THURSDAY, OCTOBER 24, 1912.

THE DAWN OF LAND VERTEBRATES.

American Permian Vertebrates. By Prof. S. W. Williston. Pp. v+145+38 plates. (Chicago, Ill.: The University of Chicago Press; Cambridge [Eng.]: University Press, n.d.) Price 10*s.* net.

IT is now evident that not only amphibians, but also reptiles with considerable diversity of habits and structure, arose in several parts of the world before the close of the Carboniferous period. It is thus becoming more and more difficult to interpret the relationships of the numerous genera—even those known by complete skeletons—which have already been described from the Permian rocks of Europe, North America, Brazil, and South Africa.

Some years ago, when only a few types were known, the direct passage from amphibians to reptiles, and that from these early groups to mammals, seemed to be almost discovered; but later researches have complicated rather than simplified the problem, and at present no satisfactory classification is possible. Realising this position, Prof. Williston and his colleagues are devoting themselves to a precise description of the numerous important skeletons and skeletal fragments which they have obtained from the Permian of Texas and New Mexico, and the small, well-illustrated volume now before us is one of the results. As Prof. Williston truly remarks, "the chief need in the palæontology of the early vertebrates is more facts," and students will gratefully accept the rich collection offered to them in his new work.

Photographs of restored skeletons of the Theromorph reptiles Varanosaurus and Casea are given to show how astonishingly similar is their general aspect to that of the contemporaneous amphibian Eryops. Other figures and descriptions suffice to indicate that there is no longer any single skeletal character by which an early reptile can be distinguished from an early amphibian; but Prof. Williston thinks that when the sum-total of characters of a skeleton is considered, there is still no difficulty in assigning the specimen to its true place in one or other of the two classes.

In some groups the various modifications of the skull seem likely to prove as numerous as those observable among modern lizards, so that caution is necessary in dealing with fragments. These and other difficulties, however, can only be recognised and overcome through the progress of such technical and detailed descriptive work as that which we welcome from the professor of palæontology in the University of Chicago.

A. S. W.

SCIENCE OF THE SOIL.

Soil Conditions and Plant Growth. By Dr. Edward J. Russell. Pp. viii+168; with diagrams. (London: Longmans, Green and Co., 1912.) Price 5*s.* net.

"HOW the chemist can help the farmer. He can analyse the soil and the crop, and by comparing the results of his analyses, can tell the farmer how to manure his land so as to grow profitable crops." The above is a quotation, as nearly as the writer can remember, which formed the preface to a syllabus on which he was asked to give a course of local lectures about twenty years ago, when local lectures were in full swing under the newly-constituted technical education committees of the county councils.

At that time there was some excuse for such misconceptions, for the literature of the somewhat hybrid subject known as agricultural chemistry was scattered through numerous periodicals, mostly in foreign languages, and by no means easily accessible to the budding lecturer. Since then many excellent text-books have been written, and are now in the hands of both teachers and students. None of them, however, go to the root of the matter, and give the substance of the classical researches which should form the foundations of the faith of the agricultural chemist, as does Dr. Russell's excellent monograph.

Dr. Russell has made a comprehensive survey of the literature of the subject so far as it deals with the relations between the soil and the plant. He has succeeded in giving the gist of the more important and fundamental contributions to the knowledge of the subject, and in pointing out with true critical spirit what is really proved to demonstration and in what directions further investigation is necessary.

His book will be of the greatest use both to the teacher of agricultural chemistry and to the investigator—to the latter especially, as it will put him in touch with the literature of the subject. It can scarcely fail to stimulate in this country the output of definite experimental work on the various problems connected with plant-growth. The chapter on soil analysis and its interpretation will be particularly welcome to the staffs of the several colleges who are engaged on soil surveys

of their own districts, or are contemplating such surveys. It should do much towards guiding their work on to really useful lines.

The book is printed and issued in the same style as the other well-known "Monographs on Biochemistry." It is singularly free from errors of all kinds, but there is a slip on p. 91, where the formula of potassium phosphate is written K_2PO_4.

T. B. W.

PHILOSOPHY AND PSYCHOLOGY.

(1) *Outdoor Philosophy: The Meditations of a Naturalist.* By Stanton Davis Kirkham. Pp. xii+214. (New York and London: G. P. Putnam's Sons, 1912.) Price 5*s.* net.

(2) *An Introduction to Psychology.* By Prof. Wilhelm Wundt. Translated from the second German edition by Dr. Rudolf Pintner. Pp. xi+198. (London: George Allen and Co., Ltd., 1912.) Price 3*s.* 6*d.*

(3) *The Composition of Matter and the Evolution of Mind. Immortality a Scientific Certainty.* By Duncan Taylor. Pp. 176. (London and Felling-on-Tyne: The Walter Scott Publishing Co., Ltd., 1912.) Price 3*s.* 6*d.*

(4) *The Triuneverse: A Scientific Romance.* By the author of "Space and Spirit." Pp. xiv+221. (London: Charles Knight and Co., Ltd., 1962!) Price 5*s.* net.

(1) THIS book is a pleasure and a refreshment to read. It is not exactly science, or philosophy, or religion, but it partakes of all three, and each is at its best in Mr. Kirkham's pages. Further, the literary quality, apart from the matter, is excellent. It is not too much to say that the reader is continually reminded of Emerson and Thoreau, by whom, indeed, the author has been influenced and inspired; yet there is no plagiarism—we feel the originality of his nature-impressions. "Something in me, deaf to all preaching, responds to that bluebird's note." "And there is the sky—the unimproved sky—the only dome that gives room for thought, the only roof that does not sometimes seem too near." Our life is sick and artificial: the birds and beasts and trees are sounder and saner than we, though they know nothing of soundness and sanity. With our book-learning and our words, words, words, we confuse ourselves until we forget to learn from Nature at first hand. Let us go to the woods and listen, the sweet wind washing us clean of morbid artificialities, and refreshing us after our contact with a "too garrulous and gregarious world."

An admirable book. May it be widely read!

(2) This is a popular introduction to the Wundtian psychology. It is translated from the second edition of the work which has had such a remarkable success in Germany. The author begins with metronome-experiments, showing the scope of consciousness and its "rhythmical" nature, with the difference between apprehension and apperception. He then proceeds to differentiate sensation and idea (simple and complex awarenesses), giving his own and rather unusual meaning to the latter word, which with most writers means a complex that does not arise from direct outward impressions. There is much to be said in favour of the Wundtian use. From this we go on to association and feeling, and the growth of abstract concepts from concrete ones—perceptions. The last chapter deals with the "laws of psychic life," holding close to psychophysical parallelism (which truly needs emphasising, in view of Bergson's ably urged heresies in "Matière et Mémoire"), and admonishing metaphysics to base itself on facts and to beware of abstractions.

Prof. Wundt and his translators are to be thanked. In this volume they give us the best elementary book of its size and kind that exists in English.

(3) The sub-title will probably have an effect contrary to the expectations of the author. Thoughtful readers—still more men of scientific training—are rendered at once suspicious by "certainties," and are apt to avoid books which make great claims. And, indeed, in this case they would be justified. The book is a queer collection of incoherent paragraphs, and, so far as the present reviewer can see, does not prove anything. Such paragraphs as are comprehensible often contain the most reckless statements, as, *e.g.*, "we know that the solar system itself, with its full-orbed, glorious centre, is circling round a greater centre" (pp. 12, 13). Similarly, the planetary structure of the atom is too stiffly put. These things may be true, but at present they are not more than provisional hypotheses or even (as in the astronomical sentence) wild guesses. We sympathise with the author's aims and feelings in certain points, but he should have made his book more carefully accurate and more coherent. He jumps about too much from physics to metaphysics—Christ and gravitation, God and æther, omniscence and mass. If we may be permitted the phrase, we might say that he seems to have got intoxicated on M. le Bon.

(4) One gets rather tired of these "Looking Backward" books, which usually follow Mr. H. G. Wells, *longo intervallo.* The one under review begins at 1950 A.D., and opens with a description

of some astronomers watching Mars split into two, then into four, and finally into about 500 bits. This cluster then proceeds to swallow Jupiter and Saturn; the sun blows up, and the earth starts off somewhere on a wild career, with a piece of sun just big enough to keep it fairly warm. Then two of our astronomers suffer a magical shrinkage in size, entering the infra-tonic (less than electronic) world. And here we may as well leave them, for NATURE is a scientific journal, and this book, though a romance of science, is more of the former than the latter.

J. A. H.

NEW BOOKS ON CHEMISTRY.

(1) *Per-acids and their Salts.* By Dr. T. Slater Price. Pp. vi+123. (London: Longmans, Green and Co., 1912.) Price 3*s.* net.

(2) *Researches on Cellulose.* III. (1905–1910). By Cross and Bevan (C. F. Cross and E. J. Bevan). Pp. x+173. (London: Longmans, Green and Co., 1912.) Price 7*s.* 6*d.* net.

(3) *Modern Research in Organic Chemistry.* By F. G. Pope. Pp. xii+324. (London: Methuen and Co., Ltd., n.d.) Price 7*s.* 6*d.*

(4) *A Second Year Course of Organic Chemistry for Technical Institutes.* The Carbocyclic Compounds. By F. B. Thole. Pp. vii+186. (London: Methuen and Co., Ltd., n.d.) Price 2*s.* 6*d.*

(5) *Experimental Science.* II., Chemistry. By S. E. Brown. Pp. vii+140. (Cambridge University Press, 1912.) Price 2*s.*

(6) *First Year's Course of Chemistry.* By James Sinclair and George W. M'Allister. Pp. vii+165. (London: G. Bell and Sons, Ltd., 1912.) Price 1*s.* 6*d.*

(7) *Elementary Quantitative Analysis.* By Dr. William Briggs and H. W. Bausor. Pp. viii+122. (London: W. B. Clive, University Tutorial Press, Ltd., 1912.) Price 2*s.*

(8) *Chemical Theory and Calculations.* An Elementary Text-book. By Dr. F. J. Wilson and Dr. I. M. Heilbron. Pp. iv+138 (London: Constable and Co., Ltd., 1912.) Price 2*s.* 6*d.* net.

(1) DR. PRICE'S monograph on the per-acids and their salts is the second volume of a series of monographs on inorganic and physical chemistry, the previous volume (Mr. Soddy's book on the chemistry of the radio-elements) having been reviewed recently in these columns. One half of the book is occupied with an account of the persulphuric acids and per-sulphates, the remainder of the volume dealing with perborates, percarbonates, pernitric and perphosphoric acids; pertitanates, perzirconates and perstannates; pervanadates, percolumbates, and pertantalates; perchromates; permolybdates, pertungstates and peruranates. The new volume will go far to establish the reputation of the series for thoroughness and utility. More than three hundred references are given to the literature of a subject which would scarcely have been credited by the ordinary readers with having provided material for one-half this number of papers.

A word of comment may be added in reference to the author's criticism of the view that in presence of concentrated sulphuric acid, the peroxidised material consists mainly of pertetrasulphuric acid, $H_2S_4O_{14}$. Such solutions on dilution undoubtedly yield an oxidised acid of the formula H_2SO_5. But the appearance of this acid is quite compatible with its formation by hydrolysis on the dilution of a solution containing the higher acid, as shown by the equation

$$H_2S_4O_{14}+3H_2O=3H_2SO_4+H_2SO_5;$$

such a hydrolysis would not disturb the ratios of "persulphuric oxygen" to "peroxide oxygen," on which the formula $H_2S_4O_{14}$ was based. The hydrolysis of Marshall's acid to Caro's acid, as shown by the equation

$$H_2S_2O_8+H_2O=H_2SO_5+H_2SO_4,$$

by dissolving it in concentrated sulphuric acid and then diluting, presents some analogy to the conversion of ethylene into alcohol by a similar process; in each case the initial process may very well be a condensation of the hydrolyte with the acid to form a more complex substance, which is then easily hydrolysed on dilution.

(2) The third volume of Messrs. Cross and Bevan's "Researches on Cellulose" covers the five years from 1905 to 1910, but has been delayed to include research work published in 1911. Special interest attaches to the final chapter on technical developments, in which a brief account is given of some important modern cellulose industries. It is noted that in the artificial silk industry the last five years have been marked by rapid developments, accompanied by a rapid gravitation to the level of competitive prices. This has arrested the development of the collodion processes, and has accentuated the struggle between the cuprammonium and viscose processes, in reference both to relative costs and to the textile qualities of the products. A remarkable development consists in the production of transparent films of viscose in lengths of 1000 to 10,000 metres at an average width of a metre, and at a thickness of 0·25 down to 0·01 mm. In view of the fact that the process involves (1) coagulation, (2) purification from sulphur, (3) bleaching and purification by special washings,

and (4) drying, and, moreover, that the shrinkage in width may amount to 30 to 40 per cent., this accomplishment is little short of marvellous. It is accomplished by a single machine, but this has a length of 50 to 60 metres. The material can be coloured and embossed in a very effective way, as is shown by a series of seven samples enclosed with the volume. Experiments are also described on cellulose acetate, which serves, amongst other purposes, as an excellent material for insulating the wire of galvanometers and other instruments in which its extreme thinness gives it a marked advantage.

(3) Mr. Pope's book on modern research in organic chemistry is one of those useful summaries of research work that have formed a conspicuous feature of recent publications. The subjects selected are the polymethylenes, terpenes and camphors, the uric acid group, the alkaloids, colour and constitution, salt-formation, pseudo-acids and bases, the pyrones, ketenes, ozonides and triphenylmethyl and the Grignard reaction. The work has been well and thoroughly done, and full bibliographies are given. The book will therefore be of considerable service both to honours students and to teachers who are not able to acquire complete series of the journals in which original papers are published, but will be glad to place this book upon their shelves.

(4) The "Second Year Course of Organic Chemistry" deals with the carbocyclic compounds, and does not differ very widely in its treatment from other books of a similar type. Some of its most valuable features are found in the appendices, which contain a scheme for qualitative organic analysis and tables of physical constants, suitable for use in identifying organic compounds.

(5) This little book covers a course of elementary chemistry which should be completed in two years by a class working two hours a week. It is based upon the report presented at the Newcastle-upon-Tyne meeting of the British Association by the committee formed to investigate the methods of teaching chemistry. The author claims to have been one of the first to put the suggestions of that committee to a complete practical test in the laboratory. He has found it advantageous to short-circuit the heuristic method in its strictly historical form, and thus finds a proof of the presence of oxygen in lime by direct combustion of metallic calcium. In one respect he has broken away from a hoary tradition, and in reconstructing Lavoisier's decomposition of the oxide of mercury has provided a spirit-lamp as a source of heat in place of the Bunsen burner usually introduced into the picture. It is unfortunate that he should have introduced the terms monoxide and dioxide before the significance of these terms can be explained; as a matter of historical treatment the anachronism may be pardoned in a book that does not profess to teach history, but there would be a great logical advantage in using in place of "carbon dioxide" one of the earlier names, "fixed air," "carbonic acid gas," or "carbonic anhydride."

(6) The "First Year's Course of Chemistry" is arranged in such a way that the experimental work of each lesson occupies the earlier part of each chapter, and is followed by a discussion of the results of the experiments. This system, which has been adopted in at least one other class-book of chemistry, possesses obvious advantages in actual practice, as it agrees with the system followed in the laboratory. The course is intended to occupy a single session, with an allowance of three or four hours per week on the time-table, and covers much the same ground as the volume noted in the preceding paragraph, the direct combustion of calcium being used here also to prove the nature of lime.

(7) The Tutorial "Elementary Quantitative Analysis" describes the simplest forms of gravimetric and volumetric analysis. A conspicuous feature of the book is the introduction of a large number of problems as variants on the usual direct analyses. These resemble closely the problems set in recent examinations, and will doubtless serve to brace the student to face the ordeal of a practical test in quantitative analysis.

(8) The text-book on chemical theory and calculations is primarily intended to provide a series of numerical examples of the different types of calculations that are likely to occur in a course of chemistry. The text is confined almost entirely to stating the theories and describing the apparatus involved in the problems, but some half-dozen chapters have been included which deal with subjects, such as the periodic classification of the elements, which do not lend themselves to numerical exercises. T. M. L.

OUR BOOKSHELF.

Handbook of the Technique of the Teat and Capillary Glass Tube, and its Applications in Medicine and Bacteriology. By Sir A. E. Wright, F.R.S. Pp. xvi+202. (London: Constable and Co., Ltd., 1912.) Price 10*s.* 6*d.* net.

In this book Sir Almroth Wright gives a full account of the ingenious apparatus and methods which he and his co-workers have evolved for making quantitative estimations, principally in connection with the blood and other body fluids. It is generally not possible in this kind of work to deal with quantities greater than a small fraction of a cubic centimetre, and therefore ordinary graduated pipettes and measures are not applicable. It is true that graduated pipettes to deal

with such small quantities are obtainable, but they are costly, and it would be out of the question to employ them in the numbers and in the manner required, for instance, for opsonic determinations. As the author says, "it is a technique for conducting quantitative tests in uncalibrated capillary tubes with minimal quantities of reagents."

Briefly, the method consists in the use of glass pipettes, formed by drawing out a piece of glass tubing in the blow-pipe flame into a fine stem. By adapting a suction apparatus in the form of a rubber teat to the undrawn-out portion, and making a mark somewhere on the drawn-out stem, we have the means of taking up any number of minute similar volumes of a fluid and of making any mixtures of fluids and dilutions thereof required with considerable accuracy.

By an adaptation of these principles, Sir A. Wright has devised methods for estimating the bactericidal, agglutinative, and opsonic powers of the blood, for measuring the coagulation time of the blood, and for estimating quantitatively its alkalinity, content of magnesium and calcium salts, and anti-tryptic power. The making of blood-films and preparation and standardisation of therapeutic vaccines are also dealt with.

Full details are given for the manipulation of the glass in the blow-pipe, the making of the apparatus required, and the carrying out of the various procedures. The descriptions are supplemented by a profusion of illustrations in the text and five plates, four of which are coloured. Truly no bacteriological or pathological laboratory can afford to omit this book from its working library, and we fancy that the chemist and physicist might gather some hints of value from it.

R. T. HEWLETT.

Lines in the Arc Spectra of Elements. By F. Stanley. Pp. 140. (London: Adam Hilger, Ltd.) Price: cloth, 12*s.* 6*d.*; half-morocco, 15*s.* 6*d.*

IN this publication the wave-lengths of the chief lines in the arc spectra of fifty-five elements are given. These are arranged in one long table in the order of the wave-length numbers. The intensities of the lines in the spectrum of the undiluted element are also given on a scale of 1 to 10, the latter denoting the brightest lines. In a separate column and on the same horizon as any particular line will be found the wave-length of the next prominent line belonging to the corresponding element. This is very useful in determining whether any element is present in a substance under investigation. The most persistent lines of any given element—that is, the lines which last longest as the proportion of the element in question is gradually decreased—are specially denoted. The wave-lengths, which extend from λ 7900 to λ 2200, are given to the nearest tenth of an Ångström unit, and have been taken from the most recent and trustworthy measures available. The pages opposite the wave-length tables are left blank for the insertion of notes. To practical workers in elementary spectroscopic analysis the compilation will be decidedly useful.

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.*]

X-rays and Crystals.

MESSRS. FRIEDRICH, KNIPPING AND LAUE have recently published (*K. Bayer. Akad. der Wiss.*, 1912, p. 303) some remarkable effects obtained by passing a fine stream of X-rays through a crystal before incidence upon a photographic plate. A curious arrangement of spots is found upon the plate, some of them so far removed from the central spot that they must be ascribed to rays which make large angles with the original pencil.

