THURSDAY, NOVEMBER 21, 1901.

ZOOLOGICAL PROBLEMS STUDIED BY A PSYCHOLOGIST, PSYCHOLOGICAL PROBLEMS STUDIED BY A ZOOLOGIST.

Animal Behaviour. By C. Lloyd Morgan, F.R.S. Pp. viii + 344. (London: Arnold, 1900.) Price 10*s.* 6*d.*

THIS interesting and highly suggestive work grew out of an attempt to revise the author's "Animal Life and Intelligence." It was found that "the amended treatment would not fall conveniently under the previous scheme of arrangement." The subject is divided into seven sections, dealt with in as many chapters, the first concerned with "Organic Behaviour," the second "Consciousness," the third "Instinctive Behaviour," the fourth "Intelligent Behaviour," the fifth "Social Behaviour," the sixth "Feelings and Emotions," the seventh "Evolution of Animal Behaviour." The illustrations are numbered 1 to 26; but some of them contain several figures. Part of the work is coarse and unsightly, although clear (*e.g.* Fig. 13); on the other hand, some of the process blocks are quite successful, especially those which reproduce Mr. Charles Whymper's three drawings (Figs. 4, 5, 15). The book is well and clearly printed, and there are very few slips or misprints.

The first chapter of the work opens with an introductory section on behaviour in general, followed by an account of the more fundamental types of behaviour, viz. of cells and cell-aggregates, of plants and of reflex action, which latter is held to involve the existence of a differentiated nervous system. The chapter concludes with a section upon the evolution of consciousness, while the five succeeding chapters similarly include discussions upon the evolution, respectively, of consciousness, instinctive, intelligent, social and emotional behaviour. The last chapter is confined to the consideration of the evolution of animal behaviour. The principles which the author lays down for his guidance in the discussion of animal behaviour are the attempts to realise, in every case,

"first, the nature of the animal under consideration; secondly, the conditions under which it is placed; thirdly, the manner in which the response is called forth by the circumstances; and fourthly, how far the behaviour adequately meets the essential conditions of the situation."

A rigid adherence to these wise principles, perhaps more than anything else, leads to a sense of confidence and security as we are guided through the intricacies of this most complex subject. Our gratitude is all the more real because of the difficulty and confusion which have been gratuitously introduced into the study of animal behaviour on account of the unfortunate conviction held by nearly every owner of a domestic pet that he, or even more frequently she, is intimately acquainted with the workings of its mind, and because of the unfortunate zeal with which hasty conclusions are spread abroad. May every lover of dog stories be induced to read the observations and conclusions on dog-behaviour (p. 141 *et sqq.*), and learn caution and restraint in interpretation. And caution is not needed less, but more, when the subjects of observation are farther removed from us in the zoological system, and combine far more wonderful instincts with a psychology more difficult to penetrate because far more remote and foreign to us. Maurice Maeterlinck's charmingly written book on the bee would have been more trustworthy if its author had received the advantage of Prof. Lloyd Morgan's friendly guidance in "Animal Behaviour" and his other kindred works. Many poetically expressed motives which are believed to bring about the wonderful instincts of the bees, and thoughts which are supposed to guide them, would thus have been advantageously omitted.

In speaking of the corporate behaviour of the cell-units of the higher animals it is well pointed out that the periods of apparent rest are in reality the periods of work during which are elaborated and stored up the unstable substances in preparation for the time of action;

"just as the brilliant display of intellectual activity in a great orator is the result of the silent work of a lifetime, so is the physical manifestation of muscular power the result of the silent preparatory work of the muscle-cells."

In explaining this apparently wasteful and roundabout process the author points out that

"only thus could the organs be enabled to act under the influence of stimuli and afford examples of corporate behaviour. They are like charged batteries ready to discharge under the influence of the slightest organic touch" (p. 23).

The adaptive behaviour of plants is illustrated by a few of the most remarkable examples, such as the fertilisation of *Vallisneria* and *Catasetum*, and we are led to the safe conclusion that the behaviour, beautiful and effective as it is, "does not afford any indication of the guidance of consciousness." Nowhere among plants do we meet with

"so much as a hint of that profiting by individual experience which is the criterion of the effective presence of conscious guidance and control" (p. 31).

With the same wise caution the terms "discrimination" and "perception" are abandoned in favour of "differential reaction" in speaking of the movements of the tentacles of the sun-dew and of some of the lower animals. Thus all possibility of confusion with conscious choice is deliberately excluded.

In the brief section on the evolution of organic behaviour the author provisionally rejects the hypothesis of the hereditary transmission of acquired characters. He follows Osborn's convenient restriction of the term *modification* to the changes wrought by use or environment, and *variation* to the inherent differences which are due to the germ-cell. The distinction between these two classes of characters is carefully drawn and clearly illustrated, although the author omits to point out with sufficient clearness that the favourable *modification* is dependent no less than the favourable *variation* upon natural selection. The power of the organism to respond adaptively to environmental stimuli is probably an even higher effort of natural selection than that put forth in the production of some favourable inherent character which comes forth ready-made in the developing individual

before any occasion for its use has arisen. The relation of body-cell to germ-cell in the struggle for existence and in evolution is clearly explained in an admirable comparison with the sterile and fertile individuals of the hive. By this means two complex and difficult subjects which have puzzled many a student of evolution are together rendered easy of comprehension.

The supposed cases of the instinctive hereditary fear of the dog by the kitten, the hawk by the young turkey, &c., are examined with much care in the chapter on consciousness. This examination and the result of the author's observations, together with those of Dr. Thorndike, Mr. W. H. Hudson and Mr. Frank Finn, lead to the conclusion that an inherited timidity ready to find instant expression at any unusual sight or sound has been erroneously interpreted as the hereditary fear of certain special enemies.

The stages of the evolution of consciousness are summed up in the statement that "in the first stage we have consciousness as accompaniment; in the second, consciousness as guide; in the third, consciousness as judge."

The term *instinct* is wisely limited to behaviour which is independent of experience. Acts which, at first voluntary, have become mechanical in the course of an individual life are regarded as *acquired habits*, the popular as well as the occasional scientific use of the term *instinctive* for this purpose being rejected. The definiteness of instinct is by no means held to imply that it is rigidly the same in all individuals of a species. Individual variation, bringing instinct under the sway of natural selection, is freely admitted, as it was by both Darwin and Wallace in their joint essay in 1858. The author's position in this respect is a return to the sound principles first laid down by the great originators of the theory of natural selection and a rejection of the attempt to improve upon these principles by a widely different, and for a time very popular, conception of instinct as due to the hereditary transmission of the results of intelligent learning, practice and habit, an interpretation which received a fatal blow in Weismann's critical attack upon the evidence in favour of the transmission of acquired characters in general. The whole question is discussed in an extremely fair and convincing manner in the section on the evolution of instinct (pp. 106-116).

