THURSDAY, SEPTEMBER 6, 1906.

NILE STUDIES.

The Physiography of the River Nile and its Basin. By Captain H. G. Lyons, Director-General, Survey Department. Pp. viii+411; with 48 plates. (Cairo: National Printing Department, 1906.)

WHEN a British army was first sent to occupy Egypt, the late Prof. Huxley called upon the Royal Society to appoint a committee to arrange for a systematic study of that most interesting country. He justly pointed out how much the French Government had accomplished in the promotion of scientific research and in the publication of its results during their short period of occupation at the beginning of last century, and he declared that it would be a national disgrace if we failed to accomplish something of the same kind with our much greater opportunities.

The publication of the work before us, and of others of a similar character, serves to show that England has not been unmindful of her responsibilities or neglectful of the opportunities which have resulted from our close association with the Egyptian Government for more than two decades. Captain Lyons, who organised the Geological Survey of Egypt—some of the admirable publications of which have been reviewed in the pages of NATURE—has now become head of the whole Survey Department of Egypt, and is administering its affairs with characteristic energy and ability.

The discovery of the Lake district of Equatorial Africa by Speke and Grant, with the surveys and observations of Gordon, Emin, Schweinfurth, Junker, and others, has afforded a safe basis for the treatises on Nile hydrography by Klöden, Lombardini, Chavanne, and de Martonne; but since the fall of Omdurman in 1898, and the consequent opening up of the Sudan, much new material has been made available. Systematic meteorological records have been collected at various stations in Uganda, Abyssinia, and the Sudan, and careful measurements have been made of the levels, at different seasons of the year, of the several lakes and of the amount of water discharged by each of the Nile tributaries. All these sources of information have been admirably utilised by Captain Lyons in his survey of the present state of our knowledge of Nile hydrography.

After a very interesting discussion of the climate and rainfall of the districts from which the waters of the Nile are supplied, Captain Lyons proceeds to describe in detail the eight regions into which the Nile basin may be conveniently divided. Recent surveys in most of these districts have given much greater precision to our knowledge of their physiography, geology, meteorology, and other natural features.

The *Lake Plateau*, which has an average elevation of about 5000 feet, is composed of various metamorphic rocks. The central part of the area is occupied by the great Lake Victoria, while in its western part is the deep rift valley with Lakes Albert Edward and Albert. The district is characterised by rapids and marshes, no regular flow of the streams having been established by erosion, but the effective supply to the Nile from the Victoria Lake varies from 500 cubic metres to 1000 cubic metres per second.

The basin of the *Bahr el Jebel, Bahr el Zaraf*, and *Bahr el Ghazal*, although having a very heavy rainfall, really absorbs, not only this, but a considerable part of the water supplied to it from the Lake Plateau. The rivers wind through level alluvial plains, and support a great marsh vegetation (the "sadd"), consisting of papyrus and various reeds with some floating plants, and evaporation and absorption by vegetation take up, not only the whole of the considerable rainfall, but diminish the amount coming from Lake Victoria by from 4 per cent. to 52 per cent.

The *Sobat Basin* is occupied by a comparatively short river with a rapid fall, and adds an appreciable but varying amount to the waters coming down the White Nile.

In the *White Nile Basin* we find that we have the most constant element in the supply of the Nile waters. The 1500 million cubic metres of water from the Sobat flood are supplied to the Nile during October, November, and December, thus modifying the fall in the water-level of the river during those months.

The Blue Nile, the Atbara, and the Khor el Gash.—These rivers drain a plateau with an elevation of from 6000 feet to 10,000 feet. Although exact information concerning the distribution of rainfall in various parts of the Abyssinian highlands is still wanting, there can be no doubt that the rainfall is very great. The regular northward movement of the rain-belt during the monsoon season leads to the flooding of the Blue Nile and Atbara, and the annual Nile flood in July, August, September, and October. The volume and continuance of this flood are clearly dependent, firstly, on the amount of rainfall in the Abyssinian highlands, and secondly, on the great length of the river courses, with their deeply-cut channels, ensuring a regulation of the water supply during torrential rains. Captain Lyons directs attention to the possible interference with this latter element in the production of the periodic Nile floods, which may result from the extensive afforestation which is said to be going on in Abyssinia.

From *Khartoum and Berber to Aswan* the united waters of the White Nile, Blue Nile, and Atbara flow in a single stream, which is eroding its bed with considerable rapidity, there being some cataracts but no flood plains. The waters of the Nile have in this part attained their maximum, and in its course northward the river is constantly losing by evaporation and the withdrawal of its waters for irrigation.

From *Aswan to Cairo* the Nile flows in a depression in which it has deposited a considerable thickness of alluvium, and the river winds through the flood plains thus formed. During the fifty centuries of which we have a record, the Nile appears to have deposited a thickness of 16 feet or 17 feet of alluvium in this part of its course, and the silting up of various water

channels and the reclamation of land in consequence have resulted. It is in this way that the lake occupying the depression of the Fayum has been diminished in area.

The floods in the *Nile Delta* of which records have been kept, that are trustworthy for the past 175 years at least, have been critically studied by Captain Lyons with the view of discovering the determining causes of their variations. While no regular periodic alternations of high and low floods can be detected by the study of these records, their dependence on the rainfall and the distribution of atmospheric pressure in the highlands of Equatorial Africa is very apparent. There is reason to believe that more numerous, systematic, and complete meteorological observations in the districts outside Egypt may enable us, in the end, to predict from month to month the probable fluctuations of the annual Nile flood.

The space at our command has only permitted the notice of a few of the more salient features of this very interesting volume. In conclusion, we must congratulate Captain Lyons and the Egyptian Government upon the great amount of valuable work which has been accomplished and is still in progress. A word of praise must also be added on the excellent typography of the volume, and the admirable plates with which it is illustrated. J. W. J.

THE HISTORY OF DETERMINANTS.

The Theory of Determinants in the Historical Order of Development. Part i. Second edition. General Determinants up to 1841. Part ii. Special Determinants up to 1841. By Dr. T. Muir, C.M.G., F.R.S. Pp. xii+492. (London: Macmillan and Co., Ltd., 1906.) Price 17*s.* net.

A MATHEMATICAL history of the right sort is much more than a mere bibliography, and in some respects is more valuable than a treatise on the subject with which it deals. It helps us to see how mathematical ideas originate, and how, as they become familiar, the symbolism by which they are expressed becomes compact and appropriate. This is especially the case with determinants, because a determinant is essentially a comprehensive symbol, and it would perhaps be more proper to speak of the calculus than of the theory of determinants. It may seem strange, at first sight, to find a history so large as this dealing with a subject so limited; but no one can complain that the author is either diffuse or irrelevant, and his work may be praised without restriction as a model of its kind.

It is unnecessary to say much of the first part, which is mainly a reprint of the volume which appeared in 1900. Dr. Muir has written a new introduction, and added a few additional notices. Two things cannot fail to strike the reader of this part. The first is the great supremacy of Cauchy and Jacobi in everything relating to choice of notation and clearness of statement; the other is the great and long unrecognised ability of Schweins. Schweins, in a way, brought this fate upon himself; his style is heavy, and his notation cumbrous in the extreme, but his contributions to the subject are of great value and generality, although they attracted no notice for many years, and were re-discovered by others. Unfortunately, they are expressed in such a repulsive notation that no one but an enthusiast would read his works, and the student will feel very grateful to Dr. Muir for his analysis of them. Part of this analysis, in some ways the most interesting, is given on pp. 311–322; this, and the subsequent section on a paper of Sylvester's, deserve careful reading, because, as Dr. Muir points out, Schweins gives some results on alternants which even now are not familiar, and Sylvester makes some hasty statements which, as they stand, appear to be incorrect, but which, if corrected, or rightly interpreted, might lead to important formulæ.

It should be noted that on p. 323 the determinant is misprinted, a, a^2, &c., being put for a_1, a_2, &c. Moreover, it is not explained so clearly as it should be that $\zeta a^r = a_r$; while the law $a_r . a_s = a_{r+s}$ is *not* used. The right statement is $\zeta(a^r . a^s) = \zeta(a^{r+s}) = a_{r+s}$; while $\zeta(a^r)\zeta(a^s) = a_r a_s$. Readers of Sylvester's papers must be careful to distinguish this ζ from the square of the operator $\zeta^{\frac{1}{2}}$. It may be noticed, in passing, that these generalised alternants present themselves in the theory of numbers, both when the elements are roots of unity and also when they are not, so that further knowledge of their properties is desirable, and the suggestion made (p. 325) that Sylvester's results are true when the elements are periodic deserves further examination.

Considerable space is given to functional and orthogonal determinants, and here, of course, Jacobi receives most attention. The results are now so familiar that it requires some effort of imagination to realise the gain in working power which has resulted from Jacobi's investigations. In this connection attention may be directed to an odd remark on p. 297. Speaking of one of Jacobi's papers, Dr. Muir says:—"The only thing worth noticing is the curious cubic equation . . . "; this "curious" equation is nothing more nor less than the reducing cubic for two ternary quadratic forms, in the exact notation of Salmon's "Conics"! And Dr. Muir even takes the trouble to express the invariants Θ, Θ' in the forms

$$Aa' + Bb' + \ldots, \text{ &c.}, \quad A'a + B'b + \ldots, \text{ &c.},$$

as if this were a quite novel idea.

Returning for a moment to alternants and their applications, attention may be directed to the work of Jacobi and Cauchy on the expansions of rational functions of several variables (pp. 331–345). This is important in the theory of functions, in that of algebraic forms, and in that of partitions. In some ways it deserves further investigation; in various applications the expansions have to be infinite series, and the question of convergency has to be faced, even when the series are used for establishing formal equivalences; this is a curious case of formal and arithmetical algebra each marching, so to speak, on the other's domain.

There is one more observation made by Dr. Muir (p. 290) which is rather puzzling. After giving some identities of Lagrange's, which are, in fact, relations between determinants, Dr. Muir says, "a reference to the original papers, already described, will make it almost perfectly certain that Lagrange did not view them in this light. The like is true of Gauss. . . ." Now Gauss, at any rate, used the term "determinant"; if this word is used in the modern sense of the *symbol*, of course Dr. Muir's remark is correct, but is then quite trivial; on the other hand, if it means the function, it is hard to see how Gauss, not to say Lagrange, could fail to see that their expressions involved determinants, especially as each was quite familiar with them in connection with the theory of numbers. This is particularly true of Gauss, who gives the name "determinant" to $(\alpha\beta\gamma)$ as well as to $(\alpha\beta)$.

It is a matter of regret that, although a bibliography of orthogonants (to 1840) has been given, Dr. Muir has not been able to include in this volume his valuable lists of writings relating to determinants. To have added them would not have increased the size of the book very much, and it would have been very convenient to have them here. But perhaps the author intends to give us the history of his favourite subject subsequent to 1841, the date at which he has now closed. G. B. M.

EUROPEAN VERTEBRATES.

Die wirbelthiere Europa's mit Berücksichtigung der Faunen von Vorderasien und Nordafrika. By Dr. O. Schmiedeknecht. Pp. vi+470. (Jena: Gustav Fischer, 1906.) Price 10 marks.

IT is always convenient to have within covers separated by a moderate distance only an account of the fauna of a definite district, especially when, as in the present instance, the fauna is one that is fairly exhaustively known. It is not likely that a manual of the scope of that which we review here will ever need substantial alteration, or even slight changes, for many years to come. The volume, in fact, is not only of permanent value, but contains the marrow of a whole library of faunistic works, and includes all that the student needs, whether the aim of his studies be purely geographical or whether he desires a handy series of definitions of families, genera, and species. Inasmuch as the volume is something less than five hundred pages in length, and seeing that the definitions of family and other characters are often from twelve to twenty lines in length, the author is compelled to deny himself any discussion of points round which opinions fluctuate, and is driven to be entirely dogmatic.

It is therefore not everyone who will follow Dr. Schmiedeknecht with complete agreement from beginning to end. He will not, for example, please all of us by placing the "reed pheasant," *Panurus biarmicus*, among the tits, though it *is* frequently called the bearded tit; nor can we agree to the use of four separate generic names for the four species of rorquals, which appears to us as a recrudescence of one of the very worst achievements of the systematists of the past. In adopting an old scheme of arrangement for birds, the author is compelled thereby to separate widely the gulls and Limicoline birds, which many anatomists have concurred in placing in very close relationship. There are plenty of similar examples to be gathered from Dr. Schmiedeknecht's pages. If the author errs at all in the number of species which he admits into his manual, it is rather on the side of economy than profusion. Of the very long series of "species" of mice admitted, or rather insisted upon, by some British naturalists, Dr. Schmiedeknecht will only consider four as established. Perhaps he carries this plan a little too far in declining to admit the "Irish weasel," *Mustela hibernica*, which is not in any way referred to. Apropos of weasels, it will certainly surprise some persons to learn that the proper name of the common weasel is not *Mustela vulgaris*, but *M. nivalis*, inasmuch as (according to Dr. Schmiedeknecht) Linnæus gave the name to an individual in winter dress.

That the weasel, like its very close ally the stoat, changes to white in winter can hardly be a fact of general knowledge, since it is not mentioned in at any rate one well-known work upon British mammals.

In classifying the snakes, Dr. Schmiedeknecht follows a somewhat curious plan. He divides the European species into five families of equal rank, which are (in the order treated by him) Crotalidæ, Viperidæ, Colubridæ, Peropodidæ, and Typhlopidæ. To give the "pit vipers" a place in the system which divides them as far from the more typical Viperidæ as from the Peropodidæ, or Boidæ as most would prefer to call them, is quite opposed to the minute details of anatomical agreement between all vipers.

To such criticisms, however, the author might well reply that his arrangement is rather a sorting than a classification, and that, as a matter of fact, judged by external characters only (and it is these alone that are made use of), the two divisions of the vipers are very distinct, and the gulls are remote from the sandpipers, plovers, &c.

In his preface, Dr. Schmiedeknecht puts himself forward as a champion of the systematic aspect of zoology as a desirable commencement for the student of that science There is no doubt that most of us, in this country at least, were led to pursue zoological studies by reason of the fervour and enthusiasm engendered by the joys of collecting objects of natural history. The quality of knowledge possessed by the pure systematist of mature years is often but little in advance of this stage, and in remarking that "he must be as a rule a remarkable systematist who is not at the same time a biologist," the author is expressing an opinion which the annals of museums do not confirm. In fact, Dr. Schmiedeknecht's introductory remarks read a little like an apology, which is not at all needed in introducing so useful and accurate a work as that which we notice here. F. E. B.

TREATMENT OF WATER FOR STEAM BOILERS AND MANUFACTURES.

Water Softening and Treatment. By W. H. Booth. Pp. xvi+308. (London: Archibald Constable and Co., Ltd., 1906.) Price 7*s.* 6*d.* net.

THE primary object of this book is the softening of hard water for use in steam boilers and for manufacturing purposes, but, in fact, it deals largely with other matters relating to the supply of water to the boilers of steam engines. Thus it is divided into five sections, the first only of which relates to the treatment of water by softening, together with the separation of oil and filtration, and occupies about half the book; whereas the four other sections, constituting the second half of the book, consist of "Section II., Air Pumps, Condensers, and Circulating Pumps"; "Section III., Feed Heating and Stage Heating"; "Section IV., Water Cooling"; and "Section V., Feed Pumps and Injectors." Accordingly, the volume ranges over the whole subject of the treatment of water supplied to steam boilers, though dealing more expressly with the all-important point of securing, so far as practicable, the purity of the water employed for raising steam.

Comparatively few towns are able to obtain a pure water-supply by storing up the flow of rain off primitive rocks in an uninhabited mountain valley, and conveying it at considerable expense to a distance, as has been accomplished for Liverpool, Manchester, Glasgow, Birmingham, and New York. Waters derived from underground sources, such as springs, rivers fed by springs, or wells, are impregnated more or less with the soluble salts contained in the strata through which they have passed; and when steam is driven off from a boiler fed with such water, these soluble impurities are deposited as scale on the sides of the boiler. This incrustation, being a bad conductor of heat, reduces the efficiency of the boiler, and when very thick may lead to an injurious heating of the metal; whilst the necessary periodical removal of the deposit is tedious and costly, and is liable to damage the inner surface of the boiler. Accordingly, in selecting a site for a factory, the available water-supply should be carefully considered; and where a bored tube well proves the most economical, and an adequate source of supply, the geology of the district should be studied to secure the best site, and ascertain the requisite depth for the well. In such cases some softening process is generally expedient—and often even when water from a river or stream is available—to avoid incrustation of boilers, to prevent a great waste of soap in laundries, and manufactories where washing is resorted to, and to obtain the soft water which is essential in dye works, paper mills, and tanneries.

