THURSDAY, AUGUST 6, 1908.

THE WORK OF J. S. BUDGETT.

The Work of John Samuel Budgett, Balfour Student of the University of Cambridge. Being a Collection of his Zoological Papers, together with a Biographical Sketch by A. E. Shipley, F.R.S., and Contributions by Richard Assheton, Edward J. Bles, Edward T. Browne, J. Herbert Budgett, and J. Graham Kerr. Edited by J. Graham Kerr. Pp. x+494; 28 plates, 173 figures. (Cambridge: University Press, 1907.) Price 25*s.* net.

THIS stately volume is an appropriate tribute to the memory of Mr. J. S. Budgett, whose untimely death in 1904 was a sad loss to zoology. He was always one who loved hard work, and it is fitting that the memorial which his friends have raised as an expression of their esteem should consist of a reprint of his papers and of a working out of the valuable material which cost him his life. Budgett was a zoologist of the best type, combining the enthusiasm of the field-naturalist with the austerity of the morphologist, and "the patient persistence of his quest for the eggs of Polypterus under crushing difficulties forms one of the most courageous episodes in the history of zoology." "After years of patience, after three unsuccessful journeys into the heart of Africa, he at last succeeded where all others had failed." He had the joy of watching the development of this remarkable type, but it was for others to enter into his labours. He succumbed to malaria and blackwater fever a few days after he had finished his drawings of the external features of the developing ova. It seems a terrible price to pay for another chapter of embryology, yet Mr. Shipley reminds us in his sympathetic biographical sketch of a remark made by Robert Louis Stevenson, that "to be wholly devoted to some intellectual exercise is to have succeeded in life."

The book begins with the biographical sketch—good reading for all, for those in particular who are not too old to learn. Then follow the reprints of Mr. Budgett's zoological papers (1899–1903) on Polypterus and Protopterus, on the habits of other West African fishes, on Phyllomedusa and other Paraguayan batrachians, on the ornithology of the Gambia River, &c. His work was characterised by "an almost fastidious degree of accuracy," and is of enduring quality. "We owe to him the first accurate account of the urino-genital organs of Polypterus, and the demonstration that the crossopterygian fin is really a uniserial archipterygium; besides a series of invaluable observations upon the life-history and breeding habits of many tropical frogs and fishes."

In spite of Budgett's work, there is still lack of definite observations regarding the oviposition and fertilisation in Polypterus; it seems that the eggs are deposited in the shallow lagoons connected with the main river early in the rainy season; they apparently adhere strongly to submerged twigs or water-plants. There are certain peculiarities—such as the modified and erectile character of the anal fin of the male—which point to internal fertilisation, and in this connection we may refer to an interesting letter (p. 291) from Mr. J. Herbert Budgett on the supposed courtship. The young fry apparently accompany the parent (probably the male) in a dense swarm, very much as is the case in actinopterygian bony ganoids.

Prof. Graham Kerr has used to good purpose Mr. Budgett's collection of the eggs and embryos of *Polypterus senegalus*, and has worked out, what has been for so long a desideratum, a fairly complete picture of the general course of development in a crossopterygian fish. The memoir is a noteworthy example of careful and skilful morphological work. We cannot do more than refer to some of the interesting results.

The segmentation is complete, and in its earliest stages nearly equal; the invagination groove is at first nearly equatorial in position; as the curve described by the groove becomes closed an enormous "yolk plug" is formed; rudiments of external gills and cement organs appear at an early stage; the buccal cavity is for a while a widely-open space bounded by the cement organs, the lower side of the head and the cardiac region. The mesoderm of the trunk region arises as it does in Lepidosiren, Protopterus, and Petromyzon, by "delamination." A well-developed solid post-anal gut is present which eventually breaks up and disappears. The secretory epithelium of the cement organ is endodermic, arising as a pair of hollow enteric diverticula, which become cut off from the rest of the endoderm and establish a connection with the outer surface. The lung rudiment is median and ventral, and very soon develops asymmetry. The pancreas arises from three rudiments, and the liver is really a hepatopancreas—the pancreatic tissue being spread out over part of its ventral surface. The dorsal aorta arises from cells or protoplasmic masses derived from the sclerotom; its lumen is derived from the fusion of originally separate vacuoles in these masses; the endocardium appears to be mesoblastic in origin; the blood corpuscles appear suddenly, and it is suggested that they are mesenchyme cells set free by an epidemic of mitosis. The chondrocranium is amphibian-like in early stages.

The neural tube arises by overarching of the medullary folds; both infundibulum and optic rudiments are clearly recognisable while the medullary groove is still widely open throughout; as in Lepidosiren, &c., the brain is, during the earlier part of its development, subdivided into two—not three—regions, the primitive forebrain and the rhombencephalon; the pineal outgrowth is single, and without any eye-like structure; in the adult the cerebellum becomes highly developed and forms anteriorly a valvula cerebelli, while posteriorly it projects back in a quite similar manner into the fourth ventricle; the material forming the side walls of the thalamencephalon does not become pushed out to form cerebral hemispheres, but is accommodated partly by the great increase in length of the thalamencephalon, partly by its becoming invaginated into the interior of the third ventricle; the two olfactory rudiments are apparently connected by an ectodermal thickening across the middle line in early stages; the cavity of the olfactory organ is a secondary excavation in the originally solid rudiment.

Prof. Kerr does not enter into any elaborate discussion of the general import of the results reached, but some very interesting, more or less speculative, conclusions are suggested:—

(1) "On the whole the general phenomena of

development in Polypterus show frequent striking resemblances with what occur in Dipnoans and in the lower Amphibia. I believe these resemblances are sufficient by themselves to indicate the probability that the Teleostomes, the Dipnoans and the Amphibians have arisen in phylogeny from a common stem, which would in turn probably have diverged from the ancestral Selachian stock. The ancestors of the Amniota probably diverged either about one or about several points from the region of the stem common to Dipnoi and Amphibia."

(2) The external gills develop in Polypterus exactly as they do in Lepidosiren and Protopterus and in the more primitive Amphibia (Urodela and Gymnophiona), *i.e.* each one arises as an outgrowth from the outer side of the visceral arch (in this case hyoidean), composed of mesenchymatous core with ectodermal covering. They appear before the perforation of the gill-clefts, and are probably organs of great antiquity. The respiratory epithelium of the gill-clefts has arisen by a spreading inwards from the ectodermal respiratory epithelium of the external gills.

(3) It may be that paired limbs are homodynamous with external gills in which the potential motor function has been accentuated.

(4) As Budgett showed, the condition of the fin-skeleton in the 30 mm. larva of Polypterus indicates its close relationship to the type of uniserial fin-skeleton occurring in sharks. Prof. Graham Kerr briefly re-states the hypothesis that both can be referred back to a primitive biserial archipterygium like that of Ceratodus.

(5) In the evolution of the head there has been a varying amount of displacement in an anteroposterior direction of the relative positions of mesoderm segments and visceral pouches, and it is suggested that the enterocœlic pouches were once wholly posterior to the visceral pouches, and that the two structures are really homodynamous.

(6) The nervous material which corresponds with the whole of the cerebral hemisphere in the higher forms—including the pallium or mantle—lies in Polypterus in the thickened wall of the thalamencephalon. What is ordinarily called the pallium in a crossopterygian is simply the roof of the thalamencephalon, and the conditions in actinopterygian ganoids and teleosts are similar.

In the river Gambia Mr. Budgett found the "nest" of *Gymnarchus niloticus*, a primitive and at the same time specialised teleostean, belonging to the family Mormyridæ. He secured a fine series of the eggs at different stages, and these have been described by Mr. Richard Assheton in a remarkably fine memoir, which is the first contribution to the embryology of Mormyrids. Mr. Budgett gave an account of the floating nest with its thousand large eggs like amber-beads. The development is extraordinarily rapid, for the eggs hatched in seven days, and in eighteen days the young fry left the nest three inches long. Mr. Budgett thought that the development was "exceedingly shark-like," but this has not been borne out by Mr. Assheton's work. There is a large mass of yolk, and the larvæ have very long gill-filaments hanging down in two blood-red branches, but the development is on the whole typically teleostean. We can only refer to a few of the many interesting features.

The alimentary canal arises as a cleft among the hypoblast cells. At an early stage—or perhaps from the beginning—the whole of the pharyngeal region is without a lumen, and it does not get one until after hatching. There is one pair of true gill-clefts between the sixth and seventh visceral arches; the other "gill-clefts" of embryonic life are invaginations of the ectoderm which undermine the visceral arches. There are long external uniramous gill-filaments upon the first, second, third, and fourth branchial arches, which shrivel after the operculum has grown over them, excepting the proximal ends which give rise to the permanent gills. The whole apparatus is lined by epiblast from first to last.

The air-bladder, which arises as a single diverticulum of the œsophagus a little to the left of the mid-dorsal line, has right and left lobes, and is extremely lung-like. Its structure, its vascular supply, and the habits of the fish all point to its use as a lung. The yolk-sac is to be regarded as an appendage of the liver—due to the accumulation of yolk in that part of the egg which normally becomes the liver. The gall-bladder and liver arise by the constriction off of a large ventral recess of the alimentary canal (just posterior to the œsophagus); the pancreas is developed as diverticula of the bile-ducts (the constricted region just mentioned), and these grow backwards to mingle with the "islands of Langerhans" tissue and even with the spleen; the islands of Langerhans arise very early as a solid mass of epithelial tissue which becomes broken up by the splitting of the mesenteric artery.

There are certain features which suggest an earlier condition of teleostean evolution than is the case with other members of the class the development of which has been studied hitherto, and Mr. Assheton inquires whether Teleosteans may not be descended from a proto-amphibian race. He refers to the amphibian-like character of the lips of the blastopore, to the vestige of neural tube formation, to various features in the development of the excretory system, to the lung-like and vestigially double air-bladder, to the trace of an auricular septum and the suggestion of a double circulation, to the large size of the aortic arch of the fourth visceral arch, and to the peculiar character of the gill-clefts, filaments, and arches.

Is it possible that the teleosteans descended from a proto-amphibian stock more amphibian than the Dipnoi, that they owe their position of prestige to having served an apprenticeship in a less regular and constant environment, that a mutation led to a return to strictly aquatic habits? With questions such as these, Mr. Assheton relieves his statement of the facts of the development of Gymnarchus.

Mr. Assheton also reports on sundry teleostean eggs and larvæ which Mr. Budgett collected in the Gambia, and Dr. E. J. Bles contributes descriptions of some stages in the development of three Anura—*Paludicola fuscomaculata, Hemisus marmoratum*, and *Phyllomedusa hypochondrialis*. The last paper reminds us of what will strike everyone who looks over this stately volume; we refer to the fine illustrations. Mr. Budgett was a skilful draughtsman, Mr. Asshe-

ton is equally gifted, and there is quite remarkable merit in the drawings by Mr. A. K. Maxwell.

One of Mr. Budgett's discoveries was a fresh-water medusa in the delta of the Niger. According to Mr. E. T. Browne this is referable to the species (*Limnocnida tanganicae*) that has been found in Lake Tanganyika, and its occurrence in these widely-separated localities becomes intelligible if we regard it as a relic of the fauna of the Lutetian Sea, which the geologists believe to have stretched across Africa in Middle Eocene times. Mr. Browne gives an interesting account of this remarkable type, which remains unclassifiable. There is probably a gymnoblastic hydroid stage awaiting discovery.

The volume is an eloquent tribute to the esteem in which Mr. Budgett was held by his friends, for besides the editorial labours and Mr. Shipley's beautifully executed sketch, the working-up of the embryological material—especially that which fell to Prof. Graham Kerr and Mr. Assheton—must have involved much time and thought. Those who have by their own masterly work thus completed Budgett's have certainly been generous in their friendship, and the memorial volume, which is a valuable contribution to embryology, will surely not fail of its highest purpose, of perpetuating by its stimulus the tradition which Budgett's life and work expressed.

HIGHER ALGEBRA AT HARVARD UNIVERSITY.

Introduction to Higher Algebra. By Maxime Bôcher. Prepared for publication with the cooperation of E. P. R. Duval. Pp. xi+321. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1907.) Price 8*s.* net.

WITH the cooperation of a former pupil, Mr. E. P. R. Duval, Prof. Bôcher has made into a book part of the subject of his lectures during the last ten years. Of course, it would be unfair to try to reconstruct the lectures from the book, but we do get an impression from this volume, and especially from the preface, of the problems which a Harvard professor has to face, and how he deals with them. We are told that

"An American student approaching the higher parts of mathematics usually finds himself unfamiliar with most of the main facts of algebra, to say nothing of their proofs. Thus he has only a rudimentary knowledge of systems of linear equations, and he knows next to nothing about the subject of quadratic forms."

For a student of this kind Prof. Bôcher provides a book which contains the elementary theory of polynomials, determinants, systems of linear equations, matrices, invariants, and symmetric functions, besides a discussion of quadratic forms which goes into considerable detail, and is based on the work of Smith, Sylvester, Weierstrass, and Kronecker.

The author makes special mention of Kronecker and Frobenius, and, in fact, it is easy to see how these great analysts have influenced the writer both in his choice of topics and mode of treatment. Whatever may be thought about the subjects discussed, there is no doubt about the soundness and thoroughness of the treatment; and it would be very interesting to know what is the effect of a course of this kind upon a class of American students, and what would be the result of giving it to an English class of a similar grade. It ought at least to arouse interest, and would probably induce the best students to read some first-rate memoirs, and possibly produce something of their own—though it must be confessed that the theory of quadratic forms, which is the *terminus ad quem* of this book, has been so thoroughly worked out now that there does not seem much chance of developing it further.

It should be stated that Prof. Bôcher by no means confines himself to abstract analysis; on the contrary, like Klein, he takes every opportunity of giving geometrical interpretations, and although he does not say so, it is likely enough that he has illustrated by diagrams and models the different ways in which two proper or degenerate quadric surfaces may intersect. Some of his groups of examples are calculated to suggest methodical lines of research in other directions; for example, on pp. 260–61 we have an outline of the theory of the binary quartic.

Generally speaking, the style of the book is very clear and simple. One exception occurs on p. 120, theorem 2, where it is not sufficiently emphasised that in the first case $\Sigma a_{ij}x_iy_j=0$ is to be made an identity in the x's by giving suitable fixed values to the y's. And although the notion of a domain of rationality is explained (pp. 175, 212, 216), it would have been better to do this at an earlier stage.

The printing, done at the Norwood Press, is very good on the whole, but the suffixes are often unpleasant to look at, owing to want of gradation in type. On the other hand, we do find $x_2^{c_2}$ printed nearly as it is written—a very rare experience in English-printed books. It would serve a useful purpose if a congress could be held between mathematicians and mathematical printers and compositors; the former often forget that what is easy to write may be difficult to print, and the latter are very conservative, besides failing to sympathise with a mathematician's way of writing formulæ, especially in matters of proportion and spacing. G. B. M.

METEOROLOGICAL OBSERVATIONS.

The Observer's Handbook, Meteorological Office, 1908. A new and revised edition of Dr. R. H. Scott's "Instructions in the use of Meteorological Instruments." (London: H.M. Stationery Office.)

THIS book consists of two parts, and appendices. Part i. follows somewhat in the line of Dr. Scott's handbook, but part ii. is practically new, and deals with recording instruments, several of which have come into use since the previous book was published.

The issuing of a new official guide for its observers by the Meteorological Office gives an opportunity of comparing the state of the science of meteorology now and twenty years ago, in so far as instruments and

observations are concerned, and in two respects the book shows considerable advance. Thus twelve pages are devoted to the Campbell Stokes sunshine recorder, and full instructions for setting the cards and adjusting the instrument are given, although the measurement of sunshine is not mentioned in the old book. Also the doubt about the measurements of wind velocity by the Robinson anemometer and the relation between the recorded velocity and the numbers of the Beaufort scale has been to a great extent removed. A useful classification of the scale, and a description of the results produced both on sea and land by the winds denoted by the various numbers, are given. Notwithstanding this, a man must be more than human if his estimation is entirely free from the influence of the prevailing conditions to which he has recently been exposed. A scale of fog intensity based on the inquiry supported by the London County Council in the winter of 1902–3 is also given.

Feinman's nephoscope and Besson's comb nephoscope are described. Probably the authors are not to blame, but it is a pity that cloud velocities are not measured in angular velocities, or rather angular velocities reduced to the zenith, the tangential velocity of the handbook. Certainly angular velocity is the only physical quantity in which cloud motion as seen from a single station can be expressed. It seems absurd, and is certainly very far from the truth, to assume that all clouds are at a height of 1000 metres, or that all clouds are moving with a linear velocity of 1 metre per second. Why, too, should the term "relative" be used? If relative means angular, as appears from the context, its use is incorrect, and although sanctioned by past usage, it would be well to give up the incorrect use of a technical word.

In the chapter dealing with the corrections to be applied to the barometer, it might have been well to point out that the reading in windy weather is to some extent dependent on the position of the room, and the way in which openings from it are situated with regard to the wind direction. There is plain evidence that an important error may be so produced.

