THURSDAY, SEPTEMBER 17, 1891.

ANIMAL CHLOROPHYLL.

Die Organisation der Turbellaria Acœla. Von Dr. Ludwig von Graff. (Engelmann, 1891.)

EIGHT years ago Dr. von Graff published his great monograph of the Rhabdocœl Turbellarians. The improved methods of histological research have enabled him to add some essential facts since that date to our knowledge of one of the most curious groups of the Rhabdocœla—namely, those known as Acœla. In 1885 he passed his Easter holidays at the Franciscan convent on the Dalmatic island of Lesina, and on the sea-shore of the garden of the convent found *Convoluta Schultzii* and *cinerea* in abundance.

Prof. Delage in 1886 published his valuable researches on *Convoluta Roscoffensis*, the green species of Roscoff, in which he made use of a method of gold-impregnation for demonstrating the nervous system. Dr. von Graff visited Roscoff in the same year, and in 1889 studied the Acœla at the Naples Station by means of Delage's and other methods of gold-impregnation. The present volume deals with *Proporus venenosus*, O. Schm.; *Monoporus rubripunctatus*, O. Schm.; *Aphanostoma diversicolor*, Oerst.; and several species of *Convoluta*; it being shown amongst other facts that the Roscoff species studied by Geddes and Delage is distinct from the Mediterranean *C. Schultzii*, and that *C. cinerea*, Graff, must be placed in a new genus, *Amphichœrus*.

The work is illustrated by ten quarto plates, coloured. A variety of important anatomical and histological details are given, and a systematic discussion of genera and species. Dr. von Graff discusses the relationship of *Trichoplax* to the Acœla, having received living specimens of this curious form from the aquarium of the Zoological Institute of Vienna, but he does not allude to the *Haplodiscus piger* of Weldon (*Quarterly Journal of Microscopical Science*, vol. xxix.), a floating form, taken off the Bahamas, which seems to be certainly a member of the group.

The chief matter of interest in Dr. von Graff's volume, which we propose to notice at greater length, is the chapter by Dr. G. Haberlandt, on "the structure and significance of the chlorophyll-cells of *Convoluta Roscoffensis*." Dr. Haberlandt states that the description by Geddes of the chlorophyll of this form, as diffused in the general plasma-body of certain cells, is erroneous. The green-coloured cells lie well below the cuticle, embedded amongst the cells of the superficial parenchyma. According to Haberlandt they are highly compressible and elastic, and devoid of anything like a cellulose envelope or even a membranous envelope. They are not uniformly green, but there is as a rule a single large chloroplast which forms a more or less complete shell to the protoplasm of the cell-body. In some of the cells Haberlandt could detect several peripheral plate-like chloroplasts. The crust-like chloroplast contains as a rule a single centrally placed pyrenoid of spherical form. As an exception two or even three pyrenoids are present. The pyrenoid is colourless; it is stained by hæmatoxylin or by borax carmine, but by no means so strongly as is the nucleus of the cell in which the chloroplast occurs. Starch granules in the form of small curved rods are grouped around the pyrenoid (sometimes within it), and are detected by a violet-brown reaction on addition of iodine solution. The colourless protoplasm of the cell is small in amount as compared with the enveloping chloroplast: its nucleus is only rendered visible by staining. The colourless protoplasm sometimes contains a group of granules of doubtful nature, erroneously taken by Geddes for starch granules.

The resemblance of these cells, especially in respect of the structure of their chloroplasts and pyrenoids, to certain cells which constitute the unicellular bodies of Volvocineæ, Tetrasporeæ, and Pleurococcaceæ, is insisted upon by Haberlandt. He raises the question as to whether they are to be regarded as parasitic Algæ in the sense of the theory of Entz and Brandt; and suggests another hypothesis—namely, that, whilst phylogenetically they must be regarded as Algæ (that is to say, have descended from Algæ), yet at the present time they have by profound adaptation to life in and with the *Convoluta*, altogether lost their character as independent algal organisms, and have become an integral histological element of the worm, and in fact constitute its assimilation tissue.

To test this hypothesis he asks: (1) How do the green cells get into the body of the worm? and (2) What becomes of them when the worm dies? Can they live in an isolated condition? To the first question he is unable to give an answer, but suggests that they *may* be handed on from generation to generation of the Convoluta, entering the egg-cell as a colourless minute cell which later develops its chloroplast just as the "leucoplasts" of higher plants are found in the egg-cell, and later become chloroplasts. As to the second question, Haberlandt has no doubt. The green cells die when they are removed from the worm's body or when the worm dies. He notes in this connection their membraneless character, and regards the loss of a cellulose envelope as one of the modifications which the ancestral parasitic Alga has undergone, rendering it incapable of living an independent life away from the tissues of its host. Lastly, Haberlandt justly remarks that *similarity* to an Alga is no proof that the green cells are really Algæ in nature. Haberlandt is inclined to place his theory as to the green cells of Convoluta alongside the suggestion of Schimper as to the origin of the chlorophyll corpuscles of higher plants—namely, that these are due to the union in the remote past of a green-coloured with a colourless organism. In this case and in that of Convoluta the highest phase of symbiotic association is attained, for the green organism can no longer be separated and cultivated apart, as in the case of the Lichens, but has, in fact, become an *organ* of the colourless organism, multiplying with it and forming an integral as well as a necessary part of its mechanism, and so greatly modified by ages of association as to be now barely recognizable as derived from an independent source. We can well suppose it possible that the green cells of Convoluta might proceed further in their modification, so as to lose the colourless protoplasm and the cell-nucleus; they would then become simple chlorophyll corpuscles like those of higher green plants.

The suggestion thus put forward by Haberlandt is in

complete accord with the view which I have several times expressed in regard to the chlorophyll corpuscles of *Hydra viridis* and of *Spongilla viridis* (see *Quart. Journ. Micr. Sci.*, vol. xxii. p. 229), viz. that there is no more reason for regarding them as symbiotic Algæ than there is for so regarding the chlorophyll-corpuscles of a buttercup. Whether there is sufficient reason for so regarding the chlorophyll-corpuscles of a buttercup is another question, and one which certainly is not yet decided in the affirmative, though there are considerations which render such a hypothesis one not lightly to be dismissed.

A difficulty in the matter seems to be this—viz. that if the chloroplasts of the cells of multicellular organisms are to be regarded as parasitic, why should not those of unicellular Algæ also be regarded as parasitic? and if "Zoochlorella," or whatever the hypothetic Alga may be called in the case of Convoluta, can form chloroplasts, why should not the tissue-cells of Convoluta themselves, or of Hydra, or of Spongilla form chloroplasts?

It is obviously necessary to distinguish for the present (though *possibly*, as Haberlandt suggests, the one may be derived from the other) the strongly-marked unicellular parasites of Radiolaria and Anthozoa (the "yellow cells") from the green cells of Convoluta, and the chloroplasts of *Hydra viridis*, of *Spongilla fluviatilis*, and of many Ciliata. The statement which is current as to the existence of a nucleus in the chloroplasts of Hydra is simply erroneous, and that as to the independent multiplication of the chloroplasts of Ciliate Infusoria when removed from the cell in which they occur is possibly a misinterpretation of a graft-phenomenon. It is to be hoped that Dr. Haberlandt will spare the time to study for himself—as he has the green cells of Convoluta—the more readily obtainable chloroplasts of Hydra, Spongilla, and Stentor.

Some extremely interesting and suggestive remarks on the physiological and biological phenomena connected with the green cells of Convoluta conclude Dr. Haberlandt's chapter. E. RAY LANKESTER.

STREATFEILD'S PRACTICAL ORGANIC CHEMISTRY.

Practical Work in Organic Chemistry. By Fredk. Wm. Streatfeild, F.I.C., &c., Demonstrator of Chemistry at the City and Guilds of London Institute's Technical College, Finsbury. With a Prefatory Notice by Prof. R. Meldola, F.R.S. "Finsbury Technical Manuals." (London: E. and F. N. Spon, 1891.)

THE numerous manuals of practical organic chemistry which have been published of late years testify to a re-awakened interest in an important subject. Some of these deal with the preparation of various typical organic compounds; others restrict themselves to describing methods of analysis. The present work combines both methods of teaching, and, as a special feature, divides the subject into "programmes of instruction" designed to meet the varied wants of the students attending the evening classes of chemical technology at the Finsbury College, taking into account the special nature of their daily avocations and the purpose to which they wish to apply their chemistry. Thus, after working through the introductory courses of "operations" and "analysis," and thus familiarizing himself with the general methods of the subject, the student would begin to specialize. The brewer would select the programme "ethyl alcohol and its reactions," which includes fermentation and the purification and estimation of alcohol, and touches on allied subjects, such as the preparation of aldehyde, acetic acid, and chloroform. The soap-maker would devote himself to the programme, "a study of the preparation and decomposition of ethyl acetate, and of the composition and reactions of some of the natural fats and oils"; thus passing from the simplest case of saponification (hydrolysis) of an ethereal salt in ethyl acetate to the more complex cases in the fats. This latter programme also includes the isolation and estimation of glycerol, and its properties; palmitic, stearic, oleic, and elaïdic acids; drying and non-drying oils; bromine and iodine absorption of oils; and other matters of interest in this connection. The tar-distiller would carry out the experiments given under "coal-tar and coal-tar products"—a very full and satisfactory chapter.

This restriction of the field of study is amply justified by the necessities of the case, and only an irreclaimable scientific purist would object to it. Even the ordinary day-student of chemistry, who can devote his whole time and energies to the subject, must work under some similar limitation when he comes to deal with the inexhaustible material of organic chemistry.

The experiments given under the various programmes are well selected, and the accompanying descriptions are evidently the outcome of a thorough practical knowledge of the subject. We may make an exception, however, in the case of the preparation of anhydrous formic acid (p. 66) by passing sulphuretted hydrogen over dry copper formate. The method is quite obsolete: Lorin's improved process of preparing the pure acid from anhydrous glycerol and anhydrous oxalic acid, drying the 95–98 per cent. acid thus obtained with boric anhydride, is now employed. Worst of all, the author recommends in this experiment that the sulphuretted hydrogen should be dried by passing it through concentrated sulphuric acid—a blunder which would go far to justify the prevailing impression that organic chemists are not always sufficiently conversant with the facts of inorganic chemistry.

In spite of this and one or two other trifling inaccuracies, we cordially recommend the book as a valuable aid to both teacher and student. What it deals with really is practical organic chemistry, and not the spurious substitute which, in the shape of "the detection of not more than one organic acid and one organic base," usurps the name in this country—thanks to the authority of examining boards, the industry of the writers of cram-books, and the credulity of the public.

Prof. Meldola, in his prefatory notice, referring to the evening classes in chemistry at the Finsbury College, says that they "cater for no examination"; and it is perhaps owing to this important circumstance that Mr. Streatfeild, on whom a considerable share of the laboratory teaching of these classes devolves, has been in a position to write a real manual of practical organic chemistry, and not a mere cram-book of tests—written up to syllabus.

TELESCOPIC WORK.

Telescopic Work for Starlight Evenings. By W. F. Denning, F.R.A.S. (London: Taylor and Francis, 1891.)

AS might be expected from such an experienced and enthusiastic observer as Mr. Denning, this book is thoroughly practical. He is not contented with describing the beauties of the skies, but gives invaluable information as to how to see them best. The opening chapters give a very complete history of the invention and development of the powers of the telescope and its accessories. These are followed by chapters on the sun, moon, planets, stars, nebulæ, and clusters; the sun being introduced for the sake of completeness, although not comprehended in the title. The question of the relative advantages of large and small telescopes is discussed at considerable length, and one almost gets the impression that large telescopes, except under very favourable conditions, are not desirable possessions. It is very gratifying to note the encouragement given to observers of limited means. To them the book will be of the greatest assistance, both in the selection and use of their instruments.

The author's style is such as to make the book very entertaining as well as instructive. Some of his remarks are well worth quoting, as, for example, his opinion of controversy in scientific matters.

"Competition and rivalry in good spirit increase enthusiasm, but there is little occasion for the bitterness and spleen sometimes exhibited in scientific journals. There are some men whose reputations do not rest upon good or original work performed by themselves, but rather upon the alacrity with which they discover grievances, and upon the care they will bestow in exposing trifling errors in the writings of their not-infallible contemporaries. Such critics would earn a more honourable title to regard were they to devote their time to some better method of serving the cause of science" (p. 56).

Mr. Denning is very emphatic in his opinion that an observer's time is too valuable to be spent in acting the showman to his friends and acquaintances. If all observers were so disposed, there might be reasonable hope for the establishment in this country of some such institution as the Gesellschaft Urania in Berlin, for the special gratification of persons desiring passing glimpses of celestial wonders.

It is scarcely necessary to say that the chapter on meteoric observations is as good as can be. More observers are undoubtedly needed in this branch of astronomy, and volunteers will find very full instructions in the pages of this book. In addition to the notes on variable stars given by the author, we would suggest the tracing of the light-curves of a small number of stars by each observer. Anyone at present attempting to determine the laws governing variability will find such information lamentably deficient.

The book is full of important practical details, and an appendix gives the chief new facts up to March 5, 1891.

The book does not attempt to deal with spectroscopic matters, but occasional references are made, and it is here, if anywhere, that fault may be found. Thus, referring to the nebula of Orion, it is stated (p. 334) that

"the spectroscopic researches of Huggins have shown this nebula to be composed of incandescent gases, so that the stars telescopically observed in it are probably in the foreground and entirely disconnected from the nebulous mass."

In 1888, however, it was shown by the spectroscope that the stars of the trapezium, at all events, are simply condensations of the matter composing the nebula.

Everyone who uses a telescope, or who intends to use one, of whatever dimensions, should read Mr. Denning's book.

OUR BOOK SHELF.

Abbildungen zur Deutschen Flora H. Karsten's, nebst den ausländischen medicinischen Pflanzen und Ergänzungen für das Studium der Morphologie und Systemkunde. With Woodcuts of 709 Species. (Berlin: Friedländer und Sohn, 1891.)

THIS is a wonderfully cheap book, for the price of it is only three marks, and it contains figures with dissections of upwards of 700 plants, illustrating all the natural orders both of Cryptogamic and Phanerogamic plants which make up the European flora or are used medicinally. The text is confined to the preliminary table of the orders and families, an explanation of the details, and a final index.

The Thallophytæ are divided into 17 families, classed under 3 orders, Lichenes being maintained as on a par with Algæ and Fungi. In Cormophytæ there are 16 families under 6 orders, the orders of Sporiferæ being Filices, Selagines, Rhizocarpeæ, and Calamariæ. In Northocarpæ (Gymnosperms) there are 7 families under 5 orders, Balanophoraceæ and Lorantheæ being placed here. Under Teleocarpæ (Angiosperms) there are 159 families classed under 48 orders, Dicotyledons being divided into Monochlamydeæ and Dichlamydeæ, and the latter into Petalantheæ (Polypetalæ) and Corollanthæ (Gamopetalæ). The "families" correspond substantially to Bentham and Hooker's orders. To have such a good and cheap book in English (the text in the original, of course, is German) would be a great boon to students.

Elementary Text-book of Botany for the Use of Schools. By Edith Aitkin. 248 pp. (London: Longmans, Green, and Co., 1891.)

THIS volume has been written to serve as an adjunct to the teaching of Botany in girls' schools, and is the outcome of the author's own experience as a teacher. Miss Aitkin arranges the subject-matter in three parts. In the first are given the general characters of a number of selected types of Flowering plants treated in a manner suitable for young girls beginning the study. In the second part the details of Cryptogamic plants are given, commencing with *Protococcus* and Yeast, and so on, up to the Fern. In the third part we return to Flowering plants again from a more comprehensive point of view. This last section concludes with a number of chapters on the leading physiological processes of plants. We think the book will be found of service by those for whom it is intended, especially from the fact that Part I. is written, generally speaking, on the lines of the Lower Schedule laid down by the Oxford and Cambridge Schools Examination Board. The only criticism we have to make on this section is that perhaps the style is a little wanting in vitality and interest. Part II. is treated along sufficiently familiar lines, but in Part III., by the introduction of physiological work, with careful instructions as to simple experiments which can easily be performed to illustrate class teaching, we think that the author will have opened up fresh fields of interest in botanical study. The volume is profusely illustrated, many of the figures being new.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

A New Mammal from Sumatra.