The author deals successively with the sources and impurities of water, the salts contained in it, the reagents used for softening and their reactions, water-softening apparatus of various kinds, filters, compounds added to the feed-water for preventing or removing scale from boilers, corrosion of boilers, incrustation of pipes, and the chemical and mechanical removal of oil from condensed steam. The contents of the second half of the book have been sufficiently indicated by the headings of the four sections given above; and the descriptions of apparatus are elucidated by one hundred figures in the text. Altogether, the book contains complete information with respect to the purification and supply of water to steam boilers, which will be valuable to users of steam; whilst the first portion, on water softening, will be very useful in indicating the methods by which hard water may be rendered available for various manufactures requiring pure water.

OUR BOOK SHELF.

Studies in Anatomy from the Anatomical Department of the University of Manchester. Vol. iii. Edited by Prof. Alfred H. Young. Pp. 289; 23 plates. (Manchester: University Press, 1906.) Price 10*s.* net.

IN the struggle to build and equip laboratories for research, the provision of means to secure the full publication of the fruits of discovery has been too often left out of sight. If the best work is to be obtained from those who devote themselves to investigation, and progress made by collective effort, the means of publication become almost as important as those of investigation. The University of Manchester has recognised this fact. The present collection of studies in anatomy—the third issued since Prof. Young occupied the chair in the Owens College—appears as the first volume of the anatomical series of the publications now being issued by the University of Manchester. In this volume there are ten papers by men who work or have worked in the anatomical department under Prof. Young.

A number of the papers in this volume, such as those by Profs. Robinson and Thompson, are reprinted from the *Journal of Anatomy and Physiology*, but all of them, old and new alike, are real additions to the knowledge of the subject with which they deal. Dr. J. Cameron's observations on the development of the optic nerves in amphibians deal with a subject which has been keenly discussed during the last thirty years, viz. the manner in which nerve fibres are developed. From a study of the appearances presented by the developing fibres in the optic nerve of amphibians, Dr. Cameron concludes that the fibres begin as outgrowths from the ganglion cells of the retina, but that their further growth towards the brain is obtained by the cooperation of the cells of the optic stalk, the growing point of the nerve fibre being formed from substance derived from the optic stalk cells.

The longest paper in the collection is Dr. C. W. S. Saberton's study of the nerve plexuses of four chimpanzees, an accurate and very useful contribution to the data which must be collected before we can finally settle the problem of man's origin. Everyone who has worked at this problem is fully aware that it cannot be settled by the examination of single specimens of each species, but by dissection of large numbers; the difficulty in obtaining anthropoids, the degree of individual variation, the great labour entailed by dissection, and the expense entailed by publication, have kept us from reaching a definite conception of the exact relationship of man and the higher primates to one another. Hence Dr. Saberton's contribution to available data is very welcome. In his paper on the development and morphology of the sternum, Dr. Lickley has reverted to the older

conception of that bone, viz. that it is of costal origin, but the evidence on which he bases his conclusions is not convincing. For three of the studies Prof. Young is either in part or wholly responsible, and he is to be congratulated on the vigour shown by the Manchester school of anatomists.

Refraktionstafeln. By Dr. L. de Ball, Direktor der v. Kuffnerschen Sternwarte. Pp. xiv+18. (Leipzig: W. Engelmann, 1906.) Price 2.40 marks.

THE methods of computing corrections for atmospheric refraction have always been more or less unsatisfactory. The conditions of the problem do not lend themselves to extreme accuracy on account of the uncertainty of the meteorological elements introduced. The determination of the density of the atmosphere at any precise moment, dependent as it is on the temperature, the amount of aqueous vapour present, and other conditions, is not simple, and custom and authority alike have sanctioned the employment of rough and approximate data. Bessel's tables, so long in use, were admittedly founded upon inadequate material, and probably would have long since been superseded but for the inconvenience that arises when any breach of continuity occurs in a long series of observations; but in observatories where measures of zenith distance have been made at small altitudes this inconvenience has had to be faced. At Greenwich, for example, corrections to Bessel's tables, or Airy's modifications of them, have been alternately introduced and rejected in the treatment of observations at large zenith distances.

In the tables which Dr. L. de Ball has issued the difficulty of continuing an unbroken series of corrections, available from the zenith to the horizon, has not been attempted. The tables as arranged are available up to 75° zenith distance, and within this limit represent a consistent theory, that of M. Radau. The form in which the tables are constructed gives the log. of the refraction presumably correct to four places of decimals. In the example worked out it has been necessary to take out five significant integers, and, if the second decimal place is to be correct, this may be rather a severe strain on four-figure logs.; but Dr. L. de Ball gives very good and sufficient reasons for not extending the tables beyond these limits. He reminds us that the determination of the temperature of the air is not so easy as the reading of a thermometer seems to suggest. The thermometer bulb is affected by the heat rays emitted by the objects which surround it, whilst the air absorbs only a part of those rays. On these grounds the temperature indicated by the thermometer may easily differ 0°.2 C. from that of the atmosphere, and such a difference would occasion an error of three units in the fourth decimal of the log. of the density, and a similar amount in the log. of the refraction. The tables aim at giving an accuracy which is sufficient and practical rather than making a claim to extreme and misleading rigour. A further proof that the author has considered the practical side is shown by the fact that he has included tables designed to assist the computation of differences of refraction, applicable to the reduction of heliometer and photographic observations.

The Butterflies of the British Isles. By Richard South, F.E.S. Pp. x+204. (London: Frederick Warne and Co., 1906.) Price 6*s.* net.

NOTWITHSTANDING the large number of books relating to British butterflies, there was still room for a pocket handbook which should do for the present generation what Coleman's "British Butterflies" did for the last, and this want Mr. South has set himself to provide. He has succeeded in giving us a portable little book, well up to date, containing full information about structure, transformation, setting, &c., besides a good account of the individual species. The plates contain coloured figures of the butterflies on one side of the page, and plain figures of caterpillars, &c., on the back, thus doubling the number of page illustrations without adding to the thickness of the book. The illustrations in the text are nearly all in the introduction. They are uncoloured, and some of them are taken from Sharp, Aurivillius, and other trustworthy authorities.

Mr. South admits sixty-eight species as British, but regards only fifty-seven of these as actual natives; but surely, though some of the remainder are extinct, and others only casual visitors, the black-veined white (once abundant, but now almost extinct in England), and the red admiral, still one of the commonest of the Vanessidæ, ought to have been included among the genuine natives. The evidence against the red admiral being a genuine British species seems to rest on the assumption of its being a migrant, though this is admittedly not proved, as it is abundantly in the case of its nearest ally, the painted lady.

The rapid disappearance of butterflies in England is doubtless largely due to the wholesale clearing away of the weeds and plants on which the caterpillars feed, by the utilisation of every scrap of waste ground. Yet this cannot be the only reason, or the black-veined white, which feeds on hawthorn as well as on fruit trees, would not be disappearing. In this case the disappearance of the butterfly seems to be due to the increase of insect-eating birds. Every fresh book on butterflies records the increasing scarcity of many species once common, and there are only a few, such as the clover-feeding clouded yellows, which are more plentiful now than in former days.

In the case of the smaller and more variable butterflies, a considerable number of varieties are figured (sometimes as many as seventeen on one plate), and we think that most entomologists who are interested in British butterflies will find Mr. South's little book a very useful supplement to any they may already happen to possess on the same subject.

W. F. K.

LETTER 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 Latest Critic of Biometry.

MR. J. J. LISTER in his presidential address to Section D at the British Association felt it his duty to go somewhat out of his way in order to urge on biometricians "that the old adage should be borne in mind recommending that before beginning culinary operations it is advisable first to catch your hare, in other words, to make sure that the problem you seek to elucidate is sound from the standpoint of biology before bringing a formidable mathematical apparatus into action for its investigation" (NATURE, August 16, p. 400). The importance of the occasion no doubt prevented Mr. Lister from illustrating his criticism; he had much else to deal with, and he probably hoped that his words without detailed proof would have all the weight which attaches to presidential utterances. These are not made without careful thought and proper study. But in order that a criticism of this kind should be effective, biometricians need more information, and they recognised that Mr. Lister could hardly refuse to cite instances of the type of work which led to his advice.

Hoping that we might profit by Mr. Lister's caution, I wrote to him as soon as I read his paper in your columns asking for definite instances upon which we might consider how to amend our courses. He has kindly consented to

give me an illustration, so that the reasonableness of his criticism can be tried on perfectly definite and narrow grounds.

He tells me that he cannot cite a better example than a paper by Dr. Raymond Pearl which appeared recently in the Proceedings of the Royal Society dealing with a species of Paramœcium, and of which a fuller statement was offered for publication in the Transactions. The author's position in this paper, according to Mr. Lister, is traversed by the objection that the conjugant individuals are possibly, and indeed probably, differentiated gametes. Until this objection be met, Mr. Lister holds that the elaborate series of measurements has no cogency whatever in establishing the results which the author thinks he has obtained. Mr. Lister further believes that if Dr. Pearl were more conversant with the biological aspects of the life-history of Paramœcium, or less keen on the biometric aspects of the matter, he would hardly have overlooked this view.

We have here a perfectly definite charge, not a vague insinuation, which can be discussed, and I heartily thank Mr. Lister for stating it so clearly. Now as to the actual facts :—

(1) Dr. Raymond Pearl is a brilliant young American biologist who has spent much time in studying Paramœcia in the biological laboratories of America and Germany. He has just been called to a chair of biology at an American university.

(2) Dr. Pearl *demonstrates* for the first time in the memoir to which Mr. Lister refers that conjugant Paramœcia are differentiated from the non-conjugant population, a fact which his critic only considers as possible or probable.

(3) Further, Dr. Pearl *demonstrates* that among these differentiated conjugants there is an assortative mating; in other words, he shows that conjugants with certain characteristics tend to conjugate with conjugants of like characteristics.

(4) Dr. Pearl assigns with a high degree of probability the definite physiological basis for this assortative mating. He thus shows for the first time that the "physiological selection" of Romanes plays an important part in the lower living forms, and suggests the physiological origin of differentiation of species, *i.e.* all sections of a conjugant population cannot equally readily conjugate together.

Surely such problems have a very sufficient biological reality.

Dr. Pearl's paper seemed to me, as a mere biometrician, a most brilliant piece of work. That view was shared by the then Chairman of the Zoological Committee of the Royal Society, who at once passed the abstract for publication—all that lay in his power to do. The referees of the full memoir failed, so I am told, to see "the biological significance of the constants calculated" by Dr. Pearl. This appears to be Mr. Lister's condition also. The full memoir will shortly be published in *Biometrika*, so that a judgment may be formed of the value of Mr. Lister's criticism. It would have been published there originally but for two reasons. Firstly, I held the paper to be an exceptionally brilliant one, which the Royal Society ought to be proud to publish, and, secondly, that in every other branch of science papers which are very extensive, and so costly to print, naturally go to societies largely endowed for the publication of such memoirs, and not to private journals. I see no reason why biometry should be cut off from such assistance, because biology has not yet become bionomy, a transition which it must make sooner or later, as astrology passed to astronomy.

Meanwhile Mr. Lister has chosen his own ground. He cites a paper by a biologist—who happens to have studied biometric methods—as one where the hare has been cooked before it was caught, as one which deals with problems unsound from the biological standpoint. I challenge Mr. Lister to substantiate his statements :—

(1) That Dr. Pearl has neglected the differentiation between conjugants and non-conjugants.

(2) That such differentiation, whether it exists or not, makes the least difference to Dr. Pearl's investigation of whether among conjugants like conjugates with like.

(3) That Dr. Pearl has dealt with a problem unsound from the standpoint of biology. KARL PEARSON.

ROYAL SOCIETY ADDRESSES.[1]

THE Royal Society of London is an exclusive and retired body, known of few, understanded of still fewer. To most of those who are not men of science, the words "The Royal" mean the Royal Agricultural Society; many know the Royal Institution and perhaps still more the British Association; but the ancient learned body the home of which is now at Burlington House is something beyond the knowledge of most people. Nor is this to be wondered at; the Royal Society makes few efforts to make itself known, and, indeed, seems to some to do much to keep itself unknown. It gives, it is true, two public soirées, and it has its anniversary dinner; but it has managed to make the former chiefly reunions of its own fellows, and the latter, held in the darkening days of early winter "when nobody is in town," contrasts, by the paucity, nay, almost the absence, of public and distinguished guests, and the prominence of the fellows and their private friends, with the annual dinner of its neighbour the Royal Academy.

The late president of the society seems to have thought it would be well to try to make the general public better acquainted with some of the features and aims of the society, and has accordingly published, in an attractive and yet exceedingly cheap volume, richly illustrated with photographic reproductions and pleasing sketches, portions of his anniversary addresses, with the addition of a brief narrative of the early days of the society.

The topic on which he dwelt in his address of 1903, namely, the relation of the Royal Society to other scientific societies, illustrates indirectly the exclusiveness of the former, not only towards the general public, but even towards workers in science. This exclusiveness seems to have been at least encouraged by the change in management brought about in 1847. It was then decided, whether because the number chosen seemed sufficient for that day or through some prescience that it would result in the society attaining and keeping its present size, that not more than fifteen new fellows should be elected each year. Since that day the workers in science have largely increased and are continuing to increase rapidly, but the number elected annually remains the same. Hence the number who yearly join the society is a continually diminishing fraction of those who in 1847 would all have been looked upon as fit and desirable persons to become fellows. Hence also the admission to the fellowship, the gaining of the right to use the letters F.R.S., has become an honour of continually increasing value, and the allotment of the honour an increasingly important function of the society, possibly encroaching on some of its other duties. This relative narrowing of the society's body tends to accentuate its exclusiveness and emphasises its isolation from the younger workers in science. Nor is this tendency to exclusiveness counteracted by any very direct efforts to establish relations between those within and those without the narrow circle. Indeed, even within the circle itself the relations of the fellows to each other are not very close. The temple of science at Burlington House is, at each weekly Thursday service, brightened by the presence of many eager worshippers; and the fact that these are increasing in number shows that the society is putting forth the vigour of youth in one of its several great means of advancing natural knowledge. But between times the temple is well-nigh empty. What in other places would be called "weekday attend-

[1] "The Royal Society, or Science in the State and in the Schools." By Sir William Huggins, K.C.B., O.M., &c. Pp. xv+131. (London: Methuen and Co., n.d.) Price 4*s.* 6*d.* net.

ance" is very rare, except for this or that committee; and the neophyte of science who, led by some special guest, enters with bated breath within its doors, finds ample rooms held in a solemn silence broken only by the scratching of the pens or the guarded tread of the officials, and goes away chilled with the rarefied air of the higher realms of science. He meets with a warmer, more congenial atmosphere in his own "special society."

The presidential address of 1903 makes it clear, on the one hand, that the special societies ought to exist, to prosper, and even to multiply, and, on the other hand, that the attempt to establish formal relations between them and the Royal Society would probably fail to secure any really useful results. But might not much be done in an informal way? If the society could put on a less solemn, more genial face, if it could make its fellows feel that it belonged to them rather than that they belonged to it, if it could make it clear that it was really the central home for all the sciences, that it was anxious to advance natural knowledge by placing its great resources freely at the command, not only of the chosen few who happen to be its present fellows, but of the great many whose work is pushing science on, it would be weaving bonds binding to it the younger men and the special societies, in a way no written treaties with elaborate compromises could ever bind them.

The addresses of 1902 and 1905 deal mainly with scientific education. Many wise words are said in them, but so much has been and is still being said about scientific education that nothing need be added here except perhaps to express regret that the manifesto of the council of 1904, a sequel to the address of 1902, should have produced so little good. It seems to have served chiefly as an instrument in the hands of those upholding the old ways, a result partly, perhaps, due to the fact that the statement of a body consisting of a number of men of diverging views was naturally purged from all strong words, and took the form of a chain of mild platitudes.

The address of 1904 deals with the difficult question of the relation of the Royal Society to the State. The late president in that address gives an account of the many great unpaid services which the society has rendered, and continues to render, to the State. On the one hand, it seems most unjust that men of science, whose wrestling against poverty is in most cases as strenuous as their wrestling for truth, should give their time and labour to the State without any remuneration whatever. Had the society been rewarded for what it has done for His Majesty's Government in the way lawyers are rewarded for what they do for it, the society would by this time have been rolling in wealth. But it receives from the State absolutely nothing beyond the use of the rooms

FIG 1.—Meeting Room of the Royal Society, Burlington House. From "The Royal Society," by Sir William Huggins, K.C.B.

in Burlington House, and that portion of the 1000*l.* grant for scientific publications which it allots to its own printed output.

On the other hand, while thus giving freely that which it cannot afford to give, it keeps untouched its own freedom; and this is very precious to it. As the late president points out in the address in question, the purpose of the society is to advance natural knowledge, and this it does mainly through stimulating, encouraging, correcting and helping research by the methods which it judges best. It is true that it also advances natural knowledge by helping and advising His Majesty's Government and in many other ways, but its main work is to promote individual research. For this it must have perfect freedom.