The positions of these spots seem to depend on simple numerical relations, and on the mode in which the crystal presents itself to the incident stream. I find that when the crystal (zincblende) is placed so that the incident rays are parallel to an edge of the cube in the crystal the positions of the spots are to be found by the following simple rule. The atoms being assumed to be arranged in rectangular fashion, any direction which joins an atom to a neighbour at a distance na from it, where a is the distance from the atom to the nearest neighbours and n is a whole number, is a direction which a deflected (or secondary) pencil will take, and it will in doing so form one of the spots. In other words, we have to seek for all the cases in which the sum of three squares is also a square, and we then recover the positions of all the spots on the diagram. For example, secondary pencils take the directions (2, 3, 6) (4, 1, 8), and so on. In a few cases the sum of the squares is one short of a perfect square, *e.g.* (5, 7, 11), but in no case is it on the greater side; and there is at least one direction (2, 5, 14) which ought by the rule to be on the diagram and is not. Otherwise the rule is quite successful.

Until further experimental results are available, it is difficult to distinguish between various explanations which suggest themselves. It is clear, however, that the diagram is an illustration of the arrangement of the atoms in the crystal.

The rule has suggested itself to me as a consequence of an attempt to combine Dr. Laue's theory with a fact which my son pointed out to me, viz. that all the directions of the secondary pencils in this position of the crystal are "avenues" between the crystal atoms.

W. H. BRAGG.

Leeds, October 18.

Glaciation and Striation.

IN your issue of September 26, Dr. A. Irving asks whether in my plate 17 (Phil. Trans., Ser. B., vol. ccii) I have not overlooked the fact that the striations are on the original cortex of the flint nodule. My answer is that I have not done so; the striations are *not* on the original cortex of the flint nodule—as is clear both from my description of the specimen and from the carefully drawn figure.

Dr. Irving also asks whether I have overlooked the probability that the markings shown in Fig. 2 are the etched-out skeletons of some spongoid fossil. My reply is that no such probability exists, and that, in consequence, I have not overlooked it.

Your correspondent appears to be under some misapprehension. He has never seen the specimen referred

to. Moreover, he is mistaken in supposing that I am not acquainted with the facts and theories as to the structure and history of flint in its various conditions. As a matter of fact, this subject has occupied my attention during the greater part of a lifetime.

The specimens of "worked" flints from the sub-Crag detritus-bed—dealt with in my recent paper in the Phil. Trans.—have now been presented to the Department of Ethnology of the British Museum (Bloomsbury), and it is now possible, for those who wish to do so, to study the actual material upon which my statements are based, and to discuss them with the needful preliminary knowledge of the things under discussion. E. RAY LANKESTER.

29 Thurloe Place, South Kensington.

Nautilus Pearls.

THE letter from Mr. H. Lyster Jameson in the last number of NATURE reminds me that I have in my possession a small pearl that is alleged to have been found in a Nautilus. It was given to me by a Dutch magistrate in North Celebes, who had in turn received it from a native. It is irregularly pear-shaped, and weighs 27·5 grains.

As there is so little substantial evidence that this or any other pearl or stone has really been formed within the body of a pearly Nautilus, I have never felt disposed to assert that I possess a Nautilus pearl. However, there can be no doubt whatever that there is a widespread belief among the natives of the Malay Archipelago and Polynesia that such pearls are occasionally found, and although in the Sulu Archipelago, according to Mr. Haynes's account, they are regarded as unlucky, in Celebes they are treasured as charm stones that bring good fortune.

Rumphius, in his "D'Amboinsche Rariteitskamer," published in 1702, gives a description of such a stone found in a Nautilus, and relates an interesting story connected with it. He says that the stone belonged to a Chinese woman in Boero, who had kept it in a little box and treasured it as a charm. One day she discovered that it had given birth to another small pearl, and later on two other small pearls were born in a similar manner. This statement reminded him of the story told by Pliny in Lib. 37 of the reproductive stones called Peantides and Gemonides.

SYDNEY J. HICKSON.

The University, Manchester, October 18.

Sailing Flight of Birds.

THERE can scarcely be a doubt that Prof. E. H. Hall has given, in NATURE of October 10, the true explanation of the sailing flight of gulls when they follow a ship without any movement of their wings. When there is a fairly strong head-wind or a wind which, without being strictly a head-wind, makes a small angle with the line of the ship's course, the gull has an up-current of air provided for him which will not only support him, but which, if he inclines his body (and supporting surfaces generally) slightly downward, will enable him to make headway.

Sometimes the gull will hang directly over the stern, at others slightly to windward, at others, but I think not so often, slightly to leeward. Some experiments which I once made with a vane that worked vertically showed that when the wind strikes a bank six feet high at right angles, there is a steady up-current four yards to windward. Five yards to leeward there was a down draught, and some ten yards to leeward irregular up-and-down draughts. Recently in Texel I frequently saw gulls hovering with motionless wings a few yards to windward of embankments some twenty feet high. F. W. HEADLEY.

Haileybury (Hertford), October 13.

The Zodiacal Light.

As of possible interest to some of your readers I beg to report to you a phenomenon which I have observed here during the last ten days. It may be described as follows: every evening after sunset when twilight has completely died out of the western sky there is observable an illumination, starting due west and extending upwards to a height of about 40° above the horizon, fading away towards the top; in character it is much like the Milky Way, a little broader at its base, slightly less brilliant but more uniform. It extended this evening (August 10) from a point due west at 7.30 p.m., Gallegos mean solar time, upwards to a height of about 35° from the horizon, in the direction of the planet Jupiter, inclining towards the north at an angle with the horizon of about 60°. A curious fact I noticed in connection with this phenomenon was that it was best observed when the rays from it were allowed to fall on the periphery of the retina, as when the eyes were fixed on a point about 20° distant. It could be observed for about two and a half hours after sunset, gradually setting in the west. I presume this is the zodiacal light, but as I never noticed the same phenomenon in these latitudes (51° south) before, I thought it worth while mentioning the fact. E. G. FENTON.

Rio Gallegos, Patagonia, Argentine Republic, August 10.

Colours of Plasmodia of Some Mycetozoa.

To my communication under this heading that appeared in NATURE of June 23, 1910, p. 489, allow me to make the following additions:—

Species of Mycetozoa.	Colours of Plasmodia.
Physarum variabile, Rex, var. *sessile*, Lister	Orange yellow.
Colloderma oculatum, G. Lister	Dingy watery-white with greenish or olivaceous tinge, then ochraceous, ultimately ferruginous and dirty throughout.
Cribraria intricata, Schrad.	Pitch-black when the plasmodium is thick, and oil-brown when it is thin; in either shade it closely simulates the solution of asphalt in oil of turpentine.
Perichaena chrysosperma, Lister.	Stated to be pale brown in Lister's "Monograph," second edition, 1911, p. 248, but I found it to be pallid pink.
Craterium concinnum, Rex.	Said to be yolk-coloured in the same work, p. 95, but I found it milky, then cream-coloured.

Since my letter above mentioned was published, I have gathered nineteen species new to Japan, which make the native Mycetozoa taken altogether amount to 105 species, of which three are new to science, viz. *Arcyria glauca*, Lister, *Hemitrichia minor*, G. Lister, and *Diachaea robusta*, G. Lister.

KUMAGUSU MINAKATA.

Tanabe, Kii, Japan, September 17.

THE "MICHAEL SARS" IN THE ATLANTIC.[1]

THE cruise of the *Michael Sars* in the North Atlantic in 1910 has shown what a great deal of excellent work in investigating the deep waters of the ocean can be done by a comparatively small vessel, when the best possible equipment is provided, and men of exceptional competence and experience are in charge. Sir John Murray's judgment was sound when, instead of fitting out *de novo* a larger vessel for the investigations he wished to carry out in the Atlantic, he arranged with the Norwegian Government for the use of its fishery research steamer, a vessel only 125 feet long and of 226 gross tonnage, together with her scientific staff and crew. The immense advantage of proved men, accustomed to work together, and each thoroughly competent in his own particular line, for the successful execution of investigations of the very difficult kind which were undertaken by this expedition cannot be overestimated.

The work of the expedition was not only well done, but the results are being well presented both to the scientific and to the lay public. The detailed scientific reports are to be published in a series of volumes issued by the Bergen Museum, and will without doubt constitute a valuable and permanent addition to our knowledge of the physical and biological conditions of the Atlantic. The book now under review is designed to appeal to a wider public, and from the interesting way in which the facts are presented and the large number of excellent illustrations which it contains, it can scarcely fail to achieve its purpose. Although the book is chiefly devoted to an account of one particular expedition, Sir John Murray and Dr. Hjort have taken the opportunity, as the sub-title indicates, of placing before the public "a general account of the modern science of oceanography." The success with which the authors, and those who have collaborated with them, have carried out their task makes "The Depths of the Ocean" by far the best English book from which the general reader can gain a trustworthy knowledge of the aims and progress of the modern science of the sea.

Within the limits of a single article it would be quite impossible to give any adequate account of the wealth of interesting matter which this large volume contains. It will only be possible, therefore, whilst noting the general contents of the several chapters, to direct special attention to some of the questions upon which the results of the *Michael Sars* expedition have thrown new light.

The first chapter, on the history of oceanographical research, is written by Sir John Murray. It condenses and brings up to date the well-known historical account of the subject which Sir John wrote for the "Summary" volume of the *Challenger* reports. If a word of criticism may be allowed, it seems a pity that the more recent work around the coasts of north Europe, more particularly that done in connection with the international investigations, receives such slight reference. We should have been glad to see some more detailed notice of the brilliant achievements of the Danish workers in the North Atlantic, and one would have expected a good Scotsman like Sir John Murray to have at least mentioned the important work done by the Scottish Fishery Board, even though he did not consider that carried out by England and by Ireland as worthy of a place.

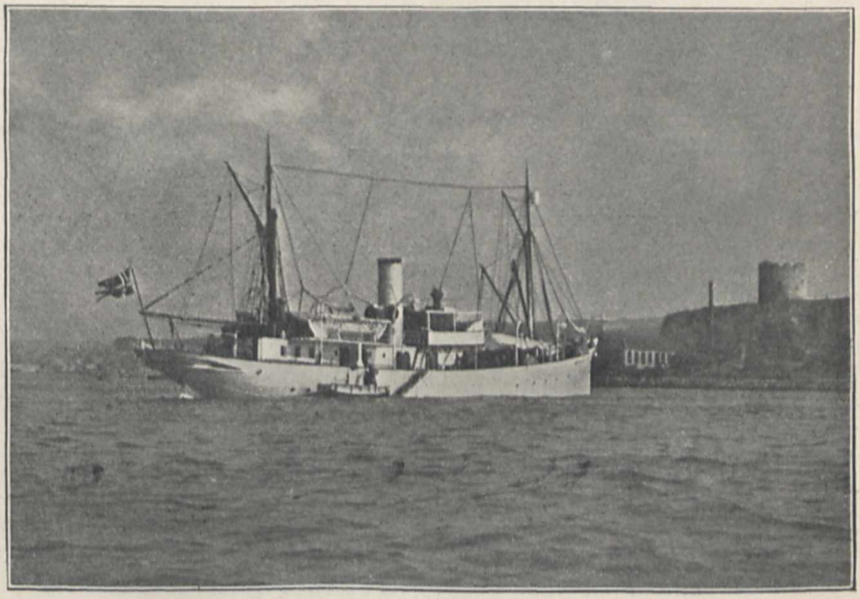

FIG. 1.—S.S. *Michael Sars* in Plymouth Harbour. From "The Depths of the Ocean."

In the second and third chapters Dr. Hjort gives a narrative of the cruise, with many details of the equipment of the ship and the methods of work. The feature of most interest to the working naturalist is perhaps the account of the number of different pieces of apparatus for capturing pelagic animals which it was found possible to work at one and the same time. As many as nine or ten nets, including two or three Petersen young-fish trawls and some very large tow-nets, were towed together at different depths, and appear to have worked well.

[1] "The Depths of the Ocean." A General Account of the Modern Science of Oceanography based largely on the Scientific Researches of the Norwegian Steamer *Michael Sars* in the North Atlantic. By Sir John Murray, K.C.B., F.R.S., and Dr. Johan Hjort. Pp. xx+821. (London: Macmillan and Co., Ltd., 1912.) Price 28*s.* net.

Sir John Murray's principal contribution, which is on the depths and deposits of the ocean, constitutes chapter iv. The chapter is mainly devoted to a general account of these subjects. Written as it is by the greatest living authority, in a style as interesting as it is scientifically accurate, it cannot fail to be welcome to all who wish to learn the present position of our knowledge of the configuration of the ocean basins and the nature of the deposits which lie upon their floors. The section dealing with the mineral collections obtained during the cruise of the *Michel Sars* is by Drs. Peach and Horne, who examined the specimens. The most interesting fact recorded by them is the discovery of glaciated stones, some of which are illustrated, at a depth of a little more than a mile, at a point 230 miles south-west of Mizen Head, Ireland.

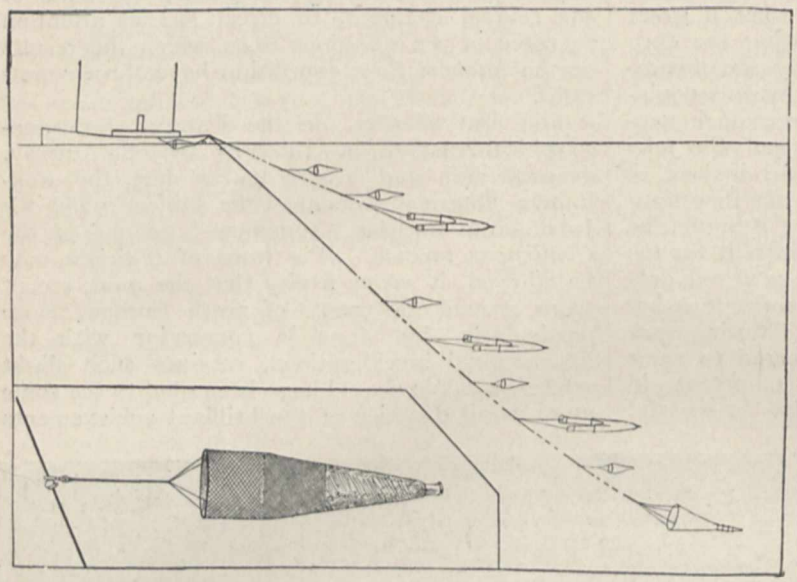

FIG. 2.—The *Michael Sars* towing ten nets and pelagic trawls (surface net not shown). From "The Depths of the Ocean."

Dr. Helland-Hansen's chapter on physical oceanography is certainly the best summary of the modern aspects of this subject which has yet appeared in English. Of the work of the expedition itself the striking features are the direct measurements of the currents entering and leaving the Mediterranean through the Straits of Gibraltar, the determination of the depths to which an amount of light penetrated sufficient to produce an effect on photographic plates, and the very close agreement which was found in the deep-water temperatures taken by the best modern instruments with those taken at the same stations by the *Challenger* expedition more than thirty years before.

Dr. Helland-Hansen is followed by Prof. Gran, with an account of the pelagic plant life, one of the most interesting chapters of the whole book. The general subject is treated in a masterly way, and the importance of these minute vegetable organisms, forming as they do the fundamental food supply of the ocean, cannot be overrated. The special contribution of the expedition to the advancement of this subject is the discovery, by means of a large centrifuge worked by the steam-winch of the vessel, of the extraordinary abundance of the most minute plankton forms, especially in the warmer seas. These forms are so small that they pass through the meshes of the finest silk nets, yet they occur in such vast quantities that they constitute in these waters perhaps the most important part of the pelagic plant life.

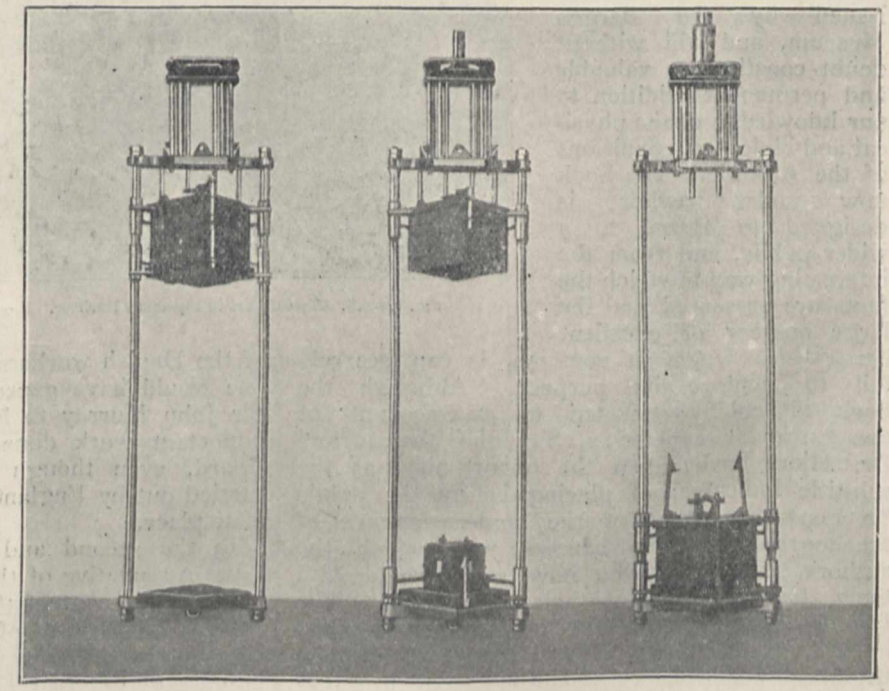

FIG. 3.—Helland-Hansen's photometer. On the left, as it is sent down; in the middle, open for exposure; on the right, closed and ready for hauling up. From "The Depths of the Ocean."

Sections dealing with the bottom fauna are con-

tributed by Dr. Hjort and Dr. Appellöf in chapters vii. and viii., the former writing on the fishes, the latter on the invertebrates. It is a task of no little difficulty to treat such extensive subjects in a concise and yet comprehensive way. With the help of a large series of figures illustrating the numerous species mentioned, both authors have succeeded well, and it is to be hoped that their efforts may result in reviving popular as well as general scientific interest in these branches of marine biology, which, fascinating as they are, have rather tended to become of late years entirely relegated to specialists on particular groups.

Following these, chapter ix., on pelagic animal life, by Dr. Hjort, contains perhaps the largest proportion of original matter to be found in the book. This is due to the fact that the collecting gear chiefly used by the expedition consisted of townets and large pelagic nets of various patterns, all of them of very much greater fishing capacity than the nets which have previously been used in ocean work. From the nature of the results already reached—and the material has as yet been only partially worked out—it seems clear, as Dr. Hjort maintains, that the qualitative results obtained by the use of these large nets towed for long periods give a more correct and comprehensive picture of the free-swimming life of the Atlantic than was obtained with the relatively small nets used by the German plankton expedition, the material from which Prof. Hensen and his helpers have attempted to work out quantitatively at the cost of such vast labour.