A FEW years ago a new and interesting mammal, which is exceedingly rare even in its native haunts, was brought to the then President of Palembang—Mr. A. Pruys van der Hoeven. This gentleman, who is not only an eager sportsman, but also well versed in natural history, recognized it to be new to science, and to be more closely allied to certain representatives of the Edentata than to any other order of mammals.

The type-specimen was preserved in captivity for several weeks, was fed on ants, and afterwards on cooked rice, and was sent alive to Europe in order to be examined, described, and ultimately preserved in the Royal Museum at Leyden. It unfortunately died on board the vessel on its way to Holland, and, by an unaccountable blunder on the part of one of those in charge, its remains were not preserved, but thrown overboard.

During my own stay in Sumatra, from February till May 1891, I took particular trouble to obtain further information concerning this animal, and have found the fact of its existence—though, at the same time, of its exceeding rarity—confirmed in a way which does not allow me to doubt that, ere long, further specimens will be available for a thorough examination, also with respect to anatomical detail. My own attempts to secure a second specimen have not as yet been successful, but as they have drawn the attention of many persons to this animal, I feel bound, in deference to the claims to priority of its original discoverer, who has put his preliminary description as well as sketches of the animal at my disposal, to introduce this peculiar mammal into science, notwithstanding the fact that the type-specimen has been lost. The generic name has been selected, not with a view of indicating any closer anatomical relations with the genus *Manis*, but only to indicate that a hairy anteater is meant.

Trichomanis Hoevenii, gen. et sp. nov.—"Animal of the size of a very large cat. Fur grey, with a black longitudinal band along the middle of the back. Snout elongated and more or less conical, with a small mouth at the extremity. A long cylindrical tongue, which is thrust out, serves the animal in the collection of ants, which are its natural food. A more or less bushy tail. Ears not conspicuous. Legs higher than those of *Manis*, strong claws to the feet."

I have no doubt that this description—however superficial—is more than sufficient for the recognition of the animal as soon as it will have been reobtained. The type-specimen was caught in the mountainous districts that separate the Residencies of Palembang and Bencoolen in Sumatra.

A. A. W. HUBRECHT.

Utrecht, September 7.

An Oviparous Species of Peripatus.

Peripatus leuckartii has proved to be by no means uncommon in Victoria, being now recorded from a good many distinct localities, and forming a very characteristic constituent of our cryptozoic fauna. Hitherto, however, little has been known of its habits, and nothing of its mode of reproduction. The only observer, so far as I am aware, who has recorded anything concerning its life-history, is Mr. Fletcher, who has described (Proc. Linn. Soc. N.S.W., October 31, 1888) four very young individuals, the progeny of a female kept by him in captivity in damp moss and leaves for four months (July to October inclusive). Mr. Fletcher did not observe the birth of the young, but found them in company with the mother when apparently only a few days old. He assumes, naturally enough, that they were born alive, as in all other species of *Peripatus* whose life-history is known; this viviparous habit being, indeed, one of the most remarkable characters of the genus.

In May last I secured a few good specimens of *Peripatus leuckartii*, which I have since kept alive in a small vivarium specially arranged for the purpose. The vivarium consists of a large glass jar, with a flat glass cover supported above the rim of the jar on two thin slips of glass, so as to admit of free ventilation. I keep a small open jar full of water inside the large one, and the floor of the vivarium is covered with a thick layer of very rotten wood, kept moist by the evaporation of the water.

Under these conditions *Peripatus* flourishes well, and the specimens may be inspected when desired, by turning over the bits of rotten wood. On making such an inspection to-day, I found that some twelve or fifteen eggs had been deposited beneath some of the pieces of rotten wood, and in crevices of the same. Careful examination showed that these eggs were undoubtedly those of *Peripatus leuckartii*. I collected all I could find, and removed them, with some of the rotten wood, to a separate receptacle, and then carefully turned out the vivarium and examined its contents. I found that there were present four specimens of *Peripatus*, one male and three females, all apparently in good health, and that there was nothing else which could have laid the eggs; a very small ant being about the largest living thing present except the *Peripatus*. It is now some ten weeks since the vivarium was stocked, and as I have carefully examined it several times during that period, I am sure that the eggs must have been recently deposited.

The view that *Peripatus leuckartii* is really oviparous receives strong confirmation from anatomical examination of adult females. In these I have nearly always found eggs in the uterus, but, although I have dissected specimens taken in December, May, and July, I have never found any embryos. The single July specimen which I have yet dissected was captured at the end of the month and given to me by Prof. Spencer; it contained neither eggs nor embryos; as it appeared to be adult, it is not unlikely that the eggs had been laid. Moreover, the structure of the eggs *in utero* is very characteristic, and argues strongly against the probability of intra-uterine development. They are very large, oval in shape, and consist of a very tough, thick, elastic membrane inclosing a quantity of thick milky fluid full of yolk granules.

I have examined microscopically only one egg after laying, as I wish, if possible, to observe the development; but this one agrees so closely with those found *in utero* that there can be no doubt of its identity. It was of just about the same shape and size ($\frac{3}{40}$ inch long by $\frac{3}{80}$ inch broad), of a very pale yellow colour, with a very tough, elastic membrane, and a milky fluid contents containing very many yolk granules. The only difference concerns the almost chitinous-looking membrane, which, instead of having a smooth surface, or nearly so, as when *in utero*, is exquisitely sculptured or embossed in a beautiful and regular design. The design consists of curious little papillæ, somewhat resembling worm casts, arranged at fairly regular intervals over the surface of the egg, with much finer, close-set, meandering ridges occupying the spaces between them. Such sculpturing is, as is well known, characteristic of many insect eggs, and it renders those of *Peripatus* especially interesting in view of the relationships of that animal. As it is not present in intra-uterine eggs, it must be formed as the egg passes through the vagina, which is large and thick-walled.

It thus appears that *Peripatus leuckartii* lays eggs in July, and it appears also, from Mr. Fletcher's observations, that the young are hatched at the end of October. As, however, I have also found large eggs in the uterus of a specimen captured in December, I think it not improbable that the animal may be double-brooded. (I have used the term "uterus" in accordance with the customary nomenclature; it would be better, perhaps, to speak only of "oviducts" in *P. leuckartii*.)

The mode of reproduction of *Peripatus leuckartii* seems thus to differ widely from that known in all other species, and to conform rather to the insect type; and, considering the immense quantity of food-yolk present, it is probable that the development also differs in a similar way. This I hope to be able to work out, but the presence of so much fluid and granular yolk will, I fear, render the task very difficult.

ARTHUR DENDY.

University, Melbourne, July 31.

The Sun's Radiation of Heat.

A FEW months ago I sent to the *National Review* a paper, which the editors kindly inserted, on the sun's radiation of heat. So far as I am aware, my theory has been completely ignored by those best competent to form an opinion upon the

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 $4\frac{1}{2}$ 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 oxyhydrogen 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

the rain-makers were roused by a crashing peal of thunder, and the rain was soon beating on the roof. At sunrise a magnificent double bow arched the heavens, and the downfall of rain did not cease till 8 o'clock a.m. A number of heavy charges of dynamite were then made, and after every one the drops again poured down, till at last the clouds were entirely expended."

In these quotations is given all that is essential in the newspaper reports now before us. Although deficient in many details that it would be desirable to know, they are written by one who witnessed what he described, and there seems no reason whatever to doubt their genuineness and good faith; we may therefore, discuss the information they afford, without misgivings of its substantial trustworthiness.

It is not antecedently improbable that, in certain states of the atmosphere, the liberation of a large amount of heated gas consisting wholly or in great part of water vapour, at an elevation where aërial movements are but little retarded by terrestrial friction, may suffice to generate an ascending current; and elementary physical considerations teach us that a mass of air that would be called relatively dry at the lower level, will in ascending speedily become saturated and condense its surplus vapour, first as cloud, and eventually as rain, not indeed by acquiring more vapour, but in virtue of dynamic cooling as it progressively expands under the diminished pressure of greater altitudes. But unless the atmospheric strata thus immediately affected be already in a condition of unstable equilibrium, unless the vertical decrease of temperature in these strata is already somewhat greater than the adiabatic rate of decrement, so that the ascending movement once started can be maintained by the store of energy already present in the form of sensible temperature and the latent heat of the included vapour, the effect must of necessity be temporary and local—more of the nature of a small thunder-storm, or cloud-burst, than of the widely extended or sporadic rainfall that accompanies a barometric depression.

In fact, the possibility of rainfall production depends on the possibility of producing and maintaining an upward movement in the atmosphere. There is always some vapour present in the air, generally sufficient to form clouds when dynamically cooled by an ascent through two or three thousand feet; although such air, while resting on the ground and warmed by its contact, may be very dry as judged by our feelings and by the evidence of the hygrometer. The amount of energy yielded by any moderate provision of oxyhydrogen balloons and dynamite is but infinitesimal in comparison with that already locked up in the atmosphere and its vapour, and which, under the circumstances above specified, viz. a vertical decrease of temperature exceeding a certain fixed rate, is available for maintaining a movement once set up; and the part played by the heated gases of such experiments as those now described can be little more than that of a trigger that releases a detent.

It seems highly probable that on August 18 the atmosphere was in this unstable condition. Even in the warm stratum resting on the ground, the humidity was 60 per cent. of saturation, clouds (indicating saturation) existed at some height, and rain began to fall almost immediately on the conclusion of the explosions. It may be noticed, too, that the time of day was that at which the barometer is lowest and the humidity highest in the cloud-forming stratum, although, in fine weather, lowest at the ground surface. In the absence, then, of any observations of the temperature and humidity of the strata primarily stirred up by the exploding balloons and dynamite, it seems likely that they were in a condition to maintain ascending currents once started, and even to communicate the disturbance to regions around.

On the 26th, the atmosphere was evidently in a much more inert condition, and four hours elapsed before rain fell, the disturbance being then apparently more local, and of the nature of a thunder-storm. However, with the meagre data as yet before us, it would be premature to attempt any critical discussion of the processes in operation.

It is needless to say that popular theorizing, on this as on most other physical phenomena, concerns itself chiefly with the things that are most obvious to the senses, but often have little or nothing to do with the process. Thus we find that attention has been fixed on the explosion; and we are told that the idea of breaking clouds by producing a motion in the air, and so destroying the equilibrium of the suspended globules of moisture, which in coalescence form rain, is not a new one; that it was the custom to keep a cannon in French villages, with which to fire at passing clouds and thus hasten the downpour; that at the battles of Dresden and Waterloo the concussion of the air by the cannonade led to the descent of torrential showers; and we are reminded that "in the same way" rain follows a peal of thunder caused by the passage of a lightning-flash through a moisture-laden atmosphere, &c. Now, all this noise and disturbance have no more to do with the production of rainfall than has the thrashing which the village rain-maker of Central India receives from his fellow villagers to stimulate him to fresh exertions when he is thought to have neglected the performance of his official duties, or the London street-boy's whistle, with which Sir Samuel Baker startled a rain-making king in the Southern Soudan, and which was followed by such a deluge that even the rain-making potentate implored him to arrest the working of the spell.[1] The effect of a concussion, as such, is to produce an instantaneous compression of the air, and a momentary heating in a wave which travels away at the rate of about 1000 feet per second, and is incapable of generating any translational movement of the atmosphere, and certainly of promoting condensation. Nor do we know of any recorded observations in support of the idea that it can cause the coalescence of cloud corpuscles into raindrops. Neither does the concussion of the air by a thunder-clap stand to the downpour that follows it in the physical relation of cause to effect. In this case Sir John Herschel adopts the opinion originally put forward by Eeles, that the order of succession is the reverse of that here assumed, that the formation of the rain-drop is the antecedent phenomenon, and the lightning-flash (and *ergo* the thunder) the consequent; the electrical discharge being determined by the sudden concentration of the electricity of (say) one thousand corpuscles on the surface of the single resulting rain-drop, in which case its intensity would be increased ten-fold. What causes the coalescence is still a matter of much obscurity, though some light has been thrown upon it by the ingenious experiment exhibited by Mr. Shelford Bidwell at the Royal Society's *conversazione* on May 14, 1890, and described in vol. xlii. (p. 91) of this journal. When the shadow of a small (condensing) steam jet was thrown upon a white screen, under ordinary conditions, it was of feeble intensity and of a neutral tint; but when the jet was electrified, the density of the shadow was at once greatly increased, and it assumed a peculiar orange-brown tint. It appeared that electrification promoted the coalescence of the exceedingly minute particles of water contained in the jet, thus forming drops large enough to obstruct the more refrangible rays of light. On this view, then, electrification would appear to be the cause of coalescence, and the electrical discharge the ulterior result; but as yet we know too little of the

[1] This story has probably been told by Sir Samuel in one of his well-known works on Africa, and is too good to be spoilt by condensation. It is, at all events, authentic, the present writer having heard it from his own lips at a Simla dinner-table.

molecular processes concerned in the formation of a raindrop to attempt anything like a complete theory.

In conclusion, while we cannot but recognize the high interest of General Dyrenfurth's results, with the imperfect information at present before us we cannot regard them as conclusive. It is the characteristic weakness of all experiments of the kind that many of the essential circumstances are scarcely ever recorded, or perhaps even capable of being brought within the limits of observation: and thus the logical conditions of a proved conclusion cannot be fulfilled. For instance, it is very unlikely that anything is known of the state of the atmosphere in respect of its humidity and its vertical temperature decrement at the elevation at which the balloons were exploded, and yet, as we have seen, these data lie at the very root of the whole matter. However, arrangements are being made for further operations at El Paso and in Western Kansas, so that it will not be long before the highly interesting and practically important problem of stimulating the precipitation of rain will receive a more satisfactory solution.

H. F. B.

NOTES.

THE Permanent Committee of the International Committee of Weights and Measures is now holding its meeting at Sèvres, near Paris. The Committee includes: Dr. Foerster (Germany); M. J. Bertrand (France); Dr. Benoît, Director of the Bureau at Sèvres; Mr. H. J. Chaney (Great Britain); Prof. Govi (Italy); Prof. Krusper (Hungary); Prof. Lang (Austria); Mr. H. de Macedo (Portugal); M. Stas (Belgium); Prof. Thalen (Sweden); Dr. Wild (Russia). The Committee has recently lost its President (General Ibañez); and one of the objects of the present meeting is to elect a new President; an election which will doubtless fall on the senior member of the Committee, Dr. Foerster.

THE members of the Heilprin Expedition, who have lately returned from the west coast of Greenland, give an extremely unfavourable account of the position in which they were obliged to leave Lieutenant Peary. His leg was broken in Melville Bay on July 11. Dr. Hughes, who has recorded in the Philadelphia *Press* the adventures of the Expedition, describes how the accident happened. "While we were going astern for the last time," he says, "to make the butt that forced us through a barrier of ice into comparatively clear water, Lieutenant Peary stepped behind the wheel-house to see how things were going. With a crash the rudder struck a piece of ice, and the next instant his leg was crushed between the rudder gearing and the side of the wheel-house. He was carried below into the cabin, when an examination showed that his right leg was broken square across just above the knee. Everything possible was done for him." When he had recovered from the shock, and had thought the matter over, he decided to go on to Whale Sound, trusting that by next spring his leg would be so far mended that he would be able to accomplish the object of his expedition. His friends thought it would be better for him to return, but they could not help admiring his spirit, and resolved to do everything in their power to further his aim. The shores of Whale Sound proved to be completely blocked with ice, so the *Kite* steamed north to McCormick Bay, on the northern shore of Murchison Sound, which they reached on July 25. Here a space of about two miles was comparatively clear; and Lieutenant Peary's men went ashore, and reported that the place was well suited for their head-quarters. A site was selected on the south shore of McCormick Bay, in latitude 77° 43′, and a wooden house erected, which Lieutenant Peary declared to be "substantial and warm enough." On July 30 the Heilprin party had to leave him, which they did with sad forebodings. Mrs. Peary bravely insisted on remaining with her husband, and they have six companions. The Lieutenant hopes to start in the spring for the unexplored interior of Greenland, but Dr. Hughes says: "It is the deliberate opinion of all our party—and this opinion is indorsed fully by all the officers of the *Kite*—that unless a relief expedition be sent to Lieutenant Peary next summer, he and his party will never be seen again alive." It is doubtful whether the food supply is sufficient; and it is thought most improbable that whalers will take them away next summer. In that case their only resource would be the whale boats, in which they would have to traverse 500 miles of ocean "filled with floes and bergs, and often shrouded with fog or swept by terrible storms."