The full definition of instinct which is here adopted closely follows Dr. and Mrs. Peckham's summary of the conclusions to which they were led by their deeply interesting study of the solitary wasps. Instinctive behaviour comprises

"those complex groups of coordinated acts which are, on their first occurrence, independent of experience; which tend to the well-being of the individual and the preservation of the race; which are due to the co-operation of external and internal stimuli; which are similarly performed by all members of the same more or less restricted group of animals; but which are subject to variation, and to subsequent modification under the guidance of experience" (p. 71).

This is a definition which it is believed that Darwinian naturalists in general will be prepared to accept, as well as its application, *e.g.*, to the flight of birds where it is inferred

"that instinct provides a general ground plan of behaviour which intelligent acquisition, by enforcing here and checking there, perfects and guides to finer issues" (p. 88).

The whole section upon the instinctive behaviour of young birds (pp. 84-98) abounds in original observations carefully carried out and interpreted with caution and judgment; they lead the author to the conclusion that experience is not hereditary.

The chapter on intelligent behaviour opens with the discussion of simple examples which lead to the statements that

"whereas instinctive behaviour is prior to individual experience, intelligent behaviour is the outcome and product of such experience,"

and again,

"instinct depends on how the nervous system is built through heredity; while intelligence depends upon how the nervous system is developed through use."

It may be doubted whether these sound and excellently expressed principles are applied with sufficient rigidity to the wonderful behaviour of insects. Thus Dr. and Mrs. Peckham's observation of the use of a stone by the solitary wasp *Ammophila urnaria* to beat down the earth with which she was filling up the entrance of her excavation is spoken of as "intelligent procedure," and is referred to even more strongly in the words, "here we have intelligent behaviour rising to a level to which some would apply the term rational." And yet it is in every way probable, in fact almost certain, that the whole behaviour of the *Ammophila* depended upon the manner in which "the nervous system was built through heredity," and that if the American naturalists had been fortunate enough to witness the first performance of the wasp it would have been found to be as perfect as any at any later period in its life. It may be questioned whether the use of the word "tool" is to be justified in speaking of the employment of the fragment of stone. A "tool" is not any object which may be used for a purpose, but an object fashioned for the purpose it is made to serve—a criticism which was suggested to the present writer by Prof. E. Ray Lankester in a conversation about this very observation. The use of decayed wood in the construction of combs by many wasps is probably a more complex piece of behaviour and more difficult to understand as a pure instinct than the behaviour of the *Ammophila*, and yet in this case the interpretation is certain. The present writer has seen the worker of a species of *Vespa* freshly emerged from the pupa, and the sole perfect insect upon the young comb (the queen mother having been previously killed) immediately seize upon the broken material of the comb and begin accurately and with exact precision to build up the thin and delicate sides of injured cells containing the living larvæ. We may feel confident from this fact that the worker possesses a nervous system which impels it from the first to seek the right material and do the highly complex work and enables it, without intelligence, at the outset to make use of wood of the right texture, dryness, &c. The use of stones, &c., for closing the mouth of the burrow is probably as ingrained in the nervous system of *Ammophila* as the use of wood in making cells is in the genus *Vespa*. In addition to the observation of Dr. and Mrs. Peckham, we

have that of Dr. S. W. Williston upon another species, *A. yarrowi*, and still later, in the summer of 1899, the present writer and three others observed the same thing in a large species of *Ammophila* (propably *A. sabulosa*) at St. Helens, Isle of Wight. The latter observation followed very closely the account given by Dr. Williston. After the wasp had placed the larva in the burrow and, as was subsequently ascertained, laid an egg upon it, she seized, not a pebble, as in Dr. Williston's case, but a piece of peat or fibrous root, and forced it into the hole. The object of this was undoubtedly to act as a plug and prevent the earth from falling into the cell where the larva lay. Then earth was thrown upon the plug and after this an angular fragment of brick, which needed some effort to force into the tube ; then more earth and a final raking of the surface and scattering of twigs, &c., which obliterated all traces of disturbance. The piece of brick seemed to be in the nature of a burglar-proof door rather than a smoothing or pounding apparatus, in this particular instance. The soil was dry and sandy and perhaps did not need such special methods. At a previous stage the wasp acted as if with intelligence in dragging the larva into the burrow and then very rapidly out again in order to enlarge it still further. But this action is also in all probability the outcome of a nervous system built through heredity which impels the wasp to bury the larva in such a manner as to provide food and space for the wasp's growing offspring. The instinct requires a trial for its complete fulfilment. The evidence required to prove intelligent behaviour would be the observation that the wasp excavated more accurately and needed fewer trials with her prey, as, in the course of her life, "the nervous system developed through use." But any such evidence is as unlikely as that the other wasps should require experience to build their combs with exactness. We are dealing, in insects, with animals which commonly require to do various elaborate acts each but once in a lifetime, and thus always "prior to individual experience." The behaviour which leads to the production of an elaborate cocoon or the burial of a larva in its earthen cell is clearly instinctive, and the most convincing evidence is required in order to prove that certain insects which perform the same elaborate act many times in their lives are guided by anything except the compulsion of a "nervous system built through heredity."

The experiments and conclusions upon the intelligent behaviour of the higher vertebrates are most convincing. They are introduced by a clear statement of the essential nature of rational behaviour and the wide difference which separates it from intelligent behaviour. The attempt made by the author and Dr. Thorndike (pp. 153, 154) to set forth the mental condition of one of the higher animals is deeply interesting. Dr. Thorndike's "animal consciousness" sometimes felt during swimming will appeal to many as a very real experience, when

"one feels the water, the sky, the birds above, but with no thoughts about them or memories of how they looked at other times, or æsthetic judgments about their beauty ; one feels no ideas about what movements he will make, but feels himself make them, feels his body throughout. Self-consciousness dies away. Social consciousness dies away. The meanings, and values, and connections of things die away. One feels sense-impressions, has impulses, feels the movements he makes ; that is all."

In the discussion upon the evolution of intelligent behaviour a most interesting and ingenious experiment made by the author is recorded. The close resemblance between specially protected species was explained by Fritz Müller in 1879 by the hypothesis that life was saved during the education of young and inexperienced enemies when the number of colours and patterns was few. Thus one appearance under this hypothesis may serve as a warning for many species, and it is not necessary for enemies to test more than a certain proportion of the species in order henceforth to avoid the whole. Prof. Lloyd Morgan made the following experiment in the attempt to discover whether the behaviour of a possible enemy is such as the Müllerian hypothesis assumes.

"Strips of orange and black paper were pasted beneath glass slips, and on them meal moistened with quinine was placed. On other plain slips meal moistened with water was placed. The young birds [chicks] soon learnt to avoid the bitter meal, and then would not touch plain meal if it were offered on the banded slip. And these birds, save in two instances, refused to touch cinnabar caterpillars [with black and orange bands], which were new to their experience. They did not, like other birds, have to learn by particular trials that these caterpillars are unpleasant. Their experience had already been gained through the banded glass slips ; or so it seemed. I have also found that young birds who had learnt to avoid cinnabar caterpillars left wasps untouched. Such observations must be repeated and extended. But they seem to show that one aspect of the Müllerian theory is not without some facts in support of it ; and, so far as they go, they afford evidence that black and orange banding, irrespective of particular form, may constitute a guiding generic feature in the conscious situation."