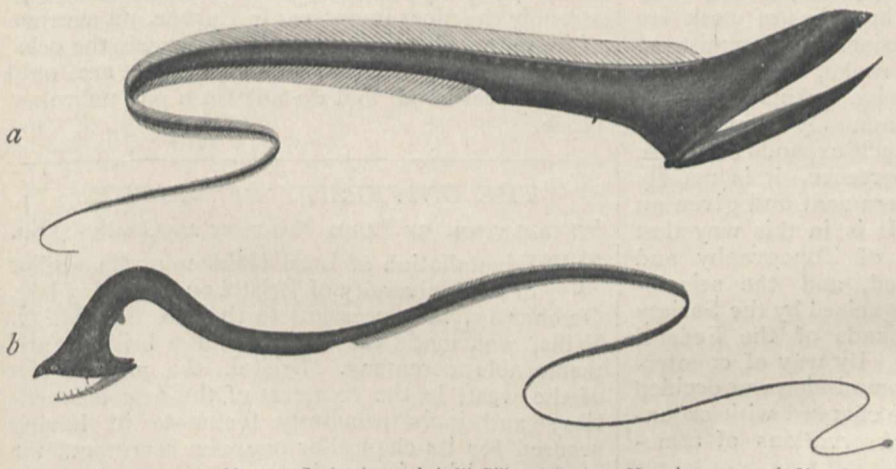

FIG. 4.—Two Gastrostomidæ. *a*. *Gastrostomus bairdii*, Gill and Ryder. Nat. size, 47 cm. *b*. New Genus. Nat. size, 20 cm. From "The Depths of the Ocean."

The final chapter, entitled "General Biology," is also written by Dr. Hjort. It deals with innumerable problems of scientific importance in a most suggestive and stimulating way, and maintains the high standard of the whole book to the end. Among the numerous questions dealt with are the colours of marine animals and their relation to the conditions in which these animals live, phosphorescence and luminous organs, the eyes of deep-sea fishes and the meaning of the great variations in their size in different species, the factors which influence the floating of pelagic organisms, and the organs which are special adaptations for floating.

One other subject in this final chapter must not be passed without notice—namely, the valuable contribution made by the *Michael Sars* expedition to the wonderful story of the life-history of the fresh-water eel. The expedition secured numerous eel larvæ of stages much younger than any previously found, and from the distribution of these larvæ the conclusion seems justified that the eel spawns south of the latitude of the Azores, and the larvæ are later carried into the northern North Atlantic and towards the coasts of northern Europe by the Gulf Stream.

Nothing could be more calculated than this book to awaken fresh interest in the importance of the thorough and complete investigation of the problems of the great oceans. A knowledge of the changes which take place from season to season and from year to year in the Atlantic would be of incalculable value to every country in Europe, for there can now be scarcely a doubt that it is upon these changes that the variations in the yield of the harvests both of the land and of the sea are mainly dependent. These changes can never be ascertained by single cruises such as that of the *Michael Sars*, brilliantly though that cruise was carried out. What we now want is systematic and sustained researches extending over a period of years. Great Britain did the pioneer work in connection with ocean research, and the time is fully ripe when a comprehensive scheme of investigation in the Atlantic should be organised in this country. The present notice can have no better conclusion than the expression of the hope that Sir John Murray will use his great experience and commanding position in trying to ensure that the British Government should make the necessary provision for such an investigation.

E. J. ALLEN.

THE SWISS SOCIETY OF NATURAL SCIENCES.

THE Société Helvétique des Sciences naturelles, which, in Switzerland, takes the place of a scientific academy, and is the centre of all concerted action in the scientific life of that country, held its annual reunion at Altdorf, in the canton of Uri, on September 8–10.

The first day was devoted to a general assembly, at which various matters were discussed, and some

general addresses also delivered. Profs. Kovalski, Wiechert, and Weiss reviewed recent work on radiations, atmospheric electricity, and the *rôle* of magnetic phenomena in the study of molecular and atomic conceptions. The second day was devoted to meetings of sections, at which a great number of communications were presented on mathematics, physics, chemistry, geology and mineralogy, botany, and zoology. Finally, on the concluding day another general assembly was held, again devoted to administrative matters and general addresses, among which may be specially mentioned that by Prof. Chodat, on vegetable pigment, and that by Dr. Paul Sarasin, on the Swiss National Park.

The Société Helvétique des Sciences naturelles, founded at Geneva in 1815, has been the moving spirit in many important scientific undertakings in Switzerland. It has successfully created, or, at least, been the means of creating, the fine topographical map of Switzerland, the geological, geodetical, and meteorological services, the investigations of earthquakes, glaciers, rivers, lakes and marshes. The various branches of work are directed by special commissions or committees, selected from the Society's ranks, which send in reports annually; they receive grants from the Swiss Government totalling annually about 80,000 francs (3200*l*). As each branch expands in course of time, and grows in importance, it is usually taken over by the Swiss Government and given an independent organisation. It is in this way that the Swiss Federal Services of Topography and Meteorology have originated, and the seismological service started and organised by the Society is now passing into the hands of the Federal Government in like fashion. By way of counterpoise, the creation of a new commission was decided at the Altdorf meeting, to be charged with organising studies and regular observations of atmospheric electricity.

But of all the recent activities of the Society, the most interesting for its importance and bearing is the work of the Commission for the Protection of Natural Sites, organised in 1906, which has culminated in the creation of a magnificent national park, situated in the lower valley of the Inn (Grisons), one of the wildest parts of the Swiss Alps. In accordance with contracts made with the commune of Zernez and various neighbouring communes, an uninterrupted stretch of territory of about 100 square kilometres area, which it is hoped soon to extend to 200 square kilometres, will be almost completely withdrawn from the interference of man. The flora and fauna, which are here relatively very rich—the region is still frequented by chamois, and a few bears are still met with—will be able to develop freely in accordance with natural laws of evolution. The only exception will be a few roads or paths to give access to the reservation, and some blockhouses constructed for the purposes of repressing poaching, enforcing the prohibition of hunting, and organising a service of regular observations. It will thus be possible to study the formation of a natural "biocénose" on a somewhat magnificent scale—a true "biological refuge" of a most interesting kind.

Part of the territory leased by the Society for the National Park of the Grisons has been taken for twenty-five years, the rest for ninety-nine years. The costs of rent, surveillance, and observations will be defrayed out of funds furnished by a popular league, the "Ligue suisse pour la protection de la nature" (founded under the auspices of the Société Helvétique des Sciences naturelles), the ordinary members of which pay an annual contribution of at least a franc, and the life members a lump sum of at least twenty francs. The Federal Government also has announced its intention of applying to the Chambers for regular annual grants.

The above details, taken from the bulky report of the Central Committee, and from the interesting address of Dr. Paul Sarasin, President of the Commission for the Protection of Natural Sites, prove that Swiss naturalists have made a great achievement. The "Territoire Réservé" of the Grisons is not only the most important in Europe, on account of its extent, but in some respects excels the celebrated American Reservations, which are only partially reserved, and do not form one unbroken block.

THE UNIVERSITY OF BRISTOL.

INSTALLATION OF LORD HALDANE AS CHANCELLOR.

THE installation of Lord Haldane as Chancellor of the University of Bristol on Thursday last, October 17, in succession to the late Mr. H. O. Wills, was made the occasion of a brilliant and memorable ceremony. Bristol, the ancient city of the west, is the youngest of the new universities; and it is peculiarly fortunate in having secured for its chancellor one who represents the modern spirit of organisation and progress. In presenting the deed to the chancellor, Mr. Lewis Fry expressed the profound satisfaction of the University that he had been able to accept the unanimous invitation to become its head. Lord Haldane, in the course of reply, remarked that he had spent a considerable part of his life and such energy as he possessed in endeavouring to forward the cause of the new civic university, and he hoped to be permitted to mould and fashion the operations of this great conception still further in the future.

In honour of the occasion, a large number of honorary degrees were conferred upon men and women distinguished in letters, art, science and public services. Lord Haldane himself received the patent of the honorary degree of LL.D., and among the other recipients of degrees were the following, who were presented in the order given.

M.Sc. (*Engineering*).—John Munro, professor of mechanical and mining engineering in the University.

M.D.S.—W. R. Ackland, lecturer in dental surgery in the University.

M.Ch.—N. C. Dobson, emeritus professor of surgery in the late University College, Bristol; J. P.

Bush, C.M.G., lecturer in operative surgery in the University.

M.Sc.—Herbert Bolton, director of the Bristol Museum and Art Gallery, and reader in palæontology in the University.

D.Sc. (*Engineering*).—W. Wilson, secretary for higher education to the County Palatine of Lancaster, formerly professor of electrical engineering in the Merchant Venturers' Technical College; H. S. Hele-Shaw, professor of engineering in University College, Bristol; J. Ryan, formerly professor of engineering in University College, Bristol; W. Ripper, dean of the faculty of engineering in the University of Sheffield.

M.D.—R. Shingleton Smith, emeritus professor of medicine in the late University College, Bristol; G. Munro Smith, formerly professor of physiology in University College, Bristol.

D.Sc.—Sydney Young, F.R.S., professor of chemistry in Trinity College, Dublin, formerly professor of chemistry in University College, Bristol; Silvanus P. Thompson, F.R.S., principal of the City and Guilds Technical College, Finsbury, formerly professor of physics in University College, Bristol; W. J. Sollas, F.R.S., professor of geology and palæontology in the University of Oxford, formerly professor of geology in University College, Bristol; Alderman Ernest H. Cook, chairman of the Education Committee of the City of Bristol; Sir Donald MacAlister, K.C.B., Vice-Chancellor of the University of Glasgow, president of the General Medical Council.

D.Litt.—T. H. Warren, president of Magdalen College in the University of Oxford, and professor of poetry in the same University.

LL.D.—D. S. Davies, medical officer of health for the city, county and port of Bristol, lecturer on public health in the University; F. Richardson Cross, special lecturer in ophthalmology in the University; Sir William Henry White, K.C.B., F.R.S., formerly Director of Naval Construction and Assistant Controller of the Royal Navy; Prof. J. Michell Clarke, pro-Vice-Chancellor of the University; Rev. T. Hamilton, Vice-Chancellor of the University of Belfast; Sir Henry R. Reichel, Vice-Chancellor of the University of Wales; Sir Alfred W. W. Dale, Vice-Chancellor of the University of Liverpool; Sir Alfred Hopkinson, Vice-Chancellor of the University of Manchester; the Right Hon. Sir William Mather, P.C.; the Right Hon. Sir Edward Fry, P.C., G.C.B., F.R.S.; the Right Hon. A. H. D. Acland, P.C., sometime vice-president of the Committee of Council on Education.

The following degrees were conferred *in absentia*, the recipients having been unavoidably prevented from attending the ceremony:—

LL.D.—The Prime Minister; the Right Hon. Arthur J. Balfour, P.C., F.R.S.

D.Sc.—Morris W. Travers, formerly professor of chemistry in University College, Bristol.

M.D.—R. Fletcher, librarian of the Surgeon-General's Library, Washington, editor of the "Index Medicus."

It was befitting that, in the presence of a chancellor who has, in more than one capacity, shown high skill in organisation, the proceedings should have been carried out with perfect precision from start to finish, thanks chiefly to the vice-chancellor (Sir Isambard Owen) and the registrar (Mr. James Rafter).

In the evening, Lord Haldane delivered his official address as Chancellor of the University before a large audience, taking as his subject "The Civic University." We give a few extracts from this address.

There was a time when men of business, accustomed to see closely to profit and loss, used to think that the work of a university was worth effort and expenditure only in so far as it produced aptitude for industrial and commercial production. Traces of this view are still apparent in the foundation deeds of some of the older university colleges of our municipalities. But this idea is now discredited, and the part played by science and by general learning in the production alike of the captain of industry and of the extension of invention is far greater than was the case even a few years ago. Applied science is in its best form only possible on a wide foundation of general science. And the fruitful scientific spirit is developed to-day on a basis of high intellectual training, the training which only the atmosphere of the fully-developed university can completely provide.

What is true of science in the narrower sense is also true of learning generally. It is only by the possession of a trained and developed mind that the fullest capacity can, as a general rule, be obtained. There are, of course, exceptional individuals with rare natural gifts which make up for deficiencies. But such gifts are indeed rare. We are coming more and more to recognise that the best specialist can be produced only after a long training in general learning. The grasp of principles which makes detail easy can only come when innate capacity has been evoked and moulded by high training. Our engineers, our lawyers, our doctors, our administrators, our inventors, cannot without it keep in front in the race. The competition is not merely with their fellow-countrymen; it is with the trained minds of other countries. These other countries are some of them advancing at least as rapidly as we are. An enlightened policy in education is the order of the day over most of the civilised world, and if we are to hold our own, even in the making of money, we are not to fall behind or lag in the endeavour to increase our efforts. We have more than ever before to see to it that we keep at least abreast in science, and science means far more now than technical training or the mere application of special knowledge to industry. It rests on a foundation of general culture which is vital to the maintenance of its standards, and it can develop only if the population has the fullest chance of an intellectual and moral training which goes deeper than mere science strictly so-called. It is the power of the highly trained mind that is required, and the full development of this trained mind can only be given by the highly organised universities.

A university to be a true university must be a place where the spirit is more important than the letter. The spirit of the university is the cooperation of professor and student in a common endeavour to learn. A university is a place where the most valuable advantage the student has is contact with an inspiring personality. That is why nothing short of the best level among the professors is enough for success. The professor must inspire. His labour must be one of love if he is to succeed. And if he is a great teacher he will have moulded the lives and tastes of the best of his students for the rest of their existence.

In Germany the technical colleges have been sharply divided from the university and given a separate existence. This is partly due to the division and separation in character of the great secondary schools in Germany. The resulting separation of the technical college from the university has been deplored by some of the most distinguished authorities on German education, notably by the late Prof. Paulsen. If this be

a thing to be avoided we have avoided it. We have made our start by treating education as a single and indivisible whole—and by trying to keep the different kinds of students in one organisation. How powerful this tendency is we may see by the example of Cambridge. We have done even more, for we have developed in connection with our new universities a system of evening teaching for a separate class of student. That the tendency to recognise this kind of instruction as legitimate for the British university is increasing appears when we look at such cases as those of Glasgow and Manchester, where the great technical colleges of these cities are being brought into the closest relation with their universities. I believe this to be entirely right, and I am glad that you in Bristol took the same course at the beginning when you brought the Merchant Venturers' College, with its evening teaching, into your new University organisation.

Specialisation in each city university there will be and ought to be. *Non omnia possumus omnes.* In one place the distinctive strength will be in chemistry —general and applied—for exist without each other they cannot. In another, as in Sheffield, it will be the metallurgy of iron and steel; and it is not unimportant in this connection that Sheffield is the chief centre for the manufacture of the national guns and steel plates, an industry in which we dare not dispense with high science. In another place, as in the case of the Imperial College in London, we should have the great training place in the metallurgy of the precious metals for the students of a people which leads the world in their production. Some universities will be strong in engineering, civil and mechanical, or, it may be, marine. But the one thing requisite is that the broad foundations of the highest general knowledge should be there in each university, and that all specialisation should rest on these foundations. You cannot, without danger of partial starvation, separate science from literature and philosophy. Each grows best in the presence of the others. Another essential feature is adequate provision for the postgraduate student—that is, the student who, having taken his degree, has in him the passion for excellence sufficiently strong to desire to continue in the university as a place of research and of the still higher learning which is inseparable from research. Such students may not be numerous, but when they are present they leaven the whole lump, and by their presence give a distinction to the university and to the professors under whom they work which could not be possible in their absence.

WILLIAM BOTTOMLEY.

THE death of William Bottomley at Glasgow on October 19, at sixty-three years of age, removes one who, throughout the greater part of his life, did genuine, unobtrusive service to the cause of applied science by the assistance he gave to his uncle, Lord Kelvin. A son of the late Mr. William Bottomley, of Fortbreda, County Down, and of Anna Thomson, the second of Lord Kelvin's sisters, Bottomley was trained as a civil engineer. In 1872, Sir William Thomson and Fleeming Jenkin undertook to act in partnership as engineers for the manufacture and laying of telegraph cables which were to connect the cities of the Brazilian coast, from the Amazon to the River Plate. Bottomley was put in charge of a staff of young assistants at the works of the Hooper Company at Millwall Docks where the cable was being made.

In those days there were no college laboratories which could compare with the testing-room of a cable factory as a scientific training ground for the practical electrician. The writer, who was a very junior member of the staff, well remembers Bottomley's cheery kindness, his capacity for management, and the ardour with which he threw himself into what was then a novel task. The art of cable testing, the necessities of which had been a chief factor in bringing into existence the scientific system of electrical units, was still undergoing evolution: new methods had to be devised, tested, and licked into shape for everyday use.

In 1873, Bottomley, along with his colleague W. F. King, accompanied Thomson and Jenkin in the maiden voyage of the cable ship *Hooper*, when the first section, from Para to Pernambuco, was laid. The sections from Pernambuco southward were laid in subsequent expeditions under their supervision, and in the absence of the chiefs.

Probably there are few parts of the later work of Kelvin in applied science with which William Bottomley was not in some degree concerned. With the Kelvin compass he had an early and intimate association. When the long struggle was over which preceded its general acceptance in the Navy and the mercantile marine, the task of looking after it as an article of manufacture and an object of business enterprise fell mainly on his shoulders. He had to train and superintend the skilled compass adjusters whose services were essential to its success. His own energy, his tact and judgment, and his appreciation of the scientific points at issue were in constant exercise for many years with the happiest results. The Kelvin compass came into universal use primarily, of course, because of its intrinsic merits; but these had to be demonstrated, defects had to be corrected, and prejudices to be overcome. In this work Bottomley's unfailing geniality, his simplicity and directness, and the warmth of his enthusiasm were valuable adjuncts to his technical knowledge: they were qualities, too, that endeared him to his friends. J. A. E.

PROF. LEWIS BOSS.

IT is with deep regret that we have to record the death of Prof. Lewis Boss on October 5. While working as an assistant astronomer on the U.S. Northern Boundary Commission in 1877, Prof. Boss was greatly impressed by the urgent necessity for greater accuracy in star catalogues, and forthwith made the remedying of the defect his life-work; the immediate outcome was the extremely valuable "Boss's Declinations," in which, after discussing some hundred catalogues, he gave the declinations and proper motions of 500 stars for the epoch 1875. In 1878 he was appointed director of the Dudley Observatory, Albany, N.Y., a position which he held until his death, and after observing the corona at the solar eclipse of that year, he settled down to the solution

of the many problems involved in the rigid determination of stellar positions. Generous friends showed their appreciation of Prof. Boss's labours by providing him with a new observatory in 1893, and later the Carnegie Institution of Washington showed practical sympathy with his work, also making him director of the Meridian Astrometry Department of the Institution.

Prof. Boss's publications are too many to refer to in detail here, but they dealt with many subjects such as the instrumental and magnitude errors in meridian work, the observation of comets, for which he published many ephemerides, and the determination of the sun's motion. In 1903 he published a standard catalogue of 627 stars distributed over both hemispheres, and in 1910 a preliminary general catalogue, in which he gave positions and proper motions of 6188 stars, of which about 4000 are brighter than the sixth magnitude.

The value of these researches is inestimable, but already many important results have accrued, such as the discovery of the Taurus stream of stars, and the value will rapidly advance as time passes. In 1905 the Royal Astronomical Society recognised Prof. Boss's work by presenting him with its gold medal, and in England, as elsewhere, the loss of a great and original investigator, and a personal friend, will be sorely felt. Prof. Boss was born at Providence, R.I., in 1846.

NOTES.

THE Huxley lecture at the University of Birmingham is to be delivered on October 30 by Prof. John Joly, F.R.S., who has chosen as his subject "Pleochroic Halos."