AN earthquake of great violence caused immense damage in the Republic of San Salvador on September 9. According to reports sent from the capital of the country to the *New York Herald*, there had been indications for several days that a seismic disturbance of more than usual power might be expected. The volcanoes of San Salvador, San Miguel, and Izalco had been unusually active, and deep subterranean rumblings with slight earth tremors had been felt. At 1.55 a.m., on September 9, the earthquake began in the city of San Salvador with a slight tremor, which gradually augmented. The duration of the first shock was ten seconds, during which time a frightful subterranean noise was audible in every part of the city. While the shock lasted, the earth rose and fell in long waves, and even strong men were unable to keep their feet. The walls of houses cracked, and then tottered and fell. In the capital alone 40 persons were killed, and 50 or 60 seriously injured. The experience of towns in the country seems to have been still worse. Of 320 houses at Comasagua only eight remain standing, and the loss of life there was great. Analquito has also been almost completely destroyed, and Cojutepeque, Santa Tecla, San Pedro, and Masahuet were so badly shaken as to be practically ruined. It is feared that the earthquake has been even more disastrous than those of 1854 and 1873.

IN the Isle of Fayal, among the Azores, several shocks of earthquake were felt on August 27 and 28.

MR. TUCKWELL writes to us from Loughrigg, Ambleside, that an aurora was seen there on Friday night, September 11. The arch spanned the heavens from south-west to north-east, passing nearly through the zenith. It was white, with slight coruscations at its south-west base. It was first seen at 9 p.m.: it had faded by 10 o'clock.

A NEW department of physics and electrical engineering will be begun this session at the new branch of the Manchester Technical School in Whitworth Street, where a large well-lighted warehouse is being fitted up for the purpose. The building will be lighted by electricity, the installation being fitted up with especial regard to instruction. For the latter purpose, the electric light installation in the Central School in Princess Street will also be available.

THE Library Association is holding its annual meeting this week at Nottingham. Mr. Robert Harrison, of the London Library, presides. The meeting began yesterday in the large theatre of the Nottingham University College.

THE Industrial Society of Mulhouse has issued a programme of prizes which it proposes to give for work done in the year 1891–92. A copy will be sent to anyone who applies for it to the Secretary of the Society. The prizes are very numerous,

and are to be granted for work of many different kinds in connection with the application of scientific methods to industry.

A CONFERENCE on Conifers will be held at Chiswick, in connection with the Royal Horticultural Society, in October. It is hoped that this Conference will not only draw attention to the best of these trees and shrubs from a garden or landscape point of view, but show what are the best varieties to plant for English-grown timber, as well as the different uses and suitabilities of the various foreign-grown timbers. The co-operation of landowners and others who may have planted these trees or shrubs in years past, or who take a present interest in them, is specially invited.

DREDGERS working in the Tiber to prepare for the construction of a new embankment brought up on September 12 a magnificent ancient Roman bronze helmet. It is perfectly preserved, and is decorated with bas-reliefs. Signor Rossi, the Italian archæologist, assigns it to the second century before the Christian era.

ACCORDING to the Calcutta correspondent of the *Times*, it is understood that the Ameer of Cabul is taking steps to obtain from England a geologist, a chemist, two miners, and a number of mechanics.

THE Royal Meteorological Institute of the Netherlands has just issued another useful work in maritime meteorology, viz. "Routes for Steamships between Aden and the Straits of Sunda." A previous edition appeared in 1881, but since that time steam navigation to the Dutch Indies has greatly increased, and consequently the number of logs received has afforded sufficient materials to allow of a fuller discussion of the outward and homeward routes for each month. Although there is a certain amount of regularity both as regards the monsoons and currents, yet there are considerable differences both in force and direction in the same months of different years, which cannot be taken into account in laying down general routes; but tracks laid down with great care from the most complete data available will give the best chance of successful passages. We cannot enter here into the details of the results, but we may mention that the tables and charts contained in the work show for each 10° of longitude the number of vessels which have cut those meridians in different latitudes, and the means of the number of hours taken. The tracks show that a very considerable divergence from the most direct routes is recommended in certain months, according as the east or west monsoon may be blowing. The usefulness of the work is attested by the fact that copies have been ordered for their vessels by the French, Russian, and Italian Governments.

IT is expected that in no other department of the "World's Columbian Exposition" will there be a greater diversity of exhibits than in that of mines and mining. Not only will there be a magnificent array of diamonds, opals, emeralds, and other gems, and of the precious metals, but a most extensive collection of iron, copper, lead, and other ores, and of their products; of coal, granite, marble, sandstone, and other building stone; of soils, salt, and petroleum. A sub-department will take special charge of the coal and iron exhibit, and later of that of copper and lead.

MR. O. CHANUTE, a well-known engineer of Chicago, has been studying the methods of preparing wood chemically to resist decay, and has expressed the opinion that great economies might be realized in America by the general adoption of these methods on railways. *Science* says he recently examined some experimental railroad ties of the most perishable kinds of wood prepared by what is known as the zinc-tannin (Wellhouse) process, in St. Louis, in 1881 and 1882, and laid in the tracks of the Atchison, Topeka, and Santa Fe Railroad, at Topeka, Kan., and La Junta, Col. After nine or ten years' exposure they show excellent results, whereas they would have lasted but from one to four years if unprepared. Unprepared ties of the same kind of timber, laid at the same time, adjoining to the prepared ties, have all decayed and been taken up, while present appearances indicate that the prepared ties (red oak, black oak, and Colorado pine) are likely to show an average life of ten to fifteen years or more. Mr. Chanute calls attention to the fact that the zinc-tannin process not only preserves ties against decay, but hardens them as well. It is found on one railroad that after three years' exposure treated hemlock ties hold the spike as well, and cut less under the rail than untreated white oak.

SOME time ago the Field Naturalists' Club of Victoria organized an excursion to the Kent group of islands, the object being to collect specimens, and to determine whether the group is most nearly related with Victoria, to which it is closest geographically, or with Tasmania. At the annual *conversazione* of the Club, held recently, Mr. C. A. Topp, the retiring President, referred to the results of the expedition. The bulk of the fauna and flora was found to be common to Victoria and Tasmania, but there were six or seven varieties of birds peculiar to Tasmania to two peculiar to Victoria. The conclusion was that the islands had been separated from Tasmania after that island was disjoined from the mainland. Among the plants, several forms were found varying somewhat from the typical forms of the same species on the mainland; while it was interesting to find that the arboreal short-eared opossum had changed his habits so far as not to feed on the leaves of the eucalypt, and to keep to the ground.

IN a paper in the American *Engineering Magazine*, on ventilation, Mr. Laurence Allen contends that in very many schools the quantity of pure air admitted is not sufficient to expel the foul air. To maintain the air in a good sanitary condition in a properly constructed schoolroom, his experience confirms the amount required as stated by Billings, to wit, 60 cubic feet of air for each occupant per minute. For 100 pupils this amounts to 360,000 cubic feet per hour. How many schools come up to this requirement? In the United States, says Mr. Allen, there are many schools that contain 100 pupils and do not introduce more than 25,000 feet of pure air per hour, and even that is rendered in a measure ineffective, because the air is not properly admitted. "The pupils do not die in the poisoned atmosphere; many of them will appear reasonably healthy. So do many persons who visit and tarry in malarial districts. But though the effects are not immediate and striking, they are sure, permanent, and easy to be traced to their causes in after years, by those who make a study of disease and its causes. It is scarcely less humane to kill a child than, by wilfully ignoring sanitary requirements, to cripple it for life, physically, mentally, and morally, as children are being crippled to-day in the vile atmosphere of many schools."

IN a paper published in the current number of the Journal of the Anthropological Society, Mr. J. J. Lister refers to the great development of the arms and chests of the natives of Fakaofu (Bowditch Island, Union Group). He thinks it may be due to the fact that they are obliged to go about so much in canoes. Sir Joseph Lister, who took part in the discussion which followed the reading of this paper, remarked that he would not have expected the frequently repeated action of paddling to produce lengthening of the arms, although he could understand its resulting in increased size of chest. He pointed out that the natives of Tonga were also accustomed to use canoes, and hence

it was not clear that the phenomenon could be traced to the cause assigned. Mr. Lister replied that, although the Tongans use canoes, canoe work is not so essential a part of their lives as it is in the case of the natives of Fakaofu. The natives of the island of Tongatabu have many avocations quite apart from the sea, for they live on an island twenty-two miles long, and many villages are situated some distance from the water. The natives of Fakaofu, on the other hand, live crowded together on a small islet situated on a ring of reefs, and to meet almost every need of their lives they must do more or less paddling.

MR. IVAN PETROFF, the United States special census agent, has been engaged in taking the census of the natives of Nunivak Island, in Behring Sea, in 60° N. lat. He found the population to consist of over 600 natives. It was previously supposed that over 300 people occupied the island. There are no white men there, and the natives live in a most primitive style. Their only food is the flesh of the walrus, and their only wealth consists of ivory obtained from the tusks of that animal. There are few land otter, but, apart from these, the natives catch no fur-bearing animals.

DR. L. WEBSTER FOX is of opinion that savage races possess the perception of colour to a greater degree than do civilized races. In a lecture lately delivered before the Franklin Institute, Philadelphia, he stated that he had just concluded an examination of 250 Indian children, of whom 100 were boys. Had he selected 100 white boys from various parts of the United States, he would have found at least five of them colour-blind: among the Indian boys he did not discover a single case of colour-blindness. Some years ago he examined 250 Indian boys, and found two colour-blind, a very low percentage when compared with the whites. Among the Indian girls he did not find any. Considering that only two females in every 1000 among whites are colour-blind, he does not think it surprising that he did not find any examples among the Indian girls.

DR. J. FRANK lately reported to the Chicago Medical Society the case of a man who periodically sheds his skin. The shedding began in his first year, and has since then occurred regularly every July. He is taken with feverish tremors, increasing almost to paroxysms. He undresses, lies down, and within a few minutes the skin of the chest begins to turn red. The redness rapidly extends over the entire skin, and the feverish tremors continue uninterrupted for about twelve hours. Then he rises, dresses, and walks about in perfect health. The skin now begins to peel, and ten hours later it comes off in great patches. From the arms and legs it can be peeled off exactly like gloves or stockings. As the old skin comes away, a new epidermis, as soft and pink as a baby's, is revealed. This new skin is very sensitive; the patient has to wear softened gloves and moccasins for about a week. After the old cuticle has been entirely removed, the finger and toe nails begin to drop off—new nails literally crowding them out. Finally, the change is complete, the man has a new skin and a new outfit of nails, and is ready to return to the mines. A lady in Washington County, Nebraska, who is thirty-nine years old, has written to Dr. Frank that since 1876 she has had a like experience every second or third year.

THE Orcutt Seed and Plant Company, San Diego, California, have issued an interesting descriptive list of Californian trees and flowers. The writer thinks that there is perhaps no country in the world where the early spring flowers so change the face of the earth from a desolate waste to a beautiful garden as on the Pacific coast—hills, mesas, mountains and valleys, and the arid plains of the desert, alike quickly responding to the vivifying rain. "California," he says, "has probably already furnished to the horticulturist a greater variety of beautiful flowers and stately trees than any other State in the Union. Yet many others are awaiting the appreciation of man, or wasting their sweetness on the desert air."

A PAPER on malformations of the bill in birds, by Mr. W. P. Pycraft, has been reprinted from the Transactions of the Leicester Literary and Philosophical Society. The most common kinds of malformation are those resulting from overgrowth of the horny sheath, and those arising from injury. Mr. Pycraft discusses these first, and then considers malformation due to embryonic disturbance.

"SYMONS'S British Rainfall, 1890," which has lately been published, contains, we need scarcely say, an enormous mass of information as to the distribution of rain over the British Isles during the year to which the volume relates. Mr. Symons points out that the only important alteration in this issue is that due to the completion of the decade 1880–89, which has enabled him to use the average for that period as a basis of comparison. He also calls attention to an article on the evaporation from soil, and to the details given as to the great rain of July 17.

THE operatives' lecture delivered at the Cardiff meeting of the British Association by Prof. Silvanus P. Thompson has been published by Messrs. E. and F. N. Spon. The subject is "Electricity in Mining."

"THE Hand-book of Jamaica for 1891–92" has just been issued. This is the eleventh year of publication. Mr. S. P. Musson and Mr. T. Laurence Roxburgh have done their best to present the fullest and latest information obtainable; and everyone who has occasion to consult the book will appreciate the care and thoroughness with which their task has been fulfilled.

A NEW edition, revised and enlarged, of the "Alkali Makers' Pocket-book," by Prof. Dr. Lunge and Dr. Hurter, will be issued in a few days in Messrs. Whittaker's Specialists' Series. As the size of the page has been somewhat increased, the designation "Hand-book" has been substituted for "Pocket-book." The same publishers are about to issue "A Practical Hand-book on the Telephone," dealing specially with telephonic exchanges, by Mr. Joseph Poole.

MESSRS. RAITHBY, LAWRENCE, AND CO. have issued a second edition, revised and enlarged, of "Simple Recipes for Sick-room Cookery," by Mrs. Buck. The writer produces an excellent impression at once by the sensible tone of the preface, in which she gives some general counsels as to the proper way of dealing with the food of the sick.

THE new number of the Journal of the Royal Horticultural Society contains, besides extracts of proceedings, a number of interesting papers. Mr. W. Warren writes on Persian cyclamen; the Rev. W. Wilks on hardy cyclamen; Dr. M. T. Masters, F.R.S., on germination of cyclamen. Snowdrops form the subject of papers by Mr. J. Allen, Mr. D. Melville, and Mr. F. W. Burbidge. There are also papers on the cultivation of hardy bulbs and plants, by Herr Max Leichtlin; Lachenalias, by Mr. F. W. Moore; Cape bulbs, by Mr. J. O'Brien; and hybrid Rhododendrons, by Prof. Henslow.

THE volume containing the Proceedings and Transactions of the Royal Society of Canada for 1890 includes papers on the American bison, by Charles Mair; the Vinland of the Northmen, by Sir Daniel Wilson; unit measure of time, by Sandford Fleming; a peculiar form of metallic iron found in Huronian quartzite on the north shore of St. Joseph Island, Lake Huron,

Ontario, by G. C. Hoffmann; sun-spots observed at McGill Observatory, by C. H. McLeod; a test of Ewing and MacGregor's method of measuring the electric resistance of electrolytes, by J. G. McGregor; the later physiographical geology of the Rocky Mountain region in Canada, by G. M. Dawson; fossil plants from the Similkameen Valley and other places in the southern interior of British Columbia, by Sir J. W. Dawson.

