exposed to a very dry atmosphere—that is to say, the metal's radiant heat would constitute a less expenditure of energy than its emission of absorbed heat. I do not see, therefore, why we should not conclude that exactly the same result, only of course on a very vast time-scale, would happen in the case of the sun.

The enormously long periods demanded for the sun's past life-time by the geologist and biologist furnish strong antecedent support in favour of my contention. W. GOFF.

New University Club, S.W., August 15.

Morley Memorial College.

YOUR readers may be interested in hearing of a successful attempt to add another round to the ladder, described by Prof. Huxley, extending "from the gutter to the University." Some supporters of the Morley Memorial College for Working Men and Women, in the Waterloo Road, last year read an account in your pages of the arrangements made by the University Extension Society for some of its students to spend a month at Cambridge during the vacation. They resolved to offer scholarships to those who took the best places in the Christmas and Easter examinations in connection with Mr. McClure's astronomy class, whereby they might avail themselves of these arrangements. This, thanks to Dr. Roberts's kind co-operation, was successfully accomplished. Three students went to Cambridge, the most successful in a class all of whom did well. A plumber and a printer's reader went to Selwyn College, an elementary schoolmistress to Newnham. Two were able to take advantage of the whole month; the third (being a family man) could only spare a fortnight from his work, but all speak warmly of the pleasure and profit they have derived. The following are some extracts from their letters.

One says:—"I took chemistry and geology on alternate days, besides attending the majority of the single lectures. The work being mostly of a practical kind, has been intensely interesting." Another, after an enthusiastic description of the place, the architecture, and the College gardens, goes on:—"Everybody was most kind, cordial, and sociable, without the slightest suspicion of stiffness or formality, of condescension or patronage. More than this, everybody we met seemed to be studying our interests especially, and doing all in their power to make our stay as enjoyable as possible. . . . In science, geology was the only subject I was permitted to take up. In literature and art I attended courses on Browning and Tennyson, and on Greek art, Greek history, and Herodotus, also single lectures on 'Leopold Ranke,' . . . and 'College Life Past and Present.' I hope to continue these studies as far as possible in my home reading. . . Beyond the actual instruction received in the lectures, there has been given an impetus to further study, from which a continuous benefit must be reaped, and I have obtained a clear idea of what a student's life in a University town is like."

Cambridge opens its doors in this way only to members of University Extension classes, but at Oxford anyone may attend the classes who pays the fee. The authorities of our College accordingly offered scholarships to those of their students who passed highest in the Science and Art examinations for electricity, chemistry, and mechanical drawing. The results of these were not known early enough for the first half of the vacation classes, but the second fortnight in August was so much enjoyed that those who made the arrangements considered themselves well repaid for their trouble, though this was not small, for working men do not find it easy to get leave of absence for even a fortnight at a certain specified time. "One of the most enjoyable holidays I ever spent," writes one; "I have quite a collection of geological specimens collected on the excursion."

No wonder they enjoyed it! They come from surroundings generally dreary, sometimes squalid. They have scrambled for their education, and gained it under difficulties. They find themselves in a picturesque town, full of interesting associations, and meet with kindness without patronage from cultured men and women. Will not the school teacher's work have an added interest and dignity now she has seen (if only by a passing glimpse) what education is in its higher branches? Will not all of them feel that life contains something besides manual drudgery for weekly wages, and that those whose lot is exempt from drudgery of this kind are willing and anxious to share with them the results of culture and leisure? We live in times of a difficult transition from the old feudal loyalty to self-respecting friendship between free men, who can be mutually helpful to each other just because their circumstances and advantages are different. Feudalism was good in its day, but it has outlasted the conditions which made it so, and the "ladder from the gutter to the University" is an important instrument in effecting the transition safely to something better.