THE annual Huxley memorial lecture of the Royal Anthropological Institute will be held on Tuesday, November 19, at 8.30 p.m., at the theatre of the Civil Service Commission, Burlington Gardens, London, W., when Prof. W. Gowland, F.R.S., will deliver an address on "The Metals in Antiquity." Dr. Alfred P. Maudsley, president, will take the chair.

THE Institute of Chemistry announces that Mr. E. White will deliver a lecture on thorium and its compounds on Friday, November 1, at 8 p.m., in the Chemical Lecture Theatre of Finsbury Technical College, London, E.C. Prof. R. Meldola, F.R.S., president of the Institute, will occupy the chair.

PROF. E. METCHNIKOFF, of the Pasteur Institute, Paris, will deliver a lecture on "The Warfare against Tubercle" in London on Friday, November 29, at 4.30, at the Royal Society of Medicine, Wimpole Street, Cavendish Square. The lecture is the Lady Priestley memorial lecture for 1912.

MUCH interest was aroused last March by the discovery of typical Upper Old Red Sandstone with fish remains beneath the neighbourhood of London. Mr. E. Procter, of the Imperial College of Science, exhibited to the Geological Society characteristic fragments of Holoptychius and Bothriolepis, which he had obtained from a depth of between 1100 and 1200 feet in a boring at Southall. He has lately presented these specimens to the British Museum (Natural History), where they are now to be seen among the fossil fishes.

PEABODY MUSEUM, Yale University, has received from the assistant professor of archæology, Dr. G. G. MacCurdy, the anthropological collections made by him during his summer visit to Europe. It has also acquired 2000 geological specimens gathered by Prof. C. Schuchert in Nova Scotia and the Lake Huron region, a collection made at Abydos in connection with the Egyptian exploration fund, and remains of a fossil three-toed horse found in Texas by Prof. R. S. Lull.

THE death is reported, within a few days of his seventieth birthday, of Mr. Bradford Torrey, well known in America as a naturalist. He was a frequent contributor to *The Atlantic Monthly*, and was for several years one of the editors of *The Youth's Companion*. He had edited Thoreau's Journal, and was himself the author of "Birds in the Bush," "A Rambler's Lease," "The Foot-path Way," "A Florida Sketch-book," "Spring Notes from Tennessee," "A World of Green Hills," "Footing it in Franconia," "The Clerk of the Woods," "Nature's Invitation," and "Friends on the Shelf."

DR. MORRIS LOEB, for several years professor of chemistry at New York University, died recently in his fiftieth year. He was a member of the executive committee of the International Congress of Applied Chemistry, which met a few weeks ago in America. His own research work was done chiefly in complex inorganic salts. Last year Dr. Loeb presented 10,000*l.* to the Walcott Gibbs Chemical Library at Harvard, of which university he was a graduate, and he was a generous benefactor of various scientific societies and Hebrew charities. He had been president of the Hebrew Technical Institute and of the Chemists' Club, and was a member of the New York Board of Education.

THE death is announced, at sixty-eight years of age, of Mr. Robert Brown, fellow of the Society of Antiquaries, and distinguished by his works on comparative mythology. He was (says *The Times*) a student of Chaldæan myths, agreeing with Prof. Max Müller in tracing their origin to the movements of sun, moon, and stars, and the ebb and flow of natural phenomena, and opposing strongly the rival theory of totemism. His chief work, "The Great Dionysiak Myth" (two vols.), appeared in 1877–8, and he also published "The Myth of Kirke," "Aratus," "Researches into the Origin of the Primitive Constellations of Greeks, Phœnicians, and Babylonians," (two vols.), and "Semitic Influence in Hellenic Mythology."

WE regret to learn from *The Times* that Prof. Otto Krümmel, who held the professorship of geography for many years at Kiel, and latterly at Marburg, and was recognised as the leading German oceanographer, died suddenly on October 12, at fifty-eight years of age. In 1911 he completed the publication of a standard treatise on oceanography, and he was joint author of the article, "Ocean and Oceanography," in the 11th edition of the "Encyclopædia Britannica."

As a member of the International Council for the Study of the Sea and of the Prince of Monaco's committee for the preparation of a chart of the depths of the ocean, Prof. Krümmel took a large share in promoting the recent advances in our knowledge of the ocean by international cooperation.

THE death is announced of Mr. James Parker, of Oxford, at seventy-nine years of age. Although best known as an antiquarian, Mr. Parker was an industrious student of geology, and made a remarkable collection of fossils from the neighbourhood of Oxford, including Teleosaurian skulls and a Megalosaurian skeleton described by Phillips in his "Geology of Oxford." For fifty years he was an active member of the Geologists' Association, and in 1876 he contributed to their Proceedings a paper on the valley of the Somme, France. In 1880, for the use of one of their excursions, he also published a map and sections of the strata south of Oxford. Earlier in life he was associated with Prof. Boyd Dawkins and the late Mr. Ayshford Sanford in the exploration of caves in Somersetshire, and he devised a raft for the navigation of underground waters.

ON Wednesday, October 16, a new gallery, which is to be entirely devoted to the illustration of local mammals, was opened at the Municipal Museum, Hull. The specimens include several historical examples from the collection of the late Sir Henry Boynton and other sources, and a number of them are the last records of the kind for the district. The collection is arranged in specially made cases, in which the animals are shown in their natural surroundings, in addition to which there are several large groups showing male, female, and their young, &c. The groups consist of otters, badgers, hedgehogs, deer, foxes, &c. On the occasion the curator, Mr. T. Sheppard, gave an address on the mammals of the East Riding of Yorkshire.

WE are informed that a new society, which has assumed the title of the South African Association of Analytical Chemists, has recently been formed, with headquarters in Johannesburg. The main objects of the association are to uphold the status and the interests of the profession of technical chemistry and to secure a high standard of professional conduct amongst analysts in South Africa. In its constitution the new association has made provision for undertaking any procedure which will encourage the study or extend the knowledge of analytical and technical chemistry. The first council of the association is:—*President*, Dr. J. McCrae; *Vice-President*, G. H. Stanley; *Honorary Treasurer*, A. Whitby; *Members*, Dr. R. B. Denison, J. Sprunt Jamieson, Dr. C. F. Juritz, Dr. R. Marloth, Dr. J. Moir; *Honorary Secretary*, Jas. Gray, P.O. Box 5254, Johannesburg.

THERE has recently been added to the exhibits in the Shell Gallery of the Natural History Museum a working model illustrating the phenomenon of "torsion" in Gastropod Mollusca. The model can be easily operated by the public, and exhibits the process of "torsion" in two stages. Two diagrammatic models of shells in skeleton outline, containing intestine and visceral commissure of the nervous system, are rotated successively by handles. The first model thus operated illustrates the production of the U-shaped flexure of the intestine by the approximation of the mouth and anus. The second shows the actual "torsion" of the intestine and visceral commissure. The model is diagrammatic and generalised, and does not attempt to suggest a cause for this phenomenon.

AT the annual meeting of the Royal Society of South Africa, held at Cape Town on September 18, the president, Dr. L. Peringuey, announced that the council had awarded the following grants-in-aid of research:—To Mr. E. J. Hamlin, of Cape Town, 90*l.*, to carry on research on commutation in electrical machinery; to Mr. A. Young, of Cape Town, 20*l.*, to continue investigations on a fluctuating well in the Karoo; to Mr. P. A. Methuen, of Pretoria, 50*l.*, for a journey to the Great Karasberg Range for the study of the taxonomy and distribution of the lower vertebrates and several groups of the invertebrates of Great Namaqualand; to Mr. G. Rattray, of East London, 50*l.*, for travelling expenses in connection with the continuation of the investigation of the taxonomy and distribution of South African Cycads; to Miss E. L. Stephens, of Cape Town, 15*l.*, for (*a*) determination of South African fresh-water Algæ, (*b*) periodic change in fauna and flora of certain South African vleis; to Miss A. W. Tucker, of Johannesburg, 50*l.*, for an ethnological survey of the Topnaar tribe of Hottentots.

AMERICAN naturalists are delighted by the announcement that Mrs. Russell Sage, widow of the late well-known Wall Street financier, has purchased Marsh Island, off the coast of Louisiana, in order to make it a perpetual bird sanctuary. "With one penful of ink," says Mr. W. T. Hornaday, in an enthusiastic letter to the American Press, "Mrs. Russell Sage has taken the greatest bird-slaughtering ground of the Gulf Coast away from the market gunners of Louisiana and dedicated it for ever to the opposite cause—the preservation of the birds of North America." The island in question is about 75,000 acres in extent. It is a sylvan labyrinth affording shelter and food to hundreds of thousands of wild birds which resort to it in winter when the northern lakes and streams are locked fast under ice. For this reason it has been the great killing ground for the markets of New Orleans, St. Louis, Cincinnati, and Chicago, no fewer than seventy market gunners being regularly employed there every winter. The price paid by Mrs. Sage for the island is 30,000*l.* This is said to be the second largest gift ever made for the protection of wild life in America, the largest being the bequest of 62,400*l.* by Mr. David Wilcox to the National Association of Audubon Societies.

THE Harveian Oration before the Royal College of Physicians was delivered on October 18 by Sir James Goodhart, who took for his subject "The Passing of Morbid Anatomy." Are physicians, he asked, sufficiently alive to the fact that pathology is no series of stationary phenomena, but constantly on the move, like

all else in nature? What alterations have not been seen in forty years? Pyæmia may be said to be wiped out; typhus is well-nigh forgotten; typhoid fever has altered; diphtheria seldom attains the initial severity that so often characterised it of yore and is much more amenable to attack; scarlatina is of a much milder type; erysipelas is more of a rarity; malaria and Malta fever have been run to earth; the late results of syphilis seem to be far less often in evidence; lardaceous disease, so very common in earlier days, is now seen but seldom; and doctors have come at grips with acute rheumatism and, it is to be hoped, with tuberculosis. Probably as much might be said of other diseases, and good old age is both more prevalent and more enjoyable. Dealing with the future of pathology, Sir James Goodhart went on to say fatigue is a disease nowadays. All know the machine that will not spark aright. There is nothing to be called structural change, and even rest furnishes no remedy. It is clear that what is required is a fresh stock of some form of energy for charging up the machine that doctors are as yet not able to supply—so far away, and yet perhaps so nigh.

THE new medical school attached to the Royal Hospital for Diseases of the Chest, City Road, London, was formally opened on October 17, when Prof. Nietner, of Berlin, delivered the inaugural address. He pointed out that the researches of the last ten years have brought to light facts that indicate that in a large majority of cases tuberculosis infection occurs during childhood, in the first years of life. Hamburger has declared that 90 per cent. of all children up to the completed twelfth year are infected. Schlossmann has gone so far as to say that tuberculosis is a true children's disease, is acquired during childhood, and must be prevented, treated, and healed during childhood. It is a fact that in by far the greater number of cases the source of infection can be traced to the human subject's suffering from "open" tuberculosis, and that infection is acquired through the close intercourse resulting from family life. Only those preventive measures can hope for success which take this fact consistently into account. But to prevent the child from becoming infected in his own home environment without weakening family ties and responsibilities offers a social problem of the utmost complexity. Tuberculosis is not a "school disease," and the school cannot justly be held responsible for the spread of infection. Finally, the lecturer said he attaches great value to the use of tuberculin in the treatment of tuberculous children, and claimed good results from it if properly administered.

MR. H. LING ROTH, honorary curator of the Bankfield Museum, Halifax, has republished as No. 1 of the second series of "Museum Notes," his paper on Oriental steelyards and bismars, reprinted from vol. xlii. of the Proceedings of the Royal Anthropological Institute. The original centres of distribution of these instruments seem to be China and Japan, whence they spread to the ports of the Malay Peninsula and India, and thence to Europe. Neither the Babylonians nor the Egyptians, until Roman times, seem to have possessed them, and an English specimen of the seventeenth century, now in the Horniman Museum, preserves the characteristic Chinese turnover arrangement. The paper, with its abundant illustrations and careful description of the different varieties, forms an interesting chapter in the transmission of culture.

THE September issue of *The National Geographic Magazine* is entirely devoted to an elaborate account, illustrated by an excellent series of photographs, of the head hunters of northern Luzon, by Mr. Dean C. Worcester, Secretary of the Interior of the Philippine Islands, who has already done much to elucidate the ethnology of the islands. Hitherto it has been supposed that the custom of head-hunting did not prevail among the Negrito tribes; but Mr. Worcester's exploration of their last important stronghold proves that this is a mistake. The difficulty of social intercourse with them is increased by the barrier reef which guards their coast. Besides the Negritos, this article contains an interesting account of the Ilongot, Kalinga, Ifugao, Bontoc, and Tingian tribes, who, in spite of various savage customs, have in certain directions attained a fairly high degree of culture. This valuable monograph on a little-known people deserves the attention of anthropologists.

THE report of the Committee on Ancient Earthworks and Fortified Enclosures, prepared for presentation to the Congress of Archæological Societies, indicates that there were during last year more cases than usual of damage, or destruction, actual or threatened, to the structures under their care. Unfortunately, most of the damage has occurred during the construction of golf links, and the committees of such clubs have been urged to use their influence for the protection of prehistoric remains. It is also unpleasant to learn that Irish tenants who have acquired ownership of their farms under the Land Purchase Acts frequently destroy ancient earthworks, and that workmen, who some years ago, through fear of the fairies, would not touch such remains, are losing their superstitious belief. On the other hand, among the more intelligent members of the community in both islands there is an increasing desire for protection, and the Royal Commission on Ancient and Historical Monuments in England and Wales is collecting much valuable information, and is exciting public opinion towards their conservation.

IN *The Victorian Naturalist* for September, Miss J. W. Raff describes the female of *Phreatoicopsis terricola*, a genus and species of isopod crustaceans previously known only by the male. It is remarkable that the species occurs in two isolated mountain areas —the Grampians and the Otways—which are about one hundred miles apart, and separated by a broad, dry valley, entirely unsuited to the habits of this isopod, which is restricted to forest.

IN an article of sixty pages on Japanese cephalopods (in which all the known species are enumerated), published in the Proceedings of the Philadelphia Academy for July, 1912, Mr. S. S. Berry emphasises the remarkable resemblance between this fauna and the

cephalopod fauna of the Mediterranean, although in its general character the former is nevertheless distinctly Indo-Malay. Apart from Loligo and Sepia, which are extraordinarily rich in peculiar forms, there are, indeed, remarkably few exclusively Japanese species. The presence of the group of species allied to *Polybus*, or *Octopus, honkongensis* suggests an invasion from the Aleutian-Californian province, although this is by no means certain.

IN an article on the cultivated and wild forms of cochineal insects, published in the September issue of *The Journal of Economic Biology*, Mr. E. E. Green protests against the transference of the name Coccus from these insects to another genus, and the substitution of Dactylopius. In retaining *Coccus cacti* for the typical cochineal insect, he will gain the approval of those naturalists who consider that familiar zoological names, which give an obvious clue to the animals they represent, ought not to be displaced. It is pointed out that the Indian cochineal insect, for which the author proposed the name *C. indicus* in 1908, was originally imported from Brazil in 1795, other importations being made subsequently. Nevertheless, it cannot apparently be identified with any American form, and therefore seems to indicate the development, within a century, of a new species, as the result of changed environment.

THE September number of *The Quarterly Journal of Microscopical Science* (vol. lviii., part 1) contains an important paper by Prof. G. E. Nicholls on the structure and development of Reissner's fibre and the subcommissural organ. Prof. Nicholls gives a very useful historical review of our knowledge of these remarkable structures, and severely criticises Sargent's work on the subject. He then passes on to a detailed account of Reissner's fibre and the subcommissural organ in the Petromyzontidæ and Myxinoidei, illustrated by a number of diagrams and some very remarkable photomicrographs. In the same number Mr. Geoffrey Smith publishes the ninth part of his "Studies in the Experimental Analysis of Sex." He finds that in hybrid pigeons, of which only males were obtained, the ripe spermatozoa are of about twice the normal size. This is explained by abnormalities in the process of spermatogenesis. In the first maturation division, the chromosomes, instead of forming the normal eight synaptic pairs, are irregularly distributed on the nuclear spindle, while the second maturation division is suppressed. Mr. Smith thus confirms the previous observations of Guyer, and adopts his view that the sterility of such hybrids is due to the inability of the chromosomes derived from specifically different parents to form the normal synapses.

WE have received a revised and enlarged edition of a neo-vitalistic essay by Prof. Moriz Benedikt, of Vienna. It is entitled "Biomechanik und Biogenesis" (Fischer, Jena, pp. 88), and deals in a somewhat esoteric, not to say eccentric, fashion with the problems of vitality. The author has devoted special attention to "action at a distance" in the life of organisms, to a monistic interpretation of psychical activity, and to the origin of living substance. As to the last, it probably occurred for the first time in the meshes of colloidal sea-sand, and the composition of our blood-serum is a hereditary reminiscence of the primeval cradle of life. But living matter has undoubtedly continued to be formed, else the organic world would long since have eaten itself up. Whether the results of present-day natural synthesis (which eludes our observation) attain to the level of the very simplest organisms we know, is questionable. But it is difficult to be quite sure when the genial author is not poking fun at us. "Biomechanik" is another word for "neo-vitalism," and Prof. Benedikt's general position is that the ordinary physical, mechanical, and chemical laws hold good for vital processes, but (to use his phraseology) do not completely dominate them. Laws "of a higher order" hold good in the realm of life—laws which cannot be deduced from those of the inanimate world. The movements of corpuscles in living matter are much more intricate than those in not living matter, and the author is especially concerned with the structural configurations that have made vital activities possible.

THE Pliocene deposits contain the key to many problems of modern animal distribution, including the centres from which man spread across the earth. Workers in European natural history will especially welcome Dr. J. P. Tesch's handsomely printed memoir, "Beiträge zur Kenntnis der marinen Mollusken im west-europäischen Pliocänbecken" (*Med. van de Rijksopsporing van Delfstoffen*, No. 4, The Hague, 1912, and Craz and Gerlach, Frieberg in Sachsen, price 6 marks). A list and commentary on the distribution of the known molluscan species of the area occupy the greater part of the paper, and considerable use is made of information obtained from borings in Holland.

THE new phenomenon Prof. Righi brought before the Academy of Science of Bologna in January, to which he gave the name of ionomagnetic rotation, is described in detail in the Memoirs of the academy and in the *Physikalische Zeitschrift* for August. If a spark from a condenser of considerable capacity is sent horizontally through a gas and two small vertical vanes of mica in the form of a cross are suspended in the middle of the discharge by a fine fibre attached to the centre of the cross, the spark produces no rotation of the cross. If, however, a vertical magnetic field is established in the gas the cross rotates through a considerable angle if the gas is air, and over a small angle in other gases. Prof. Righi ascribes this rotation to the bending of the paths of the ions or electrons and to the additional protection which the vanes afford each other against impacts from one side rather than from the other in these circumstances. The observed rotations indicate that the effects of the positive ions are in general greater than those of the negative.

A GENERAL lecture, delivered by Prof. G. Ciamician before the International Congress of Applied Chemistry in New York, is reprinted in *Science* for September 27, under the title, "The Photochemistry of the Future." At the outset some interesting suggestions are advanced as regards the utilisation of the solar

energy in the days when our coal deposits shall be exhausted, and then the author describes briefly some of the principal results obtained by himself jointly with Profs. Silber and Ravenna, at the University of Bologna, in the study of photochemical action. In a series of recent experiments made to determine the physiological function of the glucosides, it was found possible to force maize, a plant which is normally free from the substance, to synthesise salicin, whilst the production of nicotine by the tobacco plant can be controlled so as to obtain a large increase or decrease in the quantity of this alkaloid. The possibility is suggested by these experiments of greatly increasing the proportion of the useful constituents of plants by a suitable treatment during the period of their growth.