This evidence is of especial interest to the student of mimicry, particularly to the present writer, who ventured to suggest (*Proc.* Zool. Soc., 1887, p. 235) a Müllerian association between the cinnabar larva and the wasp.

In the account of "Müllerian mimicry" (p. 164) the hasty reader might infer that Dr. Fritz Müller had depended on Mr. Frank Finn's observations upon birds, observations made after Müller's death and about twenty years after the publication of his hypothesis. A reference to the publication, from which a sentence is quoted, would prevent any possible misconception.

Want of space prevents any discussion of the remaining chapters, which are full of interest. Prof. Groos' theory of animal play as a preparation for the serious business of life is explained in a luminous manner (pp. 248 *et sqq.*), so that the reader will gain a perfectly clear idea of one of the most important of recent contributions to Darwinian theory. Dr. Louis Robinson published an outline of this idea the year before Prof. Groos' work appeared. Thus in the Reports of the British Association for 1894, p. 778, the abstract of Dr. Robinson's paper to Section H contains these words :—

"It is found that in young apes, puppies, and other like animals, the most ticklish regions correspond to the most vulnerable spots in a fight. In the mock fights of immaturity, skill in defending these spots is attained."

And Prof. Lloyd Morgan himself had written still earlier on the same subject (*Atalanta*, January 1889).

The discussion of animal courtship and its psychological analysis constitute one of the most interesting parts of the work. The author's conclusions will, it is believed, be fully accepted by those who follow the Darwinian theory of sexual selection. The more exuberant phraseology of previous writers on the same subject was probably never intended to convey anything very different from the conduct and climax of courtship as here described. But it has required the assistance of one trained both as psychologist and as zoologist to expound the subject so that misapprehension is well-nigh impossible. The author's twofold capacity in dealing with subjects which require to be looked at from very different points of view, as expressed in the title of this review, renders, not only the discussion of courtship, but the whole work, of great value to students in two very different yet closely related fields of knowledge.

E. B. P.

CELLULOSE.

Researches on Cellulose from 1895–1900. By Cross and Bevan. Pp. vii + 180. (London: Longmans, Green and Co.) Price 6*s*. net.

VEGETABLE substances or products of vegetable origin have always had a peculiar fascination to chemists, not only because of the light which may be thrown on general chemical science, should methods of synthesis be discovered, but often because, as was the case with alizarin and more recently with indigo, huge industrial applications may be the outcome of this branch of research. Further, researches are often conducted with the hope that we may be enabled to reveal some of the hidden secrets of nature, as, for example, how the elements which are assimilated by plants in the form of the simplest of compounds become ultimately converted into some of the most complex combinations known to chemists.

In "Researches on Cellulose," by Cross and Bevan, we are dealing with a class of substances which may be said to form the structural basis of all natural organic substances. A very large amount of research has been carried out with the object of ascertaining the molecular configuration of the celluloses, but it cannot be said, up to the present, to have thrown very much light upon the ultimate structure of these substances. If the researches on cellulose have not been very fruitful in this direction, they have, on the other hand, been of enormous industrial importance. A very much larger number of industries are concerned with "cellulose" in one form or another than those who have not studied the subject are probably aware. We have only to think of the colossal scale upon which paper is manufactured and the employment of nitrocelluloses in the manufacture of smokeless powder to realise the far-reaching applications of cellulose.

The authors state in their preface that the present volume is intended as a supplement to the work which they published six years ago. The book is more or less in the form of abstracts of researches which have been published since 1895, but it also contains results of the authors' own investigations which have not previously been recorded. The chemistry of cellulose has attracted considerable attention abroad, but in England, with a few exceptions, it has been almost neglected. Messrs. Cross and Bevan call attention to this neglect, and remark that:—

"To the matter of the present volume, excluding our own investigations, there are but *two* contributions from English laboratories. We invite the younger generation of chemists to measure the probability of finding a working career in connection with the cellulose industry."

Considering the enormous importance, the vast extent and the almost unlimited possibilities of the cellulose industry, we trust that this invitation will meet with a hearty response. It is remarkable that in text-books on chemistry, with the exception of technical works—which in this country are few and far between—the subject of cellulose takes a very back-seat. But perhaps we can hardly blame the authors of such works, whose intention, generally speaking, is to teach the theory of organic chemistry. When very little is known about the theory of the subject, it is not unnatural that very little should be said about it.

The book commences with a general introduction, in which the authors reply to some of the criticisms of their previous work. They then explain in detail the plan of the book, and consider the following classification to be the most natural.

"Cellulose is in the first instance a *structure*, and the anatomical relationships supply a certain basis of classification. Next, it is known to us and is defined by the negative characteristics of resistance to hydrolytic actions and oxidations. These are dealt with in order of their intensity. Next we have the more positive definition by ultimate products of hydrolysis, so far as they are known, which discloses more particularly the presence of a greater or less proportion of furfural-yielding groups."

Until more definite knowledge of the ultimate structure of the various celluloses is known, this method of classification seems to be about the best.

The section on cellulose esters is extremely good, the paragraphs on the cellulose benzoates, which the authors have prepared by first treating fibrous cellulose (cotton) with a 10 per cent. solution of caustic soda and then with benzoyl chloride, being exceptionally interesting. It is rather interesting to note, by the way, that the dibenzoate is devoid of all structure, and is therefore readily recognised from the fibrous monobenzoate.

Under cellulose acetates the authors correct the statement made in their previous work that "on boiling cotton with acetic anhydride and sodium acetate, no reaction occurs." At the boiling point of the anhydride an ester is obtained, although without any apparent structural alteration of the fibre. Under esters is also included inorganic esters—the nitro-esters, which are of such importance in the manufacture of cordite, ballistite, "smokeless powders," &c.

The articles on *lustra-cellulose* or artificial silk will interest many, but the authors protest against the term artificial silk, and suggest that the term "*lustra-cellulose*" should be employed. Considering the manner in which the term "artificial" is so often misused, we quite agree. Inform the public that an article is artificial and they at once brand it as "false" or as a "substitute." In the

present case, lustra-cellulose is not silk at all. Why, therefore, call it silk? Messrs. Cross and Bevan likewise correct the oft-repeated statement that lustra-cellulose is highly inflammable, and point out that "Lehner" silk, which has been denitrated, contains only 0·19 per cent. of nitrogen.

There are many other sections in the book which we should like to dwell upon, but space forbids. We would only draw attention to the articles on constitution, furfuroids and industrial developments, all of which are of great interest.

The book before us is to a certain extent disjointed, but we have already stated that it consists largely of abstracts, therefore it is hardly to be expected that the authors could construct a connected narrative. In their anxiety not to *pad*, the authors have, at times, made the text almost too bare. For this reason it is sometimes hardly as clear as one could wish. This, however, is only a minor blemish. Messrs. Cross and Bevan are experts in this branch of chemistry, and have presented us with a book which is replete with important matter. It is not a book for the tyro, but we sincerely trust that it will be widely read by chemists, and we believe that research work on cellulose will be thereby greatly stimulated.