The appendices consist of the usual tables and a memorandum by Dr. Shaw on the important question of units. In it Dr. Shaw points out the objections to both the systems now in use. To avoid the trouble of negative temperatures he advocates the use of the absolute centigrade scale, omitting the first figure, which will almost always be 2. This would be a vast improvement, and would earn the gratitude of all who have to obtain mean temperature values for places in temperate latitudes. In addition to the question of negative values, the muddle of having two systems is most pronounced in the case of temperature, for the alternative values cannot be read off from a slide-rule, as they may be for the barometer and the rainfall. An entirely fresh system has perhaps a better chance of general adoption than either of those now in use.

The handbook is carefully prepared, and contains much interesting matter, and Mr. Lempfert is certainly to be congratulated on its publication.

SOME PHYSICAL TEXT-BOOKS AND LECTURES.

(1) *Theorie der Elektrizität.* Vol. i., Einführung in die Maxwellsche Theorie der Elektrizität. By Dr. A. Föppl. Third edition, edited by Dr. M. Abraham. Pp. xviii+460; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 12 marks.

(2) *Kleiner Leitfaden der praktischen Physik.* By Dr. F. Kohlrausch. Second enlarged edition. Pp. xviii+268; illustrated. (Leipzig and Berlin: B. G. Teubner, 1907.) Price 4 marks.

(3) *Die Stimmgabel: ihre Schwingungsgesetze und Anwendungen in der Physik.* By Dr. E. A. Kielhauser. Pp. viii+188; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 6 marks.

(4) *Luft, Wasser, Licht und Wärme.* By Dr. R. Blochmann. Third edition. Pp. vi+149; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(5) *Moleküle, Atome, Weltäther.* By Dr. G. Mie. Second edition. Pp. iv+142; illustrated. (Leipzig: B. G. Teubner, 1907.) Price 1.25 marks.

(6) *Die Stellung der Physik zu den Naturwissenschaften und der Technik.* By Aug. Hagenbach. Pp. 25. (Leipzig: B. G. Teubner, 1907.) Price 0·80 mark.

(1) OF this group of volumes the first is undoubtedly the most important. Since, however, it is the third edition which is before us, and very few changes have been made, it calls only for a short notice. These changes consist of alterations in the arrangement of the matter and a revision of the text here and there wherever it was found possible to make the exposition clearer. These changes have been made under the editorship of Dr. M. Abraham. The result is to improve a book of exceptionally high standing. We do not hesitate to affirm that we have in it one of the best expositions of Maxwellian doctrine, and at the same time one of the best introductions to vector analysis.

(2) This also is an improved edition (the second). For a "smaller" text-book it contains an enormous amount of information useful for general reference. This information is necessarily very condensed. In some cases it will probably be found insufficient by anyone except an expert experimentalist; that is to say, by one (for example, a chemist) who, though proficient in laboratory work, is not acquainted specially with practical physics, and wishes for hints in regard to physical processes.

(3) A monograph on the tuning-fork and its applications is a very welcome addition to physical literature. This one is based upon about eighty original papers published mainly since 1870; these lie within the period during which most work on this instrument has been done. When it is stated that the volume is non-mathematical, it will be obvious that it does not by any means profess to be complete; it will also be understood how it is that there are only two references to Lord Rayleigh in it, and that his "Theory of Sound" is not quoted in the list of consulted books at the end. This limitation in the treatment excludes many of the most interesting problems in connection

with this subject. But there is a great deal of valuable matter gathered here bearing on its properties, and it may very usefully be consulted.

(4) The somewhat inclusive title of the fourth volume under review covers a course of lectures on elementary physics and chemistry. Few alterations have been made from the earlier editions. A lecture has been added on liquid air. The book has found many friends, as we might have expected, and we have no doubt it will find many more.

(5) In this second edition of Dr. Mie's book a short section on radio-active bodies has been added. When it is stated that this occupies part only of a single page, it will be clear that it is not a detailed account. It is concerned only with the question of the composite nature of an atom and the transmutation of the elements. A few emendations have been made in the text to increase the lucidity.

(6) A short lecture on the relation of physics to other sciences, in the light of modern work on physical chemistry and recent discoveries of the non-valent gases and of radio-activity. While admitting the necessity of specialisation, it is urged that a broad outlook should be encouraged.

OUR BOOK SHELF.

Refrigeration: an Elementary Text-book. By J. Wemyss Anderson. Pp. ix+242. (London: Longmans, Green and Co., 1908.) Price 7*s.* 6*d.* net.

THE increasing use of refrigerating processes in the distribution and preservation of food, and also in many important industries, has already called for a special type of engineer who must possess a knowledge, not only of machines and mechanism, but also of the theoretical properties of heat. Nowadays, when the market for electrical engineers is becoming uncomfortably crowded, young men would do well to consider the prospects open to them as refrigerating engineers. To those who wish to enter this profession Mr. Anderson's book will be most welcome as an introduction to the fundamental principles on which modern refrigerating processes depend.

The treatment of the subject is accurate and lucid, and in all cases the necessary mathematical investigations are reduced to their simplest elements, many numerical examples being added. The first three chapters are devoted to a brief *résumé* of the elementary properties of heat, including radiation, conduction, and convection. In chapters iv. and v. the elastic and thermal properties of fluids are dealt with. A simple explanation of the first and second laws of thermodynamics is given in chapter vi. The remaining six chapters are of a more practical character, special attention being paid to the solution of problems which arise in connection with refrigerating processes. Cold-air machines, vapour machines, compression machines and absorption plants are described in chapter vii. The liquefaction of air is considered in chapter viii., and ice-making in chapter ix.

A very important branch of the subject is dealt with in chapter x., where the methods of insulating and cooling large chambers are described and illustrated. Miscellaneous uses of refrigeration are considered in chapters xi. and xii.; in order to appreciate the extent to which refrigerating processes are used industrially, it is only necessary to glance through the contents of these chapters. Ice-making is in demand for general purposes, and for skating rinks and curling ponds. General cooling is used for keeping meat and other food-stuffs, and for increasing the yield of butter from milk. Special cooling arrangements are required for keeping ammunition (such as cordite) in a proper condition. The growth of plants and shrubs is checked, and unripe fruit is kept so that it can ripen according to the market, by the aid of suitable methods of cooling.

In general engineering, refrigerating processes are used for drying the air supplied to blast furnaces, and for hardening sandy or boggy soils in order that tunnels may be made or shafts sunk. Cooling processes are also largely used in the brewing industry. Mr. Anderson does not profess to treat of these applications of refrigeration in detail, and the design of refrigerating machines is not dealt with; but the student commencing the study of the subject cannot do better than master the contents of Mr. Anderson's book, after which he will be in a position to understand the nature of the problems which confront a refrigerating engineer, and upon the solution of which his success will depend. E. EDSER.

Ceylon. A Handbook for the Resident and the Traveller. By Dr. J. C. Willis, Colombo Apothecaries' Company. Pp. x+247+iv. (London: Dulau and Co., 1907.) Price 5*s.* net.

THE Director of the Royal Botanic Gardens of Ceylon explains that he is the author of this handbook by default. He was of opinion that a handbook was needed, and having failed to persuade one better qualified than himself to become the author, Dr. Willis undertook to write the book himself. He gravely informs us in the preface that the idea was to write a comprehensive work of about 1000 pages, and that having devoted eight months of his leisure to writing the agricultural section he found that this alone would take 125 pages of the present book in print, whilst on the same scale the entire volume would take him ten years to complete. The chapter on agriculture was therefore reserved as the basis of a separate volume on tropical agriculture, and the present book of 244 pages was written with the assistance of many friends and authorities in the island.

The book includes a brief account of the natural features of Ceylon, of its history and peoples, with descriptions of roads, railways, towns and villages, and of the principal industries, with chapters on sports and games. It contains two small sketch-maps of Ceylon, and is illustrated with numerous photographs, many of which are excellent. As a whole the book is disappointing. It can, of course, lay no claim to comparison with Emerson Tennent's famous work, and the author's style is crude and has none of the charm of Sir Samuel Baker's. A great deal of information, solid and trivial, is conveyed in a terse but loose grammatical style of which the following sentences are examples:—"The Museum is closed for cleaning on Fridays and admission is always free." "Water is usually pretty bad in the low country and should always be filtered before use, though if used for tea-making unfiltered the boiling will have about killed all germs."

"The native who has lost his taste for his own art is in regard to whatever style of art he adopts among the most inartistic people on the face of the earth, as one glance into any native house furnished in European style will show. Many are in the worst style of early Victorian, whereas a native house furnished in the old native manner is a pleasing sight."

As the work of a man of science the book is distinctly disappointing, and is little, if any, improvement on the Ceylon handbook to the St. Louis Exhibition, on which the author has largely drawn. The

section on agriculture is one of the best in the book, but even here there are many signs of the effort which has been exerted in writing short popular descriptions.

It is to be feared that the book will fall between two stools. It is too dry and unattractive for the ordinary traveller, whilst the serious student will not find it satisfactory.

Dr. Willis would have been better advised had he devoted himself to preparing a more serious work, or, if time did not permit of this, to producing a new edition of Sir Emerson Tennent's standard treatise. The present work is not likely to add to his reputation.

The Royal Gardens, Kew. From photographs taken by permission. By E. J. Wallis, with descriptive notes by H. Spooner. Pp. 64. (London: E. J. Wallis, 42 Gloucester Road, Kew Gardens, n.d.) Price 1s. net.

IT is difficult to realise that the modern development of Kew Gardens as a public institution only dates back to the middle of the last century, when Sir William Hooker initiated the extensions and improvements that have been continued by his successors in office. Increased travelling facilities in recent years have largely augmented the number of visitors to Kew, and consequently there is certain to be a large demand for a popular account of the gardens that will serve as a memento of what must often be memorable visits. The illustrations provided by Mr. Wallis depict exteriors and general views, selected spots in various houses, and a few specimen plants. The photographs of the tropical water-lilies and of the Yulan, *Magnolia conspicua*, are especially pleasing, also of the delicate flowers *Cypripedium glaucophyllum* and *Peristeria elata*. Mr. H. Spooner has contributed the text, in which strangers will find a useful guide round the houses and to the choice specimens, as well as brief descriptions of the more regular and conspicuous tenants.

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.*]

The Ciliated "Urns" of the Sipunculids.

IN the winter of 1871–2 I studied the richly corpusculated perivisceral fluid of *Sipunculus nudus* at Naples. I was with Anton Dohrn, who was making arrangements for the building of his celebrated laboratory. That remarkable marine zoologist Krohn, who in 1851 had described the ciliated "urns" (Töpfchen) of the body-fluid of Sipunculus as parasites, was there, and spent an evening with us. I described the ciliated urns briefly in the *Annals and Mag. of Nat. Hist.*, vol. xi. (fourth series), 1873, p. 89, and pointed out their mode of origin. I say, "Further, I have found out the source of the 'Töpfchen.' They are to be observed in great numbers *attached within* the curious pair of tubes or vessels formed by duplicatures of the peritoneal membrane, which lie on each side of the œsophagus." I then give a wood-cut figure of the attached "urns" with long stalks, and state that "they develop as buttons on the cellular surface," and that "they become detached and swim off into the fluid."

This statement was erroneously quoted nearly thirty years after its publication, in the first instance by Cuenot, who said that I stated that the urns were developed on the outside of the œsophageal tubes, whereas I had italicised my statement as above to the effect that they are developed on the *inside* of those tubes.

The matter is not one of great importance, but it is not agreeable to see a statement repeated to the effect that one said just the opposite of what one did say. This repetition of an error is made by Dr. Selensky, of St. Petersburg, in the *Zeitschr. f. wiss. Zoologie*, Bd. xc., p. 558. He apparently has not consulted my paper, but, although he does not say so, has taken his information from Cuenot, to whom, erroneously, he attributes the first correct observation as to the place and mode of origin of the ciliated urns of the Sipuculids, an observation published by me now thirty-five years ago. I wish clearly to state that I am quite sure that neither Prof. Cuenot nor Dr. Selensky had any notion that they were not quoting me correctly. I should have let the matter pass altogether had there not been lately an attempt to revive the notion that these curious freely swimming corpuscles with their crown of cilia are parasites. I disposed of that hypothesis when I observed in 1871–2, and figured in 1873, their mode of growth.

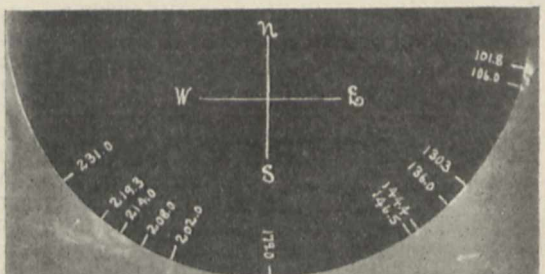
E. RAY LANKESTER.

29 Thurloe Place, S.W., July 30.

Prominence and Coronal Structure.

COMMUNICATIONS by Dr. Lockyer and by Mr. Buss have appeared in recent numbers of NATURE (April 2, June 18, and June 25) under the above heading. In the last-mentioned number Dr. Lockyer quotes a portion of a letter which I wrote to him following the publication of his original paper, showing the triple-arch prominence. I examined my plates under very unfavourable illumination, and wrote that no prominence of unusual form was discernible in the position which he gave. More careful examination shows a faint, detached, V-shaped cloud attaining an elevation of 67,000 miles, as probably the last remnant of the prominence, at considerable elevation. The accompanying figure will show this faint cloud at 146°·5.

I regret that Dr. Lockyer did not quote my letter further, for I wrote that I had so often seen a promin-



ence, risen to considerable height, topple back into the sun, thus making an arch, that it seemed unwarrantable to assume another explanation for their formation without positive knowledge that the earlier stages of development were contrary to this usual performance. Fortunately, Mr. Buss had earlier observations of this prominence, and these showed the arches to have had the usual origin.

Concerning the prominence in the south-western quadrant, Fig. 2 of Dr. Lockyer's letter, for which he suggests the possibility of false orientation on my print, the present figure shows that the orientation was correct. The part of the prominence corresponding to the prominence at 218° shown on the negatives of Dr. Lockyer and of Prof. Hale is easily recognised at 219°·3. The long arm springing for position-angle 208° is apparently a new development.

PHILIP FOX.

Yerkes Observatory, July 18.

Fossil Aphididæ from Florissant, Colorado.

THE plant-lice of the Miocene shales at Florissant, Colorado, have been described at length by Scudder in his great work on Tertiary insects (1890). He was able to recognise no fewer than fifteen genera and thirty species. All the genera were considered to be extinct, and although they included both Aphidinæ and Schizoneurinæ, they were found to differ from the modern representatives of these subfamilies in an important character running throughout the series—the length and slenderness of the marginal or stigmatic cell. In this they also differ from

the European Tertiary Aphididæ, although, according to Scudder, they resemble a species (*Genaphis valdensis*, Brodie) from the Jurassic of England. This Genaphis, however, has a short thick stigma, such as may be seen in some modern Chaitophorus, whereas the stigma in the Florissant forms is long and slender.

There are two ways in which the peculiarities of the Florissant Aphididæ might be explained. Either it might be supposed that they have undergone parallel evolution in a certain direction, giving rise to the present fauna, or it might be held that they represent an extinct series, driven out of existence by the Aphididæ of the Palæarctic fauna, which reached America in the late Miocene or early Pliocene. Supposing the original centre of Aphid evolution to have been Palæarctic (perhaps Asiatic), it may be that in late Secondary or early Tertiary times Aphididæ reached America, giving rise in due course to a series of genera, a good sample of which is preserved for us at Florissant. This would readily explain the peculiar fact of certain characters running throughout the series, these being derived from the original immigrants. While this evolution was proceeding, the old-world Aphides were undergoing developments of their own, leading directly to the present Aphid fauna of the north temperate regions. The generic uniformity (with few exceptions) of this fauna points strongly to its common source, and the European Tertiary Aphid fauna appears to corroborate the idea that this was Palæarctic. It remains only to suppose that when the Palæarctic Aphides reached America they were successful in ousting the endemic genera, which would have been totally lost to science had they not been preserved at Florissant. Perhaps, however, they have not been so completely lost, and it may be that aphidologists, with the palæontological facts in mind, will even yet discover some of the Florissant genera living in the mountains of Central or South America.

In this connection it may be well to direct attention to the very important paper by Dr. W. D. Matthew, lately published in the Bulletin of the American Museum of Natural History, June 30. In this paper Dr. Matthew discusses the evolution of the deer (Cervidæ), and concludes that these animals have successively dispersed from a local centre, driven southward before the competition of higher types evolved in the centre of dispersion. "These migrant types continue to evolve in certain respects, such as brain-capacity, which are advantageous in any habitat, but preserve most of their primitive characters as the environmental pressure is less in amount and more variable in direction." These are not mere suppositions; actual evidence is produced to show that the oldest genera are to-day the most southern, and it is suggested that had the connection between north and South America existed earlier, we might expect to find still more primitive forms in the southern continent. This *law of successive radiation*, as it might be termed, will undoubtedly throw new light on many problems of distribution and evolution. So far as it is found to be true, it will teach us that we must be cautious in thinking of the present home of the more primitive types of a group as the original centre of that group; that the occurrence of similar forms in two southern lands does not necessarily imply a former transoceanic southern bridge; or that the existence of a type in a particular region necessarily implies any *special* fitness to live in that physical environment.