MESSRS. SWAN SONNENSCHEIN AND CO. will issue the following books during the autumn season:—"The Colours of Animals," by Prof. Beddard, with coloured and other plates and woodcuts; "Text-book of Embryology: Man and Mammals," by Dr. Oscar Hertwig, Professor of Comparative Anatomy in the University of Berlin, translated and edited from the third German edition (with the assistance of the author) by Dr. E. L. Mark, Professor of Anatomy in Harvard University, with 389 illustrations and 2 coloured plates; "Text-book of Embryology: Invertebrates," by Drs. Korschelt and Heider, of the University of Berlin, translated and edited by Dr. E. L. Mark, with several hundred illustrations; "Text-book of Animal Palæontology," by Dr. Thomas Roberts, designed as a supplement to Claus and Sedgwick's "Text book of Zoology," illustrated; "Text-book of Geology," adapted from the work of Dr. Emanuel Kayser, Professor in the University of Marburg, by Philip Lake, of St. John's College, Cambridge, with illustrations; "Text-book of Zoology," by Dr. C. Claus, of the University of Vienna, and Adam Sedgwick, F.R.S., Vol. II. "Mollusca to Man," third edition; "The Geographical Distribution of Disease in England and Wales," by Alfred Haviland, M.D., with several coloured maps; "Introductory Science Text-books"—Additions: Introductions to the study of "Physiography," by H. M. Hutchinson; "Zoology," by B. Lindsay; "Amphioxus," by Dr. B. Hatschek, of the University of Vienna, and James Tuckey; "Geology," by Dr. Edward Aveling; "Physiological Psychology," by Dr. Th. Ziehen, of the University of Jena, adapted by Dr. Otto Beyer, with 21 figures. "Young Collector Series"—Additions: "The Telescope," by J. W. Williams; "British Birds," by the Rev. H. C. Macpherson; "Flowering Plants," by James Britten; "Grasses," by W. Hutchinson; "Fishes," by the Rev. H. C. Macpherson; "Mammalia," by the Rev. H. C. Macpherson.

AN instrument for optical comparison of transparent liquids, named a *liquoscope*, has been recently devised by M. Sondén, of Stockholm. Two hollow prisms holding the liquids are separated by a partition at right angles to the refracting angle. The whole is placed in a vessel filled with glycerine, and which allows of vision in a horizontal direction through plane glass plates. The deflection of the light rays through the prisms is thus compensated. So long as the two liquids have the same optical action, one sees a distant mark (say a black paper strip on a window) as a straight connected line; but its halves are relatively displaced if the liquids have different refractive power. The amount of displacement gives a measure of the difference, the positive or negative nature of which also appears from the direction of displacement. The author recommends his apparatus for chemical purposes, especially comparison and testing of fats and oils, analysis of glycerine, &c., and detection of margarine in butter, margarine greatly lowering the index of refraction.

HERR HUFNER has lately pointed out some of the biological bearings of the fact (observed in experiment along with Herr Albrecht) that long light-waves are much more strongly absorbed by water than short ones. If the lower marine animals had, like man, the liveliest light perception with yellow rays, and a certain intensity of light were necessary to them, they must live at a less depth than if their visual organs were most strongly affected by short-waved rays. Thus, *e.g.*, if they needed as much yellow light as that of the full moon, they could not live deeper than 177 metres (say, 590 feet). Yet they are found at all depths where food, oxygen, and a suitable temperature exist. On the other hand, the existence of plants having chlorophyll depends on light, and we might expect that the distribution of non-parasitic plants would be very limited; which is the case, no plant-organisms being found under 200 fathoms. Green plants assimilate best in yellow light; and supposing plants to assimilate in moonlight they would find their limit at the above depth (177 metres). But while yellow is here weakened to 0·0000016 of its brightness, indigo blue has still 0·007829 of its original strength, and the assimilation with blue rays will be 660 times as strong as with yellow. Different coloured marine plants react differently according to the colour of light, and they have accordingly different distribution in depth.

THE additions to the Zoological Society's Gardens during the past week include two Pinche Monkeys (*Midas œdipus* ♂ ♀) from Granada, presented by Mr. A. Aitken; a Fallow Deer (*Dama vulgaris* ♂), British, presented by Mr. J. Johnston; a Persian Gazelle (*Gazella subgutturosa* ♀) from Persia, presented by Baron Ferdinand de Rothschild; a Common Cormorant (*Phalacrocorax carbo*), British, two Yellow-browed Buntings (*Emberiza chrysophrys*), two Red-backed Buntings (*Emberiza rutila*), a —— Bunting (*Emberiza cioides*), two Japanese Greenfinches (*Fringilla kawarahibi*, var.) from Japan, purchased; a Yellow-footed Rock Kangaroo (*Petrogale xanthopus* ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE LINEAR ARRANGEMENT OF STARS.—Although the arrangement of stars in curves has often been noted and studied, little attention has been paid to what is apparently a more striking and prevalent feature, viz. straight lines and parallel arrangement of pairs, lines, and bands of stars, and of irresolvable wisps. Our knowledge of the structure of the sidereal universe is therefore extended in the required direction by some results obtained by Mr. T. W. Backhouse from observations which he has made during the last nine years in Sunderland. The area of the sky selected for scrutiny is that portion of the Milky Way included between 15, 13, 8 Monocerotis, α Orionis, ζ Tauri, and 5, μ, ξ Geminorum; and the configurations in this portion have been examined chiefly with a binocular field-glass of 2·05 inches aperture. The observations have been divided into sections, referring respectively to lines and parallel arrangements of stars, to those in clusters, to nebulous wisps, to nebulæ, and to miscellaneous lines. In these are given the detailed structure in different parts of the area showing various systems of parallel lines and wisps, together with their position-angles referred to that portion of Gould's galactic equator which runs through the middle of the area in question. The parallel arrangement of the stars, and an arrangement in straight lines, is strikingly obvious from the maps which illustrate the tabulated results of the observations. Besides the maps, sixteen figures have been drawn to show the various angles of position of the lines and streams with reference to the central line or axis of the Milky Way. From these figures it is apparent that the angles of position are grouped more numerously in certain directions than in others, the principal directions being nearly parallel to the galactic equator. Also, there is a great deficiency of position-angles at right angles to this equator. A wonderful case of radiation of stars and wisps in a fan-shaped group has been found, 68 Orionis being approximately the centre. One conclusion derived from the investigation is, that the stars and wisps in parallel lines are probably in the same region of space; and therefore that the majority of the stars in extensive tracts of the area examined are really near one another.

WOLF'S PERIODIC COMET.—This object can now be fairly seen by means of a small telescope. It will pass through the Hyades about September 25, and be 3° south of Aldebaran on October 2. The following ephemeris, from one given by Herr

Thraen in *Astronomische Nachrichten*, No. 3054, shows that the comet crosses the equator near the end of October :—

Ephemeris for Berlin Midnight.

1891.	Right Ascension. h. m. s.	Declination. ° ′ ″	Brightness.
Sept. 19 ...	4 9 50·40 ...	19 5 59·0 ...	9·1
,, 21 ...	13 7·99 ...	18 17 29·3	
,, 23 ...	16 16·09 ...	17 27 4·4	
,, 25 ...	19 14·09 ...	16 34 48·7	
,, 27 ...	22 1·58 ...	15 40 44·3	
,, 29 ...	24 38·50 ...	14 44 57·2	
Oct. 1 ...	27 4·25 ...	13 47 32·4 ...	11·2
,, 3 ...	29 19·10 ...	12 48 36·5	
,, 5 ...	31 22·56 ...	11 48 16·6	
,, 7 ...	33 14·86 ...	10 46 39·8	
,, 9 ...	34 55·42 ...	9 43 57·5	
,, 11 ...	36 24·69 ...	8 40 16·9	
,, 13 ...	37 42·51 ...	7 35 49·0 ...	12·0
,, 15 ...	38 49·17 ...	6 30 45·1	
,, 17 ...	39 44·06 ...	5 25 18·0	
,, 19 ...	40 27·92 ...	4 19 38·1 ...	12·1
,, 21 ...	41 0·53 ...	3 13 58·7	
,, 23 ...	41 22·25 ...	2 8 33·2	
,, 25 ...	41 33·30 ...	+ 1 3 35·1 ...	12·0
,, 27 ...	41 33·97 ...	− 0 0 47·0	
,, 29 ...	41 24·46 ...	1 3 57·7	
,, 31 ...	41 5·38 ...	2 6 8·0	
Nov. 2 ...	40 37·33 ...	3 6 51·3	
,, 4 ...	40 0·67 ...	4 5 54·6	
,, 6 ...	39 16·50 ...	5 3 7·0 ...	11·2
,, 8 ...	38 25·07 ...	5 58 14·5	
,, 10 ...	37 27·44 ...	6 51 6·6	
,, 12 ...	36 24·07 ...	7 41 33·4 ...	10·4

It will be seen that the comet is now nine times brighter than at the date of discovery (May 4). The maximum brightness will be reached about October 19.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE Address of the President of the Geological Section having been devoted to the general questions involved in the origin, association, and working of coal, it was natural that other papers on the economic side of the science should claim considerable interest. Prof. Boyd Dawkins stated that the Channel Tunnel boring had been carried to a depth of 1500 feet, with the result of penetrating coal-measures dipping gently to the south at 1113 feet. Six seams, containing 10 feet of workable coal, had been pierced between that depth and the present bottom of the boring. The author endeavoured to show the probability that a thick series of coal-measures, with workable coals like those of Liége on one side and Somerset on the other, would be met with if the boring were continued, and pointed out the advantage possessed by the south-eastern coal-field in its moderate depth and the comparatively uncrushed character of the coal.

In an exhaustive paper Mr. Topley summarized the chief facts bearing on the origin of petroleum. He pointed out that, while the American oil was mainly derived from Palæozoic rocks, that in Europe and Asia came largely from Secondary beds, and the large Caucasian supply was drawn from rocks of Miocene age. The essential conditions for the supply of oil appeared to be, a porous rock, generally of sandstone or limestone, which served as a reservoir and was underlain by or contained beds largely consisting of organic remains, with an impervious cover of shale. In many cases the limestone had been dolomitized and transformed into a cavernous rock which was capable of storing the gas and oil. Such rocks can contain from one-eighth to one-tenth of their bulk of oil. The oil was driven to the surface by artesian pressure, and so gas was generally met with on the summits of anticlines and oil on their flanks. Where the rocks were very highly disturbed oil occurred, but not in very great abundance, while gas was rarely found.

Mr. Ross, in a paper on the same subject, endeavoured to prove that the oil was mainly generated by the action of solfataric volcanic energy upon beds of limestone, basing his conclusion on the occurrence of hydrocarbon and sulphurous vapours in solfataras, and the constant association of rock salt, dolomite, and gypsum with the rocks yielding petroleum. He exhibited equations to show that the action of sulphur dioxide and sulphuretted hydrogen on carbonate of lime, with or without water and peroxide of hydrogen, was capable of producing the ethylene and marsh gas derivatives, and he quoted experiments of Bischof to show that sulphur was formed by similar reactions, arguing that the hydrocarbons must be necessary by-products.

Sir Archibald Geikie communicated two most important papers on the results of Geological Survey work in the North-western Higlands. One of these papers, relating to the discovery of the *Olenellus* zone in the North-west Highlands, was as follows:—"Ever since the Geological Survey began the detailed investigation of the structure of the North-west Highlands of Scotland, the attention of its officers has been continuously given to the detection of any fossil evidence that would more clearly fix the geological horizons of the various sedimentary formations which overlie the Lewisian gneiss. A large collection of organic remains has been made from the Durness limestone, but it has not yet yielded materials for a satisfactory stratigraphical correlation. The study of this collection, however, has confirmed and extended Salter's original sagacious inference that the fauna of the Durness limestone shows a marked North American facies, though, according to our present terminology, we place this fauna in the Cambrian rather than in the Silurian system. Below the Durness limestone lies the dolomitic and calcareous shaly group known as the 'Fucoid beds,' which, though crowded with worm-castings, has hitherto proved singularly devoid of other recognizable organic remains. In following this group southwards through the Dundonnell Forest, in the west of Rosshire, my colleague, Mr. John Horne, found that, a few feet below where its upper limit is marked by the persistent band of 'Serpulite grit,' it includes a zone of blue or almost black shales. During a recent visit to him on his ground, when he pointed out to me this remarkable zone, I was struck with the singularly unaltered character of these shales, and agreed with him that if fossils were to be looked for anywhere among these ancient rocks, they should be found here, and that the fossil-collector, Mr. Arthur Macconochie, should be directed to search the locality with great care. The following week this exhaustive search was undertaken, and Mr. Macconochie was soon rewarded by the discovery of a number of fragmentary fossils, among which Mr. B. N. Peach, who was also stationed in the district, recognized what appeared to him to be undoubtedly portions of *Olenellus*. The importance of this discovery being obvious, the search was prosecuted vigorously, until the fossiliferous band could not be followed further without quarrying operations, which in that remote and sparsely inhabited region could not be at that time undertaken. The specimens were at once forwarded to me, and were placed in the hands of Messrs. Sharman and Newton, Palæontologists of the Geological Survey, who confirmed the reference to *Olenellus*. More recently Mr. Peach and Mr. Horne, in a renewed examination of the ground, have found, in another thin seam of black shale interleaved in the 'Serpulite grit,' additional pieces of *Olenellus*, including a fine head-shield with eyes complete. There may be more than one species of this trilobite in these Rosshire shales. The specific determinations and descriptions will shortly be given by Mr. Peach. The detection of *Olenellus* among the rocks of the North-west Highlands, and its association with the abundant *Salterella* of the 'Serpulite grit,' afford valuable materials for comparison with the oldest Palæozoic rocks of other regions, particularly of North America. The 'Fucoid beds' and 'Serpulite grit,' which intervene between the quartzite below and the Durness limestone above, are now demonstrated to belong to the lowest part of the Cambrian system. The quartzites are shown to form the arenaceous base of that system, while the Durness limestones may be Middle or Upper Cambrian. On the other hand, the Torridon sandstone, which Murchison placed in the Cambrian series, can now be proved to be of still higher antiquity. The marked unconformability which intervenes between it and the overlying quartzite points to a long interval having elapsed between the deposition of the two discordant formations. The Torridon sandstone must therefore be pre-Cambrian. Among the 8000 or 10,000 feet of strata in this group of sandstones and conglomerates, there occur, especially towards the base and the top, bands of grey and dark shales, so little altered that they may be confidently expected somewhere to yield recognizable fossils. Already my colleagues have detected traces of annelids and some more obscure remains of other organisms

in these strata. These, the oldest relics of life yet known, have excited a vivid desire in the Geological Survey to discover further and more determinable fossils associated with them in the same primæval resting-place. We shall spare no pains to bring to light all that can be recovered in the North-west Highlands of a pre-Cambrian fauna."

In the other paper the Director-General dealt with some recent work of the Geological Survey in the Archæan gneiss of the North-west Highlands. "For some years past," he remarked, "the officers of the Geological Survey have spent much time and labour upon the investigation of the old or fundamental gneiss of the North-west Highlands. They have succeeded in showing that it consists mainly of materials which were originally of the nature of eruptive igneous rocks, but which by a long succession of processes have acquired the complicated structures which they now present. No evidence of anything but such eruptive rocks had been met with until the mapping was carried into the west of Rosshire. In that area it had long been known that the gneiss includes some mica-schists and limestones which were generally believed to be integral parts of its mass. With the accumulated experience of their work farther north, my colleagues were naturally pre-disposed to accept this view, and to look on even the limestones as the result of some crushing down and re-formation of basic igneous rocks containing lime-silicates. But as they proceeded in their work they encountered various difficulties in the acceptation of such a theoretical explanation. In particular, they found that with the mica-schist were associated quartz-schists and graphitic schists, and that the limestone occurred in thick and persistent bands with included minerals like those found in the Eastern Highlands in districts of contact-metamorphism. The microscopic examination of some of these rocks showed them to present close affinities to certain members of the crystalline series of the Eastern and Central Highlands, which can be recognized as consisting mainly of altered sedimentary strata (Dalradian series). Yet the officers of the Survey could not separate these doubtful rocks from the surrounding gneiss. The several materials seemed to pass insensibly into each other in numerous sections, which were examined with great care. Within the present month, however, one of the members of the staff, Mr. C. T. Clough, who has been specially engaged in this investigation, has obtained what may prove to be conclusive evidence on the subject. He has ascertained that the main bands of graphitic schist occur evenly bedded in an acid mica-schist, in which, also, thin graphitic layers are distributed at intervals of an inch or less. These rocks are sharply marked off from the true gneiss, though, where they actually join, they appear to be, as it were, crushed along a line of intense movement. Mr. Clough and his colleagues are at present disposed to believe that these schists are really an older series of sediments, into which the original igneous rocks now forming the gneiss were erupted. If they succeed in demonstrating the correctness of this inference, they will have established a fact of the highest interest in regard to the geological history of our oldest rocks. Already they have shown the thick masses of Torridon sandstone to be an accumulation of sedimentary materials of pre-Cambrian age. They will push back the geological record to a still more remote past, if they can establish the existence of a yet more ancient group of sedimentary strata among which layers of graphite and beds of limestone remain to suggest the former existence of plant and animal life."