F. MOLLWO PERKIN.

OUR BOOK SHELF.

Irish Topographical Botany. By R. L. Praeger. Pp. clxxxviii + 410. (Dublin: Hodges, 1901.)

Practical Text-book of Plant Physiology. By D. T. Macdougal, Ph.D. Pp. xiv + 352. (New York and London: Longmans, Green and Co., 1901.) Price 7*s.* 6*d.* net.

THE botanical survey of a country demands a good deal from the men who undertake it, and one source of confusion now apparent in the many and various attempts being made in many and various parts of the world is the different ideals set up by different workers as to what constitutes a botanical survey. The purpose of Mr. Praeger's well-printed but somewhat heavy book is to give records of the county distribution of plants in Ireland, and the task—probably a thankless one in proportion to the labour it must have cost—seems well done. To our thinking, however, the book is only rescued from being a very dry and bulky reference list by the attempt, in Section ii. of the introduction, to sketch in outline the botanical features of Ireland in terms of plant communities.

It must be added, however, that the list appears to be very complete and is accompanied by six excellent maps, and there can be no doubt that the work will be indispensable to the reference library of the systematic botanist.

Dr. Macdougal has written an interesting and, in many ways, an excellent text-book. We have often wondered why plant physiology should so often be treated from the point of view which emphasises the obscure relations between structure and function involved in the phenomena of life and which almost ignores the many side-issues bearing on the practice of plant-culture, and it is a pleasure to see a work in which these latter are kept in view.

Many of the experiments are neat and well chosen, and the most striking are often the simplest—*e.g.* that of Molisch for demonstrating the hydrotropism of roots (Fig. 28), or that selected for showing the swelling of seeds on imbibition (Fig. 84).

Many readers would probably have wished for fuller discussion of theoretical points. The short statement on p. 215, for instance, as to the ascent of water in plants, is meagre if not misleading. The sentence on p. 8 hardly does justice to Czapek and Pfeffer's clever work on the geotropic region of the root-tip, or to Darwin's beautiful proof that the tips of *Setaria* seedlings are alone sensitive to the heliotropic stimulus, while the wholesale acceptance of Nemec's conducting fibrillæ probably needs further justification.

As sometimes happens with American books, the English reader may be startled, if not puzzled, by some of the expressions—*e.g.* "the substances illy affected" (p. 57) and "A second experiment, exploited by Pfeffer and extended by Czapek" (p. 78) seem to need explanation.

In spite of faults, however, the book may be welcomed as a useful one.

Botany, an Elementary Text for Schools. By C. H. Bailey. Pp. xiv+355. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1900.) Price 6*s.*

THIS volume, like all Prof. Bailey's works, bears the stamp of originality, and in many respects forms an excellent model of what a school book on botany ought to be. Naturally the examples chosen for study are such as can be easily procured in America, but teachers at home might readily learn much from the author.

The details of plant-structures are introduced in a way calculated to excite the interest and attention of the learner, and the very numerous illustrations are directed to the same end. They are excellently chosen and admirably executed. The portion of the book which is devoted to an account of the minute structure of the tissues strikes us as the weakest part of the whole, and also as perhaps the least useful, having regard to the needs of beginners in the study of plants. The concluding pages give directions for forming collections of plants and for determining the species which are likely to be commonly met with.

Not the least valuable of the lessons to be drawn from Prof. Bailey's book are to be found in the preface, in which much sound advice is given as to the kind of work most suited to the needs of school children. After all, it is the training which is the thing of real value—the development of the faculties of observation and of drawing right inferences from observed facts.

(1) *Curso Elemental de Física Moderna*; (2) *Elementos de Física Moderna.* By Dr. R. Pedro Marcolain San Juan. (1) Pp. 804, with 894 woodcuts; (2) pp. 492, with 608 woodcuts. (Zaragoza: Emilio Casañal, 1900.)

THESE are two treatises on descriptive physics, of which the second book is merely an abridged edition of the first. Each is divided into three parts. The first deals with mechanics, including hydromechanics and acoustics; the second with radiology, including heat as well as light; and the third with electricity, being subdivided under the headings of electrostatics, electrodynamics and electrotechnics. In speaking of the subject-matter as descriptive physics, in contradistinction to mathematical or experimental physics, we mean to imply that the books belong to the class of popular treatises containing a general description of the properties of matter suitable for ordinary readers, and illustrated by pictures of steam engines, barometers, siphons, Atwood's machines, pumps, batteries, water boiled by cold, electric telegraphs and all that sort of thing. It is rather amusing to find in the chapter on general dynamics in the larger volume, not only an account of the *mechanism* of the Funicular Railway up Vesuvius, but also a description of the crater and of the panorama from the summit.

LETTERS TO THE EDITOR.

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

Effect of a Magnetic Field on Spectra of Helium and Mercury.

THE Department of Natural Philosophy in this University has recently acquired, through a fund provided by the liberality of the Bellahouston Trustees of Glasgow, a fine echelon grating of twenty-six plates made by Hilger, London. The instrument has excellent definition, and its great power enables it to show Zeeman effects with moderate magnetic fields. In conjunction with a new electromagnet which has been constructed for the Department by Messrs. Mavor and Coulson from the same fund, we have been able to make some preliminary observations which may be of interest to readers of NATURE. The magnet and spectroscope were shown at the recent British Association meeting, when some account of the power of the set of instruments was given. The magnet when excited by a current of only five or six amperes gave a field of about 50,000 C.G.S., and was found capable of giving still higher intensities.

We have examined the Zeeman effect for the yellow helium line D_3. The line, as is well known, is a doublet; the wave-length of the brighter component is 5875·883 Ångström units, that of the fainter 5876·206 units. The lines broaden with increasing field, till at 6500 C.G.S. the fainter is a distinct doublet. As the field is increased the components of the doublet separate farther, but we have not observed any further splitting. The brighter of the D_3 pair is not distinctly resolved till the field is 9100 C.G.S., when it appears as a triplet; it remains so in higher fields.

In a very high field, the strength of which was not observed, the green (5460) line of mercury was resolved into nine components.

We have not so far come across any previous statement of these results, though of course they may be well known to observers of magneto-optic phenomena. We are now arranging for careful measurement by photography and otherwise of displacements produced by fields of known strength, in order if possible to answer some of the outstanding questions on the subject.

ANDREW GRAY.
WALTER STEWART.

Physical Laboratory, The University,
Glasgow, November 15.

Observations of Leonid Meteors.