As Dr. Matthew states, much has been written on the geographical distribution of modern animals from the general standpoint which he advocates,[1] but not enough has been done to interpret the palæontological facts in connection with the modern. Our daily increasing knowledge of the Tertiary fauna and flora promises much in this respect, and it is interestingly significant that independent studies of deer and plant-lice should lead to similar conclusions.

The Florissant Miocene Aphididæ are given above as numbering thirty. I have before me an additional one, the largest of any yet found. It is a species of Anconatus, differing from *A. dorsuosus*, Buckton, by the wholly pallid (pale ochreous) abdomen, and the anterior wing about 9 mm. long. The legs are remarkably large, the middle tibiæ, for instance, about 3½ mm. long. This insect, found this year at Station 13 B, may be termed *Anconatus gillettei*, in recognition of Prof. C. P. Gillette's important researches on Colorado plant-lice. Detailed measurements will be given elsewhere.

If it is asked how the Palæarctic Aphids could possibly have routed the Nearctic ones, as suggested, the answer may be found in the supposition that the former brought with them certain parasites or diseases, to which they had become relatively tolerant, but which worked havoc among the American species, just as some European diseases of man have done in recent times when carried to American tribes.

T. D. A. COCKERELL.

University of Colorado, Boulder, Colorado, July 21.

[1] See, for instance, J. W. Taylor, "Monograph of the Land and Freshwater Mollusca of British Islands," vol. i., pp. 389–90. (1900.)

THE NATURAL HISTORY MUSEUM.

AS was recorded in last week's NATURE, on Tuesday, July 28, a deputation, which included Mr. F. Darwin (Cambridge), Prof. Cossar Ewart (Edinburgh), Prof. Sedgwick (Cambridge), Dr. Marr (Cambridge), Prof. Hickson (Manchester), Prof. Bourne (Oxford), and Prof. Graham Kerr (Glasgow), waited on the Prime Minister (The Rt. Hon. H. H. Asquith, K.C., M.P.) in support of a petition sent to the late Prime Minister last autumn requesting that advantage should be taken of the present vacancy in the directorship of the Natural History Museum to hold an inquiry into the methods by which the museum is governed. The deputation was introduced by Sir W. Anson, M.P., Mr. Rawlinson, M.P., and Sir H. Craik, M.P.

From the statements made by the members of the deputation it appears that the Natural History Museum is administered by the trustees of the British Museum, and that their principal librarian is responsible for the Natural History Museum at South Kensington as well as for the library and art collections at Bloomsbury. For half a century naturalists have been directing attention to the necessity for some change being made in the administration of the natural history department of the British Museum. In 1858 Mr. Darwin wrote to Sir Joseph Hooker that he could see many advantages in withdrawing natural science from the "unmotherly wing of art and archæology," but he thought that the "contempt for, and ignorance of, natural science" was so profound "among the gentry of England" that the time had not come when science could stand alone.

Some years later (1866), the situation appearing more favourable, the most distinguished men of science of the day (amongst others Darwin, Hooker, Huxley, Newton, and Wallace), in a memorial to the Government, expressed the opinion that "it is of fundamental importance to the progress of the natural sciences in this country that the administration of the national natural history collections should be separated from that of the library and art collections."

In 1874 a Royal Commission on "Scientific Instruction and the Advancement of Science" directed attention to the statements of witnesses that it was "unsatisfactory that the national collections should be managed by a body of gentlemen whose time is in most cases fully occupied by other important duties, and the majority of them are not selected with reference to any special qualifications for such a post." These commissioners, in their fourth report, recommended "that the occasion of the removal of the natural history collection to South Kensington". . . "should be taken advantage of to effect the desired change, and that on their new site the collections should be removed from the control of the trustees of the British Museum." As this

commission was a strong and representative one—it included, amongst others, the Duke of Devonshire, Sir John Lubbock, Dr. Sharpey, Mr. Huxley, and Sir George Stokes—it was anticipated by naturalists that the Government would give effect to its recommendation. In this they were mistaken, for in the Bill passed in 1878 giving the trustees power to remove the natural history collections to South Kensington, no provision was made for a change in the administration of the Natural History Museum.

The recommendation of the Royal Commission having been ignored, the British Association for the Advancement of Science in August, 1878, urged the Government to reconsider the matter, but nothing was done.

After a lapse of ten years a representative body of scientific men, including Lord Kelvin, Sir G. Stokes, Sir M. Foster, Sir A. Rücker, Sir John Murray, Dr. Francis Galton, Sir Henry Thompson, Sir W. Turner, Sir Benjamin Baker, and Mr. A. R. Wallace, presented a memorial to the trustees in which it was stated that in their opinion it was "of great importance to the welfare of natural history that the principal official in charge of the national collections relating to this subject should not be subordinate in authority to any officer in the museum."

It may here be mentioned that a concession of some importance was made by the trustees in 1885. On the recommendation of the late principal librarian, Sir E. Bond, the office of superintendent of the natural history collections was in 1885 replaced by a new office, that of director, with new duties, new responsibilities, and new salary. But the concessions made in 1885 which gave the director of the Natural History Museum a position of comparative independence were deliberately revoked in 1898.

It seems that, though it is generally assumed that the trustees as a whole administer the Natural History Museum and are responsible for the expenditure of the very considerable sum (56,000*l.*) annually voted by Parliament, the museum is actually controlled by a standing committee, while the director, inferior officers, and assistants down to servants are appointed by the three principal trustees. As there are forty-nine trustees, the board cannot act effectively as a single body, and, as the 1874 commissioners state, it is "singularly inappropriate that the three important personages who are the principal trustees, occupied as they are in the discharge of the highest functions in Church and State, should be burdened with the duty of making appointments to offices of every grade in the British Museum."

Prof. Sedgwick, in referring to the memorial presented last August to the late Prime Minister, said that zoologists thought it desirable to at once call the attention of the Government to the desirability of instituting an inquiry into the methods of administration of the Natural History Museum, and that, if necessary, a widely signed memorial could be sent later on. In concluding a very full statement, Prof. Sedgwick said:—

"We are here to ask for a full official inquiry into the organisation and administration of the Natural History Museum with a view to a reasonable treatment of the matter in the immediate future by His Majesty's Government."

Mr. Francis Darwin especially referred to the subordination of Cromwell Road to Bloomsbury. He said:—

"Quite apart from the welfare of the Natural History Museum, it seems unfair to expect of the principal librarian that he should be responsible for Cromwell Road in addition to his other heavy responsibilities. Nor can it be to the advantage of the British Museum that its principal officer should be so occupied. But it is when we look at the other side of the question that the faultiness of the arrangement becomes fully obvious. To choose a man distinguished for his technical knowledge and then to fail to give him reasonable freedom in the employment of his training and experience seems as bad a plan as it is possible to conceive.' . . . 'I believe I am right in saying that when the late director was appointed his freedom was curtailed. It was, I think, unavoidable that in these circumstances difficulties should arise, and I feel very strongly that we ought to make the recurrence of such difficulties impossible; and this can only be done with certainty by making the Natural History Museum an independent unit.'"

This view was supported by Prof. Bourne, who stated that

"the Natural History Museum will not be placed upon a satisfactory footing until it is placed under the control of a body of trustees separate from that which is responsible for the control of the British Museum at Bloomsbury."

Prof. Hickson pointed out that, notwithstanding the representations made by men of science during recent years,

"no changes or reforms had been effected, and the administration is practically the same now as it was before the collections were removed from Bloomsbury," and that for seven months "the museum has been deprived of the services of both a scientific director and a keeper of zoology."

Prof. Ewart directed attention to the present unsatisfactory method of appointment of the director and of the subordinate members of the staff of the Natural History Museum; Prof. Kerr said that, owing to the dissatisfaction which exists amongst men of science, it is "essential to hold a careful inquiry into the whole question of the organisation and administration of the Natural History Museum before coming to a decision as to the remedial measures to be adopted," and Dr. Marr directed attention to the inadequate representation in the museum of those important branches of geology which are distinct from botany and zoology.

The Prime Minister, according to an official report which has been supplied, replied as follows:—

He expressed his profound satisfaction at meeting so many eminent men of science. He pointed out that, as regards the administration of the museum, the trustees are a statutory body with whom the Government were powerless to interfere. He confessed himself still unable to grasp in what way the museum failed to perform its functions. The arguments advanced by so many of the deputation as to the management by the trustees applied equally to the Bloomsbury museum. The trustees, men of wide experience and great distinction, were equally cognisant of natural history and archæology. He announced that the trustees were about to appoint a keeper of zoology, and that it was not intended to abolish the directorship, but only to wait to ascertain who was the best man for this responsible position. He sympathised with the view that the director should have a free hand in the management of his department, and promised to convey to his fellow-trustees of the British Museum all that the deputation had suggested.

In reply to the Prime Minister's remarks, it may be pointed out that, had the Natural History Museum come into existence during the later half of last century it would doubtless, like the American Museum of Natural History and other recently established museums, have been placed under a separate board of trustees. But for the want of an appreciation of science in England, the request for an independent position for the Natural History Museum by men of science would have been almost certainly granted when the natural history collections were removed from Bloomsbury to South Kensington.

BIRDS, BEASTS, AND FISHES OF NORTH WALES.[1]

DESPITE its unrivalled scenic attractions and its popularity as a health resort, North Wales has until recently received scant attention from zoologists, references to the district in standard works on British vertebrates being comparatively few, and often erroneous. The need of a comprehensive local fauna dealing with the district has long been felt. But it was recognised that there was no one man who was able to do the work. It could only be accomplished by the cooperation of a large number of naturalists resident in Wales and non-resident. For although comparatively little has been written about the vertebrate fauna of North Wales (and a good deal of that little quite recently), a good many observers, both residents and visitors, have been working steadily at it for some years. It remained to collect, sift, and arrange the facts they had got together. Mr. Forrest came forward and undertook this arduous work, and he obtained the practical assistance of a number of naturalists (a list of whom appears in the book), who readily placed their stores of information at his disposal. He has also examined what little literature (dating some way back) there was on the subject. This information he was able to supplement from his own observations, made during many short visits to the Principality. The result has been an excellent handbook to the vertebrate fauna of North Wales.

Photo] Puffins on St. Tudwal's. From "The Vertebrate Fauna of North Wales." [*H. E. Forrest.*

The introduction comprises some account of the former zoologists of North Wales, with portraits; a bibliography; a short account of the physical features of the country; some account of bird migration, wherein the routes are carefully traced, not an easy matter in a mountainous country; and a note on the Welsh names. Two conclusions reluctantly force themselves upon us after a perusal of this work. One is that North Wales is not a natural faunal district. West and east differ too greatly. Speaking of the rugged mass of mountains which stretches almost uninterruptedly from the Menai Straits to the Dovey estuary, the author himself says that the importance of this mountain barrier in limiting the distribution of species can hardly be over-estimated. In a very large number of instances, species are confined to the eastern side of this barrier. The truth of this is particularly evident in regard to many woodland birds and fresh-water fishes. The second conclusion is that the vertebrate fauna of a district like this (which, although its actual area is small, is so diversified in its physical aspect) is too big a subject for one octavo volume, bulky almost to clumsiness as this volume is.

The work shows signs of being cramped, and there is evidence that the vast amount of information at the author's disposal has been unduly condensed, and that the material has lost in the process. This is not of too great importance, or wholly a drawback. For it is distinctly an advantage to have a fauna containing all the main facts in one volume, and, despite its fatness, we may call it a handbook to the vertebrate fauna of North Wales, if it is not a history of it; and the way is still left open to anyone who may be able and willing to write a "Birds" of any of the North Welsh counties. How fascinating such a book, dealing fully with the bird-life, would be only those who know Wales in the spring and early summer can tell. But even in the present work we should have been glad of more details. The life-histories as observed in North Wales could have been fuller with advantage. We do not notice that the habit of the merlin of breeding on the sea coast in other districts besides Anglesey is alluded to, or the fact of the overflow population of great jackdaw haunts nesting in crowds in rabbit burrows on a hillside; and many other points might have been touched upon. More exact details of the *local* nests of the buzzard built in trees would have been welcome. Nor is the distribution of birds in the breeding season so exact and full (safeguarding rare birds being understood) as might be. More details of the position of breeding stations of rock birds might have been given; and in the introduction a few pages might well have been devoted to a description of some of the more notable sea-bird stations.

This fauna is to a great extent pioneer work, and

[1] "The Vertebrate Fauna of North Wales." By H. E. Forrest. Pp. lxxiv+537; with 28 plates and a map. (London: Witherby and Co., 1907.) Price 17*s.* 6*d.* net.

the author points out that there is a great deal of work still to be done, especially among the reptiles and the marine fishes. There are blanks, too, in the general record that it has been impossible to fill owing to the lack of resident observers. The records from Snowdonia and the central moorlands, for example, are derived almost entirely from the observations of naturalists who have visited those districts from time to time, and there are few or no winter records from these districts. The author proposes to publish additional records in the form of a supplement. We might suggest instead of this a new edition in two or more volumes, with more space and greater detail and the *authority* for the statements, which should always be given in a compilation.

Mr. Forrest has carried out a difficult and laborious task so well that we feel he might well undertake a work which would be monumental as a history of the vertebrate fauna of the most interesting (from that point of view) part of these islands. It was not to be expected that many of the rare stray avian visitors which straggle to our shores would penetrate so far as Wales. Nor are its shores patrolled day after day, in season and out, by men with guns on the look-out for a rarity, as are parts of our east and south coast. Two hundred and seventy-two species of birds are enumerated. But it is in its breeding species that the richness of the North Wales avifauna consists. The author states that 143 species have been known to breed in the district. They do not all do so now; but it has a list of 126 annual breeders, although its total area is not much more than half that of Yorkshire, which, despite great diversity of physical features, can only claim three less.

Treating of the Welsh names, which are dealt with very fully, the author states that his aim has been to include only those which are actually used by the people of the district; "'book' names are excluded." We cannot, however, regard some of the names given as other than book names. The honey buzzard, for instance, seems far too rare to have a genuine Welsh name; the same may perhaps be urged in the case of the black-tailed godwit, and there seems no reason why it should be called "black plover." Again, if the Welsh locally distinguished the Arctic from the common tern at all, there seems no reason why they should have pitched upon a word meaning Arctic or northern unless they had been influenced by books. Nor can we agree with the author (while giving full weight to his authorities) in rendering barcud as kite. Bergut or bearcoot is the name for an eagle among the Kirgiz Tartars, and the buzzard is really an eagle, while the kite is not. Moreover, we have, according to Eugene Rolland, barged and barguet for the buzzard in Breton and Breton Armoricaine, but no name like it for the kite in those branches of the Celtic language. The bird of which Giraldus Cambrensis and his companions heard the sweet notes between Carnarvon and Bangor was not in all probability a golden oriole. Giraldus says "of a bird, which some said was a woodpecker, and others, more correctly, an aureolus." He was not the last to mistake a green woodpecker for an oriole. The misprints are so few that there is no sheet of *errata et corrigenda*. Had there been, perhaps the unfortunate blunder about the buzzard would not have gone uncorrected. The statements that it rears two broods in the year, and will lay again if robbed of its first clutch of eggs, are, of course, the opposite of the facts. A map of so diversified a district is doubtless a serious and troublesome matter, but the one given in this volume is on so small a scale, and the names are printed in so small a type, that it is almost useless to eyes that read ordinary small print without difficulty.

THE WATER PROBLEM IN AGRICULTURE.[1]

THE increasing use of artificial manures and of improved tillage implements has rendered possible an increase in the amount of produce obtained from a given area of land, and attention has during the past few years been directed to another factor, the water supply, which at present limits crop production in a number of cases. The amount of water actually transpired through the crop depends on too many circumstances to be stated with precision, but it may be roughly estimated at 300 lb. or more for every pound of dry matter produced, so that if two tons of dry matter is produced per acre, at least 600 tons of water, equal to 6 inches of rain, will be used in transpiration, quite apart from what is lost by evaporation, percolation, &c. A crop of this size is by no means excessive; indeed, in some types of intense cultivation three times as much produce would be aimed at. Even in England the problem is often serious; it is far more so in countries where the rainfall is deficient during the whole or part of the growing season.

In order that a large proportion of the rain-water should remain near the surface of the soil within reach of the plant roots, it is obviously necessary to reduce loss by percolation and evaporation. The practical man in dry districts has succeeded in evolving methods which go some way to doing this. The methods and implements used by the Madras cultivators are described by Mr. H. C. Sampson in the Agricultural Journal of India. In some districts recourse is had to deep ploughing with a heavy plough, followed by a lighter plough, and then when the crop is up the land is hoed. In other districts the plough is the only tillage implement. But in practically all cases the plan is to stir the surface of the soil after a rain, and to keep the top soil loose during the growth of the crop. The methods adopted in the arid regions of the United States are described in the Transvaal Agricultural Journal (April, 1908) by Mr. Macdonald, and in the Journal of Agriculture of South Australia (March, 1908) by Mr. Strawbridge, who was sent with the express purpose of reporting thereon. They include deep ploughing, followed by harrowing, so as to get the soil into a fine state; the harrowing is, as a rule, repeated after each rain. When the crop is up the surface soil is frequently stirred. It seems definitely established that when the top layer of soil is in a loose condition it retains water better than if it is compact, but the loose condition must be maintained by constant stirring.