May I add that, unless the College and the scholarships receive wider support from the public than they have done, it will be difficult if not impossible to carry them on efficiently? Our fees are necessarily so low that the institution can never be self-supporting. We charge 1*s.* entrance fee, and 1*s.* 6*d.* a term for the first class; 6*d.* for each additional class. Larger fees would exclude some of our best students (one who had a perfect passion for knowledge was a rag-sorter till a better situation was found for him by one of our Council). The public imagine that we have already received a sufficient endowment from the City Parochial Charities fund. We hope shortly to have a grant from that fund, but we have lived on this hope for the last two years, and find it a sadly insufficient resource to provide intellectual food for 800 students. At this beginning of a fresh session we should gratefully welcome either personal help, or a subscription to general expenses or to the Scholarship Fund. A month at Cambridge costs about £7, and I have no doubt that (if the money were forthcoming) we should be able to arrange for scholarships to Cambridge from the University Extension Class on Physiography which Mr. A. W. Clayden is about to conduct. A fortnight at Oxford costs £5, and we hope this winter to have ten classes in connection with the Science and Art Department, to which we should like to offer this advantage.

September 9. EMMA CONS (Hon. Sec.).

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE: WASHINGTON MEETING.

THE month of August 1891 was distinguished by the most notable array at Washington of scientific meetings ever held in America. The series began with the meeting of the American Society of Microscopists on August 11, and afterwards, consecutively or simultaneously, came those of the Association of American Agricultural Colleges and Experiment Stations; the Association of

Official Agricultural Chemists; the Society for the Promotion of Agricultural Science; the American Chemical Society; the Conference of American Chemists; the Association of Economic Entomologists; the American Association for the Advancement of Science; the Geological Society of America; and the International Geological Congress.

The fortieth annual meeting of the American Association for the Advancement of Science was held from August 19-25, President Albert B. Prescott, Professor of Chemistry at the University of Michigan, in the chair. The attendance of members was large; about one-third of all attending were residents of Washington, most of them employed in the various scientific Bureaus of the Government. 227 papers were read before the Sections, and these together with the addresses of the President and Vice-Presidents, Reports of Committees, and other documents, brought up the entire number to 291.

Prof. George L. Goodale, of Harvard University, delivered the annual address as retiring President: subject—"Some of the Possibilities of Economic Botany."

After giving an account of the meeting of the Australasian Association for the Advancement of Science, held at Christchurch, New Zealand, in January last, which he attended as delegate from the American Association, he proceeded to consider the subject above mentioned. An abstract of the address follows.

There is an enormous disproportion between the number of species of plants known to botanical science and the number of those which are used by man. The species of flowering plants already described and named number about 107,000, but the number of species used on a fairly large scale by civilized man does not exceed 1 per cent. The useful plants which are cultivated by man do not exceed one-third of this. Can the short list of useful plants be increased to advantage? After calling attention to the influence which synthetic chemistry exerts by the production of artificial vegetable products which can replace the natural products, he took up the cereal grains as illustrations of the history and improvement of cultivated plants. If all the cereals, like wheat, maize, rye, barley, oats, and rice, were now to be swept out of existence, we should not know positively where to turn for new species of grasses with which to begin again. He drew a picture of the condition of civilized man if all the known varieties of the cereal grasses should become extinct, and then pointed out the probable manner in which our experiment stations would have to choose and improve the grains of certain grasses which are not used to-day. He expressed the belief that our well-equipped stations would give us satisfactory substitutes for our cereals within a period not exceeding that of two generations of our race. But why do not experimenters attempt to improve our present neglected resources of this character? Because we all prefer to move in lines of least resistance, letting well enough alone. Plants which have been long cultivated are more susceptible to the influence of changes in surroundings, and hence of improvement, than those which are just removed from the field to the garden. Tracing the recent history of our cereals, he expressed his conviction that there is no probability that any new cereals will be added to our present list, but improvements will continue to be made in those which we have.

He included under the term vegetables all plants employed for table use, such as salads and relishes. The potato and sweet potato, the pumpkin and squash, the red or capsicum peppers, and the tomato, are of American origin. All the others are, most probably, natives of the Old World. Only one plant coming in this class has been derived from Australasia—New Zealand spinach (*Tetragonia*).