OBSERVATIONS were made of the Leonid meteors with the intention of determining the intensity and epoch of the shower. Unfortunately, however, owing to cloudy weather on November 13 and 14, observations were restricted to the three following nights. The annexed table gives the total number of meteors observed each night:—

	Extreme limits of the period during which observations were made.	Total duration of watches.	Number observed.	
			Leonids.	Other Meteors.
	h. m. h. m.	h.	h.	m.
Nov. 14	13 0–17 50	4¾	106	94
„ 15	11 45–17 35	5	89	89
„ 16	12 15–14 15	2	7	29
Total		11¾	202	212

During the whole of the time of observation the conditions were practically perfect, save that on the 16th there was a haze over the lower part of the sky.

The Leonids were rather less numerous during the earlier watches on the 15th than later on, but otherwise no well-defined variation in their number was noticed during the period of observation. The curious manner in which they came in groups was, however, very marked. One rather striking example of it occurred on the 15th, when three sprang out almost simultaneously, followed by another about four seconds later, and this at a time when the hourly rate was only about twenty. Their brightness varied in most cases between the 1·5 and the 3·5 magnitude, which was considerably above the mean magnitude of the other meteors. Only two meteors brighter than the first magnitude were observed, both of which were Leonids. The latter of these, which was seen on the 16th at 13h. 58m., commenced its path at 11 Monocerotis, and passing directly over μ Leporis, disappeared three degrees beyond. It left a train of irregular width, part of which remained visible for about six seconds.

No very systematic attempt was made to determine the radiant, but as far as could be judged it was at 150° + 23°, and was sharply defined at any rate for much the larger proportion of the meteors. It is, perhaps, worth mentioning that several meteors very similar to Leonids in appearance were observed to radiate from a point a little above the sickle, and it is possible that some of these, or some from other radiants, may have been recorded as Leonids. Doubtful meteors were in all cases counted with the class to which it seemed most likely they belonged.

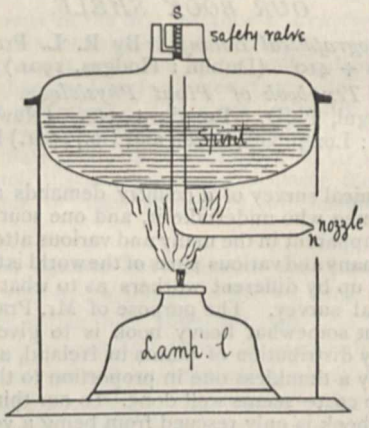
Comparing these observations with those which I made last year I should say that the shower was appreciably more intense this year on the 14th and 16th, and much more intense on the 15th. I should remark, however, that last year I recorded the maximum as occurring during the latter part of the night of the 13th, while on this occasion I have no observations for that period. For the sake of comparison, however, I may say that I consider the shower of the 14th this year about equal in intensity to that of the 13th last year. E. C. WILLIS.

Southwell Lodge, Norwich, November 18.

A Curious Flame.

FOR some time past I have shown as a lecture experiment a vibratory flame which illustrates in a striking manner phenomena similar to those to which Mr. Garbutt directs attention in your issue of October 31.

The flame (which is of the "washed-out" type) is produced by means of a common form of spirit blast-lamp, the construction of which will be sufficiently evident from the accompanying figure. If after using the blast which issues from the nozzle N,



the small subsidiary lamp L be removed from the position shown in the sketch and then placed from three to four inches in front of the nozzle, a blue flame cone will in a second or two dart back from the flame of L to N. The lamp L may now be completely removed, and the flame cone will continue—adder tongue like—to dart back and forth between N and a point three to four inches distant for hours together.

A baffle (in the form, say, of a glass tube or a knitting-needle) held in the track of the vibrating flame at a distance from N less than its normal traverse, will not permit the flame to pass it. But clearly the baffle cannot in this case *permanently* tether the flame cone. It merely curtails the amplitude of vibration without affecting materially its frequency.

If the safety-valve S be replaced by a cork carrying a U-tube the bend of which contains water, there is a rise and fall of water-level synchronising with the vibratory motion of the flame cone. The apparatus thus becomes a heat-engine producing reciprocating motion in an ideally simple manner.

If a small compound strip of ferrotype plate and zinc foil be used to baffle the flow of vapour from N, the strip curls up appreciably every time the tongue of flame licks it, uncurling again in the intervals. By including this strip in an incomplete electric bell circuit the bell may be caused to sound in synchronism with the vibrations of the flame.

Blackheath, November 11. DOUGLAS CARNEGIE.

AN ATTEMPT TO ASCERTAIN THE DATE OF THE ORIGINAL CONSTRUCTION OF STONEHENGE FROM ITS ORIENTATION.[1]

THIS investigation was undertaken in the spring of the present year, as a sequel to analogous work in Egypt and Greece, with a view to determine whether the orientation theory could throw any light upon the date of the foundation of Stonehenge, concerning which authorities vary in their estimate by some thousands of years. We beg to lay before the Royal Society the results derived from a careful study of its orientation for the purpose of arriving at the probable date of its foundation astronomically. This is not, indeed, the first attempt to obtain the date of Stonehenge by means of astronomical considerations. In Mr. Godfrey Higgins' work[2] the author refers to a method of attack connected with precession. This furnished him with the date 4000 B.C.

More recently, Dr. W. M. Flinders Petrie,[3] whose accurate plan is a valuable contribution to the study of Stonehenge, was led by his measures of the orientation to a date very greatly in the opposite direction, but, owing to an error in his application of the change of obliquity, clearly a mistaken one.

As the whole of the argument which follows rests upon the assumption of Stonehenge having been a solar temple, a short discussion of the grounds of this view may not be out of place; and, again, as the approximate date which we have arrived at is an early one, a few words may be added indicating the presence in Britain at that time of a race of men capable of designing and executing such work.

As to the first point, Diodorus Siculus (ii. 47) has preserved a statement of Hecatæus in which Stonehenge alone can by any probability be referred to.

"We think that no one will consider it foreign to our subject to say a word respecting the Hyperboreans.

"Amongst the writers who have occupied themselves with the mythology of the ancients, Hecatæus and some others tell us that opposite the land of the Celts [ἐν τοῖς αντιπέραν τῆς κελτικῆς τόποις] there exists in the Ocean an island not smaller than Sicily, and which, situated under the constellation of The Bear, is inhabited by the Hyperboreans; so called because they live beyond the point from which the North wind blows. . . . If one may believe the same mythology, Latona was born in this island, and for that reason the inhabitants honour Apollo more than any other deity. A sacred enclosure [νῆσον] is dedicated to him in the island, as well as a magnificent circular temple adorned with many rich offerings. . . . The Hyperboreans are in general very friendly to the Greeks."

The Hecatæus above referred to was probably Hecatæus of Abdera, in Thrace, fourth century B.C.; a friend of Alexander the Great. This Hecatæus is said to have written a history of the Hyperboreans: that it was Hecatæus of Miletus, an historian of the sixth century B.C., is less likely.

As to the second point, although we cannot go so far back in evidence of the power and civilisation of the Britons, there is an argument of some value to be drawn from the fine character of the coinage issued by British kings early in the second century B.C., and from the statement of Julius Cæsar (*de bello Gallico*, vi., 13) that in the schools of the Druids the subjects taught included the movements of the stars, the size of the earth and the nature of things (Multa præterea de sideribus et eorum motu, de mundi magnitudine, de rerum natura, de Deorum immortalium vi ac potestate disputant et juventuti tradunt.)