The session on Monday was opened by Sir R. S. Ball with a paper on the cause of an Ice age. This communication stated that the author had a work in the press dealing with the question of glacial climates. He had revised Herschel's figures, on which Croll's deductions were based, and discovered an arithmetical error of considerable consequence. If 63 represents the number of heat-units received by any hemisphere during summer, its winter receipt will be represented by 37. Consequently, during a period of high eccentricity the 63 units of heat may be received in 199 days or in 166 days, according to the position of the equinoxes, producing either a long and cool summer or a short and intensely hot one. The paper did not deal with geographical considerations, and advocated the occurrence of clusters of alternate glacial and interglacial periods at each phase of high eccentricity in the earth's orbit. This paper excited considerable discussion, in which Prof. Sollas, Prof. Wright (of Oberlin, Ohio), Mr. Hall, Dr. Crosskey, Dr. Hicks, and many other glacialists took part.

Dr. Crosskey followed with his Report on the Distribution of Erratics in England and Wales, in which he referred to the useful work done by the North of England Boulder Committee, in systematically surveying the north in search of boulders and groups of boulders. Details were given of boulders from Lancashire, Cheshire, Derbyshire, Staffordshire, and Yorkshire, and it was remarked that boulders were being destroyed so rapidly that many described in former reports had totally disappeared. In another paper the same author controverted a statement of Forbes with regard to the glaciation of the Dovrefjeld. Wherever the basement rock is to be seen, it is glaciated, although morainic deposits were swept away and redistributed by torrential action at the close of the Glacial period.

Prof. Wright read a most interesting paper on the Ice age of North America and its connection with the appearance of man in that continent. The glacial deposits, transported from several centres mostly outside the Arctic circle, and the absence of a Polar ice-cap, militated against an astronomical, and for a geographical, cause of the great cold, particularly as an uplift of the glaciated area was coincident with an important subsidence in Central America. The author regarded the so-called "terminal moraine of the second period" as a moraine of retreat due to the first glaciation, and thought the evidence of forest beds, mainly to the south of the area, indicated local recessions of ice, and not a single great interglacial epoch. Palæolithic remains similar to those of the Somme and Thames have been found in several gravel terraces flanking streams which drain from the glaciated region, and made up of glacier-borne detritus; they are regarded by the author as deposits of the floods which characterized the closing portions of the Glacial period. The recession of the falls of Niagara and St. Anthony gives an antiquity of not more than 10,000 years to the end of the Glacial epoch—a conclusion supported by the enlargement of post-Glacial valleys and the silting up of small post-Glacial lakes.

Other papers read on this day were: one by Dr. Hicks, who produced specimens of boulders from Pembrokeshire, which seemed to him like North Welsh or Irish rocks—his picrite was, however, recognized as an Irish rock by geologists in the room, and in any case a flow of ice down the Irish Sea and over Pembrokeshire seemed to be clearly proved; one by Mr. Kendall, on a glacial section at Levenshulme, Manchester, in which he gave evidence from the striation of the subjacent rock, and the intrusion of tongues of boulder-clay into it, the transport of fragments, the orientation of large boulders, and the direction of striæ, together with a consideration of the levels of the different portions of the rock beneath, that the district had been traversed by land ice coming from a direction a few degrees north of west; and one by Mr. Bolton on a group of boulders from Darley Dale, near Matlock, which he regarded as having been washed out of rocks skirting the valley. In connection with these papers may be mentioned a report by Mr. Harrison, who has excavated in the talus under some rock-shelters at Oldbury Hill, near Ightham, from which he obtained forty-nine well-finished Palæolithic implements and over 600 waste flakes, which were described in a separate paper by Prof. Prestwich. Prof. Wright gave also a brief account of the basaltic lava beds of the Pacific coast, which are of post-Tertiary age. New evidence in favour of the genuineness of the Calaveras skull and other human remains found under the lava beds was given; and the discovery of a small clay image in a similar position under the western edge of the lava plains of Idaho at Nampa was recorded; the lava beds are correlated with the glacial deposits of the East.

Mr. Jones's report on the Elbolton cave, near Skipton, was of unusual interest. Long-headed human skulls were found with burnt bones and charcoal in the upper stratum, associated with domestic animals and pottery ornamented with diamond and herring-bone patterns; while at a much lower level—13–15 feet below the floor—there were round skulls, much more decayed, in connection with ruder and thicker pottery than has been found in any other part of the cave. No flints or metal of any kind have been found, and bone pins and other worked bones are the only human implements hitherto discovered. The remains of bear and hare have been found in cave earth below this level, and the investigation is to be continued in the hope that remains similar to those of the Ray Gill fissure may yet be met with.

An interesting discussion was raised on the paper by Dr. Hicks on the Silurian and Devonian rocks of Pembrokeshire

and Devon. The Silurian rests transgressively on Ordovician and pre-Cambrian rocks in Pembrokeshire, but is covered by a continuous series up into the Old Red Sandstone and Carboniferous; similarly the Morte Slates, which the author regards as the oldest rocks of North Devon, and in which he has recently found *Lingulella Davisii*, are covered by the Devonian and Culm series of rocks. Mr. Ussher described the occurrence of a volcanic series in the Lower Devonian rocks of Tor Cross, and traced similar diabasic rocks amongst the chloritic series of Prawle Point, the excessive alteration of these rocks being due to the greater nearness to the old resisting rocks of the Channel. In this conclusion he was supported by Mr. Hunt, who described the occurrence of detrital tourmaline in the Devonian cliffs at the north-east end of Straiton Sands, and compared it with the occurrence of similar material in a quartz-schist west of the Start Lighthouse. Both schists and sandstone contain detrital tourmaline, mica, fine-grained quartz, and iron.

Several palæontological papers were contributed. Mr. Montagu Browne exhibited teeth, scales, and bones of Colobodus from Aust, Watchet, and Leicestershire, which seemed to indicate the identity of Colobodus with Lepidotus, and possibly of Heterolepidotus with Eugnathus, and to give Colobodus an extended upward range. Mr. Buckman gave an account of the Ammonite zones in the Inferior Oolite. There is a marked break on the Continent between the *Murchisonæ* and the *Sowerbyi* zones, which appears to be filled up by the zone of *Lioceras concavum* in England. The *Sowerbyi* zone, however, is absent in England from all localities except Dundry, and Coombe near Sherborne; and the author therefore sought and obtained a grant to open an old quarry at the latter locality, in order to fully investigate the fauna of the *Sowerbyi* zone, and its relationship to the *concavum* and *Sauzei* zones. Mr. Storrie, of the Cardiff Museum, exhibited a fine series of slides and drawings of *Pachytheca* and *Nematophycus*, and gave a minute description of them; this elicited some discussion, in the course of which Mr. Murray suggested that the former might possibly be the egg of a Crustacean or some other small organic body completely incrusted by a Nullipore. Mr. Smith Woodward exhibited Pterodactyl and Plesiosaur bones from Brazil, and gave an account of a series of Miocene fish-remains from Sardinia. Other palæontological papers were one containing a record of the occurrence of a variety of *Estheria minuta* in the Lower Keuper building-stone of Chester, by Mr. De Rance, and one by Mr. Vine on the Bryozoa of the Upper Chalk. Mr. B. Thompson gave an exhaustive report of the transition bed between the Middle and Upper Lias in Northamptonshire, from which he had obtained a large and valuable series of fossils. Mr. Newton described the occurrence of *Ammonites jurensis* in the Northampton sands, near Northampton; and Prof. Hoyes Panton gave an account of a mastodon of very large size at Highgate, Ontario, and a mammoth from Shelburne, in the same province.

The occurrence of a strip of Lower Greensand four to five miles long between Shaftesbury and Child Okeford, and running parallel to the valley of the Stour, was described by Mr. Jukes Browne. The same author attempted to explain monoclinal flexure by the recurrence of movement in rocks already faulted, but covered subsequently by unconformable strata; movement along the faults of the older series, under the influence of new pressure, would throw the overlying series into monoclinal folds or faults. The existence of a large area of Kellaways rock, near Bedford, and the extension of Fuller's-earth works at Woburn were commented on by Mr. Cameron.

Several of the Committees appointed last year had done good work. The Photograph Committee had obtained over 250 new photographs of geological interest, many of which were exhibited in the Section-room or at one of the *soirées*, where also Prof. Wright displayed a fine series of transparencies illustrating the lava and glacial deposits of the United States, and Mr. Stirrup a set of slides of the dolomite district of Languedoc. The Earth-Tremor Committee had been testing a number of recording-instruments; Mr. Smith Woodward reported that the lists of type specimens were progressing, and that many large Museums were publishing their own lists of types; Mr. De Rance gave an account of a number of wells in Yorkshire, Lincolnshire, Notts, Cheshire, Shropshire, and Glamorganshire; and Mr. Johnston-Lavis sent a description of the Vesuvian eruption of 1890–91, the chief part of which has already appeared in the columns of NATURE.

BIOLOGY AT THE BRITISH ASSOCIATION.

THE papers read at this Section were fully as interesting, though not quite so numerous, as usual. A good deal of time on one day was occupied by a discussion upon animals and plants; but as several of those who took part in the discussion did not wish their remarks to be reported, it has been thought better to leave out this part of the proceedings of Section D. Botanical papers preponderated over zoological, but it was not found necessary to divide the Section into two sub-Sections.

Mr. Grenfell read a paper upon the structure of Diatoms, describing pseudopodia in these organisms. The pseudopodia are quite easy to see in such a form as *Melosira* with even a comparatively low power. They are very long and stiff, radiating outwards from the periphery, and are apparently non-retractile (they were watched for an hour without any movements being observed); the pseudopodia are sometimes nine times the length of the diameter of the Diatom, and are occasionally branched; adjacent Diatoms were sometimes seen to be connected by a fusion of their pseudopodia. It was suggested that the use of the pseudopodia is to keep the plants floating, and to act as a protective *cheveux de frise* against their enemies. These Diatoms were compared to Heliozoa, with which they have evidently not a little resemblance in the form of the pseudopodia. Incidentally Mr. Grenfell stated that he had found a coating of cellulose upon the green corpuscles of *Archerina*, which were regarded by Lankester as chlorophyll bodies, and not as symbiotic algæ.

Mr. Wager described the presence of nuclei in Bacteria; they were met with in a species of *Bacillus* found in water containing decaying *Spirogyra*.

Dr. Gilson read a paper upon the nephridia of the leech, *Nephelis*. The ciliated funnels appear to lose their connection with the rest of the nephridium, and to perform the function of organs for the propulsion of the blood along the channels in which they lie.

The Plymouth Zoological Station sent a record of work done during the last year by the Director and by Mr. Cunningham.

Mr. Calderwood read a paper upon some economical investigations which had been carried out. He stated that three investigations had been started within the present year, which it was hoped would prove of great value to the fishing population of this country. One was an attempt to produce an artificial bait for use in long line fishing. This investigation was being carried on by a competent chemist, and a considerable advance had already been made towards a satisfactory solution of this difficult problem. Inquiries were also being conducted with regard to the occurrence of anchovies on the south-west coast of England, and Mr. Cunningham, the Naturalist of the Association, had carried out some inquiries at fishing stations on the south coast. At present no net small enough in the mesh to capture anchovies was employed, but that fish appeared so often when the ordinary pilchard nets became entangled, as to suggest that they might be present in considerable quantities. Anchovy nets had, therefore, been constructed, and would be used during the pilchard season this autumn. An investigation was also being carried on into the condition of the North Sea fisheries, which were declared to be rapidly declining. It was proposed to draw up a history of the North Sea trawling grounds, comparing their present condition with their condition some twenty or thirty years ago, when comparatively few boats were at work; to continue, verify, and extend observations as to the average sizes at which prime fish, such as soles, turbot, and brill, become sexually mature, and to collect statistics as to the sizes of all fish captured in the vicinity of the Dogger Bank and the region lying to the eastward, so that the number of immature fish annually captured may be estimated. Also to make experiments with beam trawl nets of various meshes with a view to determine the relation, if any, between the size of mesh and the size of fish taken. Mr. Calderwood added that a regular survey of the English Channel had been commenced, not only in the deep water, but in various estuaries. A meteorological station of the second order had been recently established, where observations at 9 a.m. and 9 p.m. would be taken daily by wet and dry bulb thermometers, barometers, rain-gauges, and sunshine-recorders.

Mr. J. T. Cunningham read a paper upon the reproduction of the pilchard. The ovum of this fish, described as such in the Journal of the Association for 1889, was stated by Pouchet

not to belong to the pilchard; Pouchet believed that the pilchard's ovum is not pelagic. The identification of the ovum was shown to be correct by further observations carried out in the Laboratory with the ova obtained from the mature fish. Similar results have been obtained by Marion, of Marseilles.

Another paper, by the same, dealt with the growth of food-fishes, and their distribution at different ages.

(1) *Rate of Growth and Age of Sexual Maturity.*—Numerous specimens of the flounder (*Pl. flesus*) were reared from the larval state in the aquarium of the Plymouth Laboratory. Measured in April, when a year old, they varied from 4 to 19 cm. (about 1½ to 7½ inches). Specimens obtained in the Cattewater, and known to be not less than a year old, are from 12 to 19 cm. in length. None of these captive flounders, nor any taken in the Cattewater, were sexually mature, but, according to Dr. Fulton, of the Scottish Fishery Board, sexually mature flounders have been observed which were only 7 inches long. It was concluded, therefore, that (*a*) the rate of growth varies greatly for different individuals, but its maximum for the first year is 19 cm., or 7½ inches; (*b*) sexual maturity is not reached till the end of the second year, although the minimum size of sexually mature individuals may be slightly exceeded by some specimens in one year's growth.

Similar results were obtained for the plaice (*Pl. platessa*) and the dab (*Pl. limanda*).

(2) *Distribution.*—The young of the above-mentioned species in their first year, and of certain round fish, especially *Gadus luscus* and *G. minutus*, occur in shallow water, within the 10-fathom line. But there has hitherto been considerable difficulty in obtaining young specimens of other more valuable species in order to study their rate of growth. These species—namely, the sole, turbot, brill, lemon sole, megrim (*Arnoglossus megastoma*), do not pass the first year of their lives in shallow water. Young soles in the larval state occur in tidal pools at Mevagissey, and young turbot and brill 2 to 3 cm. in length are commonly found from June to August in Plymouth Sound and Sutton Pool, swimming at the surface in a semi-metamorphosed stage. Soles a little over 16 cm. in length are frequently taken in Plymouth Sound in summer; these are just over one year old, and are not sexually mature. Turbot 23 to 34 cm. long may be taken in 5 to 7 fathoms; these also are over one year old and not sexually mature. But the young stages between 3 months and 12 months old have not been taken in shallow water, and apparently live at depths greater than 10 fathoms. It seems that our commoner and more valuable food-fishes do not attain to sexual maturity till the end of their second year, that their size at this age is subject to great individual variation, and that the young in the first year of growth have a characteristic distribution. Investigation of the deeper water from this point of view is now being carried on at Plymouth.