Among the vegetables and salad plants longest in cultivation are turnip, onion, cabbage, purslane, the large bean (*Faba*), chick-pea, lentil, and garden pea—which have an antiquity of at least 4000 years. Next in age are radish, carrot, beet, garlic, garden-cress and celery, lettuce, asparagus and the leek, three or four legumes, and the black peppers. The most prominent recent ones are parsnip, parsley, oyster-plant, artichoke, endive, and spinach. A few tropical plants, such as yams, are omitted from the list.

There is an astonishing number of varieties, which represent an enormous amount of horticultural work, each race (that is, a variety which comes true to seed) having been envolved by patient care and waiting.

For future development he recommends (1) *Arracacha esculenta*, of the parsley family, which is now cultivated in South America, near the Isthmus; (2) *Ullucus* or *Ollucus*, of the beet or spinach family; (3) the so-called Chinese artichoke from Japan.

He recommends a more thorough examination of Japanese vegetables, owing to the similarity of Japanese and Eastern North American flora.

Attention was called to the extraordinary changes produced in the commercial relations of fruits by canning and swift transportation, and the opinion was expressed that before long it would be possible to place many more of the delicious fruits of the tropics in northern markets; and even, with increasing knowledge of microbes, to preserve fruit for almost any reasonable time. Such discoveries would diminish zeal in the search for new fruits.

The improvement of fruits within historic times has been such that fruits which would once have been highly esteemed would to-day be passed by as unworthy of notice.

The list of seedless fruits may probably be materially lengthened. The common seedless fruits are banana and pineapple. Darwin mentions also bread-fruit, pomegranate, azarole, and date-palms; and says that their size and development are usually regarded as the cause of their sterility, whereas he regards sterility as rather the result than the cause of increased development.

Prof. Goodale expressed the conviction that there is no reason why we should not have seedless strawberries, blackberries, raspberries, and grapes, coreless apples and pears, and stoneless plums, cherries, and peaches, propagated by bud-division.

Promising timbers and cabinet woods, fibres, tanning materials, rubbers, and similar products were discussed in turn; the last class to be considered being fragrant flowers and plants for the florist. The necessity for caution in the introduction of new plants, lest they should prove pests by their wide dispersion through arable lands, as sweetbriar has in some parts of New Zealand, was fully illustrated. The agencies for examining useful plants were botanic gardens, museums of economic botany, and experiment stations.

SECTION A—*Mathematics and Astronomy*.

The address by Prof. E. W. Hyde, of Cincinatti, the President of this Section, was on the evolution of algebra, in which he traced the historical development of this branch of mathematics, beginning with the almost prehistoric Egyptian Ahmes; then giving a very full account of the Greek Diophantus, and explaining his use of syncopated methods. He had only one character to represent the unknown quantity; still he achieved great results. The Hindoos, Arya Bhatta about 600 B.C., and Brahma Gupta, 700 A.D., were discussed, and were presented as the source of Arabian algebra, and thus of the knowledge of that science in modern Europe.

Papers read before this Section include one on the latitude of the Sayre Observatory, by C. L. Doolittle, and on the secular variation of terrestrial latitudes, by George C. Comstock. The results of the investigations appear to be proof of a secular variation of the North Pole amounting to about 4½ seconds in a century.

Frank H. Bigelow exhibited and described a new aurora-inclinometer which will be sent to Alaska this autumn, and valuable results are expected in the study of the aurora.

One entire session of this and the Physical Section jointly was devoted to an elaborate monograph by A. Macfarlane, on principles of the algebra of physics.