Studies of such a character seem quite consistent with, and to demand, a long antecedent period of civilisation.

The chief evidence lies in the fact that an "avenue," as it is called, formed by two ancient earthen banks, extends for a considerable distance from the structure, in the general direction of the sunrise at the summer solstice, precisely in the same way as in Egypt a long avenue of sphinxes indicates the principal outlook of a temple.

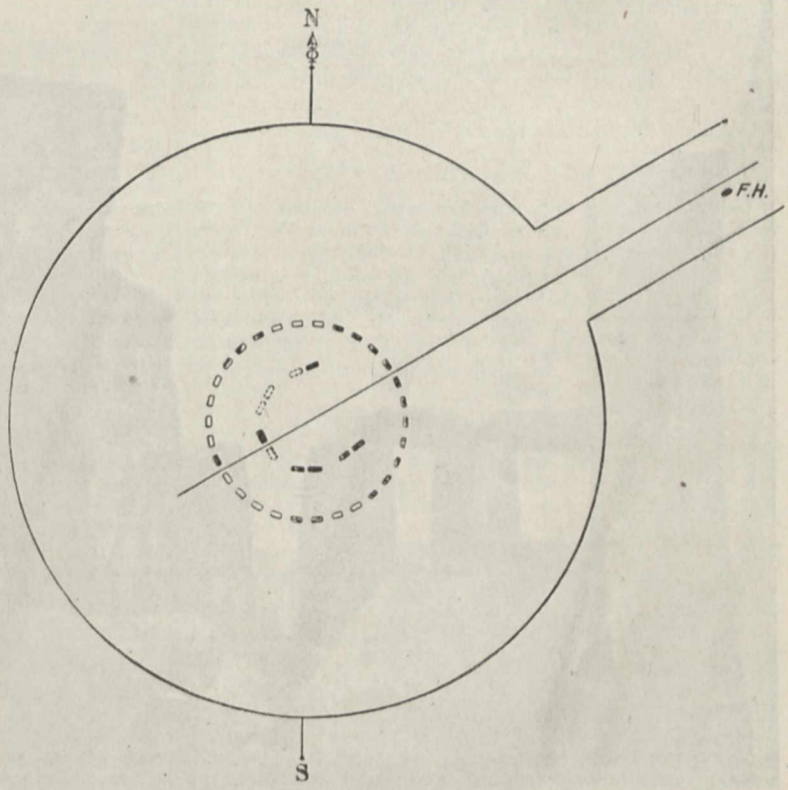


FIG. 1.—Plan of Stonehenge.

These earthen banks defining the avenue do not exist alone. As will be seen from the plan which accompanies this paper, there is a general common line of direction for the avenue and the principal axis of the structure, and the general design of the building, together with the position and shape of the Naos, indicate a close connection of the whole temple structure with the direction of the avenue. There may have been other pylon and screen equivalents as in ancient temples, which have disappeared, the object being to confine the illumination to a small part of the Naos. There can be little doubt, also, that the temple was originally roofed in, and that the sun's first ray, suddenly admitted into the darkness, formed a fundamental part of the cultus.

While the actual observation of sunrise was doubtless made within the building itself, we seem justified in taking the orientation of the axis to be the same as that

[1] By Sir Norman Lockyer, K.C.B., F.R.S., and F. C. Penrose, F.R.S., communicated to the Royal Society on October 19.
[2] "The Celtic Druids." 4to. (London, 1827.)
[3] "Stonehenge," &c. 1880.

of the avenue, and since in the present state of the south-west trilithon the direction of the avenue can probably be determined with greater accuracy than that of the temple axis itself, the estimate of date in this paper is based upon the orientation of the avenue. Further evidence will be given, however, to show that the direction of the axis of the temple, so far as it can now be determined, is sufficiently accordant with the direction of the avenue.

The orientation of this avenue may be examined upon the same principles that have been found successful in the case of Greek and Egyptian temples—that is, on the assumption that Stonehenge was a solar temple, and that the greatest function took place at sunrise on the longest day of the year. This not only had a religious motive; it had also the economic value of marking officially and

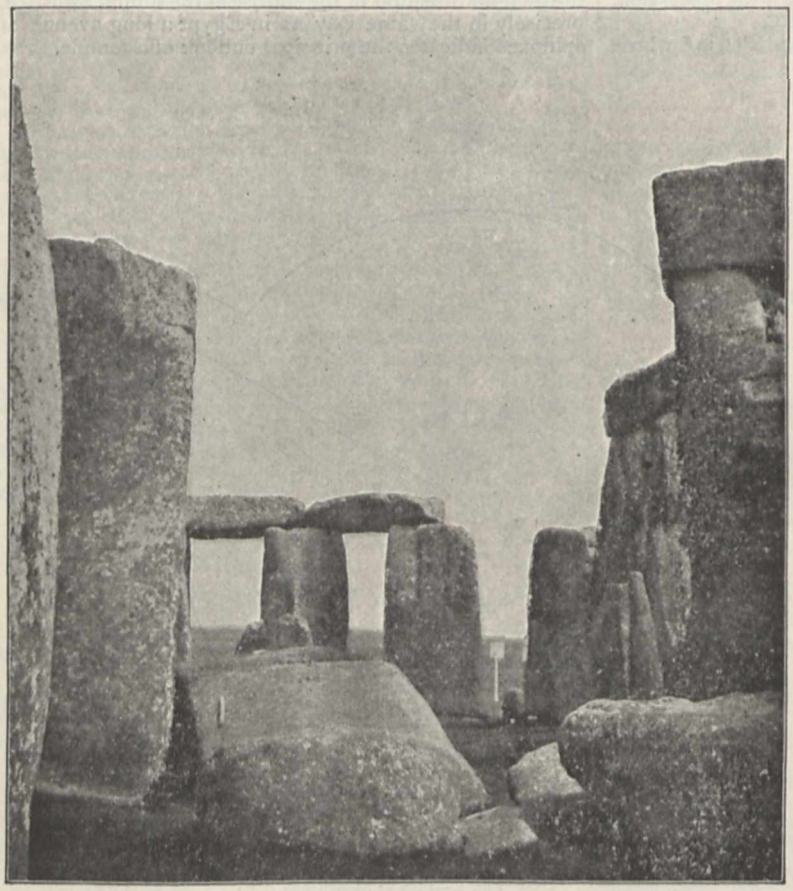


FIG. 2.—The Temple Axis (shown by the direction of the stake on the fallen stone).

distinctly that time of the year and the beginning of an annual period.

It is, indeed, probable that the structure may have had other capabilities, such as being connected with the equinoxes or the winter solstice; but it is with its uses at the summer solstice alone that this paper deals.