The distribution of *Crystallogobius Nilssoni* was recorded by the same author. It had been found by Collett in the Christiania Fjord and in other parts of Norway; also at Bohuslan, in Sweden. Mr. Cunningham dredged 100 specimens at a single haul close to the Eddystone, in 27 fathoms of water. Day mentions only one specimen found in British waters—one taken by Thomas Edwards in a rock pool at Banff. Mr. Holt subsequently dredged a number in 30 fathoms in Ballinskelligs Bay. The species is probably fairly abundant between 20 and 30 fathoms on smooth sandy ground all along the British and Irish coasts.

Mr. Cunningham also read a paper upon the larvæ of the sea crayfish (*Palinurus vulgaris*), describing most of the stages, and particularly remarking upon the presence of the first maxillipede in the newly hatched larva, which had been stated by Richter to be absent.

Prof. Herdman and Mr. J. A. Clubb communicated a paper upon the innervation of the epipodial processes of some Nudibranchiate Mollusca. The cerata of the Nudibranchs were regarded by Prof. Herdman as being probably epipodial outgrowths.

The question has, however, been raised lately by Pelseneer and others as to whether the so-called epipodia of Mollusca are all homologous structures, and one of the subjects of controversy now is the origin of the nerve supply in various forms, it being supposed that where the processes are innervated from the pleural ganglia they are pallial in their nature, and where supplied from the pedal ganglia they are to be regarded as outgrowths from the foot.

Consequently it seemed of importance to determine afresh the origin of the nerves supplying the cerata in several different types of Nudibranchiata, especially as the results of former investigations, depending entirely, we believe, upon minute dissection, are puzzling, and to some extent contradictory. We have traced the nerves from the ganglia, by means of serial sections, in representatives of the genera *Polycera*, *Ancula*, *Tritonia*, *Dendronotus*, and *Eolis*, with the following results:—

In *Polycera quadrilineata* the cerebral and pleural ganglia are completely fused to form a cerebro-pleural mass. The "epipodial" nerves are found arising from the ventral and posterior part of this mass (*i.e.* distinctly from the pleural ganglia), and they run along the sides of the back to supply the ceratal ridges.

In *Ancula cristata* the pleural ganglia are fairly distinct from the cerebral. In a specimen cut into about 500 sections we find in the 100th section or so from the anterior end six distinct ganglia (the cerebral, pleural, and pedal pairs) surrounding the œsophagus. A few sections further back, the cerebrals disappear, and then the epipodial nerves are found arising from the dorsal edge of the pleural ganglia. The nerves soon turn posteriorly, and then give off their first branches dorsally. These branches enter the mesoderm of the body wall, and can then be traced back through over a hundred sections to the first pair of cerata, which they enter. The main nerve passes back to the remaining cerata.

In *Tritonia* and *Dendronotus* also the epipodial nerves arise from the pleural ganglia; but in *Eolis* (or *Facelina*) *coronata* we find that the main nerves to the cerata arise distinctly from the pedal ganglia. We have also traced in the same series of sections the ordinary pedal nerves to the foot proper; so there can be no question as to the nature of the ganglia from which the nerves arise. The epipodial nerves spring from about the middle of the pedal ganglion, rather on the dorsal surface, and, after a short course, pass through the muscular layer of the body wall and are distributed to the clumps of cerata.

But, in addition to these main epipodial nerves in *Eolis*, we find also a nerve arising from the compound ganglionic mass, immediately ventral to the eye (probably, therefore, from the pleural element), which goes to the front cerata. This pleural nerve has its origin distinctly anterior to the origin of the main epipodial nerves from the pedal ganglia.

We arrive, then, at the curious result that the innervation of the ceratal processes is not the same in all these Nudibranchs. In *Polycera*, *Ancula*, *Tritonia*, and *Dendronotus*, the epipodial nerves arise from pleural ganglia, or from the ventral and posterior parts of cerebro-pleural masses; while in *Eolis* the chief epipodial nerves are from the pedal ganglia, but there are also smaller nerves from the pleurals. In the ordinary Rhipidoglossate Gastropod, such as *Trochus*, the epipodial ridges and processes are supplied, according to Pelseneer, by nerves arising from the dorsal part of the elongated pedal ganglia. So, judging from the nerve supply alone, it might be said that the cerata of *Eolis* are pedal in their nature, and homologous with the epipodial processes of *Trochus*, while those of *Ancula* and the rest are totally distinct structures of pallial origin. But these dorso-lateral processes in the various Nudibranchs are so much alike in their relations, and are connected by such series of gradations, that it is difficult to believe that they are not all homologous; and the presence of the accessory epipodial nerve in *Eolis* arising from the pleural ganglion suggests the possibility of another explanation, viz. that these outgrowths, starting at first as pedal structures innervated by nerves from the pedal ganglia, may have acquired, possibly as the result of having moved further up the sides of the body, a supplementary nerve supply from the adjacent integumentary nerves arising from the pleural ganglia, and this supplementary supply, while remaining subordinary in *Eolis*, may in the other types have gradually come to supplant the original epipodial nerves, which are now no longer found in such forms as *Polycera* and *Ancula*. This is at present only a suggestion, which may be disproved or supported by the examination of the nerves of a number of additional Nudibranchs.

Prof. W. N. Parker read a paper containing the results of some experiments on respiration in the tadpoles of the common frog. After referring to the great power of adaptation to external conditions seen amongst amphibious larvæ, the author described some experiments on frog tadpoles, which, although not yet complete, show as follows:—(1) Soon after the lungs become functional—*i.e.* in tadpoles measuring more than 2 cm.

in length—the gills are no longer sufficient for purposes of respiration, and the animals die in a very short time if prevented from coming to the surface to breathe. (2) If tadpoles are prevented from using their lungs from an earlier stage onwards, the gills remain perfectly functional, and development proceeds as usual. At metamorphosis, the fore-limbs are slow in becoming free, owing to the retention of the operculum, that on the same side as the spiracle appearing first. Eventually, a slit-like spiracle is present on either side. In respiration, the mouth is opened and closed, as in the tadpole. Specimens of branchiate frogs were exhibited, in which the tail had shrunk to less than half its original length.

Exhibition of, and remarks upon, some young specimens of *Echidna aculeata*, by Prof. W. N. Parker. The specimens are from the collection of the late Prof. W. K. Parker, who received them from Dr. E. P. Ramsay, Curator of the Australian Museum, Sydney. They are much curved towards the ventral side, the snout pointing backwards, and the tail, in the older of the two stages, forwards. The younger stage measures along the dorsal curve, from the end of the snout to the tip of the tail, 12 cm., the greatest diameter of the body being 3 cm.; the corresponding measurements of the older stage are respectively 21·5 cm. and 6 cm. In the latter, the body is covered with short scattered bristles. In both stages the snout is very similar in form to that of *Ornithorhynchus*, and is covered by a thick horny layer, but in other respects the specialization characteristic of *Echidna* is already apparent. The gape is narrow, and extends only a short distance down the snout, and the manus, even in the younger stage, is already much larger and stronger than the pes. The tail is short and conical. There is no caruncle, or "egg-breaker," in the snout, such as is seen in *Ornithorhynchus*. A few points in the structure of the fore-part of the head in the older stage were described. The mouth has the narrow and tubular form seen in the adult, and the long tongue has a horny tip. The glands in relation with the mouth and nose are very numerous. There is no trace of any teeth-rudiments, and in many other respects the structure of the head shows extreme specialization. Jacobson's organ is large, and highly developed. A well-marked "turbinal" is present in it.

Prof. Howes read a paper upon the classification of fishes by their reproductive organs. On comparison of the urino-genital organs of those Osteichthyes having a non-abbreviated kidney with the same organs of the higher Vertebrata and the Elasmobranchs, the female genital duct and the kidney are seen to be inversely proportionate in length. No feature more fully characterizes the development of the Müllerian duct than the accompanying abbreviation of the kidney and the disappearance of its head segment. The persistence of the last-named among the Osteichthyes, and its possible retention of the renal function in rare cases, taken in conjunction with the mode of development of the ovary duct in these fishes, point to the conclusion that the latter is in no way homologous with the Müllerian duct as ordinarily understood. Balfour's belief that the genital ducts are homologous in both sexes of the Teleosteans, is supported by the facts of anatomy; and comparison of the reproductive system of the Ganoids with that of the Teleosteans shows the two to be modifications of the same common type; and the absolute structural community of the parts in the males and females of the Sturiones, while further confirming Balfour's doctrine, is opposed to Jungersen's implication that the subtle differences in the mode of development of the ducts in the opposite sexes of the Teleostei, are indicative of their non-homology. The facts above alluded to justify us in regarding the genital ducts of the Osteichthyes, not only as homologous in the two sexes, and primarily independent of the genital glands, but as distinct structures *sui generis*, probably unrepresented in all other Vertebrates. The Plagiostomi and Holocephali, in which vasa efferentia are present and the kidney becomes an accessory to reproduction in the male, may be grouped together into a *Nephrorchidic Series*, as distinguished from an *Enthorchidic Series*, embracing the Ganoids and Teleosteans. Comparison of the pori genitales in relation to the coalesced ureters of the Marsipobranchii with the corresponding parts of the females of those Teleostei destitute of genital ducts, especially in consideration of the facts concerning the development of the parts recorded by Scott, Liszt, and others, supports Rathke's conclusion that the ancestors of the former fishes must have possessed genital ducts. The Osteichthyes, although specialized in respect to many features of their organization, have, together with the Marsipobranchs, retained the least modified type of urinogenital organs known for living Vertebrates. W. N. Parker's recent and important discovery that, while in *Protopterus* a Müllerian duct is present, vasa efferentia are absent, and the testicular products are discharged through a duct more nearly comparable to that of the bony fishes than to the genital ducts of any other Vertebrates, suggests that the development of vasa efferentia and the assumption of a genital function by the Wolffian duct may have been effected subsequently to the formation of the Müllerian oviduct. And further comparison of the Dipnoi with the Elasmobranchii suggests that the former may have struck off from the Holocephalic branch of the latter before the differentiation of the ancestors of its living members.

Another paper by Prof. Howes dealt with the customary methods of describing the gills of fishes. The gills of Plagiostomes and Marsipobranchs are not unfrequently enumerated in relation to the opposite walls of the visceral sacs which give origin to them, while those of the higher fishes are enumerated in relation to the opposite faces of the septa which bear them. The confusion arising out of this is well known to teachers, and is, in itself, sufficient to justify the introduction of a revised nomenclature for the parts concerned. The facts of development show: (1) [on the assumption that the mandibular or mouth cavity is serially homologous with a pair of post-oral visceral clefts] that each gill lies in front of its corresponding skeletal arch; (2) that the saccular type of gill met with in the Marsipobranchs and Plagiostomes is that from which the pectinate one of the higher gnathostomatous fishes has been derived; and (3) that a mandibular gill has no existence in living fishes. Gills of the Marsipobranch-Plagiostome type may be conveniently described for general anatomical purposes, as *Cystobranchiæ*, and those of the higher Telosteoid type, as *Pectinobranchiæ;* while the parts of the individual gills themselves should be in all cases enumerated in relation to the visceral pouches from which they arise. Thus, the spiracular gill of Elasmobranchs (often termed the mandibular pseudobranch) should be described as the hyoid hemibranch, and the opercular gill of the higher fishes (often termed the hyoid pseudobranch) as the first branchial hemibranch. The well-known series of buccal filaments met with in certain Chelonia appear to have the fundamental relationships of gill-folios, and, in view of the discovery of Dohrn and others that the buccal sac would appear, from its mode of development in the Teleostei, to be the morphological equivalent of a pair of gill pouches, the possibility that these filaments may (at any rate for the most part) represent mandibular gills of a reversional character must not be overlooked.

Dr. Arthur Robinson communicated some facts relative to the development of the rat and the mouse. The most important part of the paper dealt with the relation of the yolk sac to the maternal tissues. The crypt in the uterine wall which lodges the ovum becomes shut off from the rest of the cavity of the uterus by a fusion between the distal proximal walls of the uterus. The greater part of the space so formed is occupied by the ovum; the remaining portions are converted into maternal blood sinuses; the blood in these sinuses bathes the trophoblast and the distal end of the yolk sac. Later, the distal part of the yolk cavity is obliterated by the apposition of its walls, but the proximal portion remains; diverticula grow out from from this into the placenta, which maintain the intimate relation of the yolk sac to the maternal blood. It seems probable, in view of these facts, that the yolk sac plays an important part in the nutrition of the fœtus. The allantois is a solid mass of mesoblast containing no diverticulum from the alimentary tract, and does not become attached to the trophoblast until comparatively late in the life of the embryo, *i.e.* the eleventh day.

Another paper by the same was entitled "Observations upon the Development of the Spinal Cord in *Mus musculus* and *Mus decumanus:* the Formation of the Septa and the Fissures." The anterior and posterior septa of the cord were stated to be formed by the spongioblasts of the cord itself, and not by ingrowths of the enveloping sheath of pia mater.

Prof. Marcus Hartog communicated an outline classification of sexual and allied modes of protoplasmic rejuvenescence.

I. The following modes of rejuvenescence occur in cellular and in certain apocytial organisms:—

A. PLASTOGAMY: the fusion of cytoplasta into a plasmodium, the nuclei remaining free.

B. KARYOGAMY: the union of cells (gametes), cytoplast to cytoplast and nucleus to nucleus, to form a 1-nucleate cell, the zygote. The following variations occur:—

1. ISOGAMY. The union of gametes undistinguishable in size, form, and behaviour; this may vary as follows:—

(*a*) MULTIPLE: between several gametes (up to 6).
(*b*) BINARY: between a pair of gametes;

or, from another point of view—

(*c*) INDIFFERENT: between any gametes of the species.
(*d*) EXOGAMOUS: between gametes of distinct broods only.
(*e*) ENDOGAMOUS: between gametes of the same brood only.

2. ANISOGAMY: the union of two gametes differing chiefly in size; the smaller (*micro-*) gamete is *male*, the larger (*mega-*) gamete, *female*.
3. HYPERANISOGAMY: the female gamete, at first active, comes to rest before fusion with the male.
4. OOGAMY: the female is never actively motile; the male is termed a *spermatozoon*, the female an *oosphere*.

From another point of view karyogamy is—

5. ZOOIDIOGAMOUS: one gamete at least is actively motile (flagellate, ciliate, or amœboid).
6. SIPHONOGAMOUS: karyogamy is effected by a tubular outgrowth from one or both of the gametes.

II. In apocytial fungi multinucleated masses of protoplasm (*gametoids*) may conjugate to form a *zygotoid*, by a siphonogamous process. The union may be *isogamous* or *anisogamous*.

III. Gametes may be classified as follows:—

A. According to their *formation*—

1. EUSCHIST: formed by repeated complete divisions from a parent cell, the gametogonium.

(*a*) EUTHYSCHIST: each nuclear division is accompanied by cell division.
(*b*) BRADYSCHIST: the nuclear divisions are completed before any cell division takes place.
(*c*) ISOSCHIST: the brood-cells of a gametogonium are all equal and functional.
(*d*) ANISOSCHIST: the brood-cells are unequal, some of them being reduced to aborted or degraded gametes.

2. HEMISCHIST: the divisions are limited to the nucleus, none occurring in the cytoplasm.
3. APOSCHIST: the cell divisions do not occur, but a cell directly assumes the behaviour of a gamete.
4. SYMPHYTIC: the gameto-nucleus is formed by the fusion of several nuclei.

B. According to their *behaviour*, as—

1. FACULTATIVE: retaining the power of development if karyogamy fails to occur.
2. OBLIGATORY: with no power of independent development.

IV. PARAGENESIS will include the following modes, usually grouped under the term parthenogenesis, apogamy (*pro parte*), &c.:—

A. TRUE PARTHENOGENESIS: the direct development of a facultative gamete without karyogamy. This may occur in the case of—

(1) Isogametes; (2) Anisogametes (male and female); (3) Oogametes.