Undoubtedly were the society to receive aid from the State under conditions which would fetter its actions, the result would be injurious to scientific progress; it would probably be disastrous if those conditions took the form of making the society more or less a Department of State. But is it not possible for the State to buy science and pay for it, without making the seller a servant? The answer to this seems mainly to depend on whether the State is able to recognise that the value of scientific work cannot be appraised by ordinary business methods; the money worth of an inquiry carried out to-day cannot be told with certainty for many years to come, when the Government who asked that it might be done and the man who did it have both long passed away. If a Government could realise this, and be prepared to spend its money, without immediate vouchers, feeling sure that in the long run the money would be well and profitably spent, State aid to science would not be so hard a problem.

In this interesting volume the late president has not only brought before a public far wider than that which is present at the anniversary meetings and dinners of the society a knowledge of what the Royal Society is, is doing, and is striving to do, but also has directed their attention, in a striking and direct way, to questions—the importance of which cannot be exaggerated—touching the relations of science to the nation. We thank him for it.

FIG. 2.—Principal Library of the Royal Society, Burlington House. From "The Royal Society," by Sir William Huggins, K.C.B.

AN AMERICAN CONTRIBUTION TO ARCHÆOLOGY.[1]

WE welcome this publication as fresh evidence of the activity of archæological study and research in the United States at the present time. Nearly every American university now has its department of archæology, and the labours of its members are no

[1] "Transactions of the Department of Archæology, Free Museum of Science and Art." Vol. i., Part iii. Pp. iv+106+36 plates. (University of Pennsylvania, 1905.)

longer confined, as they were in great part until a few years ago, to the antiquities of Central America and Mexico, but now extend into the wider fields of original research on Greek and Oriental sites. The present volume well illustrates this extension in the scope of American archæology, for while in the first article in the Transactions Mr. G. B. Gordon treats of the serpent motive in Mexican art, the five concluding papers deal with the results of the excavations in Crete and Babylonia carried on by the American Exploration Society and the Babylonian Expedition of the University of Pennsylvania.

The papers of greatest interest and importance in the volume are those dealing with the excavations at Gournià, in Crete, and on other sites on the isthmus of Hierapetra during the year 1904, which were carried out, as in former years (see NATURE, June 1, 1905, vol. lxxii., p. 98), by Miss Harriet A. Boyd (now Mrs. Hawes) and her assistants. In the former article, above mentioned, we described Miss Boyd's discovery of the little Minoan town of Gournià, its geographical position, and the results of the first excavations. Miss Boyd's paper on Gournià, Miss Edith Hall's "Early painted Pottery from Gournià," and Mr. R. B. Seager's "Excavations at Vasiliki," published in the present volume of Transactions, enable us to bring the story of the American work in Crete up to date.

The chief result has been the discovery of some entirely new styles of pottery of very early date. Those who know what a great part the classification of pottery takes in early Greek archæology will appreciate the importance of this discovery when we describe the most important of the new "Mycenæan" pottery from the isthmus of Hierapetra as a polychrome ware much anterior in date to the well-known Kamáres ware (middle Minoan period of Evans), which was contemporary with the twelfth dynasty (*circa* B.C. 2000) in Egypt. Miss Boyd describes it as "a remarkable new ware from Vasiliki, with Trojan shapes, monstrously long beaks, and decoration in black and red, mottled, with highly hand-polished surface." It is described by Mr. Seager, who discovered it in a Mycenæan settlement on the Kephala (ridge) of Vasiliki, in the Hierapetra isthmus-depression, two miles south of Gournià. One fragment only was previously known; this was discovered at Zakro by Mr. Hogarth.

"The hard red finish is perhaps the most remarkable and characteristic feature of the ware. At first it recalls the Libyan ware of Dr. Petrie's Pre-dynastic race . . . the body-colour is usually a red shading to orange, and the patches black to bronze green, owing to the different degrees of heat to which it has been exposed. Exactly how this effect was produced has not yet been satisfactorily explained, but possibly the vases were covered with paint and then put into a bed of coals (*sic*) which were heaped over them, the black patches being the effect of a live coal lying actually against the surface of the vase. This would be only a variation of the method used in firing the Pre-dynastic Libyan ware, where the necks, which were in actual contact with the coal, have burnt to a black. Very possibly this technique may have been strongly influenced by that of Libya, but with his characteristic ingenuity the Agean (*sic*) potter, not content with the set form and colouring of the Libyan ware, experimented with the method until he produced this varied and at times gorgeous effect. The greatest charm of the prehistoric ware of the Agean is that the potters never allowed themselves to remain long tied down by a tradition of style and were constantly inventing new and original ideas of which the Egyptian workman seems never to have been capable. The Agean peoples were always ready to receive ideas from their neighbours, but they never remained content until these ideas had been changed and beautified to suit their own more artistic tastes."

We have quoted Mr. Seager's description at this length for several reasons. First and primarily because of its excellence as a description of his important discovery; this pottery is highly remarkable, and may indeed be described as "gorgeous," as the coloured plate showing specimens of it proves. The explanation of its technique is probably correct. Secondly, on account of its being a good example of the way in which Greek archæologists run down the poor Egyptians; but we will not quarrel with Mr. Seager on this score; he sins in good company, and, after all, it needs a considerable acquaintance with Egyptian archæology before one realises that the Egyptians were as capable of inventing new and original ideas as the Mycenæans. Thirdly, as an example of the way in which an archæological statement which has long been given up as incorrect by the archæologists of the branch of work to which it belongs may still be perpetuated by the archæologists of another branch: the prehistoric Egyptians, whose pottery was discovered by de Morgan and Petrie, are not known to have been Libyans, nor can their pottery be called "Libyan." We know nothing of the Libyans of 5000 B.C.; the pre-dynastic Egyptians can only be called Egyptians. We may note in passing also that it is more probable that the resemblance of early Ægean to early Egyptian pottery is due to a possible common origin of their civilisations than that Ægean technique was "strongly influenced by that of Libya" (*read* Egypt), so early. Finally, we quote this passage as a warning against misprints. "Agean" for "Ægean" three times in a few lines is not pretty, and not far off we see "Cypress" for Cyprus (p. 216). The American printer has original ideas, and often carries them out—at the author's expense.

Another unusual ware of early date was found at Gournià; its characteristic is white paint on black, with geometric ornament. This ware is described by Miss Edith Hall. The most primitive ware of all, from the rock-shelter burials at Gournià and Agia Photia near by, is also interesting; it is sub-Neolithic in date, and closely related to the Cycladic pottery of Thera and Amorgos, which it resembles.

The buildings at Vasiliki explored by Mr. Seager, in which the strange new pottery was found, are remarkable in plan and construction, and the description of the difficulties of excavating them is interesting. The rooms are filled with hard plaster, the presence of which is explained by Mr. Seager as follows. The ceilings were made of canes covered with heavy clay plaster, and these were supported by transverse beams. "When the beams gave way, the ceiling sank into the rooms below, making a layer of débris about fifty centimetres and sometimes more in thickness. This débris, owing to the action of fire and water, has become an almost petrified mass on which the picks of the men made but slight impression. Certain rooms had to be abandoned on this account, as little short of actual blasting would have been required to clear them. . . . As in Gournià, and, in fact, most of the prehistoric settlements in Crete, the building seems to have been destroyed by fire. . . . It is plain that the building must have possessed several stories, as the mass of débris which fills the rooms is far too deep to have been the result of the collapse of a single floor." Mr. Seager tells us that when, "as was often the case," the clay plaster "had fallen on a deposit of pottery or pottery from the upper rooms had fallen in with it, the objects were as fresh as on the day of the catastrophe which destroyed the building, but it

required the greatest skill and patience to save them unbroken, and in some cases to save an unusually fine piece it was necessary to sacrifice inferior ones surrounding it." A short time ago I visited Vasiliki myself under the guidance of Mr. Seager, and can testify to the great interest of his work there. The plaster-filled houses are remarkable. May it not be possible that this hard stuff, which makes the excavation of the houses at Vasiliki so difficult, can be explained in a manner different from that adopted by Mr. Seager? At Phaistos the older palace (*Middle Minoan* or *Kamáres* period) was partly razed, and the remains filled up and covered with a layer of hard beton or cement, as hard as that of Vasiliki, on which the *Late Minoan* palace was built. I would suggest that the plaster of Vasiliki may be in reality a cement filling-up, on which later houses were built. There are certainly two or three distinct superimposed "towns" at Vasiliki. Mr. Seager is now proceeding with the work at Vasiliki alone, as Mrs. Hawes (Miss Boyd) has not visited Crete this year.

Thus Miss Boyd's Mycenæan Pompeii still continues to be interesting, and we hope that she will be enabled to go on with her work in Crete. Miss Boyd's is the most important archæological work connected with the University of Pennsylvania, and we hope that the authorities of that institution adequately recognise this fact.

H. R. HALL.

THE IMMIGRATION OF SUMMER BIRDS.[1]

THOUGH great advance in our knowledge has been made during recent years concerning the migration of birds as observed in our islands, yet much remains to be learned, and any inquiry that will add to what is already known must be hailed with satisfaction. In what direction and by what methods such advancement is to be sought are questions requiring not only careful consideration, but a full knowledge of what has already been accomplished.

In electing to investigate the immigration of summer birds, the committee appointed by the British Ornithologists' Club has selected the best known of all the phases in the phenomenon. It is true that a special feature has been added in the endeavour to trace the movements of the migrants through the country after their arrival on our shores, but it is much to be doubted whether the results will contribute anything of material importance or at all commensurate with the labour involved. On the other hand, our knowledge of the autumnal departure movements, both from their inland nesting haunts and from our shores, of these same birds is far from complete.

The new committee labours under a misapprehension in supposing that the south coast was entirely omitted from the scope of the British Association committee's inquiry, for part of both the eastern and western sections were scheduled annually. Moreover, the migratory movements on the whole of that coast, for both spring and autumn, were afterwards fully investigated for three years, and the results incorporated in the later reports submitted to the Association.

Then as to methods. It may be well, perhaps, to remind the new committee of the opinions, based on long experience, expressed by Prof. Newton and his colleagues in their final report to the Southport meeting of the British Association in 1903. They say, "the last thing your committee would wish is to discourage the prosecution of observations, but they feel bound to express the opinion that no great advance of our present knowledge of the subject seems likely to be made until new methods are applied. What they should be it is impossible to suggest, but those used at present appear to have reached their limit." In this mature opinion the present writer fully concurs.

The report under notice is not lacking in interest, but it does not add anything material to our knowledge; indeed, several years' observations will be necessary before conclusions of permanent value, though possibly not advancing what is already known, can be expected. By premature publication much harm may be done, and it is to be feared that writers will arise and tell us, on the strength of this report, that, among other things, whinchats, redstarts, whitethroats, reed warblers, cuckoos, and other species do not arrive on the western section of the south coast, when further investigations by the committee will prove that they *do*. It is certainly surprising to find the new committee instituting a comparison between the weather conditions prevailing in the English Channel and the arrival of birds on its shores (of course with abortive results), for it was hoped that it had been clearly proved by exhaustive investigations that the meteorological conditions influencing such movements must be sought in the area whence the migrants took their departure.

In conclusion, one is tempted to suggest that it would be well if the members of the committee of the British Ornithologists' Club, before proceeding further with their arduous labours, took stock of the situation, and asked themselves if their energies might not be advantageously directed to more useful and productive branches of the subject they have at heart.

[1] "Report on the Immigrations of Summer Residents in the Spring of 1905." By the Committee appointed by the British Ornithologists' Club. (London: Witherby and Co., 1906)

NOTES.

PROF. I. P. PAVLOFF, professor of physiology in the University of St. Petersburg, will deliver the Huxley lecture at the Charing Cross Hospital Medical School on Monday, October 1.

PROF. EMIL FISCHER, professor of chemistry in the University of Berlin, has been elected a foreign member of the Royal Society of New South Wales.

AN Irish International Exhibition will be opened in Dublin in May next. It will be the first exhibition of its kind to be held in Ireland for nearly forty years.

THE Italian Electrotechnical Association will meet in Milan on September 30, when visits will be paid to various factories in the neighbourhood and the hydro-electrical installations which have been recently constructed.

THE Right Hon. Sir John Eldon Gorst has been appointed special commissioner to represent His Majesty's Government at the New Zealand International Exhibition, the opening of which is to take place on November 1 next.

WE regret to have to record the death of Prof. W. B. Dwight, who occupied the chair of natural history in Vassar College, Poughkeepsie, N.Y. Prof. Dwight was an original member of the Geological Society of America, and interested himself for many years in the Palæozoic rocks of Wappinger Valley and others in the neighbourhood of Poughkeepsie.

THE programme of the prize subjects of the Industrial Society of Mulhouse for the competition closing in 1907 has just been issued. Little change has been made in the pro-

gramme of 1906, a *résumé* of which was given in NATURE (vol. lxxiii., p. 164). The competition is open to all nationalities.

A REUTER telegram received at Copenhagen from Nome, Alaska, on September 3, announces that the *Gjoa*, the vessel of the Norwegian Polar Expedition, has arrived there, having completed the navigation of the North-West Passage in a westerly direction. The expedition sailed in May, 1903, in charge of Captain Amundsen, and letters recording observations made in the neighbourhood of the north magnetic pole were summarised in NATURE of November 16, 1905 (vol. lxxiii., p. 59).

DURING the past few days the following earthquake shocks have been recorded in the daily papers:—*August* 29.—A violent earthquake was felt at Tacna and Arica, and was followed by sixteen further shocks. *August* 30.—Bodö, Norway. A violent earthquake shock was felt at midnight. *August* 31.—An earthquake shock lasting two seconds was felt at San Juan at 9.45 a.m. *September* 2.—Valparaiso. Slight earthquake shocks were again felt.

HERR O. WENTZKI, of Frankfurt a. M., has been awarded the 300-marks prize of the Berufsgenossenschaft der chemischen Industrie for the discovery of the best means of purifying hydrogen which contains arsenic. According to Wentzki's method, the impure gas is led up into a cylinder containing two parts of dry calcium chloride to one part of moist sand or other similarly indifferent substance, the bottom end of the cylinder being made of wire gauze of fine mesh; the capacity of the cylinder should be about one-third that of the hydrogen generator.

THE opening session of the International Congress on Methods of Testing was held in the Palais des Académies, Brussels, on September 3, under the presidency of Mr. F. Berger (Vienna). Five hundred members were present from eighteen different countries. Addresses of welcome were delivered by Count de Smet de Naeyer, the Belgian Prime Minister, and by Mr. H. Raemarckers, Secretary of the Department of Railways. An address was then given by Prof. F. Schüle (Zurich) in memory of the deceased president, Ludwig von Tetmejer. A report on the work of the executive council since the last congress was presented by Mr. Berger, and interesting papers on the iron and steel industry of Belgium and on the Belgian cement industry were read by Baron E. de Laveleye and Mr. E. Camerman. The mornings of September 4, 5, and 6 were devoted to the work of the sections and the afternoons to excursions. Excursions to the works of the Cockerill Company at Seraing and to Ostend have been arranged for September 7, 8, and 9. The congress is held under the patronage of the King of the Belgians, who on September 2 received the members of council.

THE agenda programme of the seventeenth annual general meeting of the Institution of Mining Engineers has just been issued. The meeting will take place at Hanley from September 12–14, and the following papers will be read or taken as read:—The Courrières explosion, by Messrs. W. N. Atkinson and A. M. Henshaw; gypsum, with special reference to the deposits of the Dove Valley, by Mr. T. Trafford Wynne. The following papers will be open for discussion:—Commercial possibilities of electric winding for main shafts and auxiliary work, by Mr. W. C. Mountain; electrically driven air-compressors combined with the working of Ingersoll-Sergeant heading machines, and the subsequent working of the Busty Seam at Ouston Colliery, by Mr. A. Thompson; practical problems of machine mining, by Mr. S. Mavor; the strength of brazed joints in steel wires, by Prof. H. Louis; by-product coke and Huessener by-product coke ovens, by Dr. J. A. Roelofsen; considerations on deep mining, by Mr. George Farmer; the education of mining engineers, by Prof. J. W. Gregory; the capacity current and its effect on leakage indications on three-phase electrical power service, by Mr. S. F. Walker; petroleum occurrences in the Orange River Colony, by Mr. A. R. Sawyer; and development of placer gold mining in the Klondike district, Canada, by Mr. J. B. Tyrrell.