The gain in water content may probably be ascribed to decreased evaporation, for water evaporates less freely from loose than from compact soil. The explanation usually given is that the movement of water in soils (apart from the gravitational flow) is a surface-tension effect akin to the rise of water in capillary tubes, and is therefore facilitated when the spaces between the particles are diminished, and impeded when the spaces are kept large. Frequent stirring of the soil, which prevents it becoming compact, reduces the capillary movement of water to the surface, and consequently lessens the evaporation. This hypothesis explains a good deal, but unfortunately it has not been very fully developed; there is little doubt that if some physicist would take the matter up he could obtain results of great importance to agricultural science and practice.

[1] (1) The Agricultural Journal of India, vol. iii., part 1. (1908.)
(2) Memoirs of the Department of Agriculture in India, vol. i., No. 6, "The Loss of Water from Soil during Dry Weather," by J. W. Leather.
(3) The Transvaal Agricultural Journal, April, 1908.
(4) The Journal of the Department of Agriculture of South Australia, March and May, 1908.

A number of measurements showing the amount of evaporation from the soil, or the amount of water left behind in different circumstances, have already been made, and Dr. Leather adds a further interesting series. Water determinations were made in samples taken to a depth of 7 feet from a plot of soil at Pusa during the dry season. The results are as follows :—

Lbs. of water per Cubic Foot of Soil.

Depth	Sept. 19	Oct. 20	Nov. 30	Jan. 8	Feb. 15	March 27	May 6	June 5	June 15
0–1 foot	18·97	15·78	14·21	12·15	12·10	14·18	10·83	13·87	10·41
1–2 feet	20·96	19·27	17·95	18·17	18·79	19·62	16·39	15·40	15·38
2–3 ,,	24·75	18·84	10·68	11·95	12·00	10·51	10·35	9·67	9·03
3–4 ,,	25·55	17·51	18·35	13·54	11·27	9·27	6·55	6·63	6·36
4–5 ,,	25·65	23·69	21·91	21·07	20·18	19·56	18·10	16·20	16·64
5–6 ,,	26·42	25·60	24·50	24·00	23·54	22·45	20·82	19·45	18·99
6–7 ,,	26·42	26·00	25·00	25·00	25·30	25·26	24·5	23·10	24 00
Total	169·12	146·69	133·00	125·88	123·18	120·85	107·57	104·32	100·81
Rainfall in inches since last determination.....		0·82	nil	nil	1·14	1·85	0·89	2·08	

The showers only seem to have affected the surface layer. It will be observed that there is a considerable break below the fourth foot; this is due to a change in the soil, which unfortunately was not uniform throughout the entire depth. Taken as a whole, the figures show that the rate of loss decreases as the depth increases, but the want of uniformity of the soil makes it impossible to get out any expression showing the rate of loss. Dr. Leather argues that water moves upwards from a limited depth only, and considers that none has come from the seventh foot, but he offers no evidence on this point. The results are equally well explained on the supposition that the upward movement takes place at all depths, since the amount of water present in a particular layer depends on the respective rates at which water is gained from below and lost to the upper layers. If these measurements could be repeated on a fairly uniform piece of soil the results would furnish very valuable data for a study of the movements of water in soil.

E. J. RUSSELL.

LORD KELVIN.[1]

THESE notices of the life and work of Sir William Thomson, Lord Kelvin, are all true, and they are all quite different from one another. Prof. Larmor dwells upon the important mathematical theorems with which Lord Kelvin enriched natural philosophy, and he is almost indignant that mere inventions for the service of man should have occupied the best time in the life of the greatest of naturalists. It is a masterly essay, and will be of the greatest value to some future biographer or historian of science. As Stokes and Fitzgerald are dead, there is nobody now living who could have done the work so well as Larmor. Nobody ever could have done it better.

Prof. Gray's book gives a very straightforward and interesting account of Kelvin's work; he does not dwell so much upon that part which had the higher mathematical aspects; he writes as an old pupil, as one who was Kelvin's secretary, and as the present occupant of his professorial chair. Probably this book will give most satisfaction to the general reader, but the reader must be one who already knows something of what Kelvin did in electricity and magnetism, and elasticity and light and thermodynamics. It gives an interesting account of college life and Kelvin's relations with his assistants and students.

Prof. Ayrton's article, in spite of an obvious restraint, is intense with affection and enthusiasm for the memory of his master. He dwells on none of the great theorems which are of fundamental importance in all applications of mathematics, which indeed created many parts of natural philosophy; he only casually mentions the discoveries and inventions of his chief, for he assumes that they are all well known; he merely recalls his own experiences of forty years ago, and his story is alive with interest, with reminiscences of a thousand acts of kindness and words of sympathy from a man who never seemed to remember his greatness when he was talking to a student, for indeed he was always a fellow-student.

Prof. Thompson's lecture, delivered to the members of the Institution of Electrical Engineers, was perfect for its purpose. He touched on most of Kelvin's work, but in particular he recalled to the leaders in electrical engineering the history of their profession. That history may be said to begin with Faraday and with Thomson's papers when he was not yet twenty years of age, papers in which he recognised the inner meaning of Faraday's work. Until he died he never ceased to make electrical history, but the most wonderful time was the time of his youth, when he was developing the theories which were to educate Maxwell. The lecturer recalled the practical electrical engineering work of the man who, when he died, was president of the institution for the third time. This is not the place to speak of the many other tributes which have lately been written to Thomson's genius and ability. The real life of Lord Kelvin has yet to be written, and the biographer will take account of the notices now before us, as well as many others, and he will especially use that masterly essay by Fitzgerald which was prepared for the Kelvin jubilee.

To us, Prof. Larmor's notice is the most wonderful of these productions. Was there ever so long an obituary notice of a Fellow in the Proceedings of the Royal Society? And this notice is filled not only with an enumeration of the contributions of Kelvin to applied mathematics, with sufficient detail to keep the reader intensely interested, but also with ungrudging praise. To anyone who knows the severity of Prof. Larmor's criticism, the almost impossibly high standards which the modern Cato is in the habit of applying to all scientific work involving mathematics, this obituary notice will count as the greatest praise ever given to any scientific man! It is from another point of view that we would ask students to read particularly what Prof. Larmor says about the memoirs of Clausius of 1850 and Thomson's papers on thermodynamics until 1851 and on to 1855. It is just possible that the men who think they know the thermodynamic events of that most interesting time may find that Thomson's habits of self-effacement have made it necessary now to re-write the history. We know that it was all one to him; he never made a claim for priority except on behalf of somebody else than himself. We are sorry to say that we can make no more comments on these essays; when we try to write, memory throngs too much with reminiscences and power of expression fails us. He is still too close to us; affection and emotion are overpowering. We have

[1] Proceedings of the Royal Society; Obituary Notice of William Thomson, Baron Kelvin. By J. L. Pp. i+lxxvi.

"Lord Kelvin, an Account of his Scientific Life and Work." By Dr. Andrew Gray, F.R.S. (English Men of Science Series.) Pp. ix+318. (London: J. M. Dent and Co., 1908.) Price 2*s.* 6*d.* net.

"Kelvin in the Sixties." By Prof. W. E. Ayrton, F.R.S. An article in the *Times* Engineering Supplement, January 8, 1908.

"The Kelvin Lecture." By Prof. Silvanus P. Thompson, F.R.S. Proceedings of the Institution of Electrical Engineers.

been under the spell of the presence of a truly great man; it is impossible to describe our experiences. We loved him as no master was ever before loved by his disciples. We know something of the greatness of his work, but we are too close to him to measure its real grandeur. It is only at far-away Interlaken that one can see the magnificence of the Jungfrau; it will be a hundred years hence that anybody will be able to write justly about Kelvin. That Ayrton should write as he has done was a thing astonishing to many, but quite expected by us. That Larmor should have written as he has done has filled us with unspeakable pleasure.

THE STATURE OF THE RACES OF EUROPE.

THE spread of interest in anthropometry during recent years is clearly indicated in the second part of Dr. Deniker's treatise on European ethnography, which has just been issued by the Association Française pour l'Avancement des Sciences. A comparison of the data collected by the author in this paper with those he was able to draw on for his Huxley memorial lecture in 1904 shows that all over Europe active work is in progress, and that many of the gaps in our knowledge of the physical characters of the living populations are being rapidly filled.

In the present paper Dr. Deniker has supplemented his observations on the cephalic index published in 1899 by a study of the average stature of the male population of the various territorial units of Europe, the results being shown by means of varying shades and colours on a large-scale map. There are separate shades for each difference of twenty-five millimetres in average stature between 1599 and 1725.

The greater part of the material available for study consists of returns of the stature of conscripts in the various countries, and unfortunately the mode of return employed is not uniform. In some States the returns include the stature of all called up for service, whether ultimately enrolled or not, while in others the figures for those rejected from military service on account of deficiency in physique or other causes are omitted. To obviate as far as possible the difficulty arising from this difference of method Dr. Deniker has designed and applied various correction factors. In the main these have consisted in adding one centimetre to allow for growth subsequent to the age of twenty, when the average was based on the stature of all called up for service, whether ultimately accepted or rejected; to make no change when the stature of accepted individuals only was recorded, the deficiency of the rejected being regarded as a counterpoise to the subsequent growth of the recruits actually enrolled; and to deduct a centimetre from the average when it was based on measurements of soldiers between twenty-two and twenty-five years of age.

Dr. Deniker would seem to have utilised every possible source of information, with the result that the bibliography appended is most exhaustive, and is particularly valuable in its references to publications in the various Slavic languages. The value of the averages as recorded on the map shows wide variation, since they are based in some cases on thousands of observations, and in others only on tens. This is pointed out in the text, but it might be possible in a succeeding volume to indicate by shading, not, as in this case, the actual average, but the range within which subsequent series of averages might be expected to fall.

Information is absolutely lacking from very few districts, chiefly small areas in Russia and the Balkan peninsula, though in these countries recent work has done much to fill up the gaps appearing in previous maps of the distribution of physical characters. Far more regrettable is the fact that there are no returns at all of stature from North Germany other than Schleswig-Holstein and part of Mecklenburg. This is the more astonishing when we consider the standing and the activity in other directions of the German school of anthropology.

The map shows that the populations with the tallest average stature are to be found bordering on the shores of the North Sea and the Baltic in the British Isles, Scandinavia, Finland, and Esthonia. These people, also characterised by long heads and fair or light brown hair, are termed by Dr. Deniker the Nordic race. This term is coextensive with Teutonic, the designation more commonly employed in this country, but presents the advantage of being less liable to misconception.

The word Teutonic is rapidly tending to become as comprehensive and therefore useless as the word Celtic.

Another zone of tall populations stretches up through the Balkan peninsula into Central Europe as far as the Tyrol, and a third is situated in the Caucasus.

These latter populations are broad-headed, and, as has been pointed out by Prof. J. L. Myres, very probably represent a race which entered Europe at the close of the Ice age from the Anatolian highlands, and are referred to by Dr. Deniker as the Adriatic or Dinaric race.

Short statures predominate in two great centres, Russia, where the population is in the main broad-headed, and the Italian and Iberian peninsulas, where long-headedness is the rule. The former group is termed the Oriental race; the latter, usually referred to in this country as the Mediterranean or Iberian race, has been divided by Dr. Deniker into two groups, according to stature. Where the average exceeds 165 centimetres he refers to a population as belonging to the Atlanto-Mediterranean race; where it is below this level he terms them Ibero-Insular. Since in other characters the two groups are very similar, it would seem doubtful if the subdivision were quite necessary. The remaining populations of Europe are of intermediate stature.

The division of the European populations into northern and southern long-headed groups, the former characterised by tall stature and fair hair, and the latter by short stature and dark hair, rests on plainly established foundations, and all the members of each group are clearly related, though it is uncertain whether the two main groups had a common origin in comparatively recent times. The relations of the central European broad-headed group are less clear, and further research is needed to determine the affinities, if any, of the Cevenole or Alpine race of short broad-heads with the short eastern European broad-heads who chiefly speak Slavic languages and the taller Balkan and Caucasian broad-heads. It is only by more complete knowledge and detailed analysis, such as characterises the present work, that we may look for answers to these and allied problems.

The value assigned to the population of the British Isles in Dr. Deniker's map is probably an example of the dangers of incomplete surveys. From the figures obtainable chiefly from the report of the British Association Committee in 1883, and the work of Haddon and Browne, Beddoe, Gray and Tocher, it would seem that this country presents the highest

average stature of Europe. It is to be feared this estimate, based on somewhat small numbers, is too favourable. The impression gained on returning to England after a tour in Scandinavia is scarcely that of the superiority of the English physique. The probable explanation is that the majority of the recorded observations in this country has been made in rural districts, while the actual majority of the population has been subjected to urban influences.

During the last few years a large number of measurements of children in our large towns have been made in connection with the study of school hygiene, and afford data for comparison with the series obtained in Stockholm by Axel Key, and it may be noted that at all school ages the Swedish children show a distinct superiority both in stature and weight. Indeed, the British children present averages very nearly the mean between the Swedish and Italian averages, which would agree well with the view that both Teutonic and Mediterranean races are represented among the present-day English in about equal proportions.

A final feature of great interest recorded in Dr. Deniker's work is the distinct increase in stature which has taken place during the last half-century among several of the European populations, chiefly those which have participated in the general amelioration of social conditions and improvements in hygiene without being to a great extent subjected to urbanising influences.

Further investigations into national physique are urgently needed from the economic and public health standpoint, as well as to elucidate the problems of the systematic anthropologist. It is to be hoped that in time a detailed survey of this country may be undertaken, and that the results may be available for subsequent volumes of Dr. Deniker's comprehensive and illuminating work.

ARTHUR LISTER, F.R.S.

BY the death of Mr. Arthur Lister, F.R.S., which, as announced in our issue of July 23, took place at his residence at Leytonstone, Essex, on Sunday, July 20, the science of cryptogamic botany has sustained a severe loss. The deceased gentleman, who was a J.P. for his native county, was the son of the late Mr. J. Jackson Lister, F.R.S., of Upton Essex, where he was born in the year 1830. He was a brother of Lord Lister, and in 1855 married Susanna, daughter of the late Mr. William Tindall, of East Dulwich. From an early period of his career Mr. Lister devoted himself to the study of the Mycetozoa, a group formerly classed with the funguses, but now, largely owing to his researches, allowed to rank as a group of equal value by itself, characterised specially by the peculiar mode of development of its members. In addition to numerous separate papers on the subject in the journals of various scientific societies, Mr. Lister wrote the valuable "Monograph of the Mycetozoa," published in 1894 as one of the well-known British Museum catalogues. Since the date of its appearance this thick green volume, which is illustrated by a large number of plates and text-figures in black and white, remained the standard work on the subject. By the lapse of time it had, however, as a matter of course, become out of date, and, until incapacitated by failing health, Mr. Lister, aided by his daughter, was engaged on preparing a new and enlarged edition.

The issue of this work, as we have been kindly informed by the keeper of the botanical department of the Museum, will not be stopped by the demise of the senior author, Miss Lister having undertaken the task of bringing it to completion single-handed. The new edition will be far superior to its predecessor in the matter of illustrations, these including a number of plates reproduced by the three-colour process from Miss Lister's sketches.

In addition to cataloguing the species in the Museum collection, Mr. Lister gave in the original edition of this work a valuable account of mycetozoan development and physiology. Mr. Lister joined the Linnean Society so long ago as 1873, serving on the council from 1891 to 1896, and as a vice-president during the last year of this term of office. In 1898 he was elected a Fellow of the Royal Society.

NOTES.

ON August 5, 1858—fifty years ago—the work of laying the first Transatlantic cable was completed, and telegraphic communication was established between Great Britain and America. As is well known, the cable failed to transmit after a few weeks, but the practicability of connecting the two countries electrically had been demonstrated, and the jubilee of this enterprise cannot be passed without a word of congratulation.

COUNT ZEPPELIN started in his airship from Friedrichshafen at 6.45 a.m. on August 4, and after passing over Bâle, Strassburg, and Karlsruhe, reached Mannheim at 2.40 p.m. A descent was made near Oppenheim at 6 p.m., and the journey was continued at 10.15 p.m. The airship passed over Mainz at 11.0 p.m., and then headed up the Rhine for the homeward journey, reaching Mannheim at 1.45 a.m. on August 5, Eppingen at 4 a.m., and Stuttgart at 6.20 a.m., where, according to the latest telegrams, it broke away from its moorings and caught fire during a storm, and disappeared into the air, Count Zeppelin being safe.

THE Paris correspondent of the *Times* reports that the Russian Government has offered a prize of 50,000 roubles (5000*l*.) for a flying machine competition which is to take place next year at St. Petersburg between July 1 and August 15.

THE annual meeting of the French Association for the Advancement of Science was opened at Clermont Ferrand on August 3, when the gold medal of the association was presented to Sir William Ramsay, K.C.B., F.R.S.

THE President of the Board of Trade has appointed Lord Rayleigh, P.R.S., Prof. J. J. Thomson, F.R.S., Dr. R. T. Glazebrook, F.R.S., Sir John Gavey, C.B., and Mr. A. P. Trotter to be the British delegates to the International Conference on Electrical Units and Standards which is to assemble in London on October 12. Mr. W. Duddell, F.R.S., and Mr. M. J. Collins, of the Board of Trade, will act as secretaries to the British delegates, and Mr. F. E. Smith and Mr. C. W. S. Crawley as assistant secretaries.