SECTION B—*Physics.*

Prof. F. E. Nipher, President of Section B, opened the proceedings with an address on the functions and nature of the ether of space. Many reasons formerly given for the existence of such an ether, he said, no longer exist. For twenty-five years it was taught that light is an elastic pulsation in an incompressible jelly-like medium. In 1865, Maxwell proposed the theory that light is an electric displacement in a plane at right angles to the line of propagation. In 1888, Thomson showed that the compression wave required by the elastic theory, but absent in fact, might be dispensed with in the theory by making its velocity zero; and that this does not involve an unstable condition of the medium, and is therefore admissible. The showing up of light in space occupied by matter shows that the ether within must either be more dense (as Fresnel believed) or less elastic than that existing in free space. It is certainly very difficult to understand what there can be in the molecules of matter which can increase the density of an incompressible medium. The beautiful experiment of Michelson and Morley shows apparently that the ether at the surface of the earth moves with it. It is dragged along as if it were a vivid liquid. The field of a steel magnet is, however, a rotational phenomenon. It is a spin which is maintained permanently without the expenditure of energy. It seems, therefore, that the resistance to shear which shows itself in the adhesion of the ether to the moving earth must be a rigidity due in some way to motion. Other experiments of Michelson and Morley on the motion of light in moving columns of water have been taken as proof that the ether in water is condensed to nine-sixteenths of its volume in air. The ether in water certainly behaves as if it were more dense, but it is another matter to say that it is so. It seems improbable. It is still a mathematical fiction which covers a gap in our knowledge of the ether. The speaker thought that the experiment should be repeated with water at rest within a tube which should be mounted on elastic supports in a moving railway car. The water tube and observer's seat should be rigidly connected and swung on dampened spring supports from the top and sides of the car. The question to be settled is whether the ether or any part of it is at rest in space, and does it sweep through the interior of bodies which move through it as wind sweeps through the leaves and branches of a tree. This form of the experiment is the one contemplated by Eisenlohr's analysis leading to Fresnel's formula, and it is capable of great variations in the conditions of experiment. It is, however, more difficult and more expensive than the one so well executed by Michelson and Morley. Whatever its results may be, it promises to add greatly to our knowledge of the physics of the ether.

Prof. E. W. Morley, who has for several years been conducting researches under the auspices of, and with funds supplied by, the Association, read papers describing his method of determining the coefficient of expansion by means of interference fringes. He is able to determine the expansion of bars of any length as accurately as Fizeau did that of half-inch bars.

C. B. Thwing read a paper on colour photography by Lippmann's process, and exhibited samples which show a tinge of colour when looked at in the right light.

H. A. Hazen, of the U.S. Signal Service, discussed the question "Do tornadoes whirl?", and gave results of elaborate and careful study of tornadoes and of the *débris* left by them, from which he concludes that the common notion of a whirl in tornadoes is unfounded.

SECTION C—*Chemistry.*

Prof. R. C. Kedzie, of the Agricultural College, Michigan, chose the subject of alchemy for his annual address.

Thirty-three papers were read before this Section, and the meeting was characterized by the Secretary of the Section as the most valuable ever held.

Mr. Morley contributed valuable material to this Section also, in regard to the synthesis of weighed quantities of water from weighed quantities of oxygen and hydrogen. His determination of the ratio of atomic weights is: oxygen 15·888, hydrogen 1.

The Committee on Spelling and Pronunciation of Chemical Terms, which has been engaged in this work for several years, made their final Report, which will be printed and widely distributed, in order to secure uniformity if possible.

"Biological Functions of the Lecithines" was the title of a paper by Walter Maxwell In a paper presented by Mr. Maxwell at the 1890 meeting of the Association, he showed that a vegetable organism, during the initial stages of growth and under the action of the ferments operating in germination, possesses the power of taking the phosphorus present in seeds or in soils, as mineral phosphates, separating the phosphorus from the inorganic combination, and causing it to reappear in the young plantlet in an organic form as a lecithine. In brief, it was shown that the lecithine bodies are a medium through which the phosphorus of the mineral kingdom passes over into the vegetable kingdom. In the second part of Mr. Maxwell's paper he went on to show that the lecithine bodies, on the other hand, present in the animal kingdom revert to the mineral form under the action of the ferments present in the animal organism. The investigations were conducted with the egg of a hen. The phosphorus contained in the egg, in the respective forms of mineral phosphates and organic phosphorus compounds as lecithines, was determined. In the next place, the eggs were incubated, and the products of incubation were studied. It was found that the phosphorus contained in the natural egg as a lecithine reappeared in the incubation product as calcium phosphate, and forming the bone of the chicken.