ACCORDING to a recent report of the United States Consul at Brussels, a laboratory museum of electricity in that town will be opened to the public in October next. The museum has been built and equipped by Mr. R. Goldschmidt, of Brussels, whose object in presenting the museum is the development and extension of the use and application of electricity in Belgium by practical experimental instruction. The institution will contain all kinds of electrical models and appliances, which may be freely handled for study and experiment. Models and apparatus will be conveniently placed at the disposal of the public upon separate tables, and may be connected with the electric supply at will. The museum is divided into four large rooms, one of which will be devoted to machines serving to produce phenomena due to magnetism and to electricity and chemical reaction; another room will be given up to the demonstration of electrical laws. A circular gallery round the room is designated as the second hall; here will be found machines of all sorts, lamps, bells, agricultural and dairy implements, conveniently exhibited, which may be worked by simply adjusting the electric appliances supplied to each table. There will also be free telegraph, wireless telegraph and telephone offices. The third hall is subdivided into reading-rooms, where the latest scientific publications will be displayed. In the fourth hall will be found all kinds of large motors, dynamos, &c., with which the public are at liberty to study and experiment.

THE ancient town of Nuremberg appears to be one of the most popular places for the annual meetings of many German scientific and technical societies; for example, mention may be made of the twenty-ninth Hauptversammlung des Vereins zur Wahrung der Interessen der chemischen Industrie Deutschlands, September 20–22; the third Hauptversammlung of the Verband konditionierender Apotheker für das deutsche Reich, September 1 and 2; the Verband deutscher Gewerbevereine, September 9–12; the seventeenth deutsche Mechanikertag, August 17 and 18.

OTHER meeting places and times fixed for this year's meetings of foreign societies, &c., include:—the international congress for cork manufacturers at Eisenach, September 1; the conference of pharmaceutical faculties (founded in 1900 for the furthering of pharmaceutical instruction in America) at Indianapolis, September 5; the eighth general meeting of the Internationaler Verein der Lederindustrie-chemiker in Frankfurt a. M., September 17–20; the International Tuberculosis Conference, Amsterdam, September 6–8; the Orzagos Iparegyesület (a national industrial society), Budapest, October 20–22 (a congress to consider questions connected with the acetylene industry); the fifth Hauptversammlung des deutschen Medizinalbeamtenvereins, Stuttgart, September 13; the Hauptversammlung des Verbandes selbständiger öffentlicher chemiker in Dessau, September 23–25; and the fourth delegates' meeting for the International Union for the Protection of Workmen's Interests, Geneva, September 26–29.

THE Mysore Government has, the *Pioneer Mail* reports, published a note on the destruction of rats in Mysore city. The system of rat destruction was given a fair trial in the city of Mysore from July, 1905, with the result that the city, which used to be infected with plague year after year, has been practically free during the year 1905–6, there being only seven cases and five deaths against 1244 and 995 respectively in the previous year. The total number of rats killed in the city since the commencement of the campaign, *i.e.* from July 4, 1905, up to July 13, 1906, was 23,741, of which about 12,000 are reported to be females. The following table shows the number of rats killed monthly in the city since January, 1906:—January, 870; February, 492; March, 708; and April, 1050.

A SPELL of exceptionally bright and hot weather occurred over England during the past week, and the thermometer attained a higher reading than had been registered for many years. At Greenwich the shade temperature exceeded 90° on four consecutive days, and the following will show the remarkable character of the weather:—

	Air max.	Sun max.	Average air max.	Absolute prev'ous max. since 1841	
				temp.	date
August 31 ...	94°3 ...	152°0 ...	71	89 ...	1886
Sept. 1 ...	91·9 ...	147·8 ...	71 ...	88 ..	1886
,, 2 ...	93·5 ...	147·0 .	71 ...	83 ...	1880
,, 3 ...	91·0 ...	151·8 ...	70 ...	85 ...	1880

There is no instance in the Greenwich records of the shade temperature having previously exceeded 90° on four consecutive days at any period of the summer, and the only instances of 90° on three consecutive days are August 13–15, 1876, and August 16–18, 1893. The absolutely highest temperature ever registered at Greenwich is 97°. At the reporting station of the Meteorological Office, in St. James's Park, Westminster, the highest temperature attained was 91°, and that reading occurred on each of the three days August 31 and September 1 and 2; on September 3 the reading was 88°. Equally high temperatures occurred in other parts of England. At Nottingham the sheltered thermometer registered 93° on August 31 and September 1, 94° on September 2, and 90° on September 3. The absolutely highest temperature reported to the Meteorological Office was 95° at Colly Weston, in the Midlands. A gentle southerly wind prevailed over the whole country, and the sky throughout was peculiarly free from cloud, whilst the sun shone continuously for several days. Cooler weather set in on September 4, owing to the spreading over us of a north wind, and rain occurred in many parts of the country. In London rain set in very tardily at about 10 o'clock on Tuesday night, but it afterwards fell heavily. Very hot weather also occurred in parts of France and Germany.

BIRDS and their habits constitute the whole of the contents, so far as separate articles are concerned, of the *Zoologist* for August, Mr. G. Dalgleish discussing the wild duck and grebe, Mr. E. Selous the ruff, Messrs. Clark and Rodd the avifauna of Scilly, and Mr. G. W. Kerr that of Staines. In the "Notes" Mr. Aplin's account of the breeding of the black-necked grebe in this country will be read with interest.

THE Indian fresh-water polyp, according to Dr. Nelson Annandale (Mem. Asiatic Soc. Bengal, vol. i., No. 16), is entitled to rank as a distinct species (*Hydra orientalis*). Although diœcious, sexual reproduction does not apparently play a very important part in its development; when this takes place the individuals perish, several generations being completed in a year. The memoir on the Hydra forms a part of the results of a detailed study of the fresh-water fauna of India which is now being undertaken by Dr. Annandale, who has favoured us with copies of seven papers from the Proceedings of the Asiatic Society of Bengal relating to this subject. The first part deals with a brackish-water sponge (Spongilla), while in the second the author finds himself in a position to determine definitely the systematic place of the remarkable fresh-water polyzoan discovered at Nagpur by the geologist Hislop, in whose honour it was named Hislopia by his friend Carter. Other interesting novelties are an aquatic cockroach belonging to a group hitherto known only from the Malay countries, and an aquatic weevil, which, so far at any rate as habits are concerned, is altogether unique.

IN the *Times* of August 30 is an excellent summary, by a correspondent, of the legislation and orders relating to the protection of wild birds and their eggs in the British Islands. After referring to the statutes affecting the country in general, and mentioning the fact that "sanctuaries," within which no bird may be killed at any season, have been established in five counties and two boroughs in England, the writer comments on the absence of any provision in the law for permitting birds and their eggs to be taken when required for scientific purposes. Despite many incongruities, if not absurdities—as, for instance, an enactment in Gloucestershire which practically amounts to protection for a certain species of owl during the time it is absent from the county and permission to kill it on arrival—it appears to be the opinion of the executive authorities that the statutes and orders for the protection of birds work, on the whole, satisfactorily. On the other hand, the enactments with regard to the taking of eggs are regarded as less satisfactory. In the first place, in the writer's opinion, such law "must almost of necessity work unequally, and weigh more heavily on the poor and uneducated than on well-to-do people, such as the dealers, who do most mischief." Secondly, the scheduling of the eggs of certain species (to the exclusion of others equally deserving of protection) is considered highly unsatisfactory, since it affords (on account of the difficulty of identification) a ready means of escaping conviction by those who "know the ropes," while the unsophisticated stand a great chance of being condemned, even though they may really be innocent of the particular charge. As an alternative the writer suggests the passing of a short Act making birds and their eggs the property of the owners of the soil on which they are found, waste lands being for this purpose vested in local authorities.

THE Rev. Guy Halliday writes to report that on July 30 he found *Goodyera repens* in flower near Holt, in Norfolk. This is the most southerly limit recorded for this orchid. The plant, which was identified at Kew, has not hitherto, Mr. Halliday thinks, been found south of Market Weighton, in Yorkshire.

IN continuation of previous descriptions of new or rare pyrenomycetous fungi, Mr. C. E. Fairman notes some new species from western New York in vol. iv. of the Proceedings of the Rochester Academy of Science. A new species of Sporormia was found on pods of the locust, *Robinia pseudacacia*, thus furnishing another species growing on vegetable matter, whereas most are saprophytic on dung. Among new species of Amphisphæria one receives the specific name of *aeruginosa*, but it is not evident whether the green colour is due to this fungus or to a Chlorosplenium.

ONE of the most important collections of plants in recent years was collected by Mr. E. H. Wilson, chiefly in western China, for Messrs. James Veitch and Sons. A few of the more striking new species are described in the *Kew Bulletin*, No. 5. Three species of Berberis, a new genus Hosiea under the order Icacineæ, and some roses are among the number. Sir George Watt contributes an interesting article on Burmese lacquer-ware and varnish, the basis of which is the oleo-resin, *thit-si*, of *Melanorrhea usitata*. Less generally known than the Pagan and Prome lacquer boxes and trays is the Mandalay moulded lacquer; the resin, thickened with ground rice husk, furnishes a material suitable for modelling figures and ornamentation in relief. Mr. C. H. Wright continues his diagnoses of new African plants, and Mr. J. H. Hellier identifies the Eben tree of Old Calabar as *Pachylobus edulis*.

IN a forest survey the examination and measurement of selected plots provide data for working plans. A more detailed study of certain plots in a forest reserve on the island of Luzon with the object of investigating the origin of the different types of vegetation is being undertaken by Mr. W. H. Whitford, who has published the first part of his account in the *Philippine Journal of Science*, vol. i., No. 4. Even here disturbances caused by human agency have to be taken into account. The natives clear the land for cultivation, but leave the clearings after a while, when they change to grass-land or revert to forest. Again, where the timber has been ruthlessly cut out or burnt, only brushwood mixed with trees of invading species is left. For such a type of vegetation the writer adopts the term *parang*, distinguishing the parang according to the dominant tree or trees.

A FORMULA giving the influence of frequency upon the self-inductance of coils is discussed by Mr. J. G. Coffin in the Proceedings of the American Academy of Arts and Sciences, xli., 34. The formula itself involves hyperbolic functions, but the author shows by means of curves that the results for large or small frequencies can be given with sufficient accuracy by simple approximations.

IN a short paper in the *Verhandlungen* of the German Physical Society, Prof. F. Kohlrausch suggests the use of the term "resistance capacity" as applied to the space between two electrodes to denote the resistance of that space when filled with a medium of unit electrical conductivity, and he shows how this quantity is related to the capacity of a condenser the dielectric of which occupies the space in question.

DR. JOSEPH NABL, of Vienna, contributes to the *Naturwissenschaftliche Rundschau* an article written for the purpose of explaining in simple language the meaning of the second law of thermodynamics and its connection with the theory of probability (Boltzmann's minimum theorem), as well as the notion of entropy and the properties associated with it. The account is probably as good a one as could be given in so limited a space for the instruction of non-mathematical readers.

IN the Proceedings of the American Academy of Arts and Sciences, xli., 32, Mr. Harvey N. Davis discusses the longitudinal vibrations of a rubbed string. Instead of basing the investigation on the use of Fourier's series as was done by Helmholtz in his well-known investigation of the vibrations of a violin string, Mr. Davis makes use of the graphic methods which have been commonly employed by mathematicians in discussing the impact of elastic beams. It appears both from theory and experiment that the envelope of a string which is rubbed either transversely or longitudinally at an aliquot point $1/k$ of its length is not Helmholtz's parabola, but k chords inscribed in that parabola—a result which strikes the reader as being, on the face of it, in accordance with common sense. A number of other results, such as the verification of Krigar Menzel's law, have been discussed.

VOL. iii., No. 2, of Investigations of the Departments of Psychology and Education of the University of Colorado contains several interesting papers. Under the title "Proportion as the Quotient of Two Forms of One Equation," Mr. Heman Burr Leonard suggests certain new methods of teaching problems in proportion, and if these do not look quite so simple on paper as they really are, the article certainly confirms an important point, namely, the necessity of familiarising pupils with the use of *formulae* in solving problems, instead of the more restricted methods of "rule of three." Under the title "Relation of Course of Study to Higher Wages" Prof. John B. Phillips directs attention to the large number of important inventions that have been made by men of little or no education. His suggestion that "invention" should form part of an educational curriculum is interesting, though one may perhaps ask whether *teaching* people to be *original* is not rather a contradiction of terms. Lastly, we have an account of the Colorado Mathematical Society, founded last year, from which it appears that several important points in the teaching of mathematics, such as over-elaboration of text-books, athletic and other distractions, and what has sometimes been called "spoon feeding" on the part of teachers, have been discussed.

MR. R. J. THOMPSON deals with the development of agriculture in Denmark in a paper published in the Journal of the Royal Statistical Society, lxix., 2. He attributes the prosperity of the country to three causes: land tenure, education, and cooperation. So far from rural depopulation taking place, the land is better farmed than it was forty years ago. The rate of wage is lower than in England, and thrift is a national characteristic. The bulk of the land is cultivated by the owners in small farms.

ABOUT forty years have elapsed since Gustav Theodor Fechner laid down his principle of association. The *Psychological Review* has marked the occasion in a fitting way by devoting its May number to a paper by Prof. Lilien J. Martin on an experimental study of Fechner's principles of æsthetics. It is illustrated by a portrait of Fechner and a coloured reproduction illustrating a case of chromanæsthesia.

THE isolation and identification of radio-thorium from the sediments of Bad Kreuznach is described in detail by Messrs. Elster and Geitel in the *Physikalische Zeitschrift* (No. 13). The fact that radio-thorium is associated with iron in these sediments suggested a simple method of isolating radio-thorium from ordinary thorium salts. A nearly neutral solution of thorium chloride was mixed with a solution of ferrous bicarbonate, when it was found that the ferric hydroxide precipitated in the course of a few days was highly active. After removal of the iron, several milligrams of a thorium hydroxide were obtained having an activity twelve times that of the original thorium. These results, taken in conjunction with those already recorded (NATURE, vol. lxxiv., p. 385), leave little doubt that thorium owes its activity to radio-thorium.

DESPITE the many attempts which have been made to elucidate the nature of the blue substance formed by the action of iodine on starch paste, the question still remains

without a definite solution. Messrs. M. Padoa and B. Savarè in the *Gazzetta* (vol. xxxvi., p. 310) have attacked the problem in a new way by investigating the change in the electrical conductivity of a solution of iodine in potassium iodide caused by the addition of starch in known proportions. The conclusion is drawn from their experiments that the blue substance is an additive compound of iodine, starch, and potassium iodide (or hydrogen iodide) containing the two former constituents in the ratio $1 : C_6H_{10}O_5 = 1 : 4$. While this result supports the opinion of Mylius, enunciated some twenty years ago, it is directly opposed to the more recent view of Küster that the blue substance is not a definite substance, but is formed as a result of adsorption by the colloid starch. Küster's contention recently received striking support by the work of Biltz in 1904, who showed that basic lanthanum acetate, which resembles starch in its colloidal nature, also produces with iodine an intensely blue substance similar in all respects to that formed from starch; in this case there seems to be no evidence to consider the substance as a definite chemical compound.

THE current issues of the *Lancet* and the *British Medical Journal* are educational numbers, and are entirely devoted to communications bearing upon preparation for the medical profession.

THE Royal Geographical Society has issued through Mr. E. Stanford a general index to the first twenty volumes of the *Geographical Journal*, 1893–1902. The work, which is divided into three parts, devoted respectively to papers, maps, and general subjects, should prove a boon to geographers.

THE third edition of Prof. R. von Wettstein's "Leitfaden der Botanik für die oberen Klassen der Mittelschulen" has just been published by Mr. F. Tempsky, Vienna. The book contains 236 pages, more than half of which (134 pages) are devoted to systematic botany, while the remaining sections deal with plant anatomy, organography, physiology and ecology, geography, and economic botany. There are three coloured plates and more than a thousand figures upon 205 blocks. Within its limits, the work makes an admirable survey of the realm of botany, being attractive in illustration, concise in description, and sound in substance.

OUR ASTRONOMICAL COLUMN.

RETURN OF HOLMES'S COMET (1906*f*).—The remarkable comet discovered by Mr. Holmes on November 2, 1892, has been re-discovered on this, its second, return by Dr. Max Wolf at the Königstuhl Observatory, Heidelberg. From the Kiel telegram announcing this fact we learn that on August 28, the date of the observation, the comet's position at 13h. 52·1m. (Königstuhl M.T.) was

R.A. = 4h. 7m. 24s., dec. = +42° 28′.

This position is between one-third and one-half the distance between 52 and 53 Persei, and crosses our meridian at about 5.30 a.m.

Comparing the position with that given by the ephemeris published by Dr. H. J. Zwiers in No. 4085 of the *Astronomische Nachrichten*, we find that small corrections of about +0·5m. in R.A. and +3′·5 in declination need to be applied to the latter. A portion of this ephemeris is given hereunder:—

Ephemeris oh. (M.T. Greenwich).