UNDER the title "Une Loi Universelle," Prof. Wilden D. Bancroft publishes an interesting article in the *Revue Scientifique* for September 28, on the well-known theorem of Le Chatelier, for which he claims a wider application than it is generally credited with. He considers that this law, which in physics becomes the principle of least action, in biology becomes the law of the survival of the fittest, and in economics the law of supply and demand. In its most general form the law is stated by Prof. Bancroft in the following terms: The changes which affect a system are such that they tend to render minimum the disturbance of external origin. A number of cases are cited in which the principle is extended to vital phenomena, more particularly as regards the adaptation of plants and animals to temperature, light, humidity, and climate, and in explanation of the origin of variations. The position taken up is that no variation is spontaneous, but that if we go far enough back all variations are the result of changes in external conditions. The real problem in such cases is to show, for any given organism and any given variation, what part has been played by external conditions on the preceding generation, and the part played by conditions on the generations which preceded that one.

IN the annual report of the Minister of Mines of British Columbia, just published, the reported discovery of metals of the platinum group in certain dykes near Nelson in that province is discredited. As a result of numerous analyses carried out, at the request of the Minister by various experts in America and Europe, on samples carefully taken from the portions of the dyke in which the presence of platinum metals had been reported, the complete absence of these metals was established. In none of the samples was any trace found either of any of the platinum metals or of anything corresponding with the supposed new metal, "canadium," the reported discovery of which was announced in these columns about a year ago.

THE issue of *The Philippine Journal of Science* for July last takes the form of a memorial number to the late Dr. Paul Caspar Freer, who was director of the Bureau of Science of the Government of the Philippine Islands, dean of the college of medicine, and professor of chemistry of the University of the Philippines. Dr. Freer was also the founder and editor of *The Journal of Science*. This issue of the magazine contains eight appreciations of Dr. Freer's life and work. Mr. Martin Egan, editor of *The Manila Times*, writes of his life and career; Bishop Brent of his influence upon other men; Mr. R. P. Strong, chief of the biological laboratory in the Bureau of Science, describes his general influence upon scientific work in the Philippine Islands; Mr. Dean C. Worcester, secretary of the Interior of the Government of the Islands, gives an account of his work for the Bureau of Science; Mr. W. E. Musgrave, of the General Hospital, of his work for the university; Mr. Murray Bartlett writes of him as an organiser and administrator; Prof Calderon as a friend of the Filipinos; and Prof. H. D. Gibbs as a chemist.

A REVISED edition of Dr. J. G. Bartholomew's "School Economic Atlas," to which Prof. L. W. Lyde contributes an introduction, has been published by the Oxford University Press. The price of the atlas is 2*s*. 6*d*. net.

IN the note on the first report of the Meteorological Observatory at Montserrat (NATURE, September 12, p. 59), it should have been added that the daily maxima and minima of temperature were given in separate tables on other pages in conjunction with the values of humidity.

THE presidential address delivered last September to the British Association, at its meeting at Dundee, entitled "Life: its Nature, Origin, and Maintenance," has been published in pamphlet form by Messrs. Longmans, Green and Co. at the price of 1*s*. net.

THE most recent issue of the botanical catalogue of Messrs. John Wheldon and Co., of 38 Great Queen Street, Kingsway, London, gives particulars of some 1700 books and papers on various branches of botany. Many recent purchases and selections from several important libraries are included.

A FOURTH edition of the late Prof. Thomas Preston's "Theory of Light" has been published by Messrs. Macmillan and Co., Ltd. It has been edited by Prof. W. E. Thrift, and its price is 15*s*. net. The developments that have taken place since the publication of the third edition, in 1901, have led Prof. Thrift to make additions, which are suitably indicated. A fuller treatment of dispersion is given, an account of radiation phenomena in a magnetic field, and a more complete presentation of the electro-magnetic theory, which is dealt with from the electron point of view of Lorentz and Drude.

OUR ASTRONOMICAL COLUMN.

THE DISCOVERY OF A COMET, 1912*b*.—A telegram from the Kiel Centralstelle announces the discovery of a comet by M. Schaumasse, at Nice, on October 18. The position of the object at 17h. 5m. (Nice M.T.) on that date was:—

R.A. = 9h. 57·6m., decl. = +1° 36′,

and the motion was easterly. The magnitude was 11·5, and the position given lies in Sextantis, about 11° south of Regulus, thus rising about 2.30 a.m.

A second telegram from the Centralstelle states that

MM. Fayet and Schaumasse find the elements of the orbit of this object to be almost identical with those of Tuttle's comet.

COMET 1912*a* (GALE).—The following set of elements for the orbit of comet 1912*a*, from which he derived the corrected ephemeris we gave last week, is published by Dr. Ebell in No. 4604 of the *Astronomische Nachrichten*; it is based on observations made on September 8, 17, and 26:—

$T = 1912$ October 4·95917 M.T. Berlin.
$\omega = 25^\circ\ 33'\ 37''9$
$\Omega = 297\ \ 2\ \ 53'3$ } 1912·0
$i = 79\ \ 51\ \ 10''2$
$\log q = 9·854958$

A further extract from the ephemeris is given below:—

Ephemeris 12h. M.T. Berlin.

1912	α (true) h. m.	δ (true) ° ′	1912	α (true) h. m.	δ (true) ° ′
Oct. 25...15	57·0...+19	20·5	Oct. 29...16	0·5...+22	26·5
26...15	57·9...+20	8·1	30...16	1·3...+23	11·1
27...15	58·8...+20	55·0	31...16	2·1...+23	55·2
28...15	59·6...+21	41·1	Nov. 1...16	3·0...+24	38·7

During the period covered by this ephemeris the calculated decrease in magnitude is 0·5.

MEASURING THE ANGULAR DIAMETERS OF STARS.—In No. 2, vol. xxxvi., of *The Astrophysical Journal*, Dr. Pokrowsky suggests a method whereby it should become possible to measure the angular diameters of stellar objects, a result which, if obtained directly, would greatly widen our knowledge of stellar physics. The method is too technical in detail to be given here, but it depends upon the consideration that if two rays emanate from different points on the surface of a distant light-source, such as a star, there will be a difference of phase depending upon the distance between the two points. These two systems of rays after polarisation form two images of different intensities in the focus of a telescope, and Dr. Pokrowsky shows that by measuring the difference of intensity the angular diameter of the star may be derived; thus the problem is reduced to one of stellar photometry, and it is calculated that for bright stars, such as Arcturus, Canopus, Capella (average magnitude, say, =0·0), angular diameters of 0·0031″ might be discovered. As the method would be very sensitive, atmospheric conditions would greatly interfere, and the apparatus could only produce positive results at a mountain observatory.

THE PERSEIDS OF AUGUST 12, 1912.—Some interesting data concerning the meteor shower of August last are given by Prof. Zammarchi, in No. 10, vol. i. (2nd series), of the *Memorie della Società degli Spettroscopisti Italiani*. The observations were made at the meteorological observatory attached to the seminary at Brescia, and in a total of 13·6 hours, spread over the nights of August 10, 11, 13, and 14, six observers recorded 170 meteors. The greatest horary rate occurred on August 11, when 93 meteors were seen in four hours; on August 12 the sky was covered and observations impossible. For each meteor the time, the magnitude, and the appearance are given, and in many cases the position of the beginning and end of the path.

THE PHYSICAL CAUSE OF THE *z*-TERM IN LATITUDE VARIATION.—A possible cause producing the *z*-term in latitude variation is suggested by Mr. S. Shinjo in a paper of which we have received a reprint from the *Tôkyô Sûgaku-Buturigakkwai Kizi* (second series, vol. vi., No. 16), published by the Tokio Mathematico-Physical Society. Putting on one side, as unlikely, the possibility of its being due to systematic error in the observations and the suggestion that it is due to real changes in the earth, Mr. Shinjo reverts to the probability that the *z*-term is introduced by the action of anomalous refraction. But no such inclination of the atmospheric strata as is necessary to produce the anomalous refraction has been observed over any large area. Mr. Shinjo, however, inquires into the purely local conditions appertaining to and immediately surrounding the observing station, and suggests that in these very localised areas the atmospheric gradient is frequently sufficiently sharp; for example, the difference in temperature between the sun side and the shade side of the observing hut might produce a pressure-gradient sufficient to produce the *z*-term. He concludes that the greater part of the term is probably produced by this cause, about one-fourth as a consequence of the daily variation of the pole, as remarked by Sitter, and a small part may possibly be due to real change in the earth.

THE BECQUEREL MEMORIAL LECTURE OF THE CHEMICAL SOCIETY.

AN extra meeting of the Chemical Society was held on Thursday, October 17, when Sir Oliver Lodge, F.R.S., delivered a memorial lecture in honour of Antoine Henri Becquerel, late honorary and foreign member of the Chemical Society. Prof. Percy F. Frankland, F.R.S., president of the society, occupied the chair.

Sir Oliver Lodge referred to the changes that of recent years have come over physical science. Not many years back its progress appeared to be placid, along well-worn channels, and based upon the substantial knowledge of the past. To-day it is characterised by intense speculative activity on the one hand, and, on the other, by exceptional scepticism.

Discoveries are of two chief kinds: the discovery of law and the discovery of fact. The discovery of law often leads to the discovery of new facts, and the discovery of new facts to either the formulation of new laws or new modes of statement, or to the resuscitation of discarded ones. As examples of the discovery of law may be instanced Newton's gravitational theory of astronomy, Maxwell's electro-magnetic theory of light, the atomic theory of chemistry, and the conservation of energy. As examples of the discovery of fact may be quoted the prehistoric discovery of flame, the discovery of static electrification, of the electric current, of magneto-electricity, of the electron, and of spontaneous radio-activity.

Of the scientific discoveries made during the past fifty years, that of the Röntgen X-rays perhaps created the most widespread interest; but even more striking and revolutionary was Becquerel's discovery of the spontaneous radio-activity of matter, for the spontaneous splitting up of atoms and the consequent expulsion of constituent fragments was not provided for on any theory.

A discovery of essential novelty cannot be made by following up a train of prediction. It is often made during the process of following a clue, but the clue does not logically lead to it. A really new fact comes as a side issue—something unexpected and that might have been overlooked. The discovery which has been pointed to by theory is of great value, but it is usually the outcome of a long and fruitful period; whereas the discovery which comes as a surprise generally marks a fresh epoch, and opens a new chapter in science.

So with the discovery of spontaneous radio-activity. Becquerel was looking for the possible emission of Röntgen rays by a fluorescent substance. It was a reasonable thing to look for, and had it been found

would have made an interesting extension of our knowledge; but, when critically examined, the kind of radiation turned out to be for the most part not Röntgen rays, but corpuscular, and to have nothing to do with fluorescence.

Becquerel set himself carefully to examine the kind of penetrating radiation which fluorescent substances exposed to light might be found to emit. Though not finding that for which he sought, he made a discovery of far greater importance.

After giving an account of the recent discoveries in radio-activity, the lecturer dwelt on the present trend of scientific thought; of the tendency to return to discarded hypotheses such as spontaneous generation and the corpuscular theory of light. Our attitude amongst so many conflicting hypotheses should be to admit that any law applicable to concrete objects and established by induction on a basis of experience must be of the nature of a postulate; that we should hold some of the postulates as so well-established that arguments necessitating their overhauling should, *ipso facto*, to that extent be discredited, and should not receive our encouragement unless supported by new facts. Our endeavours should be to harmonise new facts with the firmly established laws of physics until compelled to look for some higher generalisation.

Reference was then made to some of the well-established laws, and to the attempts to construct living matter from artificially combined materials. Life demands energy for its manifestations, and radio-activity may be suggested as a possible source of such energy. It is known that atoms give off energy as they disintegrate; that organic compounds likewise disintegrate and evolve energy, finally becoming inorganic. A decaying heap of refuse represents a close chemical analogy to the physical activity of uranium—one is an affair of atoms, the other of molecules. This stock of energy running to waste seems eligible for guidance. Life has to control this spontaneous disintegration of protoplasmic cells, to regulate the activity of the ganglia in the brain, for instance, or to suspend the disintegration of organic material until some appointed time, and then to direct it along some determined channel. We have yet to discover how life achieves this control. Those who say that life cannot guide material processes unless it is itself a form of energy, and those holding that life cannot act at all unless energy is at its disposal, forget the spontaneous activity of complex organised molecules and the atomic disintegration manifested by radio-activity.

There is a great difference between matter potentially living and actually alive. In the physical universe our power is limited to the movement of matter; after that, all that happens is due to the properties of matter and its ethereal environment. If potentially living matter is ever artificially made by placing things in juxtaposition and bringing physical resources to bear upon the assemblage, then it may become alive. If this last step be taken, it will be because something beyond matter, something outside the region of physics and chemistry, has stepped in and utilised the material aggregate provided. Only in this sense did the lecturer consider that the artificial incarnation of life would be possible. Some day life may appear under observation, but it will not be manufactured, any more than radium or radio-activity has been manufactured.

Sir Oliver Lodge spoke of the tendency of present-day science to materialise the invisible, quoting, among other examples of this, the fact that plague, which in olden times was attributed to such mysterious causes as a conjunction of the planets, the iniquities of the Jews, &c., is now known to be due to a minute vegetable parasite living on the fleas of rats.

The scientific life and work of Antoine Henri Becquerel were then dealt with, and an account given of his chief discoveries. A vote of thanks to Sir Oliver Lodge, proposed by Sir William Crookes, O.M., F.R.S., seconded by Prof. Henry E. Armstrong, F.R.S., and supported by the president, was briefly acknowledged by the lecturer.

THE RELATIONS BETWEEN VARIOUS SOLAR PHENOMENA.

TWO papers recently published in the *Comptes rendus* (No. 10, September 2, and No. 12, September 16), by Prof. Riccò and M. Deslandres respectively, contain several very important statements, concerning the interrelations of such solar phenomena as *filaments, alignements,* prominences, spots, &c., which no student of solar physics can afford to neglect, and which we briefly summarise below.

Prof. Riccò, having studied his valuable records of limb prominences and also those published by Wolfer, finds that the prominences frequently appear in the same position on the sun's limb for several consecutive days, and so must form files of prominence activity across the disc, strongly resembling M. Deslandres's filaments and alignments; he also finds limb prominences recorded at the time and in the positions indicated by M. Deslandres's filaments and alignments. He concludes that there is an indisputable connection between the two sets of phenomena. With sun-spots, however, he finds no connection with the filaments and alignments. But in his paper M. Deslandres considerably modifies this latter conclusion of Prof. Riccò's, and states that there is a general connection, the several phenomena obviously belonging to one system and reacting on each other.

M. Deslandres, in order to make the investigation more precise, gives further important results concerning the filaments and alignments shown on his wonderful series of photographs. He agrees that a prominence on the limb generally means a filament or alignment joining the limb at that point. The relation between the two sets of phenomena is confirmed. Further, he differentiates more clearly between filaments and alignments, the former being a special case of the latter, which cover much greater lengths. Alignments vary in intensity from feebly bright to very dark, and then merge into filaments which are exceptionally black and well defined. The alignments are frequently bordered, diffusely, with parallel bright lines, whereas the filaments are clearly-cut lines. Filaments are found on both the "hydrogen" and the "calcium" photographs, most strongly marked on the former, whereas alignments are, in general, only found on the "calcium" photographs. The brightest prominences occur at the ends of these bright companions of the alignments, and are, therefore, as Prof. Riccò also points out, not symmetrically placed with regard to the central dark alignment. Prof. Riccò suggests that this asymmetry is due to the fact that while the prominences are emission, the alignments are absorption, phenomena, and thus the two things probably represent activity in different layers of the solar atmosphere.

M. Deslandres suggests that the restriction of alignments to the "calcium" photographs, whereas the filaments are better shown on the "hydrogen" plates, may be due to the fact that the filaments probably exist at higher levels, not so readily reached by the calcium vapours. He also suggests that those eruptive prominences not connected with spots are intimately connected with filaments, and in his radial-velocity

researches has found that these two phenomena are alike in showing an ascensional radial velocity.

The importance of these researches is obvious, and the results likely to accrue from the simultaneous study of the forms and velocities of the various features most valuable, but, as M. Deslandres points out, it will only be possible to state general and definite laws when continuous and complete observations have extended over at least one undecennial period of solar activity.

THE SIGNIFICANCE OF LIFE TO THE OMAHA.[1]

FOR twenty-nine years Miss Alice Fletcher has been studying the Omaha, and her monograph of the tribe is now published in the twenty-seventh Annual Report of the Bureau of American Ethnology. Her collaborator for most of this time was Mr. Francis La Flesche (the son of Joseph La Flesche, former principal chief of the tribe), who in his boyhood witnessed some of the ceremonies described in the memoir, which were later explained to him by his father and by the old men who were the keepers of these ancient rites and rituals. When Miss Fletcher first went to live among the Omaha, the tribe had recently been forced to abandon hunting owing to the sudden extinction of the herds of bison. All the men and women had participated in the old life, many of the ancient customs were practised, and much of the aboriginal life still lingered. The environment was changing quickly; all that they formerly had relied on as stable had been swept away; the bison, which they had been taught was given them as an inexhaustible food supply, had been destroyed by agencies new and strange; even the wild grasses that had covered the prairies were changing. Great unrest and anxiety had come to the people through the Government's dealings with their kindred, the Ponca tribe, and fear haunted every Omaha fireside lest they, too, be driven from their homes and the graves of their fathers. The future was a dread to old and young. Thanks to the strenuous efforts of Miss Fletcher on their behalf, a law was enacted in 1882 granting lands in severalty, and prospective citizenship. In 1802 the Omaha were reduced to about 300 by smallpox; twenty-seven years later they were said to number 1000; in 1906 the population of the tribe was 1228. The past is overlaid by a thriving present. The old Omaha men and women sleep peacefully in the hills while their grandchildren farm beside their white neighbours, send their children to school, speak English, and keep bank accounts.

"In the account here offered," Miss Fletcher says, "nothing has been borrowed from other observers; only original material gathered directly from the native people has been used, and the writer has striven to make, so far as possible, the Omaha his own interpreter." The most important previous accounts of the tribe are the Rev. J. Owen Dorsey's "Omaha Sociology," published in the third Annual Report of the Bureau in 1884, which ever since has been largely quoted, and his paper on "Omaha Dwellings, Furniture and Implements" (the thirteenth Report, 1896). It will be found that there are many discrepancies between Dorsey's and Miss Fletcher's statements. For example, Dorsey says that the Black Shoulder clan were originally bisons ("buffaloes") and dwelt under the surface of the water, but Miss Fletcher writes, "no Omaha believes that his ancestors ever were elk, or buffalo, or deer, or turtle, any more than that they were the wind, the thunder, or the sky" (p. 601).