In a paper by Dr. Gustav Hinrichs, facts were adduced to show that the logarithms of the molecular weights of the hydrocarbons have a direct relation to the fusing and boiling points of these substances. This is believed to be the instance discovered where logarithms exist between changes in physical or chemical condition.

SECTION D—*Mechanical Science and Engineering.*

The President of this Section, and *ex-officio* one of the Vice-Presidents of the Association, is Prof. Thomas Gray, of Terre Haute, Ind., the inventor of a great variety of ingenious apparatus, including the seismoscope and seismograph shown to the Association on their excursion to Terre Haute last year. His address was a carefully prepared discourse on problems in mathematical science. It was technical in character, and dealt with the teachings of mathematics and physics in their application to engineering.

Among the papers before this Section was one on Government timber tests, by B. E. Fermor, Chief of the Bureau of Forestry. He said there had been inaugurated in the forestry division of the Department of Agriculture a comprehensive series of tests and examinations of American timbers, the ultimate object of which is the solution of a biological problem—namely, to establish the relation of technical and physical qualities to each other and to conditions of growth. In the pursuit of this investigation, naturally, many questions of immediate practical value in the use of wood for engineering purposes will be solved. The novelty in this enterprise lies mainly in its comprehensiveness and scope. A very large number of tests alone on material of known origin and condition, and an exhaustive examination of the same will permit generalization and the recognition of laws of inter-relation. The work requires the organization of four distinct departments. First, the selection of test material from as many essentially different climatic and soil conditions as the species may occupy, five fully-matured and two young trees being carefully selected on each site and cut up for test material; secondly, the examination of the structure and physical condition of the test material, requiring the minutest detail; thirdly, the usual testing with special care; and, lastly, the compilation and comparative discussion of the results of the tests in connection with the physical examination and the known conditions of growth. Besides more trustworthy data than hitherto attainable of the qualities of our principal timbers, there is to be gained from this investigation a knowledge of conditions under which desirable qualities can be produced by the forest grower.

Prof. J. B. Johnson read a paper on the United States tests of strength of American woods, made at the Washington University Testing Laboratory, St. Louis.

SECTION E—*Geology and Geography.*

Prof. J. J. Stevenson, of New York, presided. His address was on the relations of the Chemung and Catskill on the eastern side of the Appalachian Basin. He traced the groups along the eastern outcrop from Tennessee into New York, across Southern and Western Pennsylvania, and eastward through Northern Pennsylvania again into New York, using the work of Prof. White and Messrs. Carill and Ashburne in Pennsylvania, and of Prof. Stevenson in Virginia and Pennsylvania, incidentally referring to the work of Profs. Hall and Williams in New York. In this way the continuity of the section was shown, and the insignificance of the variations was insisted upon strongly. An area in South-eastern New York and North-eastern Pennsylvania, in which the Chemung group is almost without trace of animal or vegetable life through the greater part of the thickness was described. The absence of life was thought to be due, not to fresh water, but to turbidity of the water in a shallow basin near the land. The facts that the horizons of fish-remains are much lower in the column than had been supposed, and that the plant-remains come in like manner from the home group, were thought to be of especial interest and importance. The conclusions to which the speaker was led were :—(1) That the series from the beginning of the Portage to the end of the Catskill form but one period, the Chemung, which should be divided into three epochs—the Portage, the Chemung, and the Catskill. (2) That the disappearance of animal and vegetable life on so great a part of this area toward the close of the period was due simply to gradual extension of conditions existing, perhaps, as early as the Hamilton period in South-eastern New York. (3) That the deposits were not made in a closed sea, but that the influx of great rivers with their load of *débris* made conditions in the shallow basin such that animal life could not exist. (4) That in the present state of our knowledge we are not justified in including the Chemung period in the Carboniferous age.