1906	α (app.) h. m.	δ (app.) ° ′	1906	α (app.) h. m.	δ (app.) ° ′
Sept. 6	4 17	+44 6	Sept. 14	4 25	+45 34
8	4 19	+44 29	16	4 26	+45 56
10	4 21	+44 51	18	4 28	+46 17
12	4 23	+45 12	20	4 29	+46 38

COMET 1906*e* (KOPFF).—Circular No. 90 from the Kiel Centralstelle gives three ephemerides for the comet recently discovered by Herr Kopff at Heidelberg. The following was computed by Herr M. Ebell:—

Ephemeris 12h. (Berlin M.T.).

1906	α h. m. s.	δ ° ′	log Δ	Brightness
Sept. 4	22 39 58	+9 36·0	0·0490	0·75
8	22 37 19	+9 14·9	0 0639	0 67
12	22 34 57	+8 52·0	0·0797	0·60
16	22 32 55	+8 28·1	0·0961	0·54

Several observations of this comet are recorded in No. 4117 of the *Astronomische Nachrichten*. Prof. Kobold, observing at Kiel on August 23, saw it as an undecided, round spot of 2′ diameter with a central condensation of magnitude 11·0. The magnitude of the whole was 10·5. From an observation, also made on August 23, Prof. Hartwig described it as having a diameter of 1′·5, a nucleus of magnitude 13·0, and a round shape, the total magnitude being 12·0.

A NEWLY-DISCOVERED PLANETARY NEBULA.—On examining one of the plates taken with the 10-inch Brashear lens of the Bruce photographic telescope, Prof. Barnard discovered the image of a fine planetary nebula which does not appear to be in the catalogues. The approximate position of the nebula, for 1855, is α = 11h. 7m., δ = +15° 42′. In the same region there appear to be quite a number of spiral nebulæ and nebulous stars (*Astronomische Nachrichten*, No. 4112).

PLEA FOR AN INTERNATIONAL SOUTHERN TELESCOPE.—In No. 182, vol. xlv., of the Proceedings of the American Philosophical Society Prof. E. C. Pickering advances a businesslike plea for the institution of a large international reflector in the southern hemisphere. He points out that, under the existing conditions, it is hard to see how any great step may be made in the advance of astronomy, but thinks that if a reflector of about 7 feet aperture and 44 feet focal length were erected in the best possible atmosphere to be found in the southern hemisphere, advances of immense importance might accrue. The cost he estimates at something less than 500,000 dollars (rather more than 100,000*l*.), and he suggests that such a scheme would be an eminently suitable one by which to commemorate the Franklin bi-centenary.

THE PROGRESS OF AGRICULTURAL SCIENCE.

THREE years ago the Royal Agricultural Society conceived the happy idea of holding, in connection with its annual shows, an agricultural education exhibition, at which the work of the various agricultural colleges might be brought prominently before the public, and especially the latest results of agricultural scientific research. The fourth annual exhibition of this kind was recently held at Derby, and the object of this note is to indicate several of the more important directions which agricultural research and rural education are now taking, and the results as illustrated at the exhibition.

Mendel's Laws of Inheritance.

Important hybridising experiments on the lines of Mendel's laws of inheritance are being carried out at the Cambridge University Agricultural Department by Mr. R. H. Biffen. Mendel's laws prove the recurrence in breeding of dominant and recessive characters in certain definite proportions, and their application renders possible the production of new fixed types in two or three generations with mathematical precision instead of as formerly after years of more or less haphazard breeding by selection. Thus in crossing smooth red with rough white wheat, the first cross was apparently of fixed type; but in the second generation only one out of sixteen bred true; in the third generation three bred true; in the fourth generation four bred true, and the type was fixed. The same principles are applicable to the inheritance of disease. Rows of wheats were shown proving the possibility of

obtaining in three or four generations immunity from rust in specimens the original parents of which were of rust-susceptible and rust-resisting types. Very interesting is the application of these laws to the breeding of animals. Mr. W. Bateson, F.R.S., and Mr. R. C. Punnett, of Caius College, Cambridge, lent some preserved bodies of Andalusian and rosecomb bantam fowls. The blue Andalusian never breeds true, but always produces a definite proportion of blacks and splashed whites. From a pen of blues, one-half of the offspring will be blue, one-quarter black, and one-quarter white. When blue is mated with either blue, black, or white, one-half of the offspring will be blue. When, however, black is mated with white, all the offspring are blue. In reality, the blacks and whites are both pure breeds, and the blue is the hybrid form produced by crossing these breeds. It is therefore so constituted that it cannot breed true, and no amount of selection will ever bring about this result. White rosecomb bantams belong to the class of recessive whites, and the progeny of a white rosecomb by any pure-coloured breed are always coloured. Thus when a black and a white rosecomb are crossed, all the hybrids are black. When such hybrids are mated together, three-quarters of the chicks are black and the rest white. In Mendelian terms the black is dominant and the white recessive. There are, therefore, two kinds of blacks, those which carry whites and those which do not. When crossed with white the former give equal numbers of blacks and whites, whilst the latter give blacks only. It is, however, impossible to distinguish between the two kinds of black, except by a breeding test, the eventual result of which is the production of blacks and whites, both of which breed true to colour.

Assimilation of Nitrogen by Leguminous Plants.

The nitrogen problem has received special attention at the Midland Agricultural and Dairy College, and recently experiments have been made with the pure inoculation cultures of Dr. Hiltner, of Munich. Tares, peas, alsike, lucerne, and crimson clover (*Trifolium incarnatum*) were sown in pots of boiled, sterilised, quartz sand, and the effect of inoculating the soil in these pots with the pure cultures supplied by Dr. Hiltner was shown to have decidedly beneficial effects upon the growing plants. Mr. John Golding, by whom these experiments have been carried out, has introduced a new system of inoculation for leguminous crops, which consists in mixing dried sterilised soil with crushed healthy nodules taken from the roots of plants of the same kind as those which it is desired to inoculate. The object of sterilising the soil is to effect the destruction of harmful germs and pests such as the wireworm, &c. Buhlert has shown that the microbes of the leguminous nodules all belong to one species, but are modified so that nodules coming from a particular leguminous plant are those best adapted for inoculation of the soil in which that plant is sown. Mr. Golding's inoculating material will contain, therefore, only the microbe of value for the particular plant cultivated. If this material should prove practically efficacious on a field scale, it can be supplied at a cost of from 1*d.* to 2*d.* per lb., which at the rate of an application of 56 lb. per acre represents a cost per acre of from 4*s.* 8*d.* to 9*s.* 4*d.*

Vitality of Farm Seeds.

This question has received practical elucidation from experiments carried out during the last eleven years by Mr. William Carruthers, F.R.S., consulting botanist to the Royal Agricultural Society. The results were illustrated at Derby by a large table, which showed in respect of all the farm seeds in common use the percentage of living seeds remaining each year from the commencement of the experiments in 1885 to the present year (1906). Of the cereals, oats proved to have the greatest vitality. Black oats retained 76 per cent., and white oats 57 per cent., of living seeds in the eleventh year (1906), whilst in the ninth year (1904) the percentage was no less than 95 per cent. and 97 per cent. Wheat in the ninth year showed a germinating power of 29 per cent., but none remained alive in the tenth year. Barley retained vitality to the extent of 90 per cent. in the fifth year (1890) and 19 per cent. in the ninth year (1904), but none remained alive in the tenth year. Grasses were proved to lose their vitality very much more quickly than the cereals. Sheep's fescue, for instance, was reduced by one-half its germinating power by the third year, and all the seeds were dead by the eighth year (1903). Of Timothy, 93 per cent. remained alive in the fifth year and 12 per cent. in the eleventh year. Crested dog's tail germinated 61 per cent. in the fifth year and 11 per cent. in the eleventh year. Of the rye grasses, in the seventh year the perennial and Italian rye grasses germinated 36 per cent. and 71 per cent., and in the eleventh year 6 per cent. and 10 per cent., respectively. Of the root crops, swede turnips retained their vitality almost unimpaired for the first three years, and even up to the seventh year the germination was from 84 per cent. to 85 per cent.

Improvement of Pastures.

The increasing importance of dairying has led to the renovation of a great deal of poor pasture. No small part of the work of some of the agricultural colleges has been devoted to a study of the remedies appropriate to different conditions, whilst from 1885 to 1904 a series of experiments on the improvement of grass lands in various parts of the country was carried out by the Royal Agricultural Society. The results of these experiments were illustrated by turfs cut from the actual pastures, and they brought before the farmers who visited the show lessons of supreme practical importance. In a turf sent by the Royal Agricultural Society, and cut from a pasture in Yorkshire, the application of lime was shown to have been remarkably beneficial, and the dividing line between limed and unlimed portions was clearly indicated by the difference in the character of the herbage. This turf was from land where basic slag without lime had no appreciable effect. On the other hand, turf sent by the Cambridge University Agricultural Department from land of the Boulder-clay formation proved the necessity for the application of phosphates, and basic slag was the appropriate remedy. Lime and cake-feeding in these cases proved of no avail. Turfs sent by the Royal Agricultural College showed that the addition of kainit and superphosphate resulted in a large increase of clover, and a large reduction of moss and undecayed vegetable matter that were conspicuous in the unimproved pasture. The character of the herbage was also shown to be materially influenced by other applications, such as sulphate of ammonia and nitrate of soda, while the use of 5 cwt. per acre of guano—a natural complete manure—produced a decided improvement, the abundance of white clover and sheep's fescue providing splendid food for sheep.

British Forestry.

The exhibits consisted of seeds, cones, trees, shrubs, timbers, tools, photographs, specimens, models, diagrams, working plans, and maps. They were arranged under the supervision of members of the council of the Royal English Arboricultural Society. The Duke of Northumberland, Earl Egerton of Tatton, the Earl of Egmont, and the Earl of Yarborough sent timber specimens showing the economic uses to which British plantations may be applied, and illustrating methods of preservation, chiefly by creosoting. Lord Yarborough's woods have been scientifically managed for a long period, and a chart was displayed showing that 23,564,719 trees have been planted on the Brocklesby and Manby Estates from the year 1700 to the present time. An exhibit sent by the Duke of Northumberland consisted of young trees planted out of doors, and showing the mixture of light-demanding and shade-bearing trees according to the following plan, as adopted in Germany:—(*a*) outer row of beech providing shelter; (*b*) second row with sprinkling of sycamore as a wind-resister; (*c*) oaks, 9 feet apart, for permanent crop; (*d*) other hardwood trees for returns during rotation; (*e*) sprinkling of larch for early returns; (*f*) shade-bearers of spruce, silver fir, and beech for soil production and stimulation of main crop. Several exhibits illustrated the evils arising from incorrect pruning or from neglect of pruning. Where pruning is not effected

close to the stem, the projecting stump decays, and the decay affects the trunk. Where branches are not pruned at all, or not at the right time, natural pruning caused by thick planting occurs, but the decay of the branches also affects the trunk. Too early thinning prevents the growth of clean boles with suppressed branches. All these points require careful attention in forestry, or considerable depreciation in the value of the timber ensues. The Royal Agricultural Society, the Royal Agricultural College, the Surveyors' Institution, and Mr. A. T. Gillanders (forester to the Duke of Northumberland) sent collections of mounted specimens of insects injurious to forest trees. Those of Mr. Gillanders were very complete, and were classified as beetles, saw-flies, moths, scale insects, aphidæ, and diptera.

Nature-study in Rural Schools.

This, a new feature, was by no means the least interesting department of this year's exhibition. It was organised by the County Councils Association, and was divided into groups of exhibits from public elementary schools, secondary schools, and school gardens. The counties from which exhibits were sent included Cambridge, Cumberland, Durham, Derby, Essex, Leicester, Lincoln, Nottingham, Stafford, Suffolk, Sussex, and Worcester, and the work sent was highly creditable to both teachers and scholars. It was stated that the specimens were collected and mounted by pupils of average intelligence, but the excellence of many of the water-colour drawings of common flowers was remarkable. The collections made by the scholars included mounted specimens of local flowering plants, some of them classified into hedge-row, wood, and water plants, collections of tree leaves, autumn fruits, fossils, common insects, snails, wireworms, &c. In the secondary schools the work was, of course, more advanced, and included classification into seeds, seedlings, branches, flowers, fruits, and wood in the case of common trees. The Staffordshire County Council exhibited collections of tools, seeds, and apparatus as supplied to school gardens, and a map showing that gardening classes are held in seventy-nine day schools, in thirty evening schools, and two grammar schools in that county. The introduction of nature-study into our rural schools appears to hold out great promise as a means of training and developing the intelligence of country children. It should go far to counteract that "dulness of the country" which is stated to be one of the potent causes of migration to the towns. Education of the youthful mind to the intelligent appreciation of natural phenomena may be regarded as a most important means of ensuring the future progress of agricultural science. E. H. G.

RUSSIAN GEOGRAPHICAL WORKS.

SEVERAL papers and memoirs of scientific interest and importance are included in publications received from Russia during the past few months. The publications are printed in the Russian language, and among them are four volumes of the Proceedings of the Imperial Russian Geographical Society.

In vol. xli., part iv., of the Proceedings of this society, Mr. V. V. Markovitch contributes lengthy articles, one entitled "In Search of Eternal Ice," and the other on the ice-fields of the Caucasus, illustrated with beautiful photographs and sketches. Botanists will be interested in his notes on the flora of the mountains. Elaborate reports on the subject of ground ice, by a commission appointed to study the question, appear in the Proceedings, vol. xli., part ii. A map of European Russia is given, indicating results of investigations by many observers. In vol. xl., part iv., an important examination by Mr. A. I. Voieikoff of the question whether the Pacific Ocean will become the chief commercial route of the terrestrial globe appears, with statistics and maps.

In vol. xli., part iii., Mr. L. Berg differs from Prince P. Kropotkin's opinions on progressive desiccation of Eur-Asia, maintaining that the climatic conditions of Central Asia have been practically unchanged from the earliest recorded times, and that geological desiccation has long ceased. Mr. Berg refers to a canal called after Hammurabi (Amraphel, King of Shinar), a passage in the "Song of Songs" about the cessation of winter and stoppage of rains, a plant crowning the mummy of an Egyptian princess, Quintus Curtius's account of Bactria in the time of Alexander, down to the investigations of Heim, Hess, Bruckner, and Russian explorers. The writer adduces his experiences of the Aral region in support of his conclusions.

In 1896, 1897, and 1899 Mr. N. A. Busch was commissioned by the Imperial Russian Geographical Society to investigate the glaciers of the western Caucasus, Kuban district, and Sukhum circle. The results are recorded in his report, "Glaciers of the Western Caucasus," 1905 (134 pages), which is furnished with a helpful index and some fine views.

A work entitled "Materials for the Geography of the Urals," by Mr. P. Krotov, describes orohydrographical investigations in the southern part of the central Ural range. The preface opens with a reference to Dr. Carl Hiekisch's work "Das System des Urals" (Dorpat, 1882), to show that knowledge of the geography of these regions is meagre and superficial owing to lack of expenditure of money and exertion. It is claimed that the northern and

Ice-cave of the right glacier of the Tsherin-kol.

southern parts of the range are more familiar to scientific explorers than the more accessible central part. In 1893 it was decided to make an orohydrographical survey of portions of the Ekaterinburg and Krasnoufimsky districts, Perm government, but the area proposed was afterwards limited. Mr. Krotoff reviews previous explorations, mentioning, *inter alia*, the labours of Tatistsheff, Humboldt, and Murchison.

The six chapters contain:—historical sketch of previous explorations; cartographical materials and geological sketch; orographical description; hypsometry of the western slope of the Urals; hydrographical description; concluding notes; "absolute heights" in the southern part of the central Urals; forty-two pages of lists of heights. Orographical and geological charts are given at the end on a scale of five *versts* to the inch.

The report of the Imperial Russian Geographical Society for the year 1904 contains a vast amount of useful matter, especially in the records of scientific exploration. Following the official lists there are short biographies of deceased members, including General P. S. Vannovsky and Admiral S. O. Makaroff, medallist, constructor of the ice-breaker *Yermak*.

The society regrets that owing to unavoidable hindrances many undertakings had to be abandoned. About six pages are devoted to the exploration conducted by Mr. A. V. Zhuravsky of the Bolshezemelsky tundra, starting from the Petshora, and including the river Adzva, the Vashutkin lakes, and the Adak ridge. Samoyed natives assisted as guides. As a result, some important local points were made clear, collections of flora and water fauna, molluscs, and spiders were made, besides a herbarium, map of the lakes and rivers, photographs, meteorological report, and statistics of the native population—which is in danger of dying out—were collected. In the Proceedings of the society, vol. xli., part iii., 1905, Mr. A. Rudneff contributes a preliminary report of this expedition, with illustrations. This region has only been traversed twice previously, by Mr. William Gourdon, of Hull (1614–1615), who left a diary, and by Herr A. Schrenk (1837), author of an account of travel in north-eastern European Russia. Mr. A. V. Zhuravsky's letter to the secretary, in which he relates his activities and mentions the establishment of a zoological station at Ustzilma, appears in vol. xli., part iv.