There is this difference in treatment between the observations required for Stonehenge and those which are available for Greek or Egyptian solar temples—viz. that in the case of the latter the effect of the precession of the equinoxes upon the stars, which as warning clock stars were almost invariably connected with those temples, offers the best measure of the dates of foundation; but here, owing to the brightness of twilight at the summer solstice, such a star could not have been employed, so that we can rely only on the secular changes of the obliquity as affecting the azimuth of the point of sunrise. This requires the measurements to be taken with very great precision, towards which care has not been wanting in regard to those which we submit to the Society.

The main architecture of Stonehenge consisted of an external circle of about 100 feet in diameter composed of thirty large upright stones, named sarsens, connected by continuous lintels, and an inner structure of ten still larger stones, arranged in the shape of a horseshoe, formed by five isolated trilithons. About one-half of these uprights have fallen and a still greater number of the lintels which they originally carried. There are also other lines of smaller upright stones respecting which the only point requiring notice in this paper is that none of them would have interrupted the line of the axis of the avenue. This circular temple was also surrounded by an earthen bank, also circular, of about 300 feet in diameter, interrupted towards the north-east by receiving into itself the banks forming the avenue before mentioned, which is about 50 feet across. Within this avenue and looking north-east from the centre of the temple, at about 250 feet distance and considerably to the right hand of the axis, stands an isolated stone, which from a mediæval legend has been named the Friar's Heel.

The axis passes very nearly centrally through an intercolumnation (so to call it) between two uprights of the external circle and between the uprights of the westernmost trilithon as it originally stood. Of this trilithon the southernmost upright with the lintel stone fell in the year 1620, but the companion survived as the leaning stone which formed a conspicuous and picturesque object for many years, but happily now restored to its original more dignified and safer condition of verticality. The inclination of this stone, however, having taken place in the direction of the axis of the avenue, and as the distance between it and its original companion is known both by the analogy of the two perfect trilithons and by the measure of the mortice holes on the lintel they formerly supported, we obtain by bisection the measure (viz. 11 inches) from its edge of a point in the continuation of the central axis of the avenue and temple, and which has now to be determined very accurately. The banks which form the avenue have suffered much degradation. It appears from Sir Richard Colt Hoare's account that at the beginning of the last century they were distinguishable for a much greater distance than at present, but they are still discernible, especially on the northern side, for more than 1300 feet from the centre of the temple, and particularly the line of the bottom of the ditch from which the earth was taken to form the bank, and which runs parallel to it. Measurements taken from this line assisted materially those taken from the crown of the bank itself. With this help and by using the southern bank and ditch whenever it admitted of recognition, a fair estimate of the central line could be arrived at. To verify this, two pegs were placed at points 140 feet apart along the line near the commence-

ment of the avenue, and four others at distances averaging 100 feet apart nearer the further recognisable extremity, and their directions were measured with the theodolite, independently by two observers, the reference point being Salisbury Spire, of which the exact bearing from the centre of the temple had been kindly supplied by Colonel Johnston, R.E., the Director-General of the Ordnance Survey. The same was also measured locally by observations of the sun and of Polaris, the mean of which differed by less than 20″ from the Ordnance value. The resulting observations gave for the axis of the avenue nearest the commencement an azimuth o 49° 38′ 48″, and for that of the more distant part 49° 32′ 54″. The mean of these two lines drawn from the central interval of the great trilithon, already referred to, passes between two of the sarsens of the exterior circle, which have an opening of about 4 feet, within a few inches of their middle point, the deviation being northwards. This may be considered to prove the close coincidence of the original axis of the temple with the direction of the avenue.

This value of the azimuth, the mean of which is 49° 35′ 51″, is confirmed by the information also supplied from the Ordnance Office that the bearing of the principal bench mark on the ancient fortified hill, about eight miles distant, a well-known British encampment named Silbury or Sidbury, from the centre of the temple is 49° 34′ 18″, and that the same line continued through Stonehenge to the south-west strikes another ancient fortification, namely Grovely Castle, about six miles distant and at practically the same azimuth, viz. 49° 35′ 51″. For the above reasons 49° 34′ 18″ has been adopted for the azimuth of the avenue.

The present solstitial sunrise was also watched for on five successive mornings, viz. June 21 to 25, and was successfully observed on the latter occasion. As soon as the sun's limb was sufficiently above the horizon for its bisection to be well measured, it was found to be 8′ 40″ northwards of the peak of the Friar's Heel, which was used as the reference point, the altitude of the horizon being 35′ 48″. The azimuth of this peak from the point of observation had been previously ascertained to be 50° 39′ 5″, giving for that of the sun when measured, 50° 30′ 25″, and by calculation that of the sun with the limb 2′ above the horizon should be 50° 30′ 54″. This observation was therefore completely in accordance with the results which had been obtained otherwise.

The time which would elapse between geometrical sunrise, that is, with the upper limb tangential with the horizon, and that which is here supposed, would occupy about seventeen seconds, and the difference of azimuth would be 3′ 15″.

The remaining point is to find out what value should be given to the sun's declination when it appeared showing itself 2′ above the horizon, the azimuth being 49° 34′ 18″.

The data thus obtained for the derivation of the required epoch are these:—

(1) The elevation of the local horizon at the sunrise point seen by a man standing between the uprights of the great trilithon (a distance of about 8000 feet) is about 35′ 30″, and 2′ additional for sun's upper limb makes 37′ 30″.

(2) −Refraction + parallax, 27′ 20″.

(3) Sun's semidiameter, allowance being made for greater eccentricity than at present, 15′ 45″.

(4) Sun's azimuth, 49° 34′ 18″, and N. latitude, 51° 10′ 42″.

From the above data the sun's declination works out 23° 54′ 30″ N., and by Stockwell's tables of the obliquity, which are based upon modern determinations of the elements of the solar system,[1] the date becomes 1680 B.C.

[1] "Smithsonian Contributions to Knowledge," vol. xviii. No. 232. Table ix. (Washington, 1873.)

It is to be understood that on account of the slight uncertainty as to the original line of observation and the very slow rate of change in the obliquity of the ecliptic, the date thus derived may possibly be in error by ±200 years.

In this investigation the so-called Friar's Heel has been used only as a convenient point for reference and verification in measurement, and no theory has been formed as to its purpose. It is placed at some distance, as before-mentioned, to the south of the axis of the avenue, so that at the date arrived at for the erection of the temple the sun must have completely risen before it was vertically over the summit of the stone. It may be remarked further that more than 500 years must yet elapse before such a coincidence can take place at the beginning of sunrise.

We have to express our thanks to Sir Edmund Antrobus, Bart., for much kind assistance during our survey; and to Mr. A. Fowler and Mr. Howard Payn, for skilful and zealous cooperation in the measurements and calculations. As already stated, Colonel Duncan A. Johnston, R.E., Director-General of the Ordnance Survey, has also been good enough to furnish us with much valuable information, for which our best thanks are due.