As has just been stated, Miss Fletcher gives us only first-hand matter, which she has carefully sifted and verified so far as possible. She evidently did not like to criticise or correct Dorsey's statements; there can, however, be little hesitation by students which account they should follow when discrepancies occur. On account of the great changes that have taken place in the material, social, and religious life of the Omaha it is improbable that anything of importance can be gleaned by future workers, and much that Miss Fletcher describes will then be unobtainable. Her monograph, the result of arduous and protracted toil, is the record by a field worker of wide sympathy and insight of investigations which were begun at the critical time of incipient disintegration and while the old knowledge was still fresh in the minds of the people. Some American ethnologists even go so far as to say that she reads into the native mind ideas that it does not contain, but the more we learn about the North American Indian the more apparent it is that he is imbued with a rare spirituality, and it is a common experience that one field observer will discern what another cannot see, as an old writer has said, "The natural man receiveth not the things of the Spirit of God: for they are foolishness unto him: neither can be know them, because they are spiritually discerned." Doubtless Miss Fletcher is content to leave this matter to the arbitration of the intensive study of the religion of allied tribes.

The legendary home of the Omaha and cognate tribes was in the east, "near a great body of water," and the legend gives an interesting account of cultural evolution, due partly to invention and partly to borrowing from other tribes. All children passed through a ceremony of turning, which was directly related to the wind, earth, and fire, whereby it was introduced to the tribe. Later a lock of the boy's hair was cut off and given to Thunder; thereby the life of the child was given into the keeping of the god that controlled the life and death of the warrior. The next stage in the life of an Omaha youth was marked by the rite introducing him to individual life and to the supernatural. Four days and nights the youth was to fast and pray, then in a trance he saw an object which was his personal connection with the universe, by which he could strengthen his spirit and his physical powers. There were societies the membership of which was made up of men who had had visions of the same object. The sequence of rites began at birth, with the announcement to all created things that a new life had come into their midst; when the child had acquired ability to move about of its own volition, its feet were set in the path of life, and it entered into membership of the tribe; the entrance into manhood required voluntary effort, and by prayer and fasting the man came into direct and personal relations with the supernatural.

Miss Fletcher states that "the tribal organisation was based on certain fundamental religious ideas, cosmic in significance." The real division of the tribe was based on the dual division in nature; each contained several "gentes," which in their turn were divided into "subgentes. . . . The Omaha gens was a group of exogamous kindred who practised a particular rite, the child's birthright to which descended solely through the father; and the symbol characteristic of that rite became the symbol, crest, or 'totem' of the gens." A noticeable feature in the book is the large number of prayers and songs, which are given in the native language, with a literal and free translation, and with the musical notation. A considerable space is given to an account of the social and secret societies; the

[1] Twenty-seventh Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1905-6. Pp. 672. (Washington: Government Printing Office, 1911.)

latter dealt with mysteries, and membership was generally attained by virtue of a dream vision. The Omaha were a thoughtful and practical people. The idea of personality is dominant in the language and in the religious beliefs and practices. The force within this personality was recognised as that of the will, and "the Sacred Legend, which preserved the experiences of the years, emphasised the vital fact that better conditions are always attained by the exercise of thought, not by magical interferences." Enough has been said to show that Miss Fletcher has given us a monograph that deserves the careful study of all ethnologists, and will still further increase their indebtedness to the Bureau of American Ethnology. A. C. HADDON.

THE ROYAL MICROSCOPICAL SOCIETY.

ON Wednesday, October 16, a conversazione was held in the Great Hall of King's College, about four hundred fellows and guests being received by the president, Mr. H. G. Plimmer, F.R.S., and Mrs. Plimmer. The object in view was, so far as practicable, to gather together a series of exhibits which would indicate the many uses, both in science and commerce, to which the microscope is put at the present time. In addition, the conversazione afforded an opportunity for those engaged in microscopic work to show objects of interest or to demonstrate the use of apparatus or appliances for special purposes.

The centre of the hall was occupied with pond life exhibits, about forty microscopes having been arranged on the tables under the direction of D. J. Scourfield, and these were a centre of interest to a considerable number of observers throughout the evening. Other interesting exhibits were some very beautiful botanical slides showing mitosis, by H. F. Angus and E. J. Sheppard; a Siedentopf ultra-microscope and cardioid condenser system for the observation of ultra-microscopic particles, by J. E. Barnard; an Abbe diffraction microscope illuminated by means of a quartz mercury-vapour lamp, by J. E. Barnard and Powell Swift; an instantaneous reflex photomicrographic camera, by F. W. Watson Baker; some preparations exhibiting Brownian movement, by G. P. Bate; a complete optical bench and an apparatus for polishing metal surfaces, by Conrad Beck; an extensive series of saccharomycetes, by A. Chaston Chapman; a very interesting old microscope and accessory apparatus, by Prof. A. Dendy, F.R.S.; some diffraction experiments, by J. W. Gordon; a series of foraminifera, by E. Heron-Allen and A. Earland; microchemical reactions of a very striking character, by Prof. Herbert Jackson; an extremely beautiful series of photomicrographs in colour, by J. W. Ogilvy, and another series of stereo-photomicrographs of water mites, also in colour, by H. Taverner. The possibility of applying his micro-spectra camera to the production of photomicrographs in colour was demonstrated by J. Rheinberg, and this exhibit attracted a great deal of attention.

Prof. Minchin, F.R.S., exhibited a series of trypanosomes which were of great interest. In the adjoining theatre, three lectures were delivered during the evening, Dr. E. J. Spitta giving a kinematographic exhibition of pond life, Prof. Hewlett lecturing on insects as carriers of disease, and Mr. Max Poser showing a beautiful series of liquid crystals by means of a projection micropolariscope, each of the lectures attracting a large audience. Apart from the social advantages of such a gathering, the exhibits were in all cases of real scientific interest, and demonstrated that the Royal Microscopical Society may look forward to doing an even greater work in the future than it has done in the past in bringing before scientific workers the possibilities of the use of the microscope. That the instrument is now a necessity in nearly all branches of science is, of course, well known, but it is often used merely as a tool and not as an appliance which demands considerable skill in its use for the best results to be obtained. If the council of the society should decide that this conversazione is to be but the first of a series of annual gatherings to be held with a similar object, then the success which has attended this function may be regarded as an indication that its usefulness in the future may be considerably increased.

THE BRITISH ASSOCIATION AT DUNDEE.

SECTION M.

AGRICULTURE.

FROM THE OPENING ADDRESS BY T. H. MIDDLETON, M.A., PRESIDENT OF THE SECTION.

INTEREST in the practice of improved husbandry was first aroused in England by the books of Fitzherbert. The extent to which this author stimulated agriculture may be inferred from the appreciation with which his works were received in his own day, and copied by others for a century. He himself does not appear to have been acquainted with the classical writers. He describes the English practice with which he was familiar; he quotes frequently from the Scriptures and refers to early religious works, but only in writing of animal diseases, when he cites the "Sayinge of the Frenche man," is there any indication that he was influenced by foreign authors. Fitzherbert's "Boke of Husbandry" and "Surueyenge" while they are free from the direct influence of Roman writers, show us, nevertheless, that the English agriculture of his day owed much to Roman traditions. The careful business methods and accounting of the farm bailiffs of the Middle Ages, with which Thorold Rogers has acquainted us, were the methods which Fitzherbert learned and counselled, as they were the methods which Columella taught.

It was between 1523, when Fitzherbert's "Boke of Husbandry" was first printed, and 1557, when Tusser published his "Points of Good Husbandry," that the classical writers began to exert a direct influence on English farming. In 1532 there appeared Xenophon's "Treatise of Householde," "ryht counnyngly translated out of the Greke tonge into Englyshe by Gentian Hervet," which at once became popular and ran through a number of editions. At least as early as 1542 editions of the works on agriculture and gardening of Cato, Varro, Columella, and Palladius[1] were published in England, and they must certainly have been known to Tusser, for in his "Five Hundred Points of Good Husbandry," composed some years later, there is clear evidence of the influence of the writings of Xenophon and Columella. From the latter author Tusser adopts the method of a calendar, and he appears now and again to adapt Roman maxims to modern conditions. Thus in his calendar Columella says of March that it "is the proper time to cleanse meadows, and to defend and secure them from cattle; in warm and dry places indeed that ought to be done even from the month of January," and Tusser in his calendar for March rhymes:—

> "Spare meadow at Gregorie Marshes at Pask
> for feare of drie Sommer no longer time ask
> Then hedge them and ditch them, bestow thereon pence,
> corne, meadow, and pasture aske alway good fence."

It might be, of course, that in discussing the same subject, a subject moreover which does not admit of much difference of opinion, the similarity of the above-

[1] A translation of Palladius into English was made about 1420, but it was not discovered and published until within recent times.

quoted passages is accidental; but many of Tusser's rhymes so closely follow Xenophon's "Householde" and Columella's Eleventh Book that I am satisfied Tusser was familiar with both these ancient writers. Here, for example, from Tusser, is the charge concerning sick servants which Ischomachus gives to his young wife :—

> "To Seruant in Sicknesse see nothing ye grutch,
> a thing of a trifle shell comfort him mutch."

And here is a maxim for the housewife that Columella enforces :—

> "The woman the name of a huswife doth win
> by keeping hir house and of dooings therein
> And she that with husband will quietly dwell
> must thinke on this lesson and follow it well."

Until the dawn of the twentieth century no mere man would have been found to question the conclusion come to in the above verse; nevertheless, the emphasis on the "quietly dwell" indicates that in this particular case the inspiration is derived from Columella rather than from Xenophon. For while the woman described by the Greek writer is likened to the queen bee, by the Roman there is much lamentation because of the emergence of the "butterfly." Columella refers to the diligent dames of ancient Rome who lived at home and studied to improve their husbands' estates, and contrasts them with their successors in the first century, who had become indolent, refused to make their own clothes, and spent their husbands' incomes on dress. He then remarks, "Is it a wonder that these same ladies think themselves mightily burdened with the care of rural affairs, and esteem it a most sordid business to stay a few days in their country houses?"

It was, then, the practice of husbandry that engaged the English agriculturist's attention from the time of Walter de Henley to Thomas Tusser, and the purpose of my digression into domestic subjects is to show that when the ancient writers were rediscovered in the middle of the sixteenth century, it was not the frequent references of Xenophon to the science of husbandry but his economic and moral teaching: not Columella's First Book, with its appeal for doctors and disciples who might apply themselves to the study of agriculture, but his Eleventh Book, with its calendar of operations and its directions for the ordering of the bailiff and the bailiff's wife, that attracted Tusser and his readers.

The awakening of interest in husbandry was largely due to the rapid changes in the economic conditions of England which set in about Fitzherbert's time.

The change in the cost of living directed men's attention to the husbandry and housewifery recommended by Fitzherbert and Tusser. The smaller landowners, who could no longer afford to live on their rents, and who saw that yeomen and tenant farmers were prospering, turned their attention to farming, and agriculture became an important occupation of the educated classes.

The yeoman and tenant farmer did not ask for textbooks on agriculture, but the new agriculturists required information, and thus there arose at the end of the sixteenth century a great demand for books. The booksellers were not slow to make provision for the demand, writers were secured, books were published, and of the more popular many editions were sold.

Sir Richard Weston, a Surrey landowner, who succeeded to his estates in 1613 and who had travelled in Brabant and Flanders, was the first English agriculturist to introduce practices approved on the Continent. He grew turnips for feeding cows, a century before the time of Turnip Townshend; nearly three hundred years ago he was experimenting, as we are still doing, with clover seed grown in different countries; he had thirty to forty acres of clover sown with barley, and he was inveighing against the sophistication of "outlandish" grass seeds and contriving plans for raising pure stocks at home in the approved fashion of to-day.

It was not only from Brabant and Flanders that travellers brought to England information about foreign agriculture. As one result of the development of commerce voyagers were introducing from distant countries such important plants as the potato and tobacco, and were exciting interest by their stories of foreign products. A desire to make experiments with these novelties was but natural, and experimental farming received a powerful impetus from the teachings of Francis Bacon, the first exponent of the inductive method. Having, as he wrote, "taken all knowledge to be my province," Bacon was himself an amateur farmer, and if he was not a successful one he was at least intent upon introducing methods of "industrious observation and grounded conclusions." It is to Bacon, I think, that Arthur Young alludes in a passage in which he describes a Lord Chancellor of England as having procured and read every published work on husbandry so that he might learn how to farm, and who, having met with ill-success, collected the offending books and lighted a bonfire! But let us not think lightly of the efforts of this distinguished amateur farmer. The agricultural writers of the succeeding century, indeed, refer to the influence of Bacon in terms that suggest for agricultural science the origin of the phœnix. We may, at least, agree that about the time of Bacon's bonfire this subject first began to attract the notice of scholars.

In spite of the political troubles of the second quarter of the seventeenth century, agriculture continued to secure increased attention, for England had learned that in war or peace the food-supply must be cared for, and the importance of corn-growing increased with the rise in prices. Thus when the Commonwealth was established everything favoured a forward movement. At peace and able to return to country pursuits, the combatants, Cavaliers and Roundheads alike, became active improvers. Engineer agriculturists, like Vermuyden, carried out great drainage-works. Many estates had changed hands, and the new owners, not a few of whom, as Harte remarks, "had risen from the plough," were glad to return to it; others were amateur farmers intent on learning. The books of the old and trusted writers, Fitzherbert and Tusser, had been followed by the works of such authors as Norden, Markham, Plattes, and Hartlib. Bacon's teaching emphasised the need for further study and experiment. Behind the political and economic changes were the powerful, moral influences of the Puritan movement; it was at this time and under these conditions that the spirit of the improver, which had animated Columella, appeared among English agriculturists

The first practical farmer to plead the cause of the improvement of agriculture was Walter Blith, one of Cromwell's soldiers, who is supposed to have been a Yorkshire landowner, but who for some years, at least, was stationed in Ireland. Blith was an ardent agriculturist, who prefaced his practical book, "The English Improver Improved," by seven epistles designed to attract the attention of all classes of his fellow-countrymen to agriculture. It is in the epistle to the "Honourable Society of the Houses of the Court and Universities" that chief interest lies for us, for here we find an appeal for the systematic study of agriculture in words that recall the classical writers. Blith showed that agriculture required the close study of the learned, and that the societies (*i.e.*, the Colleges) of the Universities might if they wished do much for its advancement. He adds, "You that have the Theorick, may easiest discover the Mysteries of the Practick, and from you have I found most encouragement to this work, and seen most experiences of good husbandry than from any, and from you too I expect

and waite for more discoveries of some thing I scarce know what to name it, which lies yet in obscurity, but I will call it the Improvement of the Improver."

Were we not now concerned with the spirit rather than with the form of the improvement, an interesting parallel might be drawn between the topics which Blith considers of greatest importance and those which to-day are engaging attention. In his epistle to the society, for example, there is an appeal to the learned to give their attention to applied science. Discussing the progress of the Dutch, Blith deplores that policy which Englishmen afterwards termed *laisser faire*. He says: "Our niceness in not nursing the fruits of our own bowells hath given them the opportunity to Improve our native commodities to the advance of their Manufacturidge to our shame, their praise"; then addressing members of the universities he adds, "I speak to wise men whom I would have more publique men. . . . Let me entreat you for the Peoples and your own posterity sake . . . put your shoulders to the work, greater things remaine and larger Improvements are yet to be discovered."

The earnest advocacy of Blith, the essays of "my good friend Mr. Samuell Hartleps," and the energy of landowners like Sir Richard Weston, led to a demand for the records of experiments, and in 1659 there was issued the first series of abstracts of agricultural experiments with which I am acquainted, under the title "Adam out of Eden." The experiments recorded by the author, Ad. Speed, are of considerable interest; but I mention him for another reason. He appears to have made a living by propounding improvements of an imaginary character. He wrote tracts for noblemen and others, containing estimates of the profits to be gained by adopting new methods. Blith scathingly refers to him as "Mr. Speed that superlative Improver," and remarks that so long as his books were private "I could bear it, and suffer wiser than myself to bee fooled because I was not wise enough as to beware of him, but now that they come to be sold in the Stationers' Shops, and spread about the country, to deceive, and beguile the Nation, I cannot forbear." This was written in 1652; as my edition of "Adam out of Eden" is dated 1659, it is clear that the nation continued to be "beguiled" for a considerable period by this particular Adam, the forerunner of a numerous family. Whenever there is a revival of interest in agriculture he flourishes; the new manure, the ravaging insect, the blighting fungus, all serve to bring "Adam out of Eden," and so long as an interested and gullible public exists, "that superlative Improver Mr. Speed" will be found among us. The pamphlet and the stationers' shop have become antiquated; the Adam of to-day has other methods, which I will not venture to particularise. After all, it is a healthy sign. It is only when the public thirst is deep that Adam gets his chance, and, like Blith, we must resign ourselves now and again to "bee fooled," for is it not one of the methods by which the improver is improved?

Walter Blith's appeal for the assistance of the learned did not long remain unanswered. At the time his "English Improver Improved" was published a society of scientific men had already been formed in London, and ten years later this society first received the name Royal Society, at the suggestion of John Evelyn. On October 15, 1662, Evelyn's "Discourse on Forest Trees" was presented to the society. Five years later, when the "Sylva" was published, the author in the preface tells us that the Royal Society was then doing much for husbandry.

John Evelyn was one of the prominent members of the Royal Society, and he seems to have taken a leading part in defending it against the attacks to which, in the first years of its existence, it was subjected. With much satisfaction he points out, in dedicating the second edition of the "Sylva" to King Charles II., that his essay and the work of the Royal Society have in the past eight years resulted in the planting of more than two million timber trees, and he adds that he has preserved the testimonials he has received with the more care "*because they are* Testimonials *from so many* honourable *Persons, of the* Benefit *they have receiv'd from the* Endeavours *of the* Royal Society, *which now adayes passes through so many* Censures."

With the exception of the "Societies of Learning and Gallantry" of the "Houses of Court and Universities" addressed by Blith, the Royal Society is the earliest to which any influence on agriculture may be traced, and it is certainly the first society which definitely included the improvement of agriculture as coming within its scope. It appears to have depended in no small degree for its early successes on the public interest aroused by the writings of Evelyn and Houghton, and there is evidence that the society gave much attention to agriculture during the second half of the seventeenth century, and that its patronage was much valued.

Evelyn's "Pomona," in which he discourses of fruit trees and cider, gives an interesting glimpse of some of the early activities of the Royal Society, for the work itself is based chiefly on contributions by members of the society to its "*well furnish'd Registers, and* Cimelia." Evelyn is careful to point out that these contributions were original papers, and that it was not the design of the society to "accumulate repetitions where they can be avoided." These new observations being in the society's esteem "*and according to my Lord* Bacon's" preferable even when "*rude and imperfect* draughts" than commonplaces "*adorn'd with more* pomp." Evelyn himself was not practically acquainted with cider-making, and his own interest in the subject, like that of the majority of his fellow-members, was Baconian—*i.e.* it consisted in a search for "grounded conclusions and profitable inventions and discoveries."

In other ways the members of the Royal Society encouraged one another in making improvements; thus when in 1666 Evelyn's "worthy friend" Mr. Hake went on a journey, he returned carrying with him—for eight hundred miles—some grafts for Evelyn, together with a "taste of the most superlative perry the world certainly produces." It was by means such as these, and by a policy which approved "plainness and usefulness" rather than "niceness and curiosity," that the newly-formed Royal Society commended itself to the country.

It is indeed probable that agricultural questions occupied much more of the attention of the Royal Society in the earlier years of its existence than the printed records suggest; we are told, for example, by the Scottish improver, "A Lover of his Country," that one of its most illustrious members, Sir Robert Boyle, was an enthusiastic agriculturist; he says: "I had the Honour to be known to that excellent Person and oft in his Company. He was the greatest Lover of Agriculture I ever knew, and I wonder he never wrote of it. I heard him say, it was a Pity there was not Seminaries of that, the most useful, and except Pasturage, the most ancient of all Sciences."