Mr. A. A. Makarenko made an ethnographical expedition to the Yenesei government, and collected songs and information on local medicine. Other important explorations in Turkestan and the southern steppes are reported. Condensed reports of the ethnographical and other sections, financial statements, publications issued and received, and miscellaneous notes complete the volume.

The Russians have accumulated a vast amount of material with regard to the customs and literature of the Turks and Tartars, the results of researches in fields practically inaccessible to Western scholars.

"The Story of Yedigei and Toktamysh," edited by Prof. P. M. Melioransky, consists of a preface, glossary, and nearly forty pages of Kirghiz text (in Arabic characters) of an old tradition concerning some of the leading members of the famous Golden Horde, *temp.* later fourteenth and earlier fifteenth century. Khan Toktamysh, after the defeat of the Khan Mamai at Kulikovo-polie by the Grand Duke Dmitri Donskoi, in the following year attacked and burned Moscow. Yedigei was a specially distinguished emir under Toktamysh, and, according to the story, was the son of a holy man, Hodzha Amet, and a mysterious, aqueous being with a goat's feet and a transparent body, upon whom her husband does not gaze when she removes a garment for fear she should wish to leave him. Timour or Tamerlane, styled in the story *Sa*[1] *Temiru*, revered the memory of the Hodzha and protected his son. From being a follower of Toktamysh, Yedigei induces Timour to make war on him, and is credited with a similar judgment to that of Solomon in a parallel case of maternal controversy.

The tradition exists among the Nogai, Kirghiz, and Siberian Tartars in varied form. We are not in a position to criticise the text of the poem, and the learned editor hints at a vast wealth of Tartar tradition still to be collected and arranged for publication.

THE MATTEUCCI MEDAL.

THE Italian Society of Sciences known as the Society of the Forty has awarded the Matteucci medal for 1906 to Sir James Dewar in recognition of his scientific work. In presenting the report upon the award, the committee of the society, consisting of Profs. P. Blaserna, A. Righi, and A. Roiti, referred to Sir James Dewar's researches in the following terms :—

James Dewar, born in 1842 at Kincardine-on-Forth in Scotland, completed his studies and took the first steps in his professorial career in the University of Edinburgh; in 1873 he was appointed professor of natural philosophy at Cambridge, from which post he was promoted Fullerian professor in the Royal Institution in London, where he is likewise director of the laboratory founded in memory of Davy and Faraday.

We shall not pause to enumerate all the contributions which he rendered to the knowledge of aromatic compounds, nor the other important investigations in chemistry by which he initiated his scientific career. But we cannot omit to point out the work which he carried out from 1878 to 1890, for the most part in conjunction with Prof. G. D. Liveing, of Cambridge, which work undoubtedly forms part of the finest that has yet been produced in the field of spectrometry. This work is set out in about fifty short notices free from all preconceived ideas and admirable in their experimental genius, enriched with data meriting the highest attention and universally accepted, and fertile in their theoretic bearing and scope. Dewar and Liveing were the first to investigate the phenomena of inversion in many elements; afterwards they studied the influence of temperature on the spectra of the same elements, and the way in which these spectra were modified by the presence of other elements. Extremely interesting are their researches regarding the various spectra of carbon and its compounds, and in relation to the phenomena of synthesis manifested in the electric arc. They, moreover, furnished the first exact determinations of the ultra-violet spectral region, assigning with the utmost care the wave-lengths for a fair number of elements.

Various other problems made evident Dewar's extraordinary experimental ability, and his world-wide fame was secured by the problem, more than any other, of obtaining extremely low temperatures, to which he has indefatigably and courageously devoted himself for more than twenty years, with the satisfaction of seeing his labours crowned by the liquefaction and solidification of hydrogen, which allowed him to study the chemical and physical properties of gases formerly held to be irreducible, when they have changed their state of aggregation.

Having ingeniously contrived means for rendering inconsiderable the losses by evaporation of these new and highly volatile liquids, and thus for preserving them for a length of time in large quantities, he turned this to able account in order to investigate the very varied phenomena which took place at their boiling temperatures, low in themselves, and still further lowered by expansion.

Most extensive is the field covered by Dewar in his studies of this kind: variations of density and cohesion, chemical and photographic actions, phosphorescence and radio-activity, optical properties, thermoelectricity, electric conductivity and inductivity, and magnetic susceptibility. It would take too long to enumerate here the important and partly unexpected results obtained by him, and indeed it is superfluous, as they are present in the minds of all. Let us rather restrict ourselves to accompanying the Matteucci medal, which we award him, by the wish that from the 13°, which he has already reached, he may descend still further downwards towards absolute zero, and succeed in liquefying even helium.

[1] *Sa*, it is explained, is a form of the word *Tsar* (Cæsar).

PRACTICAL METEOROLOGY.

THE Meteorological Committee has issued its first report, for the year ended March 31, 1906. In compliance with the desire expressed by H.M. Treasury, the work of the office proceeds generally on the lines hitherto followed, and the committee record "their appreciation of the services rendered in the administration of the office by Sir R. Strachey, the chairman of the council for twenty-two years," and by other members. An important addition has been made by participation in the investigation of the upper air by means of kites. It is also proposed, if practicable, to make use of unmanned balloons, and to render the service more effective by cooperating with the representatives of other bodies concerned in the work. Among some of the useful researches initiated or completed during the past year may be mentioned (1) the study of the trajectories of air in travelling storms, embodied in an official publication entitled "The Life-history of Surface Air Currents"; (2) re-determination of the velocity equivalents of the Beaufort scale of wind force; (3) connection between the yield of wheat in eastern England and the rainfall of the previous autumn; and (4) possible relationship between exceptional strength of the south-east trade wind at St. Helena and exceptional rainfall in England. Reference to these investigations has already been made in our columns. We note that the payment hitherto made to Dr. Buchan, as inspector of stations in Scotland, is to

be continued for the time being in consideration of his important work in connection with the discussion of the results obtained at the Ben Nevis observatories. The complete or partial success of the weather predictions was very satisfactory during the year in question, *e.g.* harvest forecasts, 89 per cent.; forecasts appearing in morning newspapers, 88 per cent.; in both cases the best results were obtained in eastern and southern England. The number of storm-warning telegrams justified by subsequent gales or strong winds was 88·4 per cent. The committee points out that the service of storm warnings, which is extremely difficult on account of meteorological reasons, is aggravated by the frequent impossibility of getting telegrams delivered on the day of issue when dispatched in the evening or on Sundays, and it proposes to give this serious matter further consideration in the current year. The ordinary work of the marine and land branches has been much augmented by the reduction and tabulation of the observations of the National Antarctic Expedition and of auxiliary observations made in connection therewith, both at sea and on land, south of 30° S. latitude.

We have been looking rather carefully at the last published meteorological chart of the North Atlantic and Mediterranean for September, prepared by Commander Campbell Hepworth, marine superintendent of the Meteorological Office; one cannot help being struck with the almost crowded amount of information useful and interesting to seamen that it contains. Like its younger sister, the monthly chart for the Indian Ocean, the face is chiefly occupied by roses, showing for areas of 5° of latitude by 5° of longitude the frequency, direction, and average force of the winds; by waved arrows, showing the direction of ocean currents and the maximum and minimum set in twenty-four hours; and by routes recommended for steam and sailing vessels respectively. The regions where fog is most prevalent are also shown, and the icebergs most recently observed along the Transatlantic steamer routes. The most southerly berg reported up to the early part of August was roughly in 45° N. 47° W., and the most easterly in 47° N. 40½° W. On the back of the chart are given, *inter alia*, charts of tidal currents round the British Isles at the successive hours before and after high-water at Dover, and a co-tidal chart by Dr. Berghaus, with a useful explanation by Sir G. H. Darwin. As we are in the season of West India hurricanes, indications of their approach are explained and directions are given as to the most advisable steps to be taken when the centre of such a storm has been located.

The monthly meteorological chart of the North Atlantic for September, published by the Deutsche Seewarte, contains, generally speaking, similar useful information to that issued by the Meteorological Committee. The scale is somewhat larger than that of the English chart, and the wind-stars are printed in blue, the force, according to the Beaufort scale, being represented by feathers on the shafts of the arrows; altogether they form a prominent feature of the chart. The changes in the areas of high and low barometric pressure and other weather conditions shown graphically are also explained concisely in the text. On the back of the chart the true and magnetic bearings for a large number of points on the coasts when two lights or other objects are seen in line from the deck of a vessel afford an easy method of determining the deviation of the ship's compass. There are also small charts showing the mean isobars, isotherms, percentage of frequency of storms and calms for various localities in September, and the annual change in the magnetic declination. These pilot charts, brought as closely as possible up to the date of publication, are of the greatest practical value to seamen.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

IN his presidential address to Section E, Sir George Goldie took the more or less obvious course of reviewing the progress of geography during the quarter of a century that had elapsed since the association last assembled in that city; but while necessarily saying something of the progress of exploration during that interval, he wisely passed rapidly over this side of the subject, and addressed himself chiefly to the wider aspects of the growth of the scientific treatment of the subject and the spread of the geographical spirit among the people at large. The address was therefore unusually valuable from the point of view of all who are interested in the present position and future of the subject, both as an item in the educational curriculum of the country and as a study of undeniable importance to the general welfare of the nation.

There was a particular fitness in laying stress on this side of the question from the fact that, twenty-five years ago, as Sir George Goldie pointed out, a true conception of the functions and scope of geography was confined to a very limited circle of specialists, so that the progress so far made may be said to belong exclusively to the period under review. The investigation undertaken by the Royal Geographical Society, which was undoubtedly the starting point of any success since achieved, was, in fact, set in motion a few years after the previous York meeting of the association. The report issued by the society as a result of Dr. Keltie's inquiries showed how entirely inadequate were the methods of geographical tuition in those days, and the little importance, with one or two praiseworthy exceptions, attached to it in educational circles. The "absurd prejudice" which, as then pointed out by one of the few more enlightened teachers, regarded the subject as unworthy of the attention of first-rate men, has happily since been to a large extent overcome.

Sir George Goldie aptly diagnosed the source of our weakness as being, not the absence of the necessary raw material, for few countries possessed a literature of travel and exploration so wide and of so high a class as ours, but the paucity of men qualified to apply scientific method to this raw material, and the want of an institution where a thorough training in geography might be obtained. He was able to point to the large measure of success which has attended the efforts of the Royal Geographical Society and its coadjutors to remedy these defects, as evidenced in the present position of geography at Oxford and Cambridge and other of our universities. As a main cause of a spread of interest in the subject among the people at large he assigned the marked re-awakening of the spirit of colonial expansion, from 1884 onwards, and held that "empire-building is an even greater factor than war in advancing and popularising geographical knowledge."

As regards the future, he pointed out that though the popularity of a subject is by no means a test of its place in the ranks of science, the democratisation of geographical ideas is a very hopeful feature, by reason of the widening of the area from which students can be drawn and men of genius evolved. In conclusion, he gave a by no means contemptible list of books and papers as samples of the work recently produced in this country under the stimulus of scientific method applied to geographical study.

Among the papers, discussions, and lectures which formed the remaining programme of the section, one by Mr. G. W. Hope, a young American professor from the Ohio State Normal College, may be first mentioned, on account of the close bearing which it had on the subject of the presidential address. In a valuable and suggestive paper Prof. Hope urged the importance of Social Geography as a subject of study which has hitherto been too much neglected. The paper well exemplified the wide field open to the student of the new geography, and the need that it should be taken up by first-rate men if it is to lead to the most valuable results. The speaker dwelt, for instance, on the wide and thorough knowledge, not merely of geography in its narrower sense, but of allied subjects such as history, technology, and economics, which is indispensable for a fruitful study of the problems of social distribution. His avowal that he had himself approached the subject largely under the inspiration of the geographical movement in this country should give much encouragement to those who have worked so strenuously in its furtherance.

A large part of two mornings was taken up with well-sustained discussions, one on coast erosion, the other on a proposal for improved geodetic measurements in Great Britain. The former was opened by a paper by Mr. Clement Reid, F.R.S., who insisted on the need of approaching the subject with an adequate knowledge of past geological events in order to gain a comprehensive grasp of all the factors. The erosion of our coast must be studied in conjunction with the deposition of the material

eroded, and when this is done we find that the process has not continued regularly for an indefinite period, but began, as now manifested, only some 3000 or 4000 years ago. In Neolithic times, according to evidence supplied by buried land surfaces, the sea stood 60 feet lower relatively to the land, and on the south and east coasts of England the rising downs were separated from the coasts by a wide plain. About 4000 years ago there set in a rapid but intermittent subsidence of the land or rise of the sea, on the completion of which the coast erosion now in operation began. In course of time shingle beaches and sand dunes were formed from the eroded material, and supply the best protection against further inroads. Much valuable alluvial land has also been formed in sheltered estuaries, so that it is an important question whether the net gain from protective works (if existent at all) would justify the enormous outlay involved. In the discussion which followed (in which Prof. Percy Kendall, Mr. Whitaker, Mr. E. R. Matthews, and others took part) the need of taking a broad view of the whole question was again and again emphasised, instances being given of the detrimental results of uncoordinated protective operations. Mr. Matthews, an engineer from Bridlington, gave some instructive details as to recent changes on the Yorkshire coast.

The geodetic discussion was opened by Major E. H. Hills, who pointed out that though the fundamental triangulation of these islands was excellent work for the time at which it was done, it is now far behind the standard of modern work of its class. This is the more regrettable, inasmuch as it prevents the coordination of British with Continental work, although the necessary observations to connect the two series have actually been made, and such coordination is of high importance in connection with questions such as the determination of the figure of the earth. All that is absolutely necessary is to connect geodetically, by as good a set of triangles as possible, the extreme points of our islands, and, were this done, amplitudes of 10° and 11¾° respectively would be added to two very important geodetic lines, viz. the meridional arc through the Greenwich meridian and the longitudinal arc along 52° N., which at present extend through 18° and 57°. Major Hills's proposals were warmly supported by Colonel D. A. Johnston (who presided at the discussion), Prof. H. H. Turner, Major Close (who mentioned as a less ambitious scheme the measurement of the central meridian of England running north from Southampton), Colonel Hellard, director of the Ordnance Survey, and others, the small cost of the undertaking and the reproach to British science involved in the existing state of things being generally insisted on. At the close of the discussion Mr. E. A. Reeves described a new form of range-finder invented by him, which, though at present in an experimental stage only, gives promise of proving of great use in survey work as well as, possibly, for military purposes.

Several of the papers described the scientific results of recent expeditions. Mr. J. Stanley Gardiner, besides presenting the report on the general work of the Percy Sladen expedition in the Indian Ocean, described the Chagos Archipelago in detail, discussing the coral formations and touching also on the life conditions, especially of the vegetation. He showed that there was evidence here, as throughout the Indo-Pacific coral-reef region, of a relative rise in the land-level reaching from 5 feet to 35 feet, and probably due in great part to a withdrawal of water from the equator by the piling up of ice in the Antarctic. The atolls seem to have been formed on submerged shoals by coral and nullipore growth on the edges of the latter, and the lagoons show a progressive increase in depth and area through solution, boring and triturating organisms, and tides. Mr. R. N. Rudmose Brown described the South Orkneys and other localities in which scientific collections had been made by the Scottish Antarctic Expedition; Mr. J. Parkinson gave an outline of the physical structure of southern Nigeria—a subject on which little has hitherto been known—from observations during a mineral survey of the region under the auspices of the Imperial Institute; and Mr. James Murray sketched the general scientific results of the survey of the Scottish lochs, discussing in particular the "internal seiche" which has been brought to light, and was explained as occurring on the cessation of a gale which had maintained a temporary equilibrium between two bodies of water of different densities separated by an oblique line of separation.

Two papers dealt with the economic side of geography. That by Major Beacom, of the United States Legation, gave a most interesting account of the vast irrigation projects inaugurated within the past few years by the United States Government, enlarging in particular upon the Colorado River as the American Nile, and the changes in the Colorado desert due to irrigation. Prof. L. W. Lyde spoke of the wheat area in central Canada, showing how the climatic conditions favour the growth of that crop, especially along a line through Brandon and Battleford. He expressed a high opinion of the probable output of wheat from this area in the immediate future, but held that wheat growing was here eminently the work of the small farmer.