AT the meeting of the Royal Society of Edinburgh on Monday, July 20, Dr. R. H. Traquair, F.R.S., vice-president, in the chair, the following prizes were presented in accordance with the award of the council:—(1) the Keith prize for the biennial period 1905–7 to Dr. Alexander Bruce, for his paper entitled "Distribution of the Cells in the Intermedio-lateral Tract of the Spinal Cord," published in the Transactions of the society within the period; (2) the Neill prize for the triennial period 1904–7 to Mr. Frank J. Cole, for his paper entitled "A Monograph on the General Morphology of the Myxinoid Fishes, based

on a Study of Myxine," published in the Transactions of the society, regard being also paid to Mr. Cole's other valuable contributions to the anatomy and morphology of fishes.

AT Tavistock on July 20, Colonel G. F. O. Boughey, R.E., and Mr. H. A. Steward, Light Railway Commissioners, sanctioned a line on a gauge of 4 feet 8½ inches to be constructed on Dartmoor near the famous Merrivale avenues of stones, provided that the line "be put quite 200 feet away from the Menhir." Mr. Hansford Worth, who gave evidence at the inquiry against the line, pointed out that the railway would pass through a remarkable group of prehistoric monuments, and that the embankments would interfere with the view. Mr. R. Burnard also strongly protested against the construction of the line, and read a letter from the president of the Society of Antiquaries deprecating any encroachment upon the ancient remains, which are almost unique in character. These protests, however, availed little, for the line may be brought within seventy yards of the avenues, and will in all probability lead to the destruction of the Merrivale antiquities, which are to a great extent unprotected. It is apparently too much to expect that our ancient monuments shall be protected by the State from the interference of company promoters. No doubt it is of commercial importance to convey granite from quarries easily, but this is not sufficient reason for carrying a line near ancient monuments which can never be replaced when once destroyed.

THE recently published report (Cd. 4202) of the Royal Commission on the Care and Control of the Feeble-minded will be followed by seven other volumes detailing the evidence taken by the Commission. The Commission was appointed in September, 1904. It appears from the report that the total number of mentally defective persons, including certified lunatics, in England and Wales, may be estimated to be 271,607, or 0·83 per cent. of the population. Excluding those certified, it is estimated, as a result of medical investigations, that in urban districts 12·7 per cent., and in rural areas 18·75 per cent., of the population in Poor Law institutions are "mentally defective." The Commissioners consider that from 60 per cent. to 70 per cent. of the habitual inebriates dealt with under the Inebriates Acts are mentally defective. They refer to heredity and mental defect, and sum up the effect of the evidence under three heads:—(1) That both on the grounds of fact and of theory there is the highest degree of probability that "feeble-mindedness" is usually spontaneous in origin—that is, not due to influences acting on the parent—and tends strongly to be inherited. (2) That, especially in view of the evidence concerning fertility, the prevention of mentally defective persons from becoming parents would tend largely to diminish the number of such persons in the population. (3) That the evidence for these conclusions strongly supports measures, which on other grounds are of pressing importance, for placing mentally defective persons, men and women, who are living at large and uncontrolled, in institutions where they will be employed and detained; and in this, and in other ways, kept under effectual supervision so long as may be necessary.

SURPRISE has been expressed that the provisional programme of Section A of the British Association was not published last week with the draft programmes of other sections for the meeting to be held in Dublin next month. We regret that the programme did not reach us with the others, but it has now been received, and is as follows:—

The address of the president of the section, Dr. W. N. Shaw, F.R.S., will be delivered on the Thursday morning, September 3. Discussions have been arranged on (1) the isothermal layer of the atmosphere, to be opened by M. Teisserenc de Bort; (2) the theory of wave motion, to be opened by Prof. H. Lamb, F.R.S. The section will also join with Section G in a discussion on gaseous explosions. *Papers:* Sir John Moore, is our climate changing? Commander Campbell Hepworth, R.N.R., a comparison of the changes in the temperature of the waters of the North Atlantic and in the strength of the trade winds; J. T. Craig, changes of atmospheric density in storms; E. M. Wedderburn, seiches and their relation to atmospheric phenomena, also temperature conditions of Scottish lochs; G. T. Walker, seasonal variations; Prof. H. H. Turner, on the relation between intensity of light, time of exposure, and photographic action; Rev. A. L. Cortie, S.J., on the possible existence of steam in the regions of sun-spots; Prof. F. W. Dyson, the systematic motions of the stars; Sir R. S. Ball, a generalised instrument; A. P. Trotter, position of the mercury ohm in British legislation; Sir O. J. Lodge and B. Davies, on the measurement of large inductances containing iron; Prof. A. M. Worthington, a remarkable feature in the splash of a rough sphere; Prof. J. A. McClelland, secondary radiation; G. A. Hemsalech, on new methods of obtaining the spectra of flames; Sir Wm. Ramsay, K.C.B., do the radio-active gases (emanations) belong to the argon series? T. Royds, further experiments on the constitution of the electric spark; H. Stansfield, secondary effects in the echelon spectroscope; Dr. W. G. Duffield, photographs of the spectra of metals under pressure; Dr. J. A. Harker and F. P. Seaton, on the effect of pressure upon the boiling point of sulphur; Prof. F. T. Trouton, analogy between adsorption from solutions and aqueous condensation on surfaces; Dr. S. H. Burbury, on the law of equipartition of energy between correlated variables; Lieut.-Colonel Allan Cunningham, factorisation of the A.P.F. of $N=(y^n \mp 1)$; Dr. J. W. Nicholson, the self-inductance of two parallel wires; Sir R. S. Ball, physical applications of linear vector functions; Dr. E. W. Hobson, on Sir W. Hamilton's fluctuating functions; Prof. F. Purser, on the æther-stress of gravitation; Prof. A. W. Conway (title not received); Prof. E. T. Whittaker (title not received); Sir Howard Grubb, a particular form of double-image telescope, also the new spectroheliograph for the Madrid Observatory; F. J. M. Stratton, the constants of the lunar libration; Dr. J. W. Nicholson, the asymptotic expansions of Bessel functions. The reports of the various committees connected with the section will also be read.

INVERTEBRATES from the Upper Cretaceous of Need's Camp, Buffalo River, constitute the subjects of the first part of vol. vii. of the Annals of the South African Museum, Mr. W. Lang, of the British Museum, treating of the polyzoans and corals, while the sea-urchins and their allies, the brachiopods, and the bivalve molluscs are described by Mr. H. Woods, of Cambridge.

THE migrations of flat-fishes and crabs continue, according to the report for 1907, to engage the attention of the staff of the Northumberland Sea Fisheries Committee, and it appears to be established in the case of the latter that while the females travel north, the males are more or less stationary. A large portion of the report is occupied by a paper by Miss M. V. Lebour on the trematodes infesting fishes on the Northumberland coast, in the course of which several species, presumably unrecognised by previous writers, are named and described.

THE articles in the first part of vol. xci. of *Zeitschrift für wissenschaftliche Zoologie* are all devoted to the anatomy of invertebrates, and treat of subjects for the most part interesting to the specialist. Mr. R. Demoll, for instance, discusses the mouth-parts of solitary bees, while the structure of the median eye of the ostracod crustaceans forms the subject of a paper by Dr. M. Nowikoff, and Mr. Walter Döring describes the structure and development of the female reproductive organs of certain cephalopods.

A SYSTEMATIC monograph, by Dr. J. J. Tesch, of the heteropodous molluscs included in the family Atlantidæ, with a list of the species represented in the museum collection, forms the subject of an article in the first part of vol. xxx. of Notes from the Leyden Museum. The author, who states that the group has received but little attention for many years, recognises three genera, one of which is for the first time named and described, the characteristics on which these are based being drawn partly from the shell and partly from the "animal."

To the July number of the *Zoologist* Mr. S. M. Perlmann contributes a paper entitled "Is the Okapi Identical with the 'Thahash' of the Jews?" The word "thahash" has been translated "badger" and "dolphin," but both these readings are conjectural. The Talmudists, according to Mr. Perlmann, considered it, however, to be a ruminant, of a beautiful colour, with a single horn on the forehead. To a great extent, apparently on account of the presence of "a horn-like elevation at the root of the nose" in the okapi, the writer of the paper identifies it with that animal. Apart from the improbability of an exclusively equatorial animal being known to Moses (although the possibility of skins being imported from the south into Egypt may be admitted), the Talmudists' description of the "thahash" does not accord with that of the okapi, of which the males carry a pair of well-developed horns on the forehead—a fact with which Mr. Perlmann appears to be unacquainted. The slight swelling on the nose of the female can scarcely be described as horn-like.

AMONG the biological papers in the July issue of *Science Progress*, special interest attaches to one by Mr. W. A. Brend on tuberculosis in animals. After referring to the fact that recent investigations on the subject have been conducted on two lines—one into the effects produced on animals by the bovine tuberculosis bacillus, and the other by that of human tubercle—the author points out that the animals forming the subject of experiment may be arranged, according to their relative degree of susceptibility to the human disease, in the following order, commencing with those exhibiting the greatest approximation to immunity, viz. rats and mice; dogs; cats; pigs, goats, and cattle; rabbits; and guinea-pigs, monkeys, and apes. It will not fail to be noticed that the immunity is greatest in those brought most closely into association with man. In regard to the fact that rats and mice occupy the highest position in respect to immunity, it has to be borne in mind that although in the ordinary sense these creatures can scarcely be regarded as domesticated animals, yet in a scientific sense their association with man is extremely intimate. They inhabit, for instance, his cellars and sewers, and feed upon the infected sweepings of the streets and pavements. It would be of great interest to ascertain the degree of immunity presented by field-mice.

LITTLE by little we are learning that most of the edentulous or partially edentulous mammals possess germs or other vestiges of teeth in the earlier stages of their existence, and the importance of discoveries of this nature can scarcely be overrated, since they are alone practically sufficient to demonstrate the truth of the doctrine of evolution. The latest addition to the list of mammals with such vestiges is the pangolin group (Manidæ), the members of which are completely devoid of teeth. According to a paper by Dr. H. W. Marett Tims, published in vol. xlii., part ii., of the *Journal of Anatomy and Physiology*, the jaws of a fœtus of one of these animals were found to be provided with minute pointed outgrowths, which there is every reason to regard as vestigial tooth-germs rather than hair-follicles. Some of these structures arise from the alveolar margin of the jaw, while others grow from the outer side, and if they were hair-follicles some of the hairs would fringe the alveolar margin, and others would grow outwards into the substance of the cheek. So far as can be determined, the histological structure of these growths suggests teeth rather than hairs. Assuming them to be the former, they indicate that the formula of the vestigial dentition is $\frac{3}{1\,3}$ or $\frac{3}{1\,4}$, that the teeth in the middle of the series were the largest, while all were apparently of a simple peg-like type, recalling those of armadillos.

THE two recently published parts of the *Annals of Tropical Medicine and Parasitology* (vol. ii., Nos. 2 and 3) contain a number of memoirs of great interest. Drs. Kinghorn and Montgomery report on the etiology and prophylaxis of diseases caused by trypanosomes in man and domestic animals in northern Rhodesia, and discuss incidentally the vexed question of the relation of big game to tsetse-fly disease. Messrs. Salvin-Moore and Breinl, with the collaboration of Dr. Hindle, continue their investigations upon the life-history of trypanosomes, and deal with that of *Trypanosoma lewisi*, the parasite of the common rat. A brief but pithy memoir by Dr. E. H. Ross deals with the prevention of dengue fever, by destruction of mosquitoes, in Egypt.

AMONGST parasitic protozoa, the genus commonly named Piroplasma, but more correctly Babesia, is one which has attracted great attention by its pathogenic properties, and has also given rise to much discussion concerning its systematic position, more especially as regards its relationship on the one hand to the Hæmosporidia, on the other hand to the Flagellata. Major Christophers, in his recent monograph on the development of Piroplasma in the tick, was unable to find any flagellated stages. Miyajima, however, announced (*Philippine Journal of Science*, ii., 2) that he had obtained true trypanosome-forms in a culture of a bovine Piroplasma. Drs. Breinl and Hindle state that in dogs infected with *P. canis* they have found biflagellate forms in small numbers in the peripheral blood of dogs on the day before death (Ann. Trop. Med. Parasitol., ii., 3). Their results appear to confirm the views of Laveran and Mesnil as to the affinities of Piroplasma with the genus Leishmania, the parasite of kala azar.

A SECOND portion of the "Flora of Glamorgan," dealing with the Calycifloræ, has been issued under the editorship of Dr. A. H. Trow. Besides providing a full list of localities and the Welsh names, the critical notes appended by the editor add to the interest of the work, and suggest points that require further confirmation. It is noted that *Medicago sativa* and *Melilotus arvensis* can flourish on the sterile red marl, and *Onobrychis viciaefolia* thrives on the marl, but dies off in the second year on the Lias. The gean is regarded as native to the county, but the claims of the bullace and the dwarf cherry are considered more dubious. The flora is being published as a supple-

ment to the Transactions of the Cardiff Naturalists' Society.

As in forest management we have much to learn from our Continental neighbours, it is well to ascertain the practice adopted in those countries. Mr. J. F. Annand contributes to the Transactions of the Scottish Arboricultural Society (vol. xxi., part ii.) his impressions of forestry in the Schwarzwald, observed during a course of training in the province of Baden. The silver fir generally provides the main crop, except at the higher altitudes, when spruce is the prevailing species. A small proportion of beech is found useful, but is carefully restricted. It is interesting to compare the observations recorded by Mr. Annand with the notes on the cultivation of hardwoods offered by Mr. J. Boyd. The latter, although he recommends growing coniferous and hardwood forests on separate areas, recognises that successful results can also be obtained with a mixture of both classes.

A NOTE in the *Trinidad Bulletin* (April) directs attention to the fact that the tree *Spathelia simplex*, belonging to the order Rutaceæ, is similar to the Agaves in so far as the plant grows for several years before it flowers, and then exhausts itself in the flowering and dies. A specimen that recently flowered belonged to the second generation, since the tree was introduced twenty-two years previously. In the same number will be found a detailed description of the pollination of the papilionaceous flower *Clitoria arborescens* that points to its being a complex process. Put shortly, the pollen from the stamens falls or is brushed by hairs on the stigma into a carinal pouch; the movement of bees and wasps searching for nectar causes the shedding of the pollen on to the vexillum; thence it is transferred by ants or other insects to the stigma. The flowers are inverted, and it has been demonstrated that they are self-sterile.

THE enormous advantages gained by the introduction of rapid methods for fat determination in milk has led E. B. Hart to describe in a special Bulletin (No. 156 of the University of Wisconsin) a rapid method for estimating casein in milk. The milk is mixed with chloroform to dissolve the fat, and dilute acetic acid to coagulate the casein; it is then rapidly rotated in an apparatus not unlike that used in the ordinary Gerber test, and the percentage of casein directly read off by measuring the space occupied by the clot. The trial analyses are very satisfactory, the results agreeing well with those obtained by the official method; if further work shows that the method is trustworthy, it will prove very useful to dairy chemists.

FOLLOWING up his past work on the haustorium of *Santalum album*, Mr. C. A. Barber, in No. 4 of the Memoirs of the Department of Agriculture in India, describes in detail the parasitism of *Olax scandens*. This plant is a sprawling shrub growing in the midst of thickets, thorny, with whitish sweet-scented flowers, and occurs all along the east coast of the Madras Presidency and for a considerable distance inland, chiefly at low elevations. It develops at first like an ordinary non-parasitic plant, and is capable of living for a long period on the nutriment stored in its endosperm, and, later, in its swollen stem and tap-root. There is a well-developed root system with abundant root-hairs even in old plants, and this fact, coupled with the comparative rarity of haustoria in the earlier stages of growth, suggests that the parasitism is in a somewhat elementary stage. The memoir is very well illustrated.

IN connection with an account of the observation of local earthquakes at Mt. Tsukuba in 1905 (Publications of the Japanese Earthquake Investigation Committee, No. 22 A), Prof. Omori discusses the least limit of motion which is sensible, and finds that the lower limit was a double amplitude, or range of motion, of 0·013 mm. for earthquakes unaccompanied by sound; where the earthquake was accompanied by sound, and the vibration probably more rapid, this limit fell to below 0·01 mm. In an earlier investigation of artificial vibration he had determined the minimum acceleration, which was sensible as 17 mm. per sec. per sec. These quantities give a numerical value of the feeblest earthquake which is ordinarily sensible to human beings favourably situated for noting the shock.

IN the Bulletin of the Japanese Earthquake Investigation Committee, vol. ii., No. 1, Prof. Omori deals with the annual variation in the frequency of earthquakes at Tokio and Kioto. Of the eighteen destructive and semi-destructive earthquakes which have been recorded at Tokio, seven occurred in summer and five in winter, but only three each in winter and spring; small earthquakes, on the other hand, are most frequent in winter and spring, and least frequent in summer and autumn. At Kioto the greatest frequency of small earthquakes is in March, the minimum in September; of great earthquakes, the maximum frequency is in August and the minimum from February to April, no destructive earthquakes having been recorded in these months. It will be seen that, as regards great and small earthquakes respectively, the frequency at Kioto is the reverse of that at Tokio, but in each case the frequency of one class of earthquakes is greatest when that of the other is least. The author has found that the same relation holds good for the earthquakes of Japan as a whole, and for the submarine earthquakes off the coast of Japan.