B. SIMULATED PARTHENOGENESIS:—

1. CELLULAR: a cell assumes directly the behaviour of a zygote.
2. APOCYTIAL: a multinucleate mass of protoplasm assumes directly the behaviour of a zygotoid.

C. METAGAMETAL REJUVENESCENCE:—

1. UNICELLULAR: a single cell in the neighbourhood of the gamete assumes the form and behaviour of the zygote.
2. MULTICELLULAR: a mass of cells in the position where gametes should be produced, assumes the character of the young organism formed by the zygote.

D. PARAGAMY or ENDOKARYOGAMY: vegetative or gametal nuclei lying in a continuous mass of cytoplasm fuse to form a zygote nucleus.

1. Progamic paragamy: the fusing nuclei are the normal gametonuclei of the progamous cell (ovum which has formed 1-polar body).
2. Apocytial paragamy: the vegetative nuclei of an apocytium fuse to form a zygote nucleus.

The President of the Section read a paper by himself and Miss Dorothea Pertz, on the artificial production of rhythm in plants. The apparatus, devised by the Cambridge Scientific Instrument Company, was exhibited. The plant is subjected to a series of alternate and opposite influences from light or gravitation, as the case may be. The plant to be experimented with is fixed to a spindle, which, by a clockwork escapement, makes a sudden semi-revolution every half-hour. When the clockwork is stopped, the plant continues to curve with an acquired rhythm, as if the machinery were still in action. This is similar to certain natural rhythms—for instance, to the "sleep" of flowers, which for a short time continue to open and shut although kept constantly in the dark.

Prof. Green read a paper on the occurrence of diastase in pollen. The starch in the pollen grain serves as nutriment for the growing pollen tube, and the presence of the ferment converting it into sugar enables it to travel along the growing tube.

Prof. Vines, in a paper upon diastase in foliage leaves, controverts the opinion of Prof. Wortmann, who stated that diastase was either absent from the foliage leaves of plants, or present in such minute quantities that it could be of no physiological importance. It is this diastase, and not the protoplasm of the cells, which converts the starch accumulated in the leaves into sugar.

Canon Tristram exhibited and made remarks upon the smallest known species of parrot, of which the skin measured only two inches in length.

THE CONGRESS OF HYGIENE.

WE printed on August 20 (p. 303) an account of some of the work done in the Section of Preventive Medicine in the Congress of Hygiene. The following is the conclusion of our report:—

ALCOHOLISM.

Sir Dyce Duckworth, of London, opened a discussion on "The Relation of Alcoholism to Public Health and the methods to be adopted for its Prevention."

Prof. Harald Westergaard, of Copenhagen, followed with a paper on the same subject. What are the losses of life, he asked, caused to a population by intemperance? This question can to a certain extent be answered by examining the causes of death, especially delirium tremens and chronic alcoholism. It has been objected that these causes of death supply an unsatisfactory picture of drinking excess, because the wish to spare the feelings of surviving relatives makes returns of such deaths less trustworthy, and it has therefore been proposed to use other diseases as a measure—such as liver disease (especially cirrhosis of the liver). Yet it is worth while to examine the above-mentioned causes of death. In most countries the statistics of the cause of death do not allow conclusions with regard to alcoholism corresponding to those for Denmark and Norway. But, at all

events, the statistical data sufficiently show that a great part of the civilized world is suffering greatly from the effects of alcoholism. The investigations of the Harveian Society make it probable that in London one-seventh of all adult deaths (males and females) is directly or indirectly due to the consequences of alcoholic excess. The mortality in England from alcoholism in 1871–80 among males 25 to 65 years old was about 1 per cent. of all deaths—nearly 800 yearly. What an amount of disease and poverty, of moral and physical degradation, is represented by these 800 deaths! In Belgium the yearly loss of life from delirium tremens among males was 330 in 1870–89. Still greater have been the devastations of drinking in Switzerland. Prussia has a yearly loss of 1100 males from delirium tremens. Undoubtedly we should find, if trustworthy data could be had, that chronic alcoholism and delirium tremens alone kill many thousands of men every year. What is to be done? High excises are generally looked upon as an excellent weapon against alcoholism. But we must not forget that even a very high excise, as in England, does not prevent spirituous liquors from coming within the reach of anybody, so long as the number of public-houses is so exceedingly large as in this country. If a person has to go a long way to get drunk, and if he has in addition to pay a good sum for it, he will stop to think before going. Still, high excises seem to have some effect; the German law of 1887 has, for instance, reduced the consumption of spirits to a certain extent. But generally the reduction of the consumed quantity does not seem to correspond with the increase of the excise. An interesting expedient is the new State monopoly in Switzerland. Ten per cent. of the surplus are left to the cantons for counteracting alcoholism. By regulating the price the monopoly acts like an excise, and the Government takes care that only unadulterated liquors are sold. The monopoly is reported to have had a good sanitary effect, and it has caused some decrease in the consumption of liquors. In connection with excise and duties every effort is to be commended which tends to render the access to intoxicating liquors more difficult. Among these measures, the three popular American systems deserve our attention—viz. the Maine laws, local option, and the high-licence system. The first of these expedients—the prohibitory system—has been tried in Maine and some other American States. According to this system, it is prohibited to manufacture and sell intoxicating liquors, the only exception commonly being that liquors of "foreign production" may be imported and sold in the original packages. But this exception is unjust, permitting the man who can afford it to order as much liquor as he likes, and nearly all reports agree in testifying to the perpetual violation of these laws. One curious fact from Maine, where the system was adopted in 1881 may be mentioned. During the years 1867–86, 8412 divorces of marriages took place, being probably several per cent. of the yearly number of celebrated marriages. Of these no less than 960, or 11 per cent., were caused by intemperance, combined or not with other causes. It thus seems that intemperate habits are rather frequent in this State. Curiously enough, the State of Massachusetts (where there is a considerable revenue for licences) shows, under nearly the same regulations concerning divorces as in Maine, the same proportion—viz. 1054 out of 9853. It seems impossible to suppress the liquor traffic in the larger towns. Between the Maine laws and the high-licence system is an intermediate system—local option. According to this, it is left to the citizens of a village, town, city, or a larger district, to vote for local prohibition. This system seems to work somewhat better than the Maine laws, and it may prove useful in rural districts, the control in small communities being more easily carried through; but in larger towns it is probably ineffective, tempting as it does to a surreptitious liquor traffic. The third system—high licences—has been introduced in several States. Under this system licences for the sale of liquors can be taken out, but the fees are so considerable (for instance, 500 or 1000 dollars yearly) that many small saloons disappear. In some cases the sale of liquors through grocery stores is entirely stopped (Illinois). This system is reported to work well by reducing the number of drinking saloons, thus lessening the opportunity for drinking. It is maintained that "the high-licence system has thrown the liquor traffic into the hands of a more respectable class of dealers," and that those who pay high licences "help the authorities in the conviction of breakers of the law, under the fundamental principle of self-preservation." It is also to be recommended to limit the numbers of licences that may be taken out. This is the case with the Dutch law of 1881. Still more effective have been the efforts in Sweden, Norway, and Finland. The numbers of bars have been gradually greatly reduced, especially in the rural districts; and in most of the towns the so-called "Gothenburg system" has been introduced. According to this system, adopted since 1865 in Gothenburg, all or most of the licences in a town are given to a company which is not allowed to pay more than a fixed rate of interest to the shareholders, the surplus being spent for the benefit of charitable institutions or forming part of the municipal income. The result has been a great reduction of the number of bars. In Gothenburg the company in 1865 took out 40 licenses, but at once reduced the number of saloons to 23. The persons who manage the saloons get a fixed salary for the sale of spirits, and are therefore not tempted to encourage the customers to drinking. Moreover, there is a limitation of the hours during which the saloons are open, and other steps have been taken to prevent abuses. Undoubtedly this system—in connection with the great diminution of the number of bars in the rural districts of the country—has contributed very much to the conspicuous reduction of the alcoholism in the three countries before-mentioned. A very practical expedient is also the prohibition of sale of intoxicating liquors at groceries and similar shops, and this provision ought never to be omitted where steps are taken to limit the number of saloons. And last, not least, it is highly desirable to regulate the opening hours of the saloons.

Dr. Isambard Owen, of London, said he took part in the discussion solely to correct the numerous misquotations current of the "Collective Investigation Report on Intemperance of the British Medical Association," of which Report he was the author. A certain table of figures contained in the Report had been quoted apart from the context in such a manner as to lead the public to believe that, in the view of the author of the Report, the longevity of abstainers fell below that, not only of moderate drinkers, but even of the decidedly intemperate. The conclusions of the Report, as far as concerned the general health of the public, were the following:—(1) That habitual indulgence in alcoholic liquors, beyond the most moderate amounts, has a distinct tendency to shorten life, the average shortening being roughly proportional to the degree of indulgence. (2) That of men who have passed the age of 25, the strictly temperate live, on the average, at least ten years longer than those who become decidedly intemperate. (3) That in the production of cirrhosis and gout, alcoholic excess plays the very marked part which it has long been recognized as playing, and that there are no other diseases anything like so distinctly traceable to the effects of alcoholic liquors. (4) That, cirrhosis and gout apart, the effect of alcoholic liquors is rather to predispose the body towards the attacks of disease generally than to induce any special pathological lesion.

M. Milliet, of Berne, Dr. Norman Kerr, of London, Mr. J. Phillips, of London, Sir V. Barrington, L.C.C., Dr. Robinson, of Maine, U.S.A., Sir Joseph Fayrer, Prof. E. Alglave, of Paris, Dr. Kinkead, of Galway, Dr. Arthur, of London, Prof. Böhmert, of Dresden, and Dr. Sonsino, of Pisa, also took part in the discussion.

On Thursday afternoon, Dr. W. O. Priestley read a paper "On the Improved Hygienic Condition of Maternity Hospitals," of which the following is an abstract:—

During the end of the last century and the first half of the present one, the mortality in maternity hospitals was very large, both on the Continent and in Great Britain. According to Le Fort, it was at the rate of 34 per 1000, while, according to Miss Nightingale, it was only 4·7 per 1000 when patients were confined at their own homes; or, according to Dr. Matthews Duncan, 8 per 1000, equal to 1 in 125. The cause of the increased mortality in lying-in hospitals was the prevalence in these institutions of puerperal fever, 75 per cent. being due to this cause. The infectiousness of puerperal fever, long doubted, was at length established, and also the fact that various poisons, brought from the dissecting room—from patients suffering from erysipelas, eruptive fevers, and the like—became the germs of infection which might cost the lives of many patients. The researches of Pasteur, Koch, Lister, and others have shown that these poisons owed their virulence to the presence of microscopic germs which multiply in the body of patients and produce the deleterious

results. Hence it came to be recognized that, by preventing the ingress of these germs to the bodies of puerperal patients, comparative safety, even in lying-in hospitals, was attainable; and the introduction of the antiseptic and aseptic methods has produced not only a remarkable diminution of mortality, but also of the morbidity or illness incident to the puerperal state. A short sketch was given of the modern methods adopted in several countries to insure the greater safety of patients in maternity hospitals, and of the results obtained in Europe and in the United States. The results were very striking, and were attributable mainly to the introduction of the antiseptic or aseptic modes of treatment, although other improvements are not lost sight of. In concluding he called attention to an interesting table in which were thrown together the statistics of maternal deaths in six lying-in hospitals, situated in various countries, since the introduction of aseptic or antiseptic methods. With these he had contrasted the figures of M. Le Fort before the era of antiseptics, and Mr. Newbatt, the distinguished President of the Statistical Society, had kindly computed for him the difference in the proportion of deaths in the two cases:—

Mortality in Maternity Hospitals from all Causes in various Countries of Europe (Le Fort).

BEFORE THE INTRODUCTION OF ANTISEPTICS.

	Deliveries.	Deaths.	Per 1000.
Total	888,312 ...	30,394 ...	34·21

AFTER THE INTRODUCTION OF ANTISEPTICS.

	Date.	Deliveries.	Deaths.	Deaths which would have occurred on basis of Le Fort's figures.
Vienna	1881–5 ...	15,070 ...	106 ...	516
Dresden	1883–7 ...	5,508 ...	57 ..	188
Russia	1886–9 ...	76,646 ...	290 ...	2,622
New York ...	1884–6 ...	1,919 ...	15 ...	66
Boston	1883–6 ...	1,233 ..	27 ...	42
General Lying-in Hospital, London	1886–9 ...	2,585 ...	16 ...	88
Total ...	—	102,961	511[1]	3,522

Number of lives saved out of the 102,961 since the introduction of antiseptics—

Expected deaths on Le Fort's basis	3522
Actual deaths	511
Saving	3011

Dr. Priestley said it would be seen that while, according to M. Le Fort, the maternal deaths in European lying-in hospitals were 34·21 per 1000 under the old *régime*, the mortality is now reduced to somewhat less than 5 per 1000. This computation, put in another way, indicates that if the former rate of mortality had been maintained 3522 maternal deaths might have been expected; the actual deaths were only 511. In other words, 3011 lives of mothers were saved as the result of new and purely scientific methods of treatment. This, he thought, might fairly be stated to be one of the most striking triumphs of preventive medicine. It was no mean achievement to rescue from death more than 3000 lives of women in the acme of their maturity, and when their lives were most valuable to their families.

Dr. Graily Hewitt, of London, Mr. F. Fowke, of London, and Dr. Leduc, of Nantes, spoke on the subject.

A paper was read by Dr. J. C. van Dooremal, of The Hague, on "La Prévention de la Cécité professionnelle."

Dr. Sisley, of London, read a paper on "The Prevention of the Spread of Epidemic Influenza."

Mr. Weaver and Dr. Felkin took part in the discussion.

Greene Pasha, of Cairo, read a paper on "The Influence of the Nile on Mortality in Egypt."

Dr. Felkin, of Edinburgh, read a paper entitled "Observations on Malaria and Enteric Fever in Central Africa, and on the possible Antagonism between Malaria and Phthisis."

[1] 4·363 per 1000.

Inspector-General Lawson and Mr. Weaver spoke on this subject.

Dr. Lewis Sambon, delegate of the Municipality of Naples, read a paper on "Measures adopted for the Prevention of Infectious Diseases and their Relation to our Knowledge of Epidemics." He first pointed out the similarity, which is most striking, between the mode of development and diffusion of infectious diseases and some insect pests, such as locusts for instance. Both have likewise their endemic areas, both their seasons of development, both in some years spread more widely, and at long intervals give rise to regular plagues; both migrate in the same constant direction, and both die away out of their endemic areas, subsiding in the struggle for life. He said that the diffusion of species by currents and winds will make us understand the peculiarities in the spread of infectious diseases, which had given rise, in all time, to the most strange theories. The influence of atmosphere has been very little studied in connection with infectious diseases, and by this he did not mean the registration of the prevailing lower winds during an epidemic, but serious bacteriological researches in the sinking sediment of the atmosphere and in meteoric waters. Instances of animals being carried by regular winds or wind-storms far beyond the limits of their homes are universally known. Insects of all kinds are often caught hundreds of miles from the nearest land, out on the high seas; North American birds not unfrequently are carried across the Atlantic to Scotland. Far more important is the influence of winds and currents in the distribution of microscopic animals. These minute organisms or their germs, generally adhering to other larger elements of dust, are raised and carried by the wind until they are allowed to sink again to the soil when the air is in stillness. About quarantine Dr. Sambon said that not only our modern investigations proved them useless, but that a long experience has utterly condemned them. England has been accused of being commercially and politically interested in the abolition of quarantine, and this preconception has unfortunately prevented many from valuing the most scientific and liberal ideas which have promoted their opposition to quarantine. No nation can boast of having held public health so high above commercial interest; and we must also remember that the English, at one time, have been the most sanguine supporters of quarantine. Quarantine was first instituted by the old republic of Venice, whose life and power lay entirely in commerce; and Dr. Sambon said that, although it had proved so disastrous to finance, so useless to sanitation, and so vexatious to liberty, he was proud that they were a glory of his country. Dr. Sambon concluded that the most important and perhaps the only satisfactory means against infectious diseases was the sanitation of towns and the hygiene of men. In speaking of the sanitation of towns he said how vast areas of the old city of Naples had been recently pulled down and new districts had been built. A large and splendid supply of water has been introduced since 1887, and when the drainage is completed, Naples will be one of the healthiest towns of Europe. He spoke of the poor classes of all our large towns, and said how they were the culture grounds of epidemics, and finished by saying that it is not enough to improve the sanitary conditions of a town, but that the principles of hygiene should be impressed on the minds and consciences of people, because there could be no public hygiene where private hygiene was not understood.