Notwithstanding the impending meetings of national and international Geological Societies, this Section was fully occupied with papers and discussion, mainly on the Glacial epoch, drift, &c. Mr. William Hallock read a paper entitled "A Preliminary Report of Observations at the Deep Well, Wheeling, W. Va." The question as to the conditions which exist in the interior of the earth, said Mr. Hallock, has always attracted much attention. The most important factor in the solution of this riddle is the determination or estimation of the temperatures there existing. The British Association has for years seized every opportunity to obtain data as to the rate at which the temperature increases as the earth crust is penetrated. The most recent and trustworthy contributions on this subject are by Mr. E. Dunker, of Halle, Germany, and were obtained from a 4170-foot well at Sperenberg, not far from Berlin, and a 5740-foot well at Schladabach, near Leipzig. These wells are both full of water, the circulation of which vitiates results or renders elaborate apparatus indispensable, and the thermometers must be protected from the pressure. The Wheeling deep well, sunk by the Wheeling Development Company, and by them generously dedicated to science, is 4500 feet deep, $4\frac{7}{8}$ inches diameter, and dry; cased only to 1570 feet. The strata there are nearly *in situ*, undistorted and dipping only 50 feet to the mile. More satisfactory geological conditions can scarcely be imagined. Being dry, ordinary United States Signal Service maximum thermometers were used, and no especial precaution needed to be taken to prevent circulation of the air. The thermometers were lowered and raised, and depths measured by a steel wire. Results :—

TABLE I.

Depth. Feet.	Temperature, Fahrenheit. Degrees.	Depth. Feet.	Temperature, Fahrenheit. Degrees.
1350	68·75	3125	88·40
1591	70·15	3232	89·75
1592	70·25	3375	92·10
1745	71·70	3482	93·60
1835	72·80	3625	96·10
2125	76·25	3730	97·55
2236	77·40	3875	100·05
2375	79·20	3980	101·75
2486	80·50	4125	104·10
2625	82·20	4200	105·55
2740	83·65	4375	108·40
2875	85·45	4462	110·15
2990	86·60		
		100	51·30

These observations, when plotted, show a slow increase for the upper half of the uncased portion, about 1° F. for 80 to 90 feet, whereas the lower part shows a more rapid increase—about 1° F. for 60 feet; the whole series giving a well-defined and regular curve, with a deflection at 2900 to 3000 feet, where an oil sand occurs. Practically all the rest of the uncased well is in shale. The increase in the rate at which the temperature rises as the bottom is approached can only be temporary, or we should have an inconceivable or improbable state of temperature at comparatively slight depths. The two distinct series of observations combined in Table I. nowhere disagree more than 0°·3 F., and hence are very trustworthy and accurate. Table II. gives a comparison of the results at the three great wells :—

TABLE II.

Name of well and location.	Feet for 1° F. Feet.	Total Depth. Feet.	Temperature at top. Degrees.	Temperature at bottom. Degrees.
Sperenberg, near Berlin	59·2	4170	47·8	118·6
Schladabach, near Leipzig	65·0	5740	51·9	135·5
Wheeling Development Company	—	4500	51·3	110·3
Top and greatest depths	74·3	4500	—	—
Mean of lower 3000 feet	75·4	4500	—	—
Mean of above two	74·9	4500	—	—

Inasmuch as the bottom of the well is some 3700 feet below sea-level, it seemed worth while to attempt barometer readings in it. The instruments used proved ill adapted to the work, and the results were unsatisfactory. Samples of air were taken at the bottom, but could not be analyzed in time for use. A series of observations in a coal mine near the well gave as a very probable value of the temperature of the top invariable stratum 51°·3 F. From the mean annual temperature of Marietta and Steubenville it might be taken at 52°·2 F. Drilling is temporarily stopped, but it is hoped that a depth of 5500 or 6000 feet may be reached. Mr. Anton Reyman, of the Development Company, has generously guaranteed half the expenses, and what is wanted is that some one shall furnish the other 3000 dollars, and enable the Wheeling well to be lifted from the second to the first place among the deep wells of the world.

SECTION F—*Biology*.