THE Geological Survey of Canada has issued a bulletin (No. 979) containing a report by Mr. R. G. McConnell on work done in the Klondike during the past season. The object in view was to estimate the recoverable values remaining in the high-level gravels along Bonanza and Hunker creeks, and in a portion of the Klondike valley, and also to obtain as much information as possible in regard to the values remaining in the low-level or creek gravels. The author estimates that gold to the value of 18,950,000*l*. has been produced in the past, and that the value of the recoverable gold remaining is 10,728,524*l*. While it is unlikely that any large area of rich gravel has escaped detection, minor discoveries may be expected so long as mining lasts, and on this account any estimate is apt to be somewhat under rather than over the mark. The report is accompanied by a large coloured contoured map of the auriferous gravels on Bonanza and Hunker creeks on a scale of 40 chains to the inch. In another bulletin (No. 992) issued by the Survey, Mr. W. H. Collins gives a report on a portion of north-western Ontario traversed by the National Transcontinental Railway between Lake Nipigon and Sturgeon Lake. All the rocks of the territory explored are pre-Cambrian and almost wholly crystalline. The Keewatin green schists are the most interesting series in that they are gold and iron bearing. Gold is mined on Sturgeon Lake, and very promising iron-ore deposits have been opened up near Lake Nipigon. The report is accompanied by a large coloured geological map of the district on a scale of 4 miles to the inch.

MR. A. J. PHILIP contributes to the July number of the *Reliquary* a useful article on the dene-holes of Kent and

Sussex. The name usually given to these remarkable structures probably connects them in popular tradition with the Danes. The writer reviews the many theories which have been advanced to account for their origin—that they were flint-workings; places of secret worship and repositories for the remains of the dead; underground dwellings or hiding-places; excavations for the extraction of chalk. All these are found to be inadequate. The amount of flint which could have been obtained in such places is insignificant, and no attempt seems to have been made to work the small existing supplies; there is no evidence that they served any purpose in connection with a religious cultus; the existence of many excavations within a limited area renders it improbable that they were dwelling-places or refuges, their contiguity exposing them to simultaneous hostile attack, while their construction offers no facilities for escape; their character shows that the removal of chalk was not the primary intention. Mr. Philip favours the supposition that they were intended to be used as silos, or underground granaries, and most of the arguments adduced in opposition to the other theories contribute to establish this view. Thus they were naturally close together, because the tribe clustered within a narrow area. The principal objection is the risk of damp; but, as a matter of fact, the caves seldom show signs of being affected by underground moisture, and perishable grain was probably protected by thick surrounding layers of straw. That they were not the work of a single age is shown by the fact that the character of the pick-marks varies; in the older specimens we find marks of horn, bone, and flint tools; in those of a later date metal implements were used. The shaft is invariably some 3 feet in diameter, and seldom less than 60 feet in depth, ingress and egress being provided by means of a rude ladder or by ropes of hide.

THE Deutsche Seewarte has recently published a double number (Heft 15 and 16) of its collection of over-sea meteorological observations, referring chiefly to the years 1905–6. The work includes (1) monthly and yearly means of eye observations and automatic records made under the supervision of the Seewarte at twenty-five stations; (2) individual observations and hourly means at a number of selected stations in German East Africa. The whole of the tables give evidence of great care in their preparation for publication, to the cost of which the Imperial Colonial Office contributes; they furnish a very valuable contribution to the meteorology of various remote parts of the globe. We are glad to note that, in cases where only summaries are printed, the original documents are available on loan for the purpose of scientific investigations under reasonable restrictions as to their safe return.

FIVE years ago M. Ivar Fredholm published in the *Acta Mathematica* a remarkable memoir which seems likely to prove the starting point of a host of important results, both in function-theory and in mathematical physics. One of the latest works to which it has given rise is the thesis of Dr. H. Bryon Heywood, "Sur l'Équation fonctionelle de Fredholm et quelques-unes de ses Applications" (Gauthier-Villars, 1908). In this the author gives a summary of the results of Fredholm, Picard, Poincaré, and others, and gives applications to heat-conduction, tides, potential, &c. The first chapter contains an extension of some propositions of Hilbert's; this appears to be the most original part of the thesis, but the whole is worth reading, because it brings a variety of problems under the same treatment.

THE *Physical Review* for June contains a communication from Messrs. A. H. Taylor and E. H. Williams, of the University of Wisconsin, on the distributed capacity of resistance boxes. They find by the modified bridge method used by Messrs. Rosa and Grover for comparing inductances, that the capacity of the ordinary Wolff 1000-ohm coil is 0·0005–0·0006 microfarad, while that of a 1000-ohm coil wound on a wood core is only 0·00007 microfarad. Wolff 500-ohm coils give 0·00016–0·00022 microfarad, and 2000-ohm coils 0·00041–0·00063 microfarad. The authors attribute the high capacities of Wolff coils mainly to the comparatively large wire used in constructing them, but also to the shellac between the wire and the brass tube on which it is wound not being thoroughly dry. It seems evident from these results that resistance coils must be used with great discrimination in accurate alternating current measurements.

IN May last M. C. Féry gave before the Société française de Physique an account of the methods he had in succession adopted, in his endeavour to produce a pendulum electrically driven, which should be accurate to within a second a day. His communication is printed in full in the July number of the *Journal de Physique*, and from it we gather that the arrangement he finds most satisfactory is one in which the pendulum carries beneath the bob a horse-shoe magnet, the plane of which coincides with the plane of swing of the pendulum. The lower of the limbs of the magnet enters during its swing a fixed coil, and the upper a small copper ring which forms the bob of a second pendulum having the same time of swing as the first. This ring is carried along with the moving magnet owing to the currents induced in it, and makes or breaks the circuit of the fixed coil, through which a current from a cell in series with it flows in consequence in such a direction as to supply the small impulse necessary to compensate for the decay of swing of the principal pendulum owing to friction. The same arrangement is adopted by M. Féry in controlling a number of distant pendulums by means of a central standard.

WHEN sufficiently fine solid particles are suspended in a liquid they exhibit under a high-power microscope rapid motions which are known, from their discoverer, as "Brownian." These movements form the subject of an interesting study by Dr. M. Seddig in the *Physikalische Zeitschrift* for July 15. The particles were of cinnabar, a quantity of which was stirred up with the liquid and allowed to stand in a long tube for a week. The top layer of liquid was then decanted, and a drop of it arranged as a slide in a microscope fitted with a camera. An arc light provided the strong illumination necessary. By means of a falling shutter with two holes in it, two exposures, each of 1/40 second and 1/10 second apart, were made, and the motions of a number of the particles between the two exposures measured on enlargements of the original plates. As the result of observations made on the same liquid at different temperatures, Dr. Seddig comes to the conclusion that the theory of these movements given by Einstein, according to which they should vary in intensity as the square root of the absolute temperature, is in keeping with the facts.

DR. F. A. BATHER proposes to publish a double index to the generic and specific names in E. Desor's "Synopsis des Échinides Fossiles," a work still in constant use by every worker on the Echinoidea. This index will be preceded by a "Note sur les Dates de Publication," drawn up by Mr. Jules Lambert. Intending subscribers to the index should communicate with Dr. Bather at the Natural History Museum, South Kensington, S.W.

OUR ASTRONOMICAL COLUMN.

THE SOLAR ECLIPSE OF DECEMBER 22–23, 1908.—In a note to No. 4264 of the *Astronomische Nachrichten* (p. 271) Prof. W. Krebs points out that in certain localities in the Antarctic regions the solar eclipse of December next will be total for a few seconds. At Bouvet Island, totality will last for some eleven seconds, during which time, Prof. Krebs suggests, photographs of the corona might be secured. This island is, however, very difficult of access, being situated a few degrees to the west of Cape Colony and very near the Antarctic circle, well within the mean limit of the drift ice; its longitude is about 5½° E., and its latitude about 54° S.

OBSERVATIONS OF PERSEIDS, 1907.—The results of the observations of the Perseid shower at the Paris Observatory on August 11, 13, and 14, 1907, are published, by M. L. Benès, in the July number of the *Bulletin de la Société astronomique de France* (p. 326).

Between 9h. 50m. and 14h. 13m. (M.T. Paris) on August 11, one observer recorded the paths of thirty-one meteors, despite the interference of light clouds, which probably prevented the fainter objects from being seen. Clouds interfered more seriously on August 13, and only four paths were recorded in a watch extending over the ninety minutes before midnight. Sixteen meteors were observed on August 14 during the intervals 9h. 7m. to 12h. 1m. and 12h. 26m. to 13h. 21m.

Of the thirty-one meteors seen on August 11, nineteen were probably Perseids from a radiant at $\alpha=48°$, $\delta=+58°$. Three of those seen on August 13 and three seen on August 14 were probably Draconids. The general colour of the meteors was yellow or yellowish-red, and few of them left trails. The trajectory of a Perseid seen on August 11 showed a break in the middle.

MICROMETER MEASURES OF JOVIAN FEATURES.—In No. 4260 of the *Astronomische Nachrichten* (p. 191, July 3) Dr. H. E. Lau gives the results obtained from his micrometer measures of the various features on Jupiter during the most recent opposition.

The measures of the Great Red Spot confirm the diminution of the longitude of this feature, to which the Rev. T. E. R. Phillips has already directed attention in vol. xviii., No. 6, of the Journal of the British Astronomical Association; they also indicate that the Red Spot belongs to the higher strata of the Jovian atmosphere. The measures of other spots and of the various bands and streaks are also given by Dr. Lau.

PECULIAR ORBIT OF A SPECTROSCOPIC BINARY.—Observations made at the Dominion Observatory, Ottawa, indicate that the orbit of the spectroscopic binary B.D.−1°·1004 has, probably, an even greater eccentricity than that (0·75) of *i* Orionis, for which the elements were recently determined and published; the velocity curve bears a striking resemblance to that of the latter star, and the period is about the same. Observations of B.D.−1°·1004 are to be resumed during the coming autumn (Journal R.A.S., Canada, vol. ii., No. 3, p. 161).

DEFINITIVE ELEMENTS FOR THE ORBIT OF COMET 1886 V.—Definitive elements for the orbit of comet 1886 V. have been calculated by Herr Gösta Bucht, Upsala, and are published in No. 4264 of the *Astronomische Nachrichten* (p. 257, July 20). The consideration of the least-square residuals in each case establishes the fact that the orbit is elliptical, the length of the semi-major axis being 84·073 ± 1·017; the period of the comet is found to be 770·91 ± 13·84 years.

ASTRONOMICAL SOCIETIES IN THE PROVINCES.—Nos. 3–7, vol. x., of the *Cambrian Natural Observer* (February–June) contain the record of the Astronomical Society of Wales during the period they embrace. Among other articles of interest we may mention one on solar spectroscopy, in which General Lee gives a few practical hints to amateur solar observers; an article by Mr. Mee, in which he gives brief descriptions of various large public clocks; and a paper by Miss G. Hagerty, dealing with various optical phenomena. The records of local observers, and a description of the society's exhibition of instruments, photographs, &c., at Cardiff, are also very interesting.

The record of the Leeds Astronomical Society for 1907 is contained in No. 15 of its Journal and Transactions, and includes numerous papers of interest to amateur astronomers. Among these may be mentioned a paper on the transit instrument, by Mr. Spiegelhalter; a review of astronomical research in 1906 by the president, Mr. A. Dodgson; and a *résumé* of the society's work during 1907. Some supplementary notes on Tennyson's astronomy are contributed by Mr. Whitmell.

BOLIDES OBSERVED DURING MAY.—In No. 4261 of the *Astronomische Nachrichten* (p. 223, July 13), M. C. Birkenstock, of Antwerp, records the paths, &c., of three fireballs which he observed during May. One of these was seen on May 17, the other two on May 27. Of those seen on the latter date, the second appeared at 12h. 28m. (G.M.T.), and was evidently a remarkable object. As bright as Venus, its colour was reddish-yellow, and it left behind it a trail of yellowish light; the duration of the flight was estimated by M. Birkenstock to be eight to ten seconds, but other observers, reported in No. 7 of the *Gazette astronomique* (p. 53, June 30), give four to six seconds. The path was from 330°, +77°, to 268°, +10°, and, according to the elements published in the latter journal, the bolide travelled 114 km. at a speed of 14·25 km. per second; the heights at the points of appearance and disappearance were 115 km. and 62 km. respectively.

INSTITUTION OF MECHANICAL ENGINEERS.

FOR the summer meeting of the Institution of Mechanical Engineers at Bristol an interesting programme of papers was arranged. The president (Mr. T. Hurry Riches) and Mr. B. Reynolds described a system of forced lubrication as arranged for driving axle-boxes of some of the steam-cars of the Taff Vale Railway Company. Mr. C. A. M. Smith gave an account of a method of detecting the bending of columns, for which purpose he has constructed a new type of instrument to which the name "sphingometer" has been given. Mr. William Stagg described the inclined retort coal- and coke-handling plant at Bristol.

An important paper on the evolution and methods of manufacture of spur-gearing was contributed by Mr. T. Humpage. He has designed an ingenious machine for grinding the involute teeth of gear wheels, which works on the principle of the hobbing machine. His idea is that not case-hardened wheels only should be ground on this machine, but every kind of metal should be ground in the soft state, no matter for what purpose the wheels are required. The wheels would be roughed out rapidly in the gear hobbing machine with no attempt at finish, and then sent to the grinding machine to be finished, just as all lathe work that is required to be both accurate and cheaply produced is first roughed out in the lathe and then finished on the universal grinder.

Lastly, Mr. S. O. Cowper-Coles read a paper on the direct production of copper tubes, sheets, and wire by electrolysis from impure copper. The advantages of an electrolytic process as compared to a smelting process are many, and the day is not far distant when copper will no doubt be leached direct from the ore and electrolysed with insoluble anodes, to produce finished copper sheets and tubes in one operation direct from the ore without the intermediate process of smelting and refining.

The centrifugal process is a step in this direction, as it is capable of depositing copper from its solutions by using insoluble anodes in the form of finished tubes or sheets in one operation. The centrifugal process is at least ten times faster than any existing electrolytic process, and a high current density can be employed without deteriorating the quality of the copper. There is no risk of lamination, as no burnishers are employed. The plant is simple and free from mechanical complications, and the amount of copper locked up for a given output is small compared to other processes. The process is of interest to mechanical engineers, as it conclusively proves that to get a high tensile strength in metals, combined with ductility, it is not essential to put a large amount of work into the metals as hitherto has been considered necessary, by the processes of swaging, rolling, or drawing, but that a very small amount of energy will suffice.

ELECTRICITY IN AGRICULTURE.

SOME thirty years ago Prof. Lemström, of the University of Helsingfors, sought to elucidate the Aurora Borealis by trying to imitate its appearance by electrical experiments. For this purpose he produced high-tension discharges of various kinds, and sent them through vacuum tubes until he got an appearance very like those of the northern lights. Some of these experiments he conducted in his greenhouse—to the best of my belief, according to his own account, given when on a visit to England—and he noticed incidentally that the plants seemed to thrive under the treatment, and that the electrification thus produced in their neighbourhood appeared to do them good. He also noticed, as remarkable, the flourishing development of plants in Arctic regions, where the sunlight was very weak, and he attributed part of this growth to the influence of electric discharges.

He says that when the plants in the north of Norway, Spitsbergen, and Finnish Lapland have resisted the frequently destructive night frosts, they show a degree of development which greatly surpasses that of plants in more southern regions, where the climatic conditions are more advantageous. This rich development appears principally in the fresh and clear colours of the flowers, in their strong perfume, in the rapid development of the leaves on the trees, and their scent, but particularly in the rich harvest which different seeds—such as rye, oats, and barley—will produce, when, as before stated, they are not destroyed by the frosts. From a bushel of rye sown there will often result forty bushels, and from barley twenty bushels, and so forth. It is the same with grass. These results are attained notwithstanding the fact that the people cultivate their soil very imperfectly, using only ploughs and harrows of wood.

He pursued the matter by careful observation, taking test-plants in pairs or groups; electrifying one group—that is to say, discharging some electricity into the air above it—and keeping a similar group away from the electricity, in order to be able to compare them. Then he photographed the two groups side by side, and found in nearly all cases a marked improvement as the result of the electrical treatment. He concluded that the needle-like shape of the leaves in fir-trees, and the beard on the ears of most cereals, have the discharge of electricity as their function; and he found that they do act in this way.