Deputy-Surgeon-General Bostock, C.B., and Sir Vincent Barrington, delegates of the Metropolitan Asylums Board, read a joint paper on "The Hospital and Ambulance Organization of the Metropolitan Asylums Board for the Removal and Isolation of Infectious Diseases." The paper was illustrated by plans, diagrams, and models.

Surgeon-General Bostock said that the present accommodation for fever and diphtheria consists of six hospitals:—

Name.	Position.	Acreage.	No. of beds.	Population served.
1. Eastern	Homerton	9 ...	442 ...	1,114,432
2. South-Eastern ...	Deptford	11 ...	462 ...	941,381
3. South-Western ...	Stockwell	8 ...	340 ...	582,591
4. Western	Fulham	6 ...	224 ...	690,138
5. North-Western...	Hampstead ...	11 ...	435 ...	882,514
6. Northern	Winchmore Hill ...	36 ...	480 ...	—
			2383	4,211,056

The first five are in London. The Northern is for convalescents, and is four miles outside the northern boundary of the

district. The position of these hospitals is shown on the map. The average length of the journey a patient has to be carried to reach the hospital nearest to his home is three and a half miles. During 1886–87 the number of beds in the eastern and western districts was found to be insufficient, and steps are now being taken to establish an additional hospital in the North-East of London, and to increase the number of beds in the Western Hospital to 400. These additions will give a total number of beds for fever and diphtheria of 2959, or one bed for every 1423 inhabitants. The total number of cases of fever and diphtheria admitted into the managers' hospitals from 1870 to the end of 1890 was 55,204. The accommodation for small-pox is the Floating Hospital at Long Reach, fifteen miles below London Bridge. It contains 350 beds for acute and severe cases on board the *Atlas* and the *Castalia*, the *Endymion* being used for administrative purposes, and 800 in the convalescent hospital at Gore Farm, four miles distant from the ships, giving a total of 1150 beds. The number of small-pox cases admitted into hospital since 1870 to 1890 is 56,979. To this number must be added 1028 cases other than small-pox, making a total of 58,007 admissions. The river service is exclusively used for small-pox cases, and consists of three wharves on the Thames in London for the embarkation of patients. The wharves, as shown on the map, are the "West" at Fulham, the "North" at Poplar, and the "South" at Rotherhithe. In each there is a floating pier in deep water, approached by a bridge, and a shed into which the ambulance carriage drives, with an examination room. As an example of the work, it may be stated that during the small-pox epidemic of 1884–85, 11,060 cases were removed from their homes to the Floating Hospital, 175 doubtful cases were sent from the wharves to the land hospitals, 38 cases were detained in London on account of fog, and 35 persons, not having small-pox at all, were vaccinated and taken home. The greatest number of patients taken down to the Floating Hospital in one day was 104, by the *Red Cross*, in three trips. At the close of the epidemic the Ambulance Committee were able to report the satisfaction they felt that so large a number of persons of both sexes and all ages, most of them in physical suffering, and many helpless from disease, had been carried in all weathers, throughout all seasons of the year, and to a great extent during the hours of darkness, without discomfort or detriment to the patients, and without mishap to any person whatever.

Sir Vincent Barrington, after urging the importance of preserving statistics of work done from an economical, as well as a sanitary point of view, presented statistical papers of fever and small-pox cases treated in Board hospitals. He commented upon the supposed prevalence of disease in 1887, and urged every publicity to be given to Board work, to get over the old prejudices of the working classes against sending patients to the isolated hospitals. He showed a chart demonstrating that the increased use by the public of the Board hospitals and the transport from 1879 to 1890, had been followed by steadily decreasing fever mortality in London. Now over half the cases of scarlet fever in all London are probably treated in Board hospitals. He referred to the improved sanitation of dwellings and the decreasing severity of the type of the disease as factors in the decreased mortality observed. He presented small-pox pedigrees in non-epidemic times, showwing in one case that 19 persons, in another 10 persons, were infected from a single case. Also that 20 cases of the 53 treated this year had been barren of infecting others as they were so rapidly removed to floating isolated hospitals. The deduction drawn was that the rapid system of removal of recent years by the combined land and river service of the Board had a sensible effect in checking a possible epidemic. He presented the forms for recording the evidence of the existence of vaccination cicatrices on the improved system adopted after conferences with Board medical officers and the Local Government Board, and advocated other sanitary bodies adopting the same system, thus facilitating the compilation of statistics, invaluable for the advance of science, and therefore for the treatment and check of small-pox, and the consideration of protection by vaccination.

Dr. Seaton, of London, Dr. Armstrong, of Newcastle, Dr. Dudfield, of London, Prof. Stokvis, of Amsterdam, and Dr. Hauser, of Madrid, also spoke on this subject.

Surgeon-General Beatson, M.D., of Eastbourne, read a paper on "Prevention of Disease in Growing Towns."

Prof. Stokvis and Dr. Dickson spoke on the subject.

Dr. Pistor, of Berlin, read a paper entitled "Ueber die Desinfection," of which the following is an abstract. Dr. Pistor dealt with the general rules and methods to be observed in the disinfection of infectious diseases. Such rules should be short, clear, and capable of being understood by everyone. Incineration and boiling for half an hour are, of course, very effectual disinfectants, but they are not always applicable. A 1 to 2 per cent. solution of caustic soda is a very useful disinfectant. Other methods are steaming, mechanical cleansing (such as rubbing, brushing, &c.), carbolic acid solution (2 to 5 per cent.), lime-water containing about 20 per cent. of caustic lime, and a 1 to 2 per cent. solution of calcined carbonate of soda. These methods and solutions are effective against all the poisons of infectious diseases. The head of the house or institution ought to be responsible for the disinfection under the direction of the doctor, and a record ought to be preserved of the mode of disinfection used.

Sir William Moore, K.C.I.E., Q.H.P., read a paper on "The Prevention of Fevers in India."

A discussion followed, in which Surgeon-General Cook of Bombay, the President, Surgeon-General Beatson, Dr. Leduc of Nantes, Dr. Payne of London, Surgeon-Major Poole of London, and Dr. W. Dickson, R.N., took part.

Dr. Prospero Sonsino, of Pisa, read a paper on "The Principal and most Efficacious Means of preventing the Spread of Entozoal Affections in Man."

Dr. Sandwith, of Cairo, and the President, made a few remarks.

Dr. F. M. Sandwith, of Cairo, read a paper on "Cholera in Egypt."

Dr. Stekoulis, of Constantinople, and Dr. Simpson, of Calcutta, took part in the discussion.

Dr. Curgenven, of Teddington, read a paper on "The Disinfection of Scarlet Fever and other Infective Disorders by Antiseptic Inunction."

Dr. W. Gemmell, of Glasgow, spoke.

Dr. Phineas S. Abraham, of London, read a paper entitled "On the Alleged Connection of Vaccination with Leprosy."

Mr. Milnes, of London, Dr. Cassidy, of Toronto, and Surgeon-Major Pringle spoke on this subject.

Dr. J. P. Williams Freeman, of Andover, read a paper entitled "Importance of more actively enforcing Ventilation: suggesting a Standard of Air Impurity as a Basis of Prosecutions." Dr. Freeman said that ventilation is of well-recognized importance; the causation of phthisis is a good example of it. Foul air is a cause of tuberculosis in three ways: *directly*, by supplying the bacillus to the lungs, and through the saliva to the intestinal canal; *indirectly*, by causing tuberculosis in cattle, and by so reducing the human body's vitality as to render it a suitable nidus. The bacteriologist leads us to expect that fresh air will be hostile to the virus; the demographist shows that the death-rate from phthisis increases from islands, coast districts, agricultural districts, small towns, to large towns; also in occupations, according to their exposure to the open air, from farmers and fishermen up to drapers and printers (see Dr. Ogle's table). The loss of health from want of ventilation is so familiar as to be little thought of, but the deaths from phthisis alone, fully preventable, must be enormous. The Public Health and Factories Acts provide for proper ventilation of buildings. Any standard that public opinion, lay and medical, may demand might be enforced. Beyond seeing to the cubic space in common lodging-houses, practically nothing is done, and the air of buildings is often "dangerous and injurious to health." An inspector should frequently "sample" the air of buildings, and if it exceed a certain limit of impurity the owner should be prosecuted, cubic space and means of ventilation being left for the architect; the limit to be when the air inside a building contains twice as much carbonic acid gas as the air outside at the same time. This would usually correspond to De Chaumont's "Rather close, organic matter becoming perceptible." Students of preventive medicine should demand this reform from the administrators of the law. Polluted air is as recognizable, preventable, and harmful as unsound food or bad water, and should be treated on the same lines.

Two other papers were taken as read, one by Dr. S. Lodge, Jun., of Bradford, entitled "On the Occurrence of the Broncho-pulmonary form of Anthrax amongst Rag-pickers in England, and Suggestions for its Prevention," and one by Dr. H. Rident,

of Elbœuf-sur-Seine, entitled "Des Troubles du Côté des agents de la Respiration chez les Fileurs, et de leur Conséquences."

After a speech by the President, complimenting the Secretaries on their work, and a vote of thanks to the President, the meetings of the Section terminated.

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, September 2.—Mr. Frederick DuCane-Godman, F.R.S., President, in the chair.—Mr. G. F. Scott-Elliot exhibited a series of various species of Diptera collected on *Ranunculaceæ*, *Papaveraceæ*, and *Cruciferæ*. He said that during the past summer he had studied about forty species of plants belonging to the orders named, and that they had all been visited by insects which were probably necessary for nectariferous flowers. The majority of the Diptera caught were not confined to one species or even genus, but, in view of the unmodified character of the flower in the orders named, this was only to be expected. Mr. Verrall observed that certain insects affected certain plants, but that the *Geraniaceæ* were seldom visited. The discussion was continued by Mr. McLachlan, Mr. Kirby, and others.—Mr. W. L. Distant exhibited a specimen of the orthopterous insect *Hemisaga hastata*, De Sauss., which, in the Transvaal, be observed to attack and feed on *Danais chrysippus*, a butterfly well known from its protective character and distasteful qualities to have a complete immunity from the usual Lepidopteral enemies. The *Hemisaga* lurked amongst the tops of tall flowering grasses, being consequently disguised by its protective resemblance to the same, and seized the *Danais* as it settled on the bloom. From close watching and observation, Mr. Distant could discover no other danger to the life of this well-known and highly protected butterfly.—Mr. T. R. Billups exhibited four species of Diptera, which he believed to be respectively *Oxycera terminata*, *Pipezella annulata*, *Clidogastra puncticeps*, and *Oxyphora arnicæ*, taken at Oxshott, Surrey, on July 11 last. He mentioned that all of them were recorded in Mr. Verrall's list only as "reputed British." He also exhibited a specimen of *Hypoderma bovis*, Deg., taken at Plumstead on July 29 last.—Dr. D. Sharp, F.R.S., exhibited several species of *Forficulidæ*, and called attention to the diverse conditions of the parts representing the wings in the apterous forms.—Mr. H. Goss exhibited living larvæ of *Scoria dealbata*, reared from ova. They were feeding on *Polygonum aviculare*, but not very freely; *Brachypodium sylvaticum* had been named as a food-plant for this species, but he did not find that the larvæ would eat this or any other grass.—The Rev. Dr. Walker exhibited, and read notes on, a collection of Lepidoptera, Hymenoptera, Coleoptera, Neuroptera, and Diptera, which he had recently made in Norway.

PARIS.

Academy of Sciences, September 7.—M. Duchartre in the chair.—Remarks on the influence that the aberration of light may exercise on spectroscopic observations of solar prominences, by M. Fizeau. Several observers have recently measured remarkably high velocities in solar prominences by the application of the Doppler-Fizeau principle. It is evident that if the matter of which the eruption consists be ejected in the neighbourhood of the ecliptic with a velocity equal to that of the earth in its orbit, the prominence will suffer an apparent displacement of 20″·445, in the same manner that a star is displaced by 20″·445 owing to the motion of the earth combined with the velocity of light. Aberration should therefore be taken into account in determining the positions and heights attained by the phenomena in question.—On the number of roots common to several simultaneous equations, by M. Émile Picard.—On the blending of separate chromatic sensations perceived by each of the two eyes, by M. A. Chauveau. If two colours are simultaneously and separately received on the corresponding points of the two retinas and transmitted respectively to the nervous centres, do they blend together at these centres and give rise to the sensation of the resultant colour? This is the question investigated by the author. And he finds that there is a real blending of the colour perceptions resulting from the independent excitation of each of the two retinas.—On the influence of the products of the culture of *naphylocque doré* on the vaso-motor nervous system and on the formation of pus, by M. S. Arloing.—Observations of the asteroid discovered by Dr. Palisa on August 30, made at Toulouse Observatory, by M. E. Cosserat. Three observations for position were made on September 1 and one on September 2.—On the distribution in latitude of the solar phenomena observed at the Royal Observatory of the Roman College during the first half of this year, by M. P. Tacchini. Prominences have been most frequent in the southern solar hemisphere, as was also the case in 1889 and 1890, and the maximum of frequency in the zones ± 40°-50°. The spots and faculæ have preserved their preponderance north of the equator, with maxima of frequency in latitudes slightly lower than the prominences. All the phenomena have been rare near the solar equator.—Direct synthesis of primary alcohols, by M. Paul Henry.—On some attempts to reproduce acid rocks, by M. H. Le Chatelier.—On the quantity of starch contained in the tubercles of the radish, by M. P. Lesage.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Livingstone and the Exploration of Central Africa: H. H. Johnston (Philip).—My Water Cure: S. Kneipp, translated (Blackwood).—Monthly Weather Reports of the Meteorological Office, May to December 1887 (Eyre and Spottiswoode).—Hourly Means, 1887 (Eyre and Spottiswoode).—Meteorological Observations at Stations of the Second Order, 1887 (Eyre and Spottiswoode).—Quarterly Weather Report of the Meteorological Office, July to December 1880, and October to December 1880 (Eyre and Spottiswoode).—Cyclone Tracks in the South Indian Ocean (Eyre and Spottiswoode).—Manufacture of Sulphuric Acid and Alkali; vol. i. Sulphuric Acid, 2nd edition: Dr. G. Lunge (Gurney and Jackson).—A Hand-book of the Destructive Insects of Victoria, Part 1: C. French (Melbourne, Brain).—Notes on Elementary Physiography: H. C. Martin (J. Heywood).—Peloponnesische Bergfahrten: Dr. A. Philippson (Wien).—An Account of British Flies, Part 1: M. C. E. Leigh and F. V. Theobald (E. Stock).—Studies from the Kindergarten, vol. iv., No. 1 (Laurie).—Carta delle Strade Ferrate Italiane al 1° Aprile, 1891 (Roma).—Jahrbuch der k. k. geologischen Reichsanstalt. Jahrg. 1890, xl. Band, 3 and 4 Heft (Williams and Norgate).—Himmel und Erde, September (Berlin, Paetel).—L'Anthropologie, 1891, Tome ii., No. 4 (Paris, Masson).—Journal of the Royal Horticultural Society, vol. xiii. Part 2 (117 Victoria Street).

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