Not only were agriculturists attracted by the practical investigations of the Royal Society, but impressed by the value of its methods and organisation, and Worlidge suggests that nothing would more conduce to improving agriculture than the constitution of subordinate provincial societies "*whose*

principal care and office might be to collect all such Observations, Experiments, and Improvements they find within their Province . . . which of necessity must abundantly improve Science *and* Art *and advance* Agriculture *and the* Manufactures."

The proposal made by Worlidge was unheeded at the time, for not until nearly a century after his suggestion was made did English agricultural societies begin to appear. A retrograde movement set in soon after the Restoration, and although the Government sought to foster improvements and passed several Acts with the object of stimulating farming, Harte tells us that a "total change of things, as well as the very cast and manner of thinking, joined with immoral dissipation, and a false aversion to what had been the object and care of mean despised persons, soon brought the culture of the earth into disrepute with the nobility and gentry."

An insight into the conditions of the last quarter of the seventeenth century and the first quarter of the eighteenth is given us by Lisle, who wrote the introduction to his "Observations on Husbandry" in 1713. He begins by remarking that it is one of the misfortunes of the age that it lacks honourable conceptions of a country life; he directs attention to the fact that in the decadent days of Rome luxury increased and husbandry was neglected. He calls on the landowner to look round him and see how many fine estates are daily mortgaged or sold, "and how many antient and noble families destroyed by the pernicious and almost epidemic turn to idleness and extravagance." He discusses at length the advantages of an agricultural career, and recommends it as a profession for the eldest sons of gentlemen, who might regard it as "a school of profit and education; whereas," he continues, "it is rather looked on as a purgatory for the disobedient, a scene of punishment, to which a son, who answers not his father's expectations, is to be abandoned; or a condition of life of which none would make choice, but such whom fortune has not in other respects favoured. If the country gentlemen therefore frequently consist of persons who are either rusticated by their parents in anger, or who, making a virtue of necessity, settle on their estates with aversion or indifference, it is no wonder the comedians exhibit them on our stage in so despicable and ridiculous a figure; but this is the fault of the persons and not of the art. Were they properly initiated in the study of Agriculture, and pursued it as they ought, it would be so far from excluding them from useful knowledge, and bringing them into contempt, that I may venture to assert they would find it the best school of education, and the fittest to prepare them for the service of their country in the two houses of parliament of Great Britain."

Such were the dispiriting social conditions with which the successors of Evelyn in the Royal Society had to contend. The agricultural experiments of the society therefore attracted but little attention outside the ranks of the curious. Houghton, a contemporary of Evelyn's, started a periodical publication, *Houghton's Letters*, but it soon ceased. A generation later, and about the period to which Lisle refers in the above quotation, a work on husbandry was written by a fellow, John Mortimer. It is dedicated to the society, "to whose encouragement, inquiries, and direction it owes its birth." Special thanks are given to another fellow, Dr. Sloane, who assisted the author, and "has greatly contributed to the advancement of useful knowledge."

Testimony to the activity of the Royal Society at this period is also to be found in a work on "Curiosities of Nature and Art in Agriculture and Gardening," a translation from the French of the Abbot de Vallemont by Bishop William Fleetwood, published anonymously in 1707; this work contains the passage: "The Royal Society of *England* who are so zealous for the Perfection of Agriculture and Gardening, have apply'd themselves with great Care to find out the true way to make Salt-petre, which they likewise allow to be the chief Promoter of the Vegetation of Plants."

About this time botanical questions of much interest to agriculturists were occupying the attention of the Royal Society. Robert Ball and Samuel Moreland were investigating reproduction in plants, and a few years later Richard Bradley, another fellow, professor of botany at Cambridge, but more of an agriculturist than a botanist, was explaining how, by cross-breeding, "such rare kinds of plants as have not yet been heard of" may be produced. He refers specifically to a cross between a carnation and a sweet-william, but by inference to Burgoyne's Fife and the other things "not yet heard of" that are associated with agriculture and botany in the Cambridge of to-day.

Various causes, among which the influence of fellows of the Royal Society must be given an important place, led the landowners and the educated classes of England again to turn their attention to agriculture about the beginning of George II.'s reign. The revival was associated with and followed, as it has in recent time, a development in gardening. William and Mary were patrons of horticulture, they greatly improved the Royal gardens, and the nobility, in imitation, laid out parks and *parterres*.

A writer on agriculture and gardening of this period, the Rev. John Laurence, of Bishop Weremouth, Durham, attributes the revival, not merely to progress in the art of gardening, fostered by nobles and statesmen, but to the Royal Society—of which he says that its Philosophical Transactions "are standing Memoirs of the Zeal and Activity of many Persons of Quality and Learning," whose "Discourses and Experiments" have "advanced much Light in the Art of Husbandry."

Although for seventy years after its formation, and throughout a period during which agriculture was neglected by the landed classes, the Royal Society did much to keep alive the spirit of the improver, the unfortunate apathy of the agriculturist prevented that progress which appeared to be imminent when John Evelyn wrote his "Pomona." It was not possible for a learned society in London to investigate agricultural questions in the absence of the scientific agriculturist himself; subjects of agricultural interest were therefore discussed chiefly from a theoretical point of view, and, neglecting the teachings of Bacon and the example of Evelyn, there arose that use of the deductive method which in the past two centuries has done so much to hinder the progress of agricultural science.

The first to show up the fallacy of the deductive method in studying this subject was Jethro Tull, who, though he himself fell into the errors which he condemned, was, in his understanding of the true relationships of science and practice, far ahead of any of his contemporaries. A lawyer by training, he probably took to agriculture because of his poor health. He worked at it for twenty years before he was induced to set out his views in writing, and it was years after he began farming before he read anything on the subject. Dissatisfied with the practice of his times, he set himself to reason out new methods and to make experiments. He got suggestions from foreign travel; he tells us, for example, that the first hint of the value of horse-hoeing husbandry was derived from the

ploughed vineyards of France; but he was careful to submit his ideas to the test of experiment before he adopted them in farm practice. His temper, which, if one may judge from his references to his labourers, was far from serene, was much tried by his controversies with *Equivocus*, and his criticisms of the writers and scientific men of the preceding half-century are severe. He remarks, for example, on the superficial knowledge of agriculture shown by "Mr. Laurence, a divine; Mr. Bradley, an academic; Dr. Woodward, a Physician; Mr. Houghton, an Apothecary; these for want of practice could not have the true theory; and the writers who are acquainted with the common practice, as Mr. Mortimer (whether for want of leisure, or not being qualified, I do not know) have said very little of any theory." He freely criticised the writings even of "Mr. Boyle" and of that "miracle of a man Sir Isaac Newton," and in a characteristic sentence he remarks: "From Sir Isaac's transmutation arguments we may learn that a man never ought to depend entirely upon his own for support of his own hypothesis." An admirable sentiment which I am afraid that Tull himself, and many another agriculturist since his time, failed to lay to heart.

Jethro Tull's great work was published two generations after Walter Blith first endeavoured to awaken the spirit of the improver in English farmers. Throughout this period not much progress had been made, but a change was at hand. When in 1730 Turnip Townshend left politics and went down to Norfolk to farm his estate, the tide had turned, and henceforward throughout the eighteenth century there was a rapid improvement in the practice of English agriculture. Of these developments no small share may be attributed to the influence exercised by the Royal Society during the first seventy years of its existence.

The agriculture of Scotland had not shared in the revival due to the work and writings of the English improvers, and was in a very backward state in the middle of the seventeenth century. Its condition is indicated by John Ray, who, in 1661, some months before the Royal Society received its charter, set out from Cambridge to spend the Long Vacation in a Scottish tour. He crossed the Tweed on August 16, and proceeded from Berwick, via Dunbar, to Edinburgh. His first day's journal gives us his impressions of what is now, and probably was then, one of the foremost agricultural districts in Scotland. "The ground in the valleys and plains bears good corn," he says, but "the people seem to be very lazy, at least the men." Scottish women, he writes, "are not very cleanly in their houses, and but sluttish in dressing their meat." "They have neither good bread, cheese, or drink. They cannot make them, nor will they learn. Their butter is indifferent, and one would wonder how they contrive to make it so bad."

After the Union Scotchmen in increasing numbers took the high road to London, and at first with much less profit to themselves than those acquainted with the Scot in modern times might suppose. As a result of social intercourse, the upper classes began to copy the manners and customs of their rich English neighbours, and prices and the cost of living rose rapidly. These economic changes, as in England a century before, turned the attention of landowners to the improvement of their estates; but as the Scottish laird of the beginning of the eighteenth century did not take readily to farming, a few of the more enlightened men among them saw that if improvements were to be made special measures were necessary. Impressed by the usefulness of the Royal Society, these reformers conceived the idea of establishing an Agricultural Society in Scotland. This society, which met for the first time in Edinburgh on June 8, 1723, and adopted the name of "The Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland," was the first association to be formed for the express purpose of promoting agriculture. Some account of its work is given in its Transactions, published twenty years later, but for a contemporary view of the problems which engaged the society's attention we must go to a book published in Edinburgh in 1729, under the title of "An Essay on Ways and Means for Inclosing, Fallowing, Planting, &c., Scotland, and that in Sixteen Years at farthest, by a Lover of his Country."

Of all old books on agriculture this is, to me, the most interesting. The anonymous writer is believed to have been Brigadier-General Mackintosh of Borlum, one of the rebel leaders of 1715, who fell into the hands of the English at Preston, was imprisoned in Newgate, and sentenced to death. But this Highlander was not to be held by English gaolers. With some of his comrades he overpowered the prison guard and made good his escape; recaptured in 1719, he spent the rest of his life in prison. The essay was written, its author informs us, in "my Hermitage"—a cell in Edinburgh Castle—and the writer remarks that he can give no better reason for his work "*than other* Enthusiasts *do, the Spirit* moves me."

The prisoner employed his enforced leisure to great advantage. He displays more familiarity with the classical authors than any of his predecessors, or for that matter than any of his successors, except Harte and Adam Dickson, and he had obviously studied all the more important works published in England in the previous century. He argues that since the Union, Scotland had not made progress, and that, while extravagance had spread and necessaries greatly increased in cost, no attempt had been made to learn good rural economy from the English. He points out that until they improve their estates Scottish lairds cannot hope to emulate English landowners. He counsels fallowing and inclosing, and recommends that skilled English labourers should be brought to teach English methods. He indicates where the best workmen might be obtained. Men from Devonshire for denshiring (paring and burning); men from Cambridgeshire for draining; men from Hertfordshire for ploughing; from Hereford for fruit planting; and from Shropshire for hedging. He estimates that six hundred and forty men would be required for Scotland. A "regimental number," he facetiously remarks, but a welcome regiment, for they would be armed only with spade and shovel! He would apportion a group of these men to every county in Scotland and place them under the guidance of county supervisors. "And if I might have my wish," he says, "we should not go on by Halfs, and all *Europe* should be quickly disabused of the Reproach they load us with of *Idleness* and *Poverty*." In another passage he prophesies that "*Scotland* from one of the poorest, ugliest, and most barren Countries of *Europe*, is, in a very few *Years*, become one of the richest, most beautiful and fertile Nations of it," and who would now assert that the old rebel's prophecy has not been fulfilled?

As already mentioned, the Society of Improvers was constituted at a meeting held on June 8, 1723. A council of twenty-five members was elected, the council was divided up into subcommittees, each of which was charged with the care of a special branch of agriculture; the rules set out that the members of committees were to "chuse different subjects in Agriculture and mark down their thoughts thereon in writing." They were also to correspond with the most intelligent agriculturists all over the country and to endeavour to get small local societies formed. The

chief duty of each subcommittee was, however, to give advice on the means of carrying out improvements. Members were asked to send in an exact statement of their difficulties, and answers were forwarded by the society. If the suggestions proved useful, the recipient of advice was expected to report the result for the benefit of his fellow-members.

The volume of "Select Transactions," published in 1743, contains a number of specimens of the questions sent in and the answers supplied. Such subjects as the draining of boggy land, the use of marl and lime, the effects of seaweed as manure, the cultivation of potatoes, hops, sainfoin, and flax; the feeding of cattle and the employment of steeps for corn were dealt with. Most of the correspondence is with Scotchmen, but occasionally letters from others occur, including an interesting communication from Jethro Tull in which he says that "twenty years ago there was much the same way of tillage in England as is now in Scotland, but it has since been exploded by experience, and the farmers have enriched both the land and themselves by plowing it more than they were wont." Directions for lime-burning are contributed by Mr. Lummis, "who came from England and made the Rotheran Plough." The Transactions have an advertisement of this plough, from which it appears that the Earl of Stair had sent one of his men to be taught by "the best Plough and Wheel-Carriage wrights in England," and that Rotheran ploughs of very superior workmanship were being made at Newliston, West Lothian. The Earl of Stair further laid agriculturists under obligation by introducing turnips, cabbages, and carrots as field crops, and he bred very good Galloway cattle. Another notable man among these early improvers was the Earl of Islay, who gave special attention to the cultivation of peaty soils and succeeded in producing good corn and grass on land previously thought to be of little value. He also planted extensively, and, according to Maxwell, introduced the larch, among other trees, to Scottish foresters.

The society did not confine its attention exclusively to agriculture. It noted a natural connection between the agricultural and fishing industries, and did much to promote the latter, thus establishing an early precedent for the association of agriculture with fisheries for administrative purposes. Manufacturers, too, were encouraged, and in this connection there stands out the name of the Duke of Hamilton, who moved the following "Overture": "That all of you and all under your Influence, should, for Examples to others, buy no foreign Linen for Shirting, Bed-linen, or any other Household-furniture; and that you should propagate to the utmost of your power the wearing of home-made stamped Linen." The consequence, we are informed, was that "even at Publick Assemblies of Persons of the greatest Distinction, the whole Company appeared dressed in Linen of our own Manufacture." The Duke's success with linen led him next to propose a resolution against the drinking of foreign spirits, so that the great sum annually sent to France for brandy might be kept at home! The consequences were not so immediately noticeable as in the case of linen, for the local records of the east of Scotland show that the smuggling of French brandy was a very profitable trade throughout the eighteenth century. It is, however, the case that at a later date the Duke's advice was followed, for not only linen but liquor of native manufacture came to be appreciated, "even at Publick Assemblies of persons of the greatest Distinction"; at assemblies, moreover, on both sides of the Tweed!

During the twenty-two years of its existence the Honourable Society of Improvers became a powerful and important body. Its influence, it should be noted, was obtained by educational methods, for its funds were small, it had no State subsidy, as had the Irish Society, it offered no premiums, but it drew together in the cause of agricultural improvement many of the most prominent Scotchmen of the period, and it undoubtedly laid the foundations of that successful agriculture for which Scotland has ever since been noted. In 1743 the society had 299 members, and an examination of the list reveals many well-known names representing all sections of the educated classes of Scotland, with the notable exception of the clergy.

Of all the members, those who best deserve our notice are Thomas Hope of Rankeilor, president, and Robert Maxwell of Arkland, editor of the Transactions. Mackintosh refers to Hope as a man who had taught improved agriculture to hundreds of his fellow-countrymen. He studied the subject, not only in England, but in France, Flanders, Holland, and other Continental countries, and Maxwell says of him "that it has been much owing to *Mr. Hope of Rankeilor* your Preses, that this Society was entered into and that the Spirit of it rose so high," and adds that he "has been instructing others in the Knowledge of it and been preaching up the publick and private Advantages arising from it for a continued Tract of more than Twenty Years' Time." Of the spirit which animated Robert Maxwell himself we have ample evidence in the dedication of the "Select Transactions." Reviewing what has been done by the society and considering that which might still be done, Maxwell writes, "since the Case stands thus, how much doth it concern the Publick and every Individual that Agriculture be encouraged and that the *Knowledge* of it, the efficient Cause of all those inestimable Benefits, should be taught to all who are willing to learn the Principles of this the most useful of all Sciences; to all who desire to know the secret Causes why some plants enrich, and others impoverish the Ground in which they grow; why different Methods of Husbandry produce different Effects; and in general to all who incline to study the Reasons for and against, the different Methods practised? They that do not study Agriculture as a Science do right only by chance, and that rarely happens. Why then should Reason be so little exercised, as generally it is, in this Matter of the greatest Importance?" He then refers to the opinions of Virgil, and to the views expressed by Columella on the subject of teaching agriculture, and he urges the society to take steps to found a professorship.

Maxwell proposed that the society should address a memorial to the King on the subject of a professorship. "You are," he wrote, "a great Body of loyal Subjects and generally of great Distinction, and I humbly think upon a proper Application to his Majesty, you could not fail to have sufficient Influence to get such a Professor or Inspector named or both."

But, alas! neither professor nor inspector did Maxwell see, for within two years Prince Charles Edward had landed in Scotland, the Marquis of Tullibardine was rallying the Highlanders to the Stuart flag, and the loyalty of the Honourable Society was subjected to a strain which it could not withstand. Most of the members took the advice of Duncan Forbes and held out for the King, but others, like the Duke of Perth and Lords Cromatie, Balmerino, and Lovat, followed Prince Charlie. When peace was restored, the Honourable Society, and not a few of its members, had ceased to exist; but the purpose for which it was founded had been achieved, and the spirit of the improver lived on.

One of the objects of the Honourable Society of Improvers was to develop local societies. Two of these may be traced in Scotland before 1745, one in

Buchan, the other in East Lothian. The former appears to have been started about 1730 by James Ferguson of Pitfour among his Buchan tenantry. Ferguson was a friend of Thomas Hope's and believed in his methods of "preaching improvements." He supplied the members of the Buchan Society with books, and he himself attended their meetings. In 1735 this society published a small volume which had been drawn up by the members at their meetings, entitled "A True Method of Treating Light Hazely Ground; or, an Exact Relation of the Practice of Farmers in Buchan containing Rules for Infields, Outfields, Haughs, and Laighs." In many respects this is a remarkable little work. It relates exclusively to local farming, and while the inspiration may have come from Edinburgh, the book itself bears no evidence of outside influence. Their independence is indeed a noteworthy characteristic of the members of this Buchan Society. From certain references which appear in their Proceedings it may be surmised that they were well acquainted with agricultural writers. But instead of recounting the opinions of others, and speculating as to their value for Buchan, this society of tenant-farmers adopted the true scientific method, they described their practices in detail, discussed them fully, and, being satisfied that they were applicable to local conditions, they reduced their methods to rules. In matters too deep for them, their philosophy rested on a firm basis. Here, for example, is an explanation of the early fruiting of wild oats. This pestilent weed they urge all farmers to destroy by "cropping the wild oats how soon they come out of the hose, who appear always about eight days before the tame. Thus is Providence so kind as to tack that to their nature which is the means of their own destruction."

The second of the local Scottish societies, existing before 1745, was that established by an enlightened landowner, John Cockburn of Ormistown, in East Lothian. Robertson, in his "Rural Recollections," gives July 18, 1736, as the date of its formation. With Cockburn were associated Sir John Dalrymple and other country gentlemen. From a reference made to their meetings by Henry Home, it would appear that in this society we have the origin of the "farmers' dinner." Home counsels landlords to "convene" tenants once a year to a "hearty meal," at which they were to be instructed in new methods of husbandry. "It was by such means," he adds, "that the late John Cockburn of Ormistown promoted emulation and industry among his people." But Cockburn did not confine himself to an annual dinner. Monthly meetings were held for the discussion of agricultural improvements, and these were much appreciated not only by Cockburn's tenants, but by neighbouring landowners like the Earl of Stair and the Duke of Perth, who attended regularly. Even the '45 did not suppress these monthly meetings, and after Preston Pans the Duke of Perth was mindful enough of Ormistown to send troops to protect the members, so that they might quietly continue their criticisms of Tull and their appreciations of turnips.