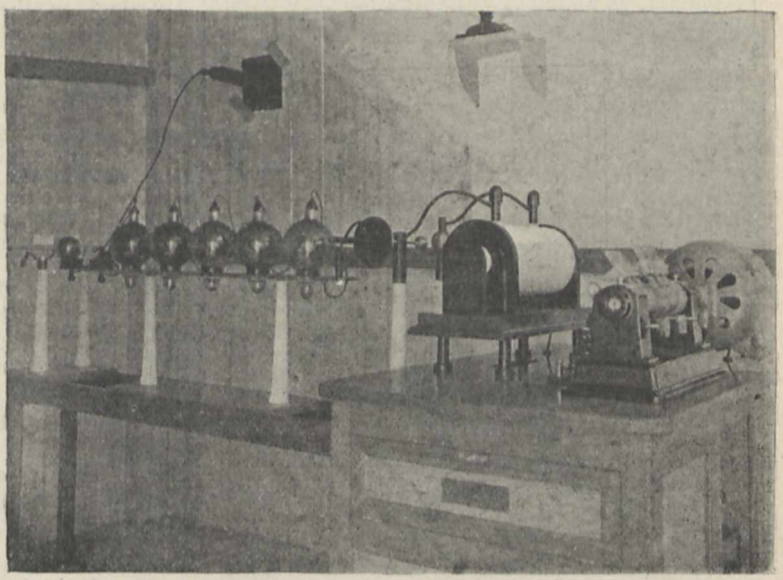


FIG. 1.—Inside the transformer shed, showing the inductive break, special coil, and high-tension valves.

This observation and these experiments of Prof. Lemström were not, indeed, the beginning of the application of electricity to plant growth, because pioneer attempts had been made long before by the Abbé Berthelon in 1783, but it was the beginning of a thorough and scientific treatment of the problem. Prof. Berthelot, at Meudon, has also attacked it; so have Dr. Cook and Mr. J. H. Priestley, of Bristol. During the winter of 1904 Mr. J. E. Newman installed a small trial apparatus, consisting of a small influence machine of the Wimshurst type and overhead discharge wires, at the Golden Valley Nurseries at Bitton, near Bristol. The wires ran about sixteen inches above the tops of the plants, or above the rows of tomatoes in the glasshouses; and short pieces of fine wire, with the free ends pointing downwards, acted as discharge points. Mr. G. R. Newman has now established a large-scale installation there.

Attempts of a different kind had also been made by other experimenters. Plates had been sunk in the ground, and a current passed between them among the roots of plants; but whatever effect is thus caused is of a totally different kind from that excited by high-tension electricity supplied to the air above them. Both in a manner are natural processes. There are natural earth currents, and these must flow among the roots of plants, though whether they produce an appreciable effect may be doubted. There is a natural atmospheric electrification, and this must be playing an important part in many phenomena. Atmospheric electrification is responsible for the coalescence of cloud globules into rain. During fine weather the electricity in the air is usually of one sign: positive. When wet weather sets in, the electricity in the air usually changes sign, becoming negative. The whole subject is a large one; a great deal is known about it, and vastly more remains to be known; but meanwhile it can hardly be doubted that the electrification of the air has some effect on growing plants. For it is found that under the influence of ultra-violet light, electrified plants can give off electricity into the air from the leaves; and the fact that the upper air is normally electrified, relatively to the soil, must cause all plants to be electrified also; so that in all probability they are in a constant state of slow electrical discharge, which becomes more rapid when the sun is up. In what way this discharge of electricity from their growing tips, and hair, and surface generally, really acts, must be studied and reported on by physiological botanists, but it is natural to suppose that it cannot be without influence, and reasonable to think that that influence may be beneficial—a hypothesis which direct experiment confirms.

Possibly in some sunny countries the effect is excessive, and might, with advantage, be moderated, but in this climate it turns out that artificial supply of electricity does increase the rapidity and assist the amount of growth. At any rate, the experiments of Lemström, which had been repeated and extended by others, clearly pointed in that direction. So when, after some preliminary experiments at Bitton, Mr. J. E. Newman, of 3 Howard Street, Gloucester, acting in conjunction with Mr. R. Bomford, of Bevington Hall, Evesham, at his farm near Salford Priors, determined to try the phenomenon on a really large scale, and came to me to see if I could help them electrically, and enable them to maintain a continuous high-tension discharge for hours together each day over ten or eleven acres by means of power furnished by an oil engine and dynamo, I very willingly assented, and set my son, Mr. Lionel Lodge, upon the work.

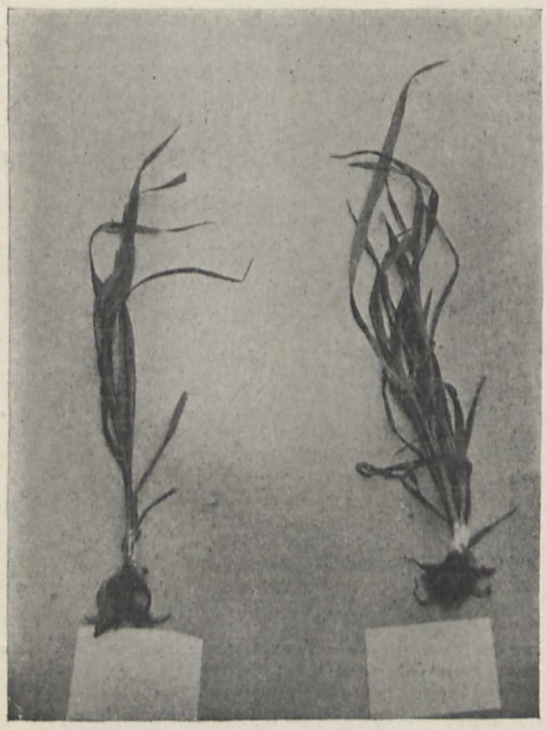
The method is to stretch over the field to be treated a number of wires on poles, something like low telegraph wires, but high enough for loaded waggons and all the usual farming operations to go on underneath the wires without let or hindrance. The wires are quite thin, and

are supported by a few posts in long parallel spans, about 30 feet apart. One pole per acre is enough. The electrified area was about 19 acres. The wires are supported on the posts by elaborate high-tension insulators, and they extend over all the acreage under experiment, a control plot of similar land under similar conditions being, of course, left without any wires.

The system of conductors is then connected at one point with a generator supplying positive electricity at a potential of something like a hundred thousand volts, and with sufficient power to maintain a constant supply of electricity at this kind of potential.

Leakage immediately begins, and the charge fizzes off from the wires with a sound which is sometimes audible, and with a glow which is just visible in the dark. Anyone walking about below the wires can sometimes feel the effect on the hair of the head, as of a cobweb on the face. They are then feeling the stimulating action of the electrification.

The electrification is maintained for some hours each day, but is shut off at night; it is probably only necessary



Control. *Electrified.*

FIG. 2.—Comparison of electrified wheat with wheat grown in the control field under the same conditions, an average plant being taken in each case. Note the broader leaves and greater number of shoots of the electrified wheat.

to supply it during the early morning hours in summer-time, and in spring-time or in cold cloudy weather for the whole day. During bright sunshine it seems unnecessary, and may even be harmful. But at what stages of the growth of a plant the stimulus is most effective has still to be made out; probably the earlier it is begun the better; and since in the case of wheat both the ear and the straw is valuable, the electrification should be applied for a time each day during the whole period of growth, except perhaps during drought.

The power required to generate the electricity is very small, for although the potential is high, the quantity is insignificant, and the energy is accordingly comparatively trivial. The electricity can be generated in more than one way. It can be generated by a Wimshurst machine, or it can be generated by transforming up to high tension, and rectifying to one direction, the current of a dynamo. The first is in many respects the simplest, and was used in the early and small-scale experiments, but it can hardly be regarded as an engineering method adapted to continuous or rough use. The latter is the one which in the trials now to be described we have adopted.

The power is generated by a two-horse oil engine driving a small dynamo in an outhouse of the farm. Thence the current is taken by ordinary overhead wires to the field, where they enter a suitable weather-tight hut, which contains the transforming and rectifying apparatus. The only moving part here is the "break," and if the original dynamo had been an alternator, even this might be dispensed with. The transformer is a large induction coil, specially made to stand continuous use, and its current is then rectified by means of vacuum valves in accordance with a patented device of my own.

The negative electricity is conveyed direct to earth, while high-tension electricity, all of positive sign, is led by a specially insulated conductor out of the shed to the nearest point of the overhead insulated wires, which are thereby maintained at continuous high positive potential.

THE RESULTS AND FURTHER DETAILS.

The following is a very brief summary of returns and information supplied to me by Mr. Newman and Mr. Bomford, showing the results from the electrified as compared with the control unelectrified plots.

SUMMARISED RESULTS OF THE 1906 EXPERIMENTS.

Bushels of Wheat per Acre.

(Estimated corresponding increase in straw not measured.)

	From the electrified plot	From the unelectrified plot	Increase
Canadian (Red Fife)	35½	25½ ...	40 p.c.
English (White Queen) ...	40	31 ...	30 ,,

Moreover, the electrified wheat sold at prices some 7½ per cent. higher, several millers in baking tests finding that it produced a better baking flour.

The increase appears to be mainly due to better stooling. No marked difference was observable in the development of ears.

SUMMARISED RESULTS OF THE 1907 EXPERIMENTS ON WHEAT.

RED FIFE, SPRING SOWN.

Bushels per Acre (Head Wheat).

Electrified	Unelectrified	Increase
41·4	32	29 p.c.

Electrified wheat brighter, and a better sample.

Increase again partly due to better stooling, but this time there was better filling out of ears.

These results are for wheat alone, but a good many other crops were tried at the same time.

HOURS OF RUNNING.

1906.

March 16 to July 10, inclusive, 621¾ on 90 days.
Average electrical pressure corresponded to a ¾-in. spark.
Current shut off after ears in bloom.

1907.

March 28 to July 27, 1014 hours on 115 days.
Average pressure corresponded to a half-inch spark.
Current kept on to harvest.

Those interested in the experiments are much indebted to the enthusiastic cooperation of Mr. Bomford. It may be interesting to note that it was at a farm belonging to Mr. Bomford's father that the first steam ploughing in England was done.

Prof. Lemström is undoubtedly the pioneer in this sort of work, though circumstances connected with the natural electrification of the atmosphere and with the discharge of electricity from various surfaces have been pertinaciously examined by Profs. Elster and Geitel.

OLIVER LODGE.

THE BRITISH MEDICAL ASSOCIATION AT SHEFFIELD.

A VERY successful general meeting of the British Medical Association was held at Sheffield last week, when, under the most agreeable conditions, a considerable amount of valuable work was accomplished by the association.

While there was no dramatic announcement of any epoch-making discovery, or the, often premature, propounding of a theory—such as that relating to the non-transmissibility of bovine tuberculosis to man—which time would fail to substantiate, yet many subjects were discussed of both theoretical and practical interest to the general public.

Among others may be mentioned the problem of infection by typhoid carriers, which was considered in two able and interesting papers by Dr. Ledingham and by Drs. Davies and Walker Hall.

It has been recognised for some time past that the *Bacillus typhosus*—latent yet virulent—may exist in the human organism for years after the acute attack has subsided. Still earlier was the bacillus of diphtheria, in like case, tried and found guilty. Mysterious epidemics, which could not be traced either to direct contact or to infected clothing or towels, or to the milk supply, broke out from time to time in various places. Famous among such epidemics was that which occurred at the Charité Hospital in Berlin, when, by a process of elimination, the responsibility was at last found to rest with a nursing sister, who, without exhibiting any of the signs of diphtheria, was found to harbour the virulent germs in her throat. A small dose of antitoxin was administered, the ordinary precautionary measures were taken, and the epidemic ceased.

Unfortunately, in the case of typhoid, the matter is not so simple. In the first place, the isolation of the *B. typhosus* from the stools—when the systematic examination of many suspects is in question—is a far more arduous undertaking than the technique involved in the search for the *B. diphtheriae* in the fauces. Further, as pointed out by Dr. Walker Hall—and by others before him—the excretion of the bacillus by the carrier is intermittent, and it may therefore be missed unless numerous and systematic examinations be made extending over a period of many months. Even when found, the danger to be feared from the carrier as a focus of infection is not entirely averted, as, up to the present, we have no really trustworthy method of destroying the organism *in situ*.

Dr. Ledingham rightly laid great stress upon the incidence of gall-stone disease in a carrier. The proportion of female to male carriers is three to one—figures which exactly coincide with those appertaining to gall-stone disease; again, only 10 per cent. of the subjects of gall-stone disease show any symptoms, while, curiously enough, 10 per cent. of chronic carriers show symptoms of gall-stone disease.

In view of the above, and of the fact that the *B. typhosus* has been isolated from the gall bladder and stones of such cases, any symptom of hepatic trouble in a typhoid convalescent—or even in a person known to have had typhoid previously—should be viewed with the gravest suspicion. This applies all the more strongly to those whose duties bring them into contact with the food supply of their *entourage*, as, for example, dairymaids, milk vendors, cooks, &c. In any attempt at prophylaxis, the difficulty lies in enforcing, over a sufficiently lengthy period, the necessary regulations. It is not yet known how long the infection of typhoid may remain latent, although the dogma has been enunciated, "once a carrier, always a carrier."

With regard to the periodicity, Dr. Walker Hall showed that a carrier, after remaining innocuous for many months, might suddenly again become infectious and spread the disease far and wide. This always occurred after an illness in which the patient showed diarrhœa and a rise in temperature and pulse rate. An examination of the blood at these times showed a pronounced increase in the number of mononuclear leucocytes, and this Dr. Walker Hall considered a most important diagnostic point, as a differential blood-count can be readily undertaken by the physician in attendance. The greatest number of cases resulting from this form of infection occurred in the warm weather, *i.e.* during the months of July, August, and September. It was suggested, in explanation, that it is during the warm weather that the typhoid organism develops most rapidly in milk; on the other hand, it was pointed out that the lactic acid bacilli are also more active then, and would thus tend to render the milk less suitable a pabulum for the bacillus of typhoid. In conclusion, Dr. Walker Hall presented the meeting with a copy of suggested instructions to typhoid convalescents, which were admirable in their lucidity and simplicity; the only criticism which suggests itself is that he should specify the disinfectant solutions to be used.

In the section of pathology, the mornings of Wednesday and Thursday were occupied with a discussion on cerebro-spinal meningitis. From a practical point of view, the most interesting communications were those relative to the brilliant results obtained by serum treatment; from being almost a hopelessly incurable disease, "spotted fever" may now be regarded as giving a most hopeful prognosis, in view of the reduction in the mortality rate from more than 80 per cent. to between 30 per cent. and 40 per cent.

In the section of dermatology, an intensely interesting discourse was given by Prof. Neisser, of Berlin, in which he communicated the results of his work on the experimental inoculation and treatment of syphilis. The experiments, which were carried out on anthropoid apes in Java, extended over a period of more than three years; the magnitude of the work may be imagined from the fact that from 600 to 800 animals were always under observation. Prof. Neisser's results go far to confirm the dicta already promulgated by Metchnikoff and others, namely, the importance of the prophylactic inunction of a $33\frac{1}{3}$ per cent. calomel ointment at the site of inoculation. Washing with sublimate solution 2 : 1000 and 3 : 1000 also gave good results. The necessity of energetic and prolonged mercurial treatment was insisted upon; or, better still, the chronic intermittent treatment by the combined application of atoxyl—or Ehrlich's arsacetin—and iodine, as well as mercury. The minimum period over which the treatment should be continued was given as four years. In this connection we may notice also the excellent collection of microscopical and lantern slides, demonstrating the presence of the *Spirochaeta pallida* in syphilitic lesions, which were exhibited by Dr. Mackenzie in the section of pathology.

An important discussion took place on Thursday morning in the industrial diseases section, with regard to the relation of pneumoconiosis to phthisis. Although Sheffield, as the great centre in England of the "dusty trades," furnished the greatest number of examples, the questions raised apply equally to all towns where a large number of workmen are subject to the deleterious effects of inhaled dust. Statistics show that in Sheffield the mortality rate from phthisis of adult males engaged in "dusty trades" is five times greater than the average for the rest of England. As pointed out by Mr. Edmund Owen in his popular lecture, the process known as "dry grinding" is responsible in great part for this excessive mortality. In the old days, grinding sheds were placed along the banks of the Don for the sake of the wheel power; plenty of water was at hand, and it was made to drip upon the wheels. With the advent of steam power the old river-side sheds were abandoned, over-crowded, dusty, and ill-ventilated factories took the place of the breezy sheds, and the men became too busy to water their wheels. It is, moreover, asserted that "dry grinding" is more efficient than "wet grinding." However this may be, the introduction of the new process resulted in a startling increase in the mortality rate from phthisis.

It was pointed out that the quality of the dust inhaled is a determining factor of no small importance in the causation of tuberculosis; the more irritating the particles the more dangerous the dust. Colliers, for instance, are particularly subject to anthracosis, and yet the death-rate from phthisis among them is not abnormally high. The first effect of inhaling "grinder's dust" is to produce rhinitis, followed by erosions of the mucous membrane and septal ulcers. This, again, is followed by atrophy of

the Schneiderian membrane, and loss of smell. As the process descends, first irritation and then atrophy of the mucous membrane of the pharynx and larynx occur. At this stage the cough induced by the irritating particles becomes "dry" and useless; the entrance of dust into the lungs being thus facilitated, nodules of dust-filled, inflammatory infiltration are formed, which break down and provide a nidus for the tubercle bacillus.

A further argument against the dry-grinding process was brought forward by Dr. Barnes (of Sheffield). He maintained that the great susceptibility of grinders to tuberculosis was due to the fact that the dust amongst which they worked aided in the dissemination of the tubercle bacillus by inducing the rapid drying of the sputum. He pointed out that, whereas now a tuberculous worker spits upon a dusty floor, in the old days he spat into a trough containing water. The speaker, in effect, insisted that "grinder's disease" was pure tuberculosis and not pneumoconiosis, and called upon the contents of the pathological museum to substantiate his contention.