Prof. John M. Coulter, President of Indiana State University, gave the annual address, as President of Section F, on the future of systematic botany. He contended that for the systematists of to-day and of the future there must be three distinct lines of work, related to each other in natural sequence in the order presented, and each turning over its completed product to the next. (1) *The Collection and Description of Plants.*—He expressed great gratitude to the noble army of self-denying pioneer collectors, but claimed that the time had now come when the same amount of labour could be expended to better advantage, and that a race of field workers must be trained who shall follow their profession as distinctly and scientifically as the race of topographers. In reference to the work of description he read an unpublished note of Prof. Asa Gray, in which that distinguished botanist lamented the work of those who were incompetent. The speaker also expressed the opinion that the exclusive use of gross organs in the description of higher plants would be given up, and that the more stable minute characters would prove valuable aids in steadying diagnosis. A danger in the use of these minute characters was pointed out, viz. the tendency to use a single set of minute characters too far, and to make the fabric of a whole group conform to it. The character of a species is an extremely composite affair, and it must stand or fall by the sum total of its peculiarities, and not by a single one. There is nothing that involves a broader grasp of facts—the use of an inspiration rather than a rule—than the proper discrimination of species. (2) *The Study of Life-histories.*—The work of searching for the affinities of great groups is the crying need of systematic botany to-day. The speaker called attention to the danger of magnifying the importance of certain periods or organs in indicating affinities, and summed up what was said under this general head as follows :—"I have thus spoken of the study of life-histories to indicate that its chief function lies in the field of systematic botany; to suggest that it take into account development at every period and of every organ, and so obtain a mass of cumulative evidence for safe generalization; and to urge upon those not thoroughly equipped great caution in publication." (3) *The Construction of a Natural System*.—The speaker spoke of the necessity of constructing a natural system with easy advance in the knowledge of affinities, as a convenient summary of information, a sort of mile-post, to tell of progress and to direct future effort. The concluding summary was as follows:—"The points presented in this consideration of the third phase of systematic botany are that the last and highest expression of systematic work is the construction of a natural system, based upon the accumulations of those who collect and describe, and those who study life-histories; that this work involves the completest command of literature and the highest powers of generalization; that it is essential to progress for a natural system to be attempted with every advance in knowledge; and that all the known facts of affinity, thus brought within reach, should be expressed in all systematic literature."

This Section, as usual, was the most crowded of all, forty-seven papers having been read before the Section itself, and many more before its two offshoots, the Botanical and the Entomological Club. This was another of the Sections which its Secretary considered to have had the most successful meeting on record. A feature now at every annual session is the report of members appointed the year before to study certain assigned questions. This year four such reports were presented:—Transpiration, or the loss of water in plants, was treated by Chas. E. Bessey and Albert F. Woods. "Movements of fluids in plants" was read by Prof. Wm. J. Beal, of Michigan. Dr. J. C. Arthur, of Purdue University, Lafayette, Ind., read a paper entitled "Gases in Plants." A paper was read by Prof. L. H. Pammel, of Ames, Iowa, on the absorption of fluids by plants.

SECTION H—*Anthropology*.

The youngest Vice-President at this session, if not the youngest man who ever held a Vice-Presidential office in the American Association, is Prof. Joseph Jastrow, whose age is 28 years. His address was entitled "The Natural History of Analogy."

Major J. W. Powell, Chief of the U.S. Geological Survey, exhibited and explained his linguistic map of North America, on which he showed the classification of languages of the aborigines.

Mr. Cushing read a paper on the Zuñi Indians, and danced the Messiah dance, which a few months ago was so much talked about, and almost involved a war with the Government.

SECTION I—*Economic Science and Statistics*..

Of all the Vice-Presidential addresses, that of Prof. Edmund J. James, of Philadelphia, before this Section, aroused the most widespread popular interest and attention, on account of the vital practical importance of the theme presented, which was "The American Farmer: his present economic condition and future prospects."

The silver question was carefully considered, and all who took part in the discussion agreed in opposing the free coinage schemes which are now so vehemently urged upon Congress.