At the afternoon meetings illustrated lectures appealing to a more general audience than some of the above were given. Prof. W. M. Ramsay gave an instructive account of the past and present of Asiatic Turkey as influenced by physical conditions, tracing the fortunes of the region through their various vicissitudes, and forecasting a prosperous future from the advent of railway communication. Major P. M. Sykes described a tour in south-east Persia, dwelling on the many interesting historical associations and speaking of the ruined cities of the Narmáshir district. Mr. Yule Oldham interested a large audience with an account of the visit of the association to South Africa in 1905, while, lastly, Mr. Trevor-Battye showed a striking series of views illustrative of life and nature on the Zambezi above the falls, which he ascended at the close of the same visit of the association.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

SEVERAL subjects of great practical importance were discussed at the Physiological Section of the British Association; so much was this the case that the section proved to be the resort of larger audiences than formerly, and before the end of the week the building placed at the disposal of Section I was all too small for its purpose.

Of the discussions, none was more appropriate to York than that introduced by Dr. F. Gowland Hopkins on the minimum proteid value in diet. This question has two aspects, the physiological and the sociological; the former was the subject of extended researches some time back under the guidance of Prof. Atwater and Dr. Benedict, and more recently under the very able superintendence of Prof. Chittenden at Yale. It is, however, the sociological aspect of the question which gives it an especial interest in York, for in that city, as is very generally known, Mr. B. Seebohm Rowntree has made a very laborious and complete investigation of the dietetic conditions which obtain amongst the poorer classes, and has convinced himself that about one-quarter of the whole population is insufficiently fed. The value of his research depends essentially upon a correct judgment as to the minimum diet upon which a labouring man can perform an efficient day's work. The sociologist is therefore dependent upon the physiologist for his fundamental data.

The physiological requirements of the body are twofold—requirements of matter and requirements of energy; the necessary carbon and nitrogen must be provided, and they must be provided in a form which yields the number of calories equivalent to the energy dissipated by the human organism as work and heat. The subject was greatly simplified by Dr. Hopkins, for he showed that as the practical outcome of a large number of researches the energy value of the food might be almost disregarded. "It always worked out," he said, "that if the nitrogen-value of the food was looked after the calorie-value would look after itself." Very different views obtain as to the minimum nitrogen value of a daily ration, and the disparity of view has been much increased within the last five years. We used to think that 100 grams of proteid food per day, giving 15 grams of nitrogen, was a somewhat restricted diet. Prof. Atwater has raised this figure considerably, whilst Prof. Chittenden has reduced it. Facilities have

been given to Prof. Chittenden and his colleagues by the American Government, and they have studied, not only themselves, but athletes in training and squads of soldiers, and have constantly found that by gradually accustoming these men to a carbohydrate diet a condition of physical efficiency and nitrogenous equilibrium can be obtained, though with some loss of weight. As the result of this gradual process the proteid might be reduced until only about 7 grams or 8 grams of nitrogen were excreted daily.

Actual figures of nitrogenous output were given by Dr. J. M. Hamill and Mr. E. P. Poulton; the former with Dr. Schryver has investigated the nitrogenous output of the workers in the physiological laboratory of University College, London; the latter has experimented upon an Oxford student, *aet.* twenty-two, while he was going through the ordinary routine of university life at Oxford. There was great disparity amongst their figures. The workers at University College varied from 8 grams to 16 grams of nitrogen daily, whilst Mr. Poulton's figure was a high one.

The low nitrogen values indicated above are of great scientific interest, but from the practical point of view they were shown to be of rather academic value by Dr. Hopkins. He made it quite clear that the observers who had obtained these values for the daily nitrogen output had done so on diets which were many times more expensive than those to which the working classes had access. He showed, in fact, that such food as a working man could buy must have a nitrogen value and a calorie value which was of the order indicated by Voit. The point at issue, then, between Dr. Hopkins and Mr. Rowntree was whether the moderate diet indicated by Voit or the more considerable one indicated by Atwater was to be taken as the basis of a proper daily allowance for the working classes. Now though there is a considerable difference between these two diets it is clear that there are lines along which a solution may be forthcoming. Three such directions were indicated by Dr. Hopkins:—

(1) More searching analyses must be made into the nature of foodstuffs (and this point was developed by Prof. Armstrong). Maize, for instance, is particularly unsuitable as a staple dietary, not because it is of insufficient nitrogen value or even of insufficient calorie value, but because a particular kind of proteid, which is necessary to growth, is conspicuously absent from maize.

(2) The relative values of the various tissues as energy transformers must be attested. This work is being carried on by a committee of the British Association, and its annual reports for the past three years have been very instructive, but only the fringe of this large subject has been touched.

(3) Conditions of age and sex have not been thoroughly investigated. It seems clear that a developing individual—say of twenty years—requires a richer diet than a man of twice that age.

Dr. Hopkins readily conceded that even the trained athlete or the soldier might transform much less energy than was entailed in the daily toil of a bricklayer or a rivetter, and in view of this uncertainty we have some sympathy with Mr. Rowntree's contention that the calorie value demanded by Atwater, if acquired in the form of bad food eaten amid unappetising surroundings, was none too much for a heavy day's work.

Another discussion of great interest, entitled "The Physiological Value of Rest," was introduced by Dr. Theodore Dyke Acland and Dr. Bevan Lewis. The former dealt chiefly with the hours of rest prescribed in the large public schools of this country. His views are so well known that it is not necessary to give them at length. The discussion was useful from several points of view, which may be briefly summarised:—

(1) The necessity of obtaining scientific data concerning fatigue phenomena. This matter was dealt with by several of the pioneers in that branch of physiology, namely, psychophysics, which is rapidly springing up, and which bids fair to yield far-reaching results. Dr. Rivers, Prof. McDougall, and Dr. Myers indicated how the question might be approached on strictly scientific lines.

(2) The necessity for limiting the prevalent idea that "recreation is a change of occupation." This dictum is useful and true so long as occupation does not amount to fatigue, but its utility ends at this point. When the system becomes fatigued, and this is especially true of the brain, the toxic bodies produced affect unused as well as used cells. It is futile to throw these cells, already prejudiced, into activity. Such action simply adds to the amount of poisonous or toxic bodies in the circulation. This point was worked out with great clearness by Dr. Bevan Lewis, whose introductory address was on very different lines from that of Dr. Acland. Dr. Lewis treated the subject from a neurological, not a statistical, standpoint; he opened with a defence of the "neuron theory," now assailed from so many quarters, and on this theory worked out a conception of the neurological basis of rest and of fatigue. The practical outcome of his argument, as well as of Dr. Acland's, was that physical exercise was no substitute for sleep, but that active physical exertion added to severe mental strain demanded a double meed of slumber. In illustration of this point Dr. Acland recounted how that Mr. C. B. Fry, at once a scholar and an athlete, frequently slept till midday or even late in the afternoon during his school vacations, and in doing so gratified nothing more than the healthy demand of his frame—physical and mental—for rest.

(3) This discussion made clear the individual differences in the depth and time of slumber; thus day workers attain the maximum soundness of sleep early in the night, whilst night workers begin their slumber by sleeping somewhat lightly and sleep more soundly as morning approaches. Neurotic subjects, on the other hand, have two maxima on their sleep curve, one in the early part of the night, another in the morning; between these there is a period of shallow sleep. If any occurrence happens which causes a general reduction in depth of slumber, the period of shallow sleep in the middle of the night is replaced by a period of wakefulness.

(4) Prof. Gotch, who showed the utmost skill in weaving the separate items of this discussion into a continuum, dwelt upon the nature of dreams as an index of the soundness of sleep. If a dream was a connected series of events and was recollected as such after waking, it was clear that the mental rest was impaired. The more coherent and the more realistic the dream, and the more directly it was concerned with events in the recent past, the less restful was the sleep in which it occurred. The quality as well as the quantity of the sleep was all-important.

The sitting of Friday morning, August 3, was devoted to a paper on public health. Dr. George Reid, the medical officer of health for Staffordshire, put forward a number of telling arguments, the result of experiments which he had performed, in favour of changing the form of many sewage filters. It appears that the chemical changes which take place in a filter of fine particles are completed relatively near the surface. Dr. Reid advocates the use of one-eighth inch particles, and of filters only about 4 feet deep. Such filters would be much less expensive than those now in use. A detailed account of his investigations was recently published by the Royal Society.

Dr. Hime, of Bradford, brought forward a strong indictment of the present system of reporting and isolating infectious diseases. His data were collected from twenty-five large towns in the United Kingdom, and dealt with diphtheria, scarlatina, and typhoid, which taken together formed 95 per cent. of the cases reported. His general argument was that the epidemics of these diseases had increased in virulence and number within recent years in spite of the present system. The most telling figures which he adduced were from cases where the hospitals had been closed to one or other of these complaints and the cases sent back to their homes. On one such occasion more than ninety cases of scarlatina were sent back to the poor neighbourhoods of a town. No epidemic followed; in fact, the epidemic which was prevalent ceased at once.

The discussion which followed Dr. Hime's paper turned rather upon a matter of principle. Granted that experts were in doubt concerning the present system of reporting and isolating cases, was it wise to make the matter one of public discussion? Some medical officers held that such debate weakened the trust in the public authority, and introduced an element of personal option as to whether

it should be obeyed. The view more generally taken was that, since the civic control was becoming daily more vested in the popular vote, it was desirable for the British Association to emphasise the responsibility which rested upon the public to acquaint themselves with matters connected with the public health, and to put the most trustworthy information before them in the most open way.

Amongst the more technical communications there were two excellent ones by Drs. Nasmith and Graham, of Toronto, on the hæmatology of carbon monoxide poisoning, and by Dr. Dawson Turner on the electrical resistance of the tissues. Both communications were the result of much laborious research; their interest lay along the more strictly medical line. JOSEPH BARCROFT.

LOCAL SOCIETIES AT THE BRITISH ASSOCIATION.

THIS conference was presided over by Sir Edward Brabrook, C.B., who fitly represented those societies which have recently been brought into relationship with the British Association under the title of "Associated Societies." These comprise such local bodies as exist for the encouragement of the study of science, but are not at present in a position to undertake and publish original investigations. The chairman, in opening the proceedings, dwelt on the useful work which these modest societies might accomplish, and suggested various ways in which local societies, whether belonging to the affiliated or to the associated class, might aid those sections of the British Association in which he was specially interested, namely, the sections of anthropology, economics, and educational science.

Dr. H. R. Mill delivered an address on local societies and meteorology, in which he commended the study of this science as peculiarly suitable for cultivation by the corresponding societies. Local climate can be determined only by a long, continuous record of local observations; and this continuity, so difficult to maintain by private observers, can be readily secured by a local society, which by its nature is, or should be, immortal. Sunshine and rainfall are two elements of climate which still need much further study. A vast body of meteorological observations in the past has been absolutely useless either because the instruments used were not trustworthy or the hours of observation were irregular; whilst in many cases the observations, otherwise of value, have lost their usefulness through not having been dealt with by competent authorities. In the course of a discussion, Mr. E. Kitto, the superintendent of the Falmouth Observatory, referred to the special value of the magnetic records regularly issued from his station. Dr. J. R. Ashworth, of Rochdale, pleaded for a meteorological survey of the British Islands—a work in which the local societies might obviously render material assistance.

The second meeting was presided over by Mr. J. Hopkinson, vice-chairman of the conference, who in his introductory remarks pointed out the great value of photographic surveys of counties. This subject was elaborately treated by Mr. W. Jerome Harrison, of Birmingham, in a communication on the desirability of promoting county photographic surveys. The paper gave a history of the movement, which was practically initiated by the author, and has spread from Warwickshire, where it was started, to several other counties, including Worcestershire, Essex, Surrey, and Kent. Mr. Harrison suggested that a committee should be formed to coordinate the photographic societies with the literary and scientific societies, so that all should join in the work of the surveys. The subject was warmly taken up by the delegates, and it was determined to apply, at next year's meeting, for the appointment of a county photo-survey committee. The Rev. Ashington Bullen suggested that at every meeting of the British Association there should be a photographic exhibition illustrating the archæology, ethnology, and natural history of the particular county in which the meeting was held. Prof. H. H. Turner referred to the value of pairs of photographs on the stereoscopic plan, inasmuch as they enabled the distances between various objects represented on them to be ascertained by calculation. In the course of the discussion much approval was expressed of the work of those committees of the British Association which dealt with photography as applied to geology, anthropology, and botany.

THE BOMBAY LOCUST.[1]

ANOTHER new venture among Indian memoirs has lately been issued, and if subsequent numbers are like this first instalment they will prove of great value. Mr. Maxwell-Lefroy deals in this first issue with the Bombay locust; we prefer to call it by its popular name, for its scientific one seems in doubt. Specimens were sent by Mr. Lefroy, and have been named at the British Museum by Mr. Kirby as *Acridium rubescens*, Walker, which is apparently quite correct; but we learn from this report that Mr. de Saussure assigns the Bombay locust to Linnæus's species *Acridium succinctum*. In this report the latter name is chosen as probably being most accurate, but it is extremely doubtful if Mr. Lefroy has made the right choice. It is best, therefore, as "doctors disagree," to call this pest simply the Bombay locust.

The work comprises 109 pages of letterpress and thirteen plates, the latter being an improvement on the majority we see from India. The report deals with investigations made in 1903–4, and contains an amount of useful information concerning "locust swarms."

Part i. is devoted to the subject of the formation and movements of locust swarms. In it the author shows and explains how a swarm arises, how from grasses in which they were concealed they entered the crops and "gradually formed into swarms and moved over the country-side." Then these definite bodies of locusts could be traced from village to village. Later they were shown to move in definite directions, migrating at nights, when their wings were constantly and suddenly seen glistening against the moon as they flew by, and as suddenly they vanished.

These swarms settled in the forest regions at last during November and December, and then in March and April a second or outward migration was traced. After the outward migration the swarms were shown to break up, and only scattered locusts could be found. A vast area of land thus became infested with them, but little or no damage was done, for "the locusts had apparently lost the swarming and migrating instinct." Reproduction then set in.

The summary given is as follows:—

Winged locusts emerged and entered crops ...	Oct. 1—20.
,, ,, migrated	Oct. 20—Nov. 30.
,, ,, remained in forests	Dec. 1.—March 20.
,, ,, migrated	March 20—May 20.
,, ,, scattered	May 20—June 10.
,, ,, reproduced and died	June 10—Aug. 10.

In part ii. Mr. Lefroy deals with the life-history of this locust, giving an account of the egg-laying, hatching, development, and the description of the "hoppers" after each moult.

In part iii. are related the habits of locusts and methods employed for their destruction. The first is dealt with in a clear and interesting manner, and is well worth the study of anyone engaged in locust work.

The rewards given for collecting this pest and its eggs varied, but during cold weather winged locusts were paid for at the rate of ¼ to ½ anna per seer (2 lb.), and this pay was sufficient to give a fair wage to an active man. Later 4 annas were paid per seer, a seer containing 400 to 450 locusts. Amongst natural enemies mentioned we notice monkeys, the striped squirrel and the grey-necked crow, and several insects. No doubt these all do some good, but to rely on them to prevent locust swarms is futile. Amongst methods of destroying these noxious insects is the employment of poisoned baits. Experiments recorded here show that a weak solution of arsenate of lead proved better than a strong solution of sodium arsenate or the well-known Natal locust mixture. More than 80 per cent. of the locusts were killed when fodder baits were sprayed with 1 lb. of lead arsenate, and 5 lb. of jaggery, to 100 gallons of water, in twelve hours. For

[1] "Memoirs of the Department of Agriculture in India." Vol. i., No. 1. By H. Maxwell-Lefroy. (Calcutta, April, 1906.) Price Rs. 2.8.

some reason the locusts would not touch the other poisoned baits.

The concluding part (v.) reviews the systematic position of the Bombay locust, and gives a useful list of other species found with it. These locusts are figured in the plates.

Half this report consists of four appendices. The first deals with the action taken against locusts in the Bombay Presidency. Summing up the campaign against the locust in 1904, it is made quite evident that a very determined effort was made to cope with this pest, and that the excellent organisation that extended to every village in the Presidency was effectual in producing a very general action on the part of the people. This is all the more remarkable when we consider the natural apathy of the ryot and his strong objection to take life of any kind. Yet we are told in the report that "4152 maunds of adults, equivalent to 66,432,000 individuals, were destroyed, or two-tenths of a per cent. of the estimated number." One hundred maunds of eggs were destroyed, representing 400,000,000 individuals, and 13,252 maunds of "hoppers," which represented some 530,000,000. That is, 930 millions of young were destroyed!

In all some 1500 millions were probably accounted for, including adults, eggs, and hoppers; of these 66 millions were adults, which would have been responsible for another 3000 million "hoppers" had they lived. To accomplish this the Bombay Government spent a little more than two lakhs in rewards. Anyone knowing what "locust swarms" mean to the cultivator will acknowledge that this sum was well spent. In the same appendix are notes on the latest invasion of the Portuguese territory of Goa, where the damage in 1904 was also very great. Fears were entertained that the locusts might make their way to the seaboard and destroy the magnificent paying cocoanut trees, one of the chief sources of revenue to the country.