We were surprised to notice that no mention was made of the growing belief that tubercular infection of the lung takes place *viâ* the alimentary canal. Even in the case of the Sheffield grinder this theory would not be antagonistic to the general principles which we know to lie at the root of all systematic infections. It is well known that an infection, no matter how introduced into the system, will always seek out a *locus minoris resistentiae*; in this case it would be a lung weakened by pneumoconiosis. It is now universally recognised that the prognosis in tubercular disease is very largely dependent upon early diagnosis. In a disease such as pneumoconiosis, which so closely resembles tubercle in its clinical signs and symptoms, we were rather surprised that some form of easily applied tuberculin diagnosis—such as Calmette's ophthalmo-reaction—was not mentioned as having been tried, at least to any extent.

The Pathological Museum presented a mass of excessively interesting material, the specimens being, however, for the most part of interest rather to the specialist than to the general public. Among the exhibits having a somewhat wider interest may be mentioned the sections of Egyptian mummy organs shown by Dr. Armand Ruffer. The sections were taken from the mummy of a priest of Amen, and in spite of the fact that the material was at least 2400 years old, the microscopical structure was surprising in its detail and perfection.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—In the faculty of engineering at University College, London, a new lectureship in electrical design has been instituted, and Mr. H. M. Hobart has been appointed thereto. By the assistance of a committee of former engineering students and of other friends of the college, the new laboratories and extensions of the departments of the faculty of engineering, which were opened by the Chancellor, Lord Rosebery, last March, will be further equipped during the present long vacation. The new equipment will include a new boiler in the department of mechanical engineering, a steam turbine, and hydraulic apparatus, and equipment for research in metallography and radio-telegraphy. The facilities for advanced and post-graduate students, as well as for undergraduate students, will thus be considerably increased.

SHEFFIELD.—Dr. Ralph P. Williams has been appointed to the professorship of public health rendered vacant by the resignation of Dr. Harold Scurfield.

By the will of the late Dr. H. J. Hunter, the residue of his property, which will, apparently, amount to between 15,000*l.* and 20,000*l.*, is bequeathed to the University.

AN anonymous gift of half a million kronen (about 20,833*l.*) has been made to the Vienna Academy of Sciences for the establishment of a "Radium Institute" in connection with the new physics laboratories of the University of Vienna.

AN interesting proof of the efficiency of mathematical teaching in Poland in the seventeenth century is afforded by M. H. Merczyng's paper on a mathematical text-book for Polish students under Sigismund III., published in the Bulletin of the Cracow Academy, part x. (1907), recently received. The book in question is a treatise on arithmetic and geometry by Joachim Stegman, who about the year 1630 was principal and professor of mathematics in the gymnasium of Rakow. This school was founded by Polish unitarians, but was attended by pupils of all creeds numbering up to 1000, and existed from 1602 to 1638. The writer of the present notice applies the English expression "up-to-date" to the contents of the book in relation to the times in which it was published. The paper is illustrated by reproductions of the title-page, a drawing of the pantograph, anticipating by three years the previous records of its discovery by Scheiner, and a diagram for the solution of trigonometric problems, as we should say in "modern" examination papers, "by drawing and measurement."

THE report of the departmental committee appointed by the Board of Agriculture and Fisheries to inquire into and report upon agricultural education in England and Wales has been published as a Blue-book (Cd. 4206). The committee of twelve included Lord Reay (chairman) and Profs. T. H. Middleton and William Somerville. All institutions in receipt of grants from the Board of Agriculture were invited to submit evidence, witnesses from numerous institutions not in receipt of such grants were examined, and witnesses also attended from county councils, agricultural and other associations, in addition to those from Government departments at home and in the colonies. The total number of persons attending to give evidence was 113. It is impossible in a note to deal fully with the conclusions and recommendations of the committee, but one result arrived at is that there is no doubt that, by a general adoption of scientific methods, an important development could be effected in every branch of agriculture and in the various rural industries subsidiary to it. It is urged that a complete system of technical agricultural education is the natural corollary to the vast sums spent on elementary education in the rural parts of the country. The committee is of opinion that it will be possible to build up in England and Wales, at no excessive cost and within a reasonable time, a system of scientific and practical agricultural education equal, if not superior, to that now existing in any other country.

THE Lancashire Education Committee maintains a flourishing agricultural department. We have received an illustrated account of the scheme of agricultural education which has been devised for the county and is carried out at the County Council Farm, Hutton, the County Council Agricultural School, Harris Institute, Preston, and in various parts of the county. The county farm consists of 157½ acres, and in connection with it are permanent dairy and poultry schools, with a chemical and bacterial laboratory. Manurial, feeding, and other experiments are conducted at the farm. The object of the agricultural school at Preston is to prepare young men and women for the work of a farmer's life by instructing them in the principles which underlie farming operations, and demonstrating modern and scientific methods of agriculture. A county staff of lecturers in agriculture, horticulture, butter-making, cheese-making, and poultry keeping is, so far as practicable, placed at the disposal of local education committees, agricultural societies, and farmers' or horticultural associations. Numerous farmers' bulletins have been issued, advice is given to farmers with respect to farming operations and agricultural experiments, and analyses of manures, feeding stuffs, soils, waters, and dairy produce are made at low fees for the farmers of the county. In these and other directions the Lancashire Agricultural Department is doing much to encourage and develop scientific agriculture.

THE regulations (Cd. 4187) for technical schools, schools of art, and other forms of provision of education other than elementary in England and Wales for the year 1908–9 have been issued by the Board of Education. There are not many changes, and those introduced are in the direction of greater efficiency and more elasticity. The

limit imposed in previous years to the number of hours of instruction which may be counted for the purposes of grant has been relaxed, a fact which will encourage local education authorities to plan prolonged and well-organised courses of evening instruction and help to remove a reproach that much of the work in evening classes has been scrappy, unrelated to local industries, and not part of a coordinated scheme. Greater encouragement than formerly is being given to vacation courses for teachers, and the sensible advice contained in the prefatory memorandum as to the necessity of securing due recreation for teachers during the progress of the holiday work deserves the careful study of the organisers of such courses. It is now laid down by the Board that there shall in future be a principal, or head teacher, in those institutions where in the past unrelated classes in charge of separate teachers, responsible only to the managers, have been held. The new regulation will, if the right type of head teacher is appointed, lead to a greatly improved state of things. Students will be able to receive much needed advice in planning suitable courses of study to assist them in their industrial pursuits, and the work of succeeding sessions will form part of a complete scheme. The changes as a whole are conceived in a broad spirit, and should assist to develop still further the excellent work which is being done in technical and other schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 7.—"A Tantalum Wave-detector, and its Application in Wireless Telegraphy and Telephony." By L. H. **Walter.** Communicated by Prof. J. A. Ewing, C.B., F.R.S.

It has hitherto not been possible to employ a metal in conjunction with mercury as a wave-detector which is spontaneously restored to the sensitive condition, without some artifice which assisted decoherence; much less has it been possible to use a noble metal for this purpose. The only metal that has been found usable is iron, and this latter is, owing to its tendency to rust, manifestly not adapted to stand prolonged use, besides being otherwise not satisfactory.

The author has found that the metal tantalum gives an effect with mercury which greatly exceeds that obtainable with iron, the sound being very loud and of a pure tone. The tantalum, in the form of a fine wire point, dips into a pool of mercury so that the point is only just immersed. An external applied potential difference of about 0·2 to 0·4 volt gives the best results, the tantalum point being connected to the negative terminal.

As now generally constructed, the device comprises a glass containing-vessel into which are sealed two platinum wires. One of these wires dips right into the mercury, and serves to make contact therewith, while the other has its end hammered out into a form of clip which is made to hold the tantalum point.

The level of the mercury is adjusted while the usual telephone receivers are connected to the detector, and this adjustment, when once properly carried out, during the filling process, renders all further adjustment unnecessary. The whole arrangement is hermetically sealed in the glass bulb, which may previously have been exhausted.

The detector has been tried at various wireless telegraph stations, and has shown that for not too weak signals the sound is several times louder than the same signals with the electrolytic detector, it being understood that the most suitable telephones for each type of detector are employed. At a distance of 450 miles from a ship station fitted with a 2-kilowatt plant the signals obtained on the electrolytic and the tantalum detectors were of about equal loudness, although in this case the telephones were not at all suited to the tantalum detector.

The device just described is rather sensitive to shaking, and so a second form of detector is described which, owing to its construction, is quite indifferent to vibration and even to shock. Experiments were afterwards made with numerous other metals, but no other case of an imperfect contact of this nature was observed; the behaviour of tantalum is apparently unique.

From the physical standpoint the chief interest lies in the fact that by a suitable choice of materials it has been possible to revert to the primitive simplicity of a metal point in contact with another metal, and yet all the attributes of a modern detector be retained.

EDINBURGH.

Royal Society, July 7.—Prof. Crum Brown, F.R.S., in the chair.—The craniology of the aborigines of Tasmania: Sir William **Turner**, K.C.B. This race had become extinct in 1877, and of the eighty skulls which were known to be deposited in various museums of this country and the Continent, no less than ten were in Edinburgh. The main features of these dolichocephalic skulls were described in detail, the curious roof-shaped top and the thick orbital ridges specially being noted. A cast of the face which belonged to the University Anatomical Museum was shown. The woolly or frizzled hair which differentiated the Tasmanians from all neighbouring races had been described by several travellers. The question of the affinities of the race was very obscure. All attempts to find relationship with the indigenous races of the Malay Peninsula and islands, with the Polynesian races, or with the inhabitants of Australia or New Zealand, could not bear close inspection. When first discovered by European travellers, there could not have been more than 70,000 Tasmanians in an island almost as large as Ireland. Throughout their isolation there must have been in-breeding for centuries, leading to an accentuation of any peculiarities which might have arisen, and so giving to the race its own peculiarities.—Inversion temperatures and the form of the equation of state: Prof. W. **Peddie.** It was shown that a number of equations of state, all fairly satisfactory otherwise as representative of facts, lead to the conclusion that the inversion temperature of air decreases as the initial pressure rises, which is contrary to Olszewski's experiments. Also the discrepancy cannot be explained as due to difference of initial and final kinetic energies. Some other source of error has probably affected the results. Observations of the critical temperature and its variation with pressure might discriminate among various equations of state.—Magnetic quality in the most open cubic arrangement of molecular magnets: Prof. W. **Peddie.** It was found that such an arrangement, unlike the closest packed arrangement, cannot explain the magnetisation of magnetite, but presents analogies to the magnetic properties exhibited by pyrrhotine.—Energy accelerations and partition of energy: C. W. **Follett.** From this discussion it appears that equipartition is not possible amongst the freedoms in some of the cases.—Combustion analysis: Prof. J. **Walker** and T. **Blackadder.** The paper described certain modifications of Liebig's method, which enabled the experimenter to use a smaller combustion tube and to carry through the operations in much shorter time and with less expenditure of gas.

PARIS.

Academy of Sciences, July 27.—M. Bouquet de la Grye in the chair.—The necessity of making use of the three dimensions in space for the successive directions of the two moving right lines joining the sun and a planet to the earth, for determining in a simple manner the relative variations of magnitudes of these lines: J. **Boussinesq.**—The total sugar of the blood: R. **Lépine** and M. **Boulud.** It has been stated by MM. Hugounenq and Morel that larger amounts of sugar are found after hydrolysis with hydrofluoric acid than with sulphuric or hydrochloric acids, and they regard this as being due to the less destructive action of the hydrofluoric acid. The authors of the present paper confirm this fully, and have applied this reagent to the determination of the virtual sugar in the blood. Details of the technique are given, and it is shown that the amounts of sugar obtained by hydrolysis of the blood clot with hydrofluoric acid are of the same order as those obtained from the serum, the sum of the two representing the total sugar of the blood.—

The apparent dispersion of light in interstellar space and the hypothesis of M. Lebedew: J. **Stein.** A discussion of the theory put forward by M. Lebedew to explain the experimental results of Nordmann and Tikhoff. The theory would appear to be insufficient to explain all the phenomena observed with β Aurigæ.—A new variable star with very short period discovered at the Observatory of Paris: Jules **Baillaud.** The existence of this star was noted from the photographic charts of P. and Pr. Henry, of 1900. The magnitude varies between 12·8 and 14·3, the passage from the maximum to the minimum taking about 1 hour 41 minutes.—A left-handed circular sextic: M. **Stuyvaert.**—The name of Fleurieu in geography: M. **de Fleurieu.**—A comparison of the different modes of action of imperfect contacts with variation of resistance and thermoelectric contacts as detectors of electric oscillations: C. **Tissot.** Replying to the criticisms of M. Branly, the author points out an essential difference between the detectors working by imperfect resistance and those depending on thermoelectric power; the latter require no auxiliary electromotive force in the form of a battery.—The ultra-violet spectrum of silicon: A. **de Gramont** and C. **de Watteville.** A comparison of the wave-lengths and intensities of the line obtained in the spark spectrum and in the flame spectrum.—The magnetic susceptibility of solutions: P. **Pascal.** The author finds that whenever an aqueous solution of a metal ion of a salt changes with its valency into a complex ion or into a colloidal compound, there is a diminution of the magnetic or diamagnetic properties superadded to the diamagnetism of the water by the simple metal ion. There may even be an inversion of the magnetic *rôle* of the metal on the solution. These phenomena are repeated when the complex ion passes over into a more complex ion.—The gases occluded in a special nickel steel: G. **Belloc.** The chief point of interest was the marked difference between the quantities of gas extracted from the same metal in the form of wire and turnings. The cause of the difference has not yet been ascertained.—A new method of estimating the fixed and volatile acids in wines: Emm. **Pozzi-Escot.**—The oxidation of isoeugenol. On dehydro-diisoeugenol: H. **Cousin** and H. **Hérissey.** By the oxidation of isoeugenol in alcoholic solution by ferric chloride, a substance having the composition $C_{20}H_{22}O_4$ is obtained. This corresponds to the formation of a double molecule following on the removal of two atoms of hydrogen by the oxidising agent. The properties of the new compound and the preparation of three of its esters are described.—A new method of preparing the mixed anhydrides of organic acids: J. **Bougault.** The method of preparation is peculiar in that the reaction takes place in aqueous solution and in presence of sodium carbonate. Phenylisocrotonic acid, treated with iodine in presence of a considerable excess of sodium carbonate, is converted quantitatively into benzoylacrylic acid. If the sodium salt of an aromatic acid is present during this reaction the mixed anhydride is precipitated. The mixed anhydrides of benzoylacrylic acid with benzoic, cinnamic, phenylacetic, and benzoylpropionic acids have been obtained in this way.—The constitution of vicianine: Gabriel **Bertrand** and G. **Weisweiller.** Vicianine is a glucoside obtained from the seeds of *Vicia angustifolia* and of several other species of the same genus. Under the hydrolysing action of diastases it gives hydrocyanic acid. In the present note vicianin is shown to resemble amygdalin in being a derivative of *l*-phenylglycollic nitrile.—The formation of jadeite in crystalline schists: Const. A. **Ktenas.**—Folotsy and Voharanga, two new Asclepiadeæ from Madagascar: MM. **Constantin** and **Bous.**—The formation of the conidia in the Aspergillaceæ: L. **Mangin.**—Contribution to the study of the serum of animals whose thyroid glands have been removed: L. **Launoy.** Poisonous properties have been attributed to the blood serum of animals the thyroid glands of which have been excised; the experiments of the author here given do not confirm this.—The influence of ferrocyanides and ferricyanides of the alkalis on the coagulation of the blood: J. Larguier **des Bancels.**—The diastatic hydrolysis of lactose, maltose, and their derivatives: H. **Bierry** and J. **Giaja.**—The inequality of the volume of the mammary glands in woman: the physiological consequences: G. **Variot** and P. **Lassablière.** In 550 cases, in only 24 per cent. was there equality in the size of the mammary glands; in 51 per cent. the left predominated, and in 25 per cent. the right. When the inequality is very pronounced the smaller gland appears to atrophy, and can only furnish a very small quantity of milk relatively to the other, and these variations in quantity are accompanied by changes in the composition of the mik.—The experimental study of the transmissibility of tuberculosis by dried sputum: G. **Kuss.** Petersson, Cadéac, and Calmette have emphatically denied the possibility of tuberculous infection by dried sputum, Cadéac affirming that the drying and loss of virulence go together. The author details fresh experiments made to settle this important point. It was found that when the conditions are favourable to desiccation tuberculous sputum dries readily in a few days, and was easily converted into dust, the virulence of which was proved by inoculation experiments. The inhalation of these powders caused tuberculous infection with extreme readiness, a result diametrically opposed to those of Calmette and Cadéac.—The kidney of the bony fishes: Louis **Roule** and I. **Audigé.**—Experimental researches on the adipose bodies of the Amphibia: R. **Robinson.**—The localisation of the sense of alimentary discrimination in the Limneæ: Henri **Piéron.**—The classification of the Tertiary strata of the Guelma region, Algeria: J. Dareste **de la Chavanne.**—The Calabrian earthquake of October 23, 1907: G. **Mercalli.**

CONTENTS.