The general business of the Association included a change in the constitution, so as to admit fifty foreign honorary members, and many recommendations to Congress as to forestry, water supply and management, and other topics. Preliminary arrangements were made to participate in the Columbian World's Fair in 1893. A Committee was appointed to solicit donations for the endowment of the Association with a fund of at least $100,000. Three hundred and seventy-one new members were elected, bringing the total membership up to about 2300, which is high-water mark in the history of the Association.

Prof. Joseph Le Conte, of California, was elected President; and the Association adjourned, to meet at Rochester, N.Y., on the third Wednesday of August 1892.

RAIN-MAKING IN TEXAS.

THE announcement in the *Standard* about a fortnight since, that rain had been artificially produced in Texas by exploding oxyhydrogen balloons and dynamite, was probably received by most scientific men with a suspension of judgment. The somewhat sensational form of the report, the emphasis with which it dwelt on the unfavourable antecedent conditions, and the omission of all details that might enable us to form some rough estimate of the forces employed and of the resulting effects, seemed calculated to appeal to the barren emotions of astonishment and love of the marvellous rather than to the sober judgment of well-balanced minds; and but for the fact that the experiments were stated to have been made by the officers of the U.S. Signal Service, which, on the hypothesis of a hoax, would have been a needless challenge to speedy denial, one might have been disposed to regard the story as only an additional instance of a kind of produce for which the Western States are somewhat notorious. The further accounts that have now reached us prove, however, that this is not one of Jonathan's amusing attempts to play off on the credulity of his simple-minded cousins across the Atlantic. Not only have experiments of the kind described been actually made, but they have been apparently successful, and they seem to have been repeated sufficiently often to render it at least improbable that this success has been entirely fortuitous. The improbable features of the *Standard's* report are, indeed, somewhat toned down; the dryness of the local atmosphere was by no means so great as was to be inferred from the vague language of the *Standard's* informant; but, as far as can be judged from the notices now before us, it seems unlikely that the rain which followed General Dyrenfurth's experiments would have occurred in the undisturbed course of natural events.

The experiments were made at a place known as Ranch C. One writer states that an intermittent series of experiments had been carried out for three weeks, and that "not in a single instance has rain failed to fall within ten or twelve hours after the explosion." But the number of trials is not stated—an omission the more to be regretted, because the improbability that the results are fortuitous increases in a certain geometric ratio of the number of successful repetitions. We have definite accounts of those made on August 18, 26, and apparently the morning of the 27th, and it is by no means clear that the evidence is not limited to these, although the expression quoted above would seem to imply otherwise. The first, that of August 18, was made about 3 p.m. There were at the time a few scattered clouds, but no indication of rain. The reading of the barometer is not reported, but the relative humidity of the air immediately before the experiments (presumably at the earth's surface) was not more than 60 per cent. of saturation. An oxy-hydrogen balloon, the capacity of which is not stated, was exploded by electricity at an altitude of a mile and a quarter. Several kites, with packets of dynamite attached, were sent up immediately after the balloon, and the charges exploded by similar means, and "rendrock powder was distributed for a distance of two and three-quarter miles from head-quarters, and fired by igniting dynamos." These explosions "sent up great volumes of white smoke, which rose only a short distance, and was then beaten down by heavy rain, which at once began falling and continued for four hours and twenty minutes." Prof. Curtis, the meteorologist of the expedition, estimates that the rain covered an area of not less than 1000 miles.

On August 26 it is stated that "balloons containing several thousand feet of oxyhydrogen gas were sent up and exploded at heights varying from 1000 to 10,000 feet, and at sundown batteries on the ground began their work, and until 10.30 p.m. a constant cannonade was carried on under a sky of perfect clearness, lit by countless stars of a brilliancy seldom seen in the north. The barometer promised fair, and the hygrometer stood between dry and very dry," whatever these expressions may mean. The account continues:—"At 11 p.m. General Dyrenfurth withdrew his forces, and all retired for the night. Sleep, however, was soon interrupted, for at 3 a.m. the first return fire flashed from the heavens, when