The second appendix is by Mr. B. P. Standen. In it are mentioned various methods used to cope with the locusts, such as the American "hopper dozer," the Russian wheeled revolving brush, bags, poison bait, bonfires, &c. But in the end of all this Mr. Standen tells us (p. 92) that "the efforts were aided in a remarkable fashion by juari birds (the Rosy Pastor), which arrived in large flocks earlier than usual and devoured the locusts greedily." . . , "It is quite possible that the preservation of the crops was due as much to these birds as to the effects of human agency." Yet a few lines further back we are told in his report that the Deputy Commissioner of Wardha considered that a third of the total number of hoppers were destroyed by the measures adopted, whilst others estimated that half at least were destroyed.

Besides the plates of various species and structural peculiarities, there is also a map showing the infested area in 1903–4. FRED. V. THEOBALD.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The second Frank Smart studentship in botany, tenable at Gonville and Caius College, has been awarded to Mr. F. T. Brooks, late scholar of Emmanuel College, the understanding being that the student shall prosecute research in some special branch of scientific forestry.

MR. SYDNEY PENNINGTON has been appointed an instructor in veterinary science in the School of Agriculture, Ghizeh, Egypt.

MR. J. BLAKEMAN, Trinity College, Cambridge, has been appointed mathematical master at the Municipal Technical School, Leicester.

THE results of the annual examination held last July by the Oxford and Cambridge Schools Examination Board have now been issued. The total number of candidates for higher certificates was 2054, of whom 462 were girls offering letters only. Of these candidates 1084 offered Latin, 882 Greek, and 1369 French. In natural philosophy there were 143 candidates in the mechanical division, 131 in the physical division, and 132 in the chemical division. Physical geography and geology were offered by forty candidates, and biology by 183. The total number of candidates for lower certificates was 1046, and the number of candidates offering the several subjects mentioned was as follows:—Latin, 668; Greek, 393; French, 993; mechanics and physics, 74; physics and chemistry, 235; chemistry and mechanics, 23; and botany, 62. The candidates in this examination are almost entirely from public schools, and the numbers given are interesting, since they indicate the relative importance attached to linguistic and scientific studies in these schools.

AMONG calendars which have been received recently, that of the East London College, in the Mile End Road, is of special interest, showing as it does the admirable provision now made in East London for higher education. The object of the college is to provide such instruction in the various branches of a liberal education as will qualify students to take degrees at the University of London and other universities of the United Kingdom; to give such instruction in science and technology as will be serviceable to students who intend to pursue a profession or trade in which a knowledge of science in its practical applications is required; and generally to promote higher education in East London. The engineering department and other portions of the college premises have been enlarged recently at the expense of the Drapers' Company, which has made a further grant of 5000*l.* for this purpose. This company is again awarding valuable scholarships tenable at the college. The staff, too, has been strengthened, and there is every prospect of a highly successful session's work.

THE London County Council has organised for the session 1906–7 courses of instruction for teachers. These courses are open without fee to teachers in London schools, and are intended to offer to teachers in the various types of schools opportunities for developing their knowledge of different subjects and of coming into contact with those who have made a special study of the subjects in question. The Council is of opinion that few things can be of greater assistance to teachers than personal contact with some experienced teacher who has devoted special attention to a particular subject, or has made a study of the best methods of presenting the subject to others. The courses include partly lectures and demonstrations in special subjects, such as manual training, general elementary science, physics, chemistry, botany, and also courses conducted under the auspices of the County Council at the schools of the university, namely, University College, King's College, Bedford College, and the London School of Economics and Political Science. Full particulars with regard to the courses may be obtained from the executive officer, Education Offices, London County Council, Victoria Embankment, W.C.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 24.—Croonian Lecture, 1906.—"On Nerve Endings and on Special Excitable Substances in Cells." By Prof. J. N. **Langley**, F.R.S.

The author stated in his general conclusions that the paper had shown there was reason to believe that in each of the three great types of connection of the peripheral end of an efferent nerve with a cell, it is some constituent of the cell substance which is stimulated or paralysed by poison ordinarily taken as stimulating or paralysing nerve endings. Reasons, though less complete, have been given for supposing that these poisons have no special action on nerve endings, and that physiologically the nerve ending is not essentially different from the nerve fibre. In that case, not only the function of reacting to numerous chemical bodies, but probably also the special liability of both afferent and efferent nerves to fatigue must be transferred from the nerve endings to the same constituent of the cell.

This theory adds to the complexity of the cell. It necessitates the presence in it of one or more substances (receptive substances) which are capable of receiving and

transmitting stimuli, and capable of isolated paralysis, and also of a substance or substances concerned with the main function of the cell (contraction or secretion, or in the case of nerve cells of discharging nerve impulses). So far as this is concerned, it does but accentuate a view which has often been put forward, and which, indeed, in some form or other is inseparable from the idea of protoplasm.

The author had spoken of different "substances" in the cell with the intent to use as vague a term as possible. The "substances," he took it, are radicles of the protoplasmic molecule; at present, however, he did not think it advisable to speculate further, either on this question or on certain other questions raised by the conclusions arrived at in the paper. There are a number of obvious experiments still to be made, and these, it may be hoped, will settle some of the problems, the solution of which is now but guesswork.

June 14.—"The Experimental Analysis of the Growth of Cancer." By E. F. **Bashford**, J. A. **Murray**, and W. H. **Bowen**.

The proliferation of Jensen's tumour when propagated in large numbers of mice is not uniformly progressive, but presents fluctuations which can be referred, with confidence, to the tumour cells themselves. The experimental conditions which introduce irregularities are shown to be (1) differences in race of the mice used, *e.g.* tame or wild; (2) differences in age of mice even of the same kind—young animals are measurably more suitable than adult animals; (3) the site of implantation of the cellular graft—the subcutaneous tissue of the back was found to be more suitable than, for example, the peritoneal cavity; (4) the size of the graft was found to be of importance, but mainly as modifying the apparent rate of growth; large grafts of more than 0·1 gram, however, were less successful than smaller ones of from 0·01 gram to 0·02 gram, as previously shown by Jensen; (5) the mode of introduction influences the success of the experiments, transplantation of small fragments of unaltered tumour giving better results than the injection of a suspension of tumour cells in physiological salt solution.

Artificial propagation was carried out on a large scale for a long period by transplantation of grafts of from 0·01 gram to 0·02 gram of unaltered tumour into the dorsal subcutaneous tissue of young tame mice from five to seven weeks old. Each tumour was transplanted into forty or more mice, and the results compared by estimating the percentage of success on the number of animals remaining alive after ten days. The method adopted results in the separation in a large number of animals of the descendants of cells previously living in one animal, so that after two or three successive transplantations the whole of the tumour in one animal represents the offspring of a very small part of a preceding tumour, and in the limit the progeny of a single cell in a tumour more or less remote. The percentage of success obtained with any tumour is used as an indication of the frequency in it of cells capable of continuing growth, and the results at different times and with a number of propagated tumours are compared by means of graphic records. The dates of transplantation are measured as abscissæ and the percentages of success as ordinates. Several such graphic records illustrate the paper, and show that the percentage of success does not vary irregularly, but that, commencing with a tumour giving a low percentage, successive transplantations may be more and more successful until a maximum is reached, it may be at 60 per cent., at 70 per cent., or at 100 per cent. The subsequent transplantations are not so successful. The percentage of success falls rapidly either at the first essay or in two or more steps until a minimum is reached, after which the process is repeated. It is concluded that the tumour cells present a cyclical activity, and suggested that the period of lower percentage of success represents a failure of the proliferative powers from which recovery occurs when the transplantations show again a progressively higher percentage of success. A graphic record of the behaviour of a large number of separate strains shows a continuously high maximum of success between 70 per cent. and 90 per cent. due to the successive development of maxima in separate strains, and it is suggested that sporadic tumours possess a similar complexity, so that growth may be proceeding rapidly at one part while dying out at another.

Spontaneous absorption of well-established tumours occurred at the same time as the rapid fall in percentage of success, failure of the cells to establish themselves in new animals coinciding with cessation of growth and extinction in animals in which they had been able to grow for a time. Without prejudice to other factors, it may be presumed that the greater frequency of spontaneous absorption in transplanted tumours may be due to their greater homogeneity resulting from the repeated intercalation of what is virtually a unicellular stage.

The extinction of certain strains of Jensen's tumour is alluded to and compared with the results of transplanting two other spontaneous mouse carcinomata, which after successful transference to normal animals gave progressively lower percentages of success until negative results were obtained.

The results indicate the necessity for caution in interpreting experiments designed to modify the growth of propagated tumours, and for accurate records of their previous history as a necessary accompaniment to therapeutical experiments.

June 21.—"On the Electric Inductive Capacities of Dry Paper and of Solid Cellulose." By Albert **Campbell**.

June 28.—"Sex-determination in Hydatina, with some Remarks on Parthenogenesis." By R. C. **Punnett**.

July 12.—"A Method for determining Velocities of Saponification." By James **Walker**.

The author takes advantage of the change in electrical conductivity for following the progress of the action of a caustic alkali on an ester. The conductivity of the original solution falls off to about one-third as the saponification proceeds, and the relation between change of conductivity and proportion transformed is very nearly linear. A device is described for simplifying the calculation of the velocity constant by appropriate selection of the resistance in the rheostat. Readings can easily be taken every minute, and the method is much less troublesome than the titration method usually employed, whilst yielding equally accurate results.

EDINBURGH.

Royal Society, July 16.—The Hon. Lord M'Laren, vice-president, in the chair.—Limnographic apparatus and measurements on Loch Earn: Prof. **Chrystal**. The paper gave a detailed account of the various modifications and simplifications which experience had suggested during the recording of seiches on the Scottish lochs. The effects of friction had been reduced to a minimum, so that it was possible to obtain records of short period motions such as wind and other meteorological causes produce. The effect of access tubes connecting the well of the limnograph with the free water of the loch had been studied with great care. By use of a proper sized access tube the shorter disturbances could be cut off and the seiche recorded in all its purity. A new and very simple method of reduction of limnograms so as to separate the various orders of seiches was described. This method of "residuation" consisted simply in superposing the seiche record upon itself displaced half the uninodal period forward. This eliminated the uninodal seiche and left the binodal and trinodal, if such were present. A second application of the same method eliminated the binodal, and in this way the principal nodalities could be separated with great ease and accuracy. It was impossible to apply harmonic analysis to seiches simply because there was no harmonic relation among the periods of the various nodalities.—Preliminary limnographic observations on Loch Earn: Mr. James **Murray**. This paper supplemented the previous paper, and described the difficulties encountered in measuring the seiches by the forms of apparatus devised by Prof. Chrystal. For eye observations the portable seismoscope had been found very serviceable. It could be installed and taken down again in a few minutes, and packed into a compass small enough to go into one's pocket.—A note on the polarimeter: J. R. **Milne**. Two appliances were described. The first, which consists of a thin plate of glass placed obliquely across half the beam of light passing through the instrument, gives the slight rotation of

the plane of polarisation which is necessary to give the "half-shade" effect. It takes the place of the half wave-length plate used by Laurent and of the subsidiary Nicol used by Lippich. The principle, it was subsequently discovered, had been used by Poynting, but the particular form here described had certain advantages over its predecessor. The second appliance provides a means for increasing the brightness of the very faint field of view given by all half-shade polarimeters, and depends on the fact that when two equally bright fields of view polarised at right angles to each other are received through a double image prism, the brightness of the single field seen by the eye is twice that of each of the component fields. To obtain this effect in the polarimeter, the ordinary half-shade field is divided into two identical portions, the light of one passed through a quartz plate with a 90° rotation, and then both are superposed by a double image prism, which also takes the place of the ordinary analysing Nicol. —Spectroscopic observations of the rotation of the sun (further communication): Dr. J. **Halm.** In addition to distinct evidence of changes in the rotation of the sun as shown by the displacements of the Fraunhofer lines at the limbs, the observations made between 1901 and 1906 have also revealed the fact of a new displacement of the solar lines which affects both limbs in the same direction. During the interval 1901–6 the Fraunhofer lines have gradually shifted towards the red by an amount slightly more than 0·02 tenth-metre. The solar lines also show greater wave-lengths at the limb than near the centre when compared with the same telluric standards. The relative shift in the case of two iron lines employed by Dunér and by the author is 0·012 tenth-metre. While at least six other "low-level" lines show the same behaviour, the high-level lines appear to occupy essentially the same positions at centre and limb. This remarkable phenomenon may be explained on the assumption that the radiation from the solar gases is affected by pressure. If this explanation be correct, the gradual shift towards the red during the interval 1901–6 would indicate that the solar gases to which the Fraunhofer lines are due are under higher pressure at times of maximum than at times of minimum sun-spot frequency.—A monograph on the general morphology of the myxinoid fishes based on a study of Myxine; part ii., the anatomy of the muscles: F. J. **Cole.**

PARIS.

Academy of Sciences, August 27.—M. A. Chauveau in the chair.—The earthquake at Valparaiso, August 16, 1906, registered at Paris: G. **Bigourdan.** A reproduction of the curves registered by the seismograph recently set up at the Observatory of Paris on the night of August 16–17. —The two specific heats of a slightly deformed elastic medium: some extensions of Reech's formula: P. **Duhem.** —The origin of the carbon monoxide contained in normal blood, and especially in the blood of persons suffering from anæmia: R. **Lépine** and M. **Boulud.** The injection into the veins of a dog of sodium oxalate or tartrate causes an increase in the amount of carbon monoxide present. A solution of glucose or levulose has the same result.—The laws of music: Maurice **Gandillot.**—The copper-steel alloys: Pierre **Breuil.** Alloys containing proportions of copper varying from 0·0 per cent. to 10·0 per cent. of copper were prepared, and determinations made of the strength of notched specimens submitted to shock, torsional strength, and resistance to corrosion. Micrographical examination gave results confirming those previously published by Stead. —The mechanism of the influence of acids, bases, and salts on the liquefaction of potato starch: A. **Fernbach** and J. **Wolff.**—A disease of the potato produced by *Bacillus phytophthorus*: Georges **Delacroix.**—The hæmopoietic activity of serum during the regeneration of the blood: Paul **Carnot** and Mlle. Cl. **Defiandre.**

NEW SOUTH WALES.

Linnean Society, June 27.—Mr. Thos. Steel, president, in the chair.—Studies in Australian entomology, part xv., revision of the Cicindelidæ of Australia: Thomas G. **Sloane.** The paper includes descriptions of two new species, synoptic lists of the tribes (2), genera (5), and species (47) of the family Cicindelidæ found in the continent of Australia; also notes on taxonomy, phytogeny, geographical distribution, &c.—Two undescribed species of Eucalyptus from eastern Australia: R. T. **Baker.** *Eucalyptus carnea*, sp.nov., and *E. thozetiana*, F.v.M., the species diagnosed in this paper, are found respectively in the coast district and dry interior of the continent. The former is a typical forest stringybark, with a pinkish or flesh-coloured, hard, durable timber. The mature fruits differ very little in shape and size from those of *E. acmenioides*, Schau., but otherwise these two species can be differentiated by their leaves, timber, and oil. This latter constituent is of some chemical and industrial importance, as it contains, besides a dextrorotatory pinene and eucalyptol, an acetic acid ester. Only a small quantity of free acetic acid was found in the crude oil, but the ester split off acid on distilling the oil under atmospheric pressure. Systematically the species should be placed with the stringybarks, and in sequence with *E. nigra*, R. T. B., and *E. acmenioides*, Sch. *E. thozetiana*, F.v.M., ined., has only been known previously to systematists from imperfect material, and both Baron von Mueller and J. H. Maiden refer to it in their writings on the genus. The material upon which the complete description is now based was obtained by Mr. N. C. Champion from his station of Tandawanna, Gooniwindi, Queensland. It attains a height of about 60 feet, has a tesselated bark at the base, and is smooth above to the ultimate branches. The wood is very hard and very heavy, dark coloured, close grained, and interlocked and very durable. It is the hardest yet recorded from any Eucalyptus tree, and very much resembles the South American "lignum vitæ," *Guaiacum officinale*, Linn., and is specially suitable for cog-wheel teeth, mallets, girders, bridge-work, &c. Systematically it might be placed with *E. tesselaris*, F.v.M. As both the species described in this paper yield excellent timber, they are recommended for forest cultivation.—The formation of slime or gum by *Rhizobium leguminosarum*: Dr. R. **Greig-Smith.**—The structure of *Rhizobium leguminosarum*: Dr. R. **Greig-Smith.**

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