Maxwell tells us that the Dublin Society (established 1731) was formed in imitation of the Society of Improvers. It is clear when Arthur Young wrote that to the Dublin Society "belongs the undisputed merit of being the father of all similar societies now existing in Europe" he meant that it was the oldest of existing agricultural societies, and not the first society of its kind. The Dublin Society soon after its formation received a Government grant and could therefore spend much more on its work than its Scottish prototype. Time will not permit of a reference to the work of this society, but mention may be made of the experimental farm established by the unfortunate John Wynn Baker, under its auspices. The farm was started in 1764 and continued until about 1770. Schemes were drawn up by Baker in consultation with the society, and an annual grant of 200*l.* was made in support of the experiments; two volumes giving the results were issued.

In 1754 the Royal Society of Arts was established, and almost immediately afterwards it began to give attention to agriculture. A record of its valuable work written by Sir Henry Truman Wood has recently been published in the society's Journal.

The same year that saw the formation of the Royal Society of Arts brought together in Edinburgh a small group of distinguished men who formed themselves into the Select Society. The purposes were the discussion of philosophical questions and practice in public speaking. The idea came from Allan Ramsay, an artist and son of the poet. Alexander Wedderburn was elected chairman (as Lord Loughborough, the first Scottish Lord Chancellor of England, he affixed the seal that gave Sir John Sinclair his Board of Agriculture), and among the members were Adam Smith, David Hume, Henry Home (later Lord Kames), and William Robertson (afterwards Principal of Edinburgh University). This society soon attracted all Edinburgh residents who were in any way distinguished. But in one respect it was a failure; certain members, we are informed, always talked, and the wisdom of others was in danger of being suppressed and unavailing. It is said, for example, that Adam Smith and David Hume never opened their lips! It appears, therefore, to have been decided that the society's genius should be turned to practical objects, and within the Select Society a new organisation, the Edinburgh Society, was formed in 1755, "for the encouragement of Arts, Sciences, Manufactures and Agriculture"—*i.e.* for the same purposes as the Society of Arts had been established in London a few months earlier.

An account of the Edinburgh Society is given by Ramsay in his "History of the Highland and Agricultural Society of Scotland," from which it appears that the methods of this society—the offering of premiums for live-stock and implements—were those which have since been everywhere adopted. In 1759, for example, we read that at the show of horses nine stallions were exhibited, "all very good." But the goodness of the stallions and of the objects did not bring prosperity to the Edinburgh Society; talent was more abundant than money in Edinburgh in the middle of the eighteenth century, subscriptions remained unpaid, the premium list had to be reduced, and finally the Select and the Edinburgh Societies disappeared together in 1765.

Before concluding these notes on early associations let me ask your attention very briefly to some of the evidences of their influence on the agriculture of a later period.

The chief aims of the early societies were to impress upon landowners in the first place the interest afforded by the study of agriculture and in the second the duty of providing an increased supply of food for the nation. Nothing is more marked in the writings of such improvers as Blith, Worlidge, Lisle, Laurence, and Mackintosh than their insistence on the importance of agriculture as a subject of study. Until the educated among their fellow-countrymen could be interested in the principles of agriculture, it was clear to these far-seeing men that progress could not be made.

The change in the attitude of the educated classes to agriculture that took place within a century of the formation of the Royal Society is indicated in all the works published after 1750. Hirtzel, of Berne, *e.g.* in

"The Rural Socrates" (second edition, 1764) remarks: "It is no longer a controvertible point whether the science of Agriculture merits the distinguished attention of philosophical minds, and is the proper study of the most enlightened understanding; since the proof is beyond contradiction, that a judicious rural economy is one of the chief supports of the prosperity of a State." In Henry Home's dedication of "The Gentleman Farmer" to the president of the Royal Society (1776), we find this passage: "Agriculture justly claims to be the chief of arts, it enjoys beside the signal pre-eminence of combining deep philosophy with useful practice"; and in the preface to the same work he says: "Our gentlemen who live in the country have become active and industrious. They embellish their fields, improve their lands, and give bread to thousands." He contrasts these pursuits with those which formerly occupied the country gentleman: "His train of ideas was confined to dogs, horses, hares, foxes; not a rational idea entered the train, not a spark of patriotism, nothing done for the public."

How unlike the state of affairs described by Home were the conditions in a country resembling Britain, but in which the spirit of the improver had not been awakened, may be indicated by a quotation from a report on the farming of Holstein and Mecklenburg sent to Sir John Sinclair in 1794. The writer, M. Voght, states that the agriculture of North Germany was fifty years behind that of England, and explains its depressed state by saying: "Our noblemen are no farmers, and our farmers no gentlemen; our authors on agriculture possess no cultivated land, and those few who could give to the public the precious results of long experience and labour would starve their printer for want of readers."

The landowner of North Germany, towards the end of the eighteenth century, was, indeed, in very much the same state as the landowner of Britain in the first quarter; and it is when we compare the conditions described by Lisle, Mackintosh, Home, and Voght that we begin to appreciate how much British farming owes to such associations as the Royal Society of England and the Honourable Society of Improvers of Scotland. Had not the interest of landowners, and of the educated classes generally, been secured, there is no reason to suppose that the agriculture of Britain in 1794 would have been markedly in advance of that of Germany.

Both in England and Scotland the first impetus towards progress was economic in its character, and throughout the seventeenth and eighteenth centuries economic causes were constantly accelerating the improvement of agriculture; but we must not make the mistake of supposing that a rise in prices necessarily brings about improvements in husbandry. A motive for improvement is provided and more labour may be drawn to agriculture, but it does not follow that there will be a real advance, and that there will be more food produced for the use of workers in other industries. Without changes of system, *i.e.* without improvements based on new discoveries, the effect of a rise of prices in a self-supporting country would merely be to alter the proportion of the population engaged in agriculture, and to form congested districts. This was the danger that threatened England early in the seventeenth and Scotland early in the eighteenth centuries; but fortunately for each country an intellectual revival followed close on the rise in prices, and attention was directed not only to the necessity for more food, but to the need for improvements which would afford a surplus for the support of the industrial classes.

Within recent years the improvers of the eighteenth and early nineteenth centuries have been much criticised for their land policy, their enclosures, and their treatment of labourers; but one thing at least the agriculturists of 1760–1815 saw more clearly than their modern critics—they recognised that if their country was to become a great manufacturing nation, more food must be grown; and to this task they applied themselves so successfully that, as Porter points out, the land of Great Britain, which in 1760 supported about eight million inhabitants, in 1831 supported sixteen millions. When we reflect that the implements of husbandry were rude, that thorough drainage had not been introduced, that artificial manures (except crushed bones) were scarcely known, that oilcakes were scarce, that grain was too valuable to be given freely to cattle, that in bad seasons live-stock had to be starved so that men might be fed, that in good seasons prices fell rapidly, and with them farming profits, and that credit was difficult to obtain and interest high, those of us who know something about the ordinary work of the farmer can realise the strenuous efforts that must have been necessary to wring from land a sufficiency to feed this rapidly growing nation and to maintain it in health and comparative comfort. Even as late as 1836 Porter shows that it would have been impossible to feed any considerable part of the people on imported food. "To supply the United Kingdom with the single article of wheat," he says, "would call for the employment of more than twice the amount of shipping which now annually enters our ports."

Part of the additional food-supply was obtained by enclosing about seven million acres of land between 1760 and 1834; but as more than three times this area must already have been enclosed, as much of the land enclosed after 1760 was of poor quality, and as all of it had formerly contributed in some degree to the food-supply of the country, it is obvious that between 1760 and 1834 the rate of production per acre must have been largely increased.

Improvements in the art of agriculture cannot be rapidly introduced; there is first of all an experimental stage, and when improved methods have been learned they pass but slowly from district to district. Before any marked advance in the art can take place, there must therefore occur a period during which a foundation is being laid. It was about 1760 that our population began to increase rapidly, and it was then that agriculturists were called upon to produce more food. As we have seen, they were able to double the food-supply in seventy years. It cannot be doubted that this marvellous feat was rendered possible by the pioneer societies of the preceding century, or that it was the spirit of the improver, which the early associations had fostered, that animated the men from whom Arthur Young and Sir John Sinclair learned. If, in place of those enterprising agriculturists whose improvements are described in the reports of the first Board of Agriculture, our shires had been occupied by the dull-witted country gentlemen referred to by Lisle, or the "upstart sparks" condemned by Mackintosh, the history of this country must have been very different. Behind the military and naval victories which made Britain a great Power, was a commissariat supported by the agricultural classes. For the great industrial army which the genius of Arkwright, Watt, and other inventors provided with employment there was raised an ever-increasing food-supply. Political and industrial development alike depended on the rate of increase of the population, and this again on the rate at which the means of subsistence could be raised from British soil.

Although the economic position has undergone a revolution there is still work for the improver; no longer indeed do our industrial classes depend for sub-

sistence on the surplus products of the British farmer, but after a long period of forgetfulness, once again it has been recognised that a progressive agriculture is essential to the well-being of the nation. This is not the time to discuss the nature of the questions which press upon us to-day; but let us not forget that they are our questions. To this newly-formed section of the British Association has descended the task of the early associations; it is the privilege of its members to preserve, and to hand down to their successors, that spirit of the improver which animated alike the ancient writers of Greece and Rome and the British societies of the seventeenth and eighteenth centuries; and to-day we may take to ourselves the exhortation of Walter Blith, for his words apply to Section M as they did to its predecessors, "from you, too, I expect and waite for more discoveries of some thing, I scarce know what to name it, which lies yet in obscurity, but I will call it the Improvement of the Improver."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The electors to the Isaac Newton studentships give notice that in accordance with the regulations an election to a studentship will be held in the Lent term, 1913. These studentships are for the encouragement of study and research in astronomy (especially gravitational astronomy, but including other branches of astronomy and astronomical physics) and physical optics. The persons eligible are members of the University who have been admitted to the degree of Bachelor of Arts and are under the age of twenty-five years on the first day of January, 1913. The studentship will be tenable for the term of three years from April 15, 1913. The emolument of the student will be 200*l.* per annum. Candidates for the studentship are invited to send in their applications to the Vice-Chancellor between January 16 and 26, 1913, together with testimonials and such other evidence as to their qualifications and their proposed course of study or research as they may think fit.

The Arnold Gerstenberg studentship has been awarded to A. E. Heath, of Trinity College. The Gedge prize has been awarded to A. V. Hill, of Trinity College, for his essay entitled "The heat production of amphibian muscle and of cold-blooded animals."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, August 23.—F. W. **Aston**: The influence of the nature of the kathode on the length of the Crookes dark space. (1) The relations between the values of pressure, voltage, current, and the length of the dark space are determined for plane kathodes of many different materials, and found to satisfy the same form of equations as those previously given for aluminium, the constants varying considerably. (2) Roughness of the kathode surface does not appear to affect the discharge, if the dimensions of the irregularities are small compared with the length of the dark space. (3) The length of the dark space is shown, in the cases examined, to be greatest for silver and least for magnesium, the metals following the same order as in the case of the kathode fall. (4) The rate of change of length of the dark space with change of current density at the surface of the kathode seems much the same for all kathodes. (5) Difficulties in the way of arriving at a satisfactory explanation of these and other data connected with the dark space are indicated and shortly discussed.—F. W. **Aston**: The discharge between concentric cylinders in gases at low pressures. (1) The relations between pressure, voltage, and the length of the Crookes dark space in the discharge between concentric cylinders take much the same form as those in the discharge between parallel planes. (2) Curvature of the surface of the kathode appears to have no influence upon the rate of alteration of the length of the dark space with change of current density, *so long as the latter is measured at the surface of the kathode.* (3) *Ceteris paribus*, the length of the dark space is greater for a convex cylindrical surface than a plane, and for a plane than a concave one.

MANCHESTER.

Literary and Philosophical Society, October 1.—Prof. F. E. Weiss, president, in the chair.—Prof G. **Elliot Smith**, F.R.S.: Ancient stone monuments. There is, stated the author, no longer any room for doubt that the monuments known as "megalithic," which are to be found along the coast-lines of Europe, North Africa, and Asia, ranging from the Atlantic to the Pacific, embody the same general idea which has been elaborated in various ways amongst the different peoples. The repetition of apparently insignificant details in these monuments in countries as far apart as France and India, and Ireland and Japan, makes it quite certain that no theory of independent evolution of the idea of erecting these curious monuments can be entertained. All the evidence we possess tends to prove quite definitely and conclusively that the farther away from the eastern Mediterranean, whether east or west, north or south, the more recent the date of their construction. Thus, there can be no doubt that the idea of erecting such monuments originated somewhere in the region of the eastern Mediterranean. Now, so far as we know, the art of building in stone was cultivated in Lower Egypt at an earlier period than elsewhere. It is also known that every stage in the evolution of the burial customs associated with stone mausolea and every phase of the gradual development of the craft of stone-working have been preserved in Egypt. Further, in Egypt, the people were making a variety of stone tombs and mortuary chapels, which are obviously the prototypes of every kind of megalithic monument, long before any such monument is known to have been erected elsewhere. The conclusion is that the idea of building such monuments originated in Egypt.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts 5 and 6 for 1912, contain the following memoirs communicated to the society:—

May 18.—P. **Hertz**: A proof by Boltzmann of the second law of thermodynamics.—W. **Voigt**: Electric and magnetic double-refraction (i.), with an appendix by P. Langevin. Th. **Brandes**: Plesiosaurus (Thaumatosaurus) aff. megocephalo Stutchbury from the lower Lias of Halberstadt.—W. **Blaschke**: Proof of the undeformability of closed convex inextensible surfaces.—K. **Försterling**: The theory of the Zeemann effect in any direction.—E. **Landau**: The number of integer-points in certain regions (*i.e.* the number of points with integral coordinates included within given regions of any number of dimensions).

July 20, 1912.—P. von **Liebermann** and G. **Révész**: Binaural combination of tones.—J. **Thomae**: The convergence of a Fourier's series.

The business communications (part 1 for 1912) contain the prize-subjects proposed by the society, the eleventh report of the Samoa Observatory for 1911–12, and a memoir of Sir Joseph Dalton Hooker by A. Peter.

BOOKS RECEIVED.

Les Anaglyphes Géométriques. By H. Vuibert. Pp. 32. (Paris: Vuibert.)

Die Zustandsgleichung. By Prof. H. K. Onnes and W. H. Keesom. Pp. 615–945. (Leipzig: B. G. Teubner.)

Animal Secrets Told. By H. C. Brearley. Pp. xvi+274. (London: Headley Bros.) 5*s*. net.

Tabellen der Luftgewichte γ_t^b, der Druckäquivalente β_t^b und der Gravitation *g*. By Dr. S. Riefler. Pp. iv+102. (Berlin: J. Springer.) 6 marks.

A School Economic Atlas. By Dr. J. G. Bartholomew. With Introduction by Prof. L. W. Lyde. Revised edition. Pp. xii+64. (Oxford: Clarendon Press.) 2*s*. 6*d*. net.

Map Projections. By A. R. Hinks. Pp. xii+126. (Cambridge University Press.) 5*s*. net.

The A.B.C. Guide to Astronomy. By Mrs. H. P. Hawkins. Second edition. Pp. iv+120. (London: Simpkin and Co., Ltd.) 1*s*. 6*d*. net.

The Tribes of Northern and Central Kordofán. By H. A. MacMichael. Pp. xv+259. (Cambridge University Press.) 10*s*. 6*d*. net.

Statics, including Hydrostatics and the Elements of the Theory of Elasticity. By Prof. H. Lamb. Pp. xii+341. (Cambridge University Press.) 10*s*. 6*d*. net.

The Annual of the British School at Athens. No. XVII. Session 1910–11. Pp. liv+335+xxi plates. (London: Macmillan and Co., Ltd.) 25*s*. net.

An Introduction to Algebraical Geometry. By Dr. A. Clement-Jones. Pp. 548. (Oxford: Clarendon Press.) 12*s*.

Geschlechtszellen und Körperzellen im Tierreich. By Dr. von Berenberg-Gossler. Pp. 22. (Jena: Gustav Fischer.) 60 pfennigs.

The Montessori System. By Dr. T. L. Smith. Pp. x+78. (New York and London: Harper and Brothers.) 2*s*. 6*d*. net.

Die Gattung Hedera. By F. Tobler. Pp. v+151. (Jena: G. Fischer.) 6.50 marks.

Picturesque Nepal. By P. Brown. Pp. xvi+205. (London: A. and C. Black.) 7*s*. 6*d*. net.

The Naturalist in Siluria. By Capt. Mayne Reid. Cheap edition. Pp. 240. (London: The Year Book Press.) 2*s*. net.

The Calculus. By Prof. E. W. Davis, assisted by Prof. W. C. Brenke. Edited by E. R. Hedrick. Pp. xx+63. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 8*s*. 6*d*. net.

A Laboratory Manual in Chemistry. By Profs. W. C. Morgan and J. A. Lyman. Pp. xiii+142. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 1*s*. 8*d*. net.

The Beginner in Poultry. By C. S. Valentine. Pp. x+450. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

A College Text-book on Quantitative Analysis. By Dr. H. R. Moody. Pp. vi+165. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

Lecture Notes on Elementary Statics and Dynamics for Intermediate Students. By Prof. J. Sen. Pp. 95. (Calcutta: Hilton and Co.) 1*s*.

Ueber die krankhaften Erbanlagen des Mannes. By F. Lenz. Pp. 170. (Jena: G. Fischer.) 4.50 marks.

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 25.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Characteristic Dynamical Diagrams for the Motion of a Train during the Accelerating and Retarding Periods: Prof. W. E. Dalby.

PHYSICAL SOCIETY, at 5.—The Constitution of Mercury Lines examined by an Echelon Grating and a Lummer-Gehrcke Plate: Prof. H. Nagaoka and T. Takamine.—Note on the Mutual Inductance of Two Coaxial Circular Currents: Prof. H. Nagaoka.—The Absorption of Gas in Vacuum Tubes: S. E. Hill.

SATURDAY, OCTOBER 26.

ESSEX FIELD CLUB (at the Essex Museum, Stratford, Essex), at 6.—Some Recent Observations of the Physiography of the Stort Valley, with special reference to the Rubble-Drift Deposits: Rev. Dr. Irving and Percy A. Irving.—Report of Club's Delegates at the Dundee Meeting of the British Association: W. Whitaker and Joseph Wilson.

TUESDAY, OCTOBER 29.

ZOOLOGICAL SOCIETY, at 8.30.—(1) "*Gazella hayi*" = *Gazella fuscifrons*; (2) The Bornean Bantin: R. Lydekker.—Notes on the Breeding of the "Millions" Fish (*Girardinus pœciloides*): E. G. Boulenger.—The Crustacea Isopoda of the *Porcupine* Expedition: Rev. T. R. R. Stebbing.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea.—VII. On Six Species of Tapeworms from Reptiles belonging to the Genus Ichthyotænia (s.l.): Dr. F. E. Beddard.—Descriptions of New Butterflies of the Genus Thecla from S.E. Brazil: E. Dukinfield Jones.

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