TWO BOOKS OF TRAVEL.[1]

IN its general scope and character the first-named of these two works is very similar to Hudson's "The Naturalist in Plata"; the one giving as excellent a picture of wild animal life in the more remote parts of the United States as the other does for the Argentine Republic. Mr. Fountain, although evidently not a trained naturalist, appears to be an excellent observer of the habits of animals, and many of the facts he records, if not new, are certainly not matters of common knowledge. So far as the title is concerned, it might well be concluded that the work is a record of observations made during recent travel, but this is far from being the case, the author's journeys having been made during the 'sixties and early 'seventies, when a large part of the territory of the United States was more or less unexplored, and when the bison still swarmed in its untold thousands on the prairies. Consequently, in many respects, the observations on the fauna of the various districts traversed and on the habits and distribution of the larger mammals are far more valuable and important than any which could be made at the present day. It is perhaps to be regretted that greater pains were not taken to identify some of the animals referred to, which would have avoided certain corrections made in the appendix and have considerably increased the value of the work. Not improbably, however, the author may have had only his notes, and not actual specimens, to rely upon; and if this be so, he may well be excused the lack of the details in question. Taken altogether, with a certain allowance for more or less pardonable faults, it may truly be said to be one of the most delightful works of its kind that it has been our pleasure to read for a very long time, and it may be recommended to all lovers of Nature and a life in the wilds without a shadow of reserve.

To judge from its title (in the selection of which we think the author has scarcely done himself justice) the work might well have been taken for a record of travel, but, as a matter of fact, a very large proportion of it is

[1] "The Great Deserts and Forests of North America." By Paul Fountain. Pp. ix + 295. (London: Longmans, Green and Co., 1901.) Price 9*s*. 6*d*. net.

"Sunshine and Surf; a Year's Wanderings in the South Seas." By D. B. Hall and Lord Albert Osborne. Pp. xiv + 320. Illustrated. (London: A. and C. Black, 1901.) Price 12*s*. 6*d*.

devoted to natural history. In the first two chapters the author describes the leading features of the fauna of the Mississippi prairies at a time when, in many parts, it still existed in its pristine abundance. Like most amateur naturalists, Mr. Fountain is on the side of those who take a broad view of the limits of species, and we can fully endorse his remarks as to the close relationship of the American wolves to their Old World cousin. When, however (p. 5), he says that the American bison is a mere variety of the European species, and that the differences between the two animals are very slight, we take leave to differ from his opinions. And before putting in print a statement as to his doubts whether the number of ribs in the two is or is not identical, he might surely have taken the trouble to visit a good museum or consult some standard work on the subject.

A different phase of animal life is presented in the chapter entitled "A Day in a Cypress Swamp"; while in a later one (v.) we have many interesting observations on insects. The seventh chapter is devoted to the red man, who in some respects is viewed in a more favourable light than by many other writers. Of especial interest is the chapter headed "A Little Bit of the Desert," which is devoted to a description of Arizona and its fauna at the time when that State was an almost unknown land. This journey was made in 1871, only two years after Cope had described the poisonous lizard of Arizona, the so-called Gila monster (*Heloderma suspectum*), as a species distinct from the Mexican form. The author's account of its habits is probably one of the earliest on record, his description of how he found out its poisonous nature being an excellent instance of his careful observation.

The remaining three chapters deal with the Yosemite Valley and California and Colorado generally; and it is with a feeling of regret that limitations of space prevent our alluding to these otherwise than by name.

FIG. 1.—A Marquesan High-Priest, with girdle of human hair, and stone idol. (From "Sunshine and Surf.")

Very different in character from the first is the second of the two books named at the beginning of this notice, which is in the main the description of a trip to a number of the islands of the South Seas, with observations on their inhabitants and a few scattered notes on their natural history. Pleasantly written and beautifully illustrated, this work appeals more to the general reader and traveller than to the naturalist; and, in spite of the existence of such books as Kingsley's "The Earl and the Doctor" and Stevenson's "South Seas," both the former will scarcely fail to find much to interest them in its pages. The first visit of the authors was to Tahiti, with which they appear to have been as delighted—alike as regards scenery, climate and the people—as have all previous visitors. Of greater interest is the account of their visit to the Marquesas; and the excellent photograph of a Marquesan high-priest standing alongside a stone idol (herewith reproduced) should be of value to anthropologists as representing a phase of savage life rapidly on the wane. Among other interesting photographs, special mention may be made of one of a "Maori Belle" and a second of a "Samoan Beauty," the latter exhibiting the supreme development of the handsome Polynesian type. We should, however, like to know whether the Maori girl is pure-bred or a half-caste. In the islands under French rule, where it was formerly the universal custom, tattooing, the authors tell us, has been prohibited in the case of females, with a corresponding improvement in their personal appearance—at least from a European point of view. It may be added that much interesting information will be found with regard to the administration of the islands under French rule.

Much interest also attaches to the too brief remarks with regard to the feral goats, sheep and cattle—the descendants of animals introduced in 1813—now found in the interior of the Marquesas. The pleasures—and dangers—of reef-fishing are alluded to in some detail; and the authors endorse previous observations as to the diving powers of the natives, some of whom, they assert, are able to remain under water for four minutes at a time. A novel mode of shark-fishing, in which a diver fixes a running noose round the tail of the victim, is also described. But even in the South Sea Islands life has some drawbacks; and the authors speak in bitter terms of the miseries they

endured from sand-flies, centipedes and mosquitoes on certain islands, and from monstrous cockroaches on board the vessels in which they made some local trips. R. L.

NOTES.

THE close attention which the Emperor of Germany gives to scientific and technical subjects, and the personal interest he takes in the work of men who study them, have been shown on many occasions. The latest instance occurred on Monday, when, attended by a large naval staff, he was present at the annual general meeting of the Society of Naval Architects, founded three years ago on the plan of our own Institution of Naval Architects. The *Times* correspondent at Berlin states that the chief item in the programme was a lecture by Geheimrath Brinkmann on the changes which have been adopted in the disposition of guns in battleships and the results of these changes upon naval architecture. The lecturer pointed out the reasons which had caused the arrangement of the guns with the sole object of firing broadsides to be superseded. He spoke of the beginnings of independent systems of construction in Italy, in the United States and, to a certain extent, in Germany. In the course of the discussion reference was made to the advantage which Germany enjoyed in having the opportunity of constructing an entirely new navy while profiting by the experience of older naval powers, and it was pointed out that, as regards materials, German steel was excelled by none. To the surprise of the audience, the Emperor ascended the platform, and after beckoning all who were present to remain seated, spoke upon the subject of the influences of military requirements upon the development of naval construction and the disposition of artillery on ships. The presence of the Emperor at scientific and technical meetings is itself a mark of sympathy with their aims; and when, in addition, he shows himself keenly interested in the subjects discussed, the influence upon the public mind must be very great. To this influence must partly be ascribed the regard in which scientific investigation is held in Germany.

CONSIDERABLE interest attaches to a circular said to have been issued by the Italian War Office to the veterinary surgeons of the Italian Army. The circular recommends to their attention a new treatment for the so-called foot and mouth disease of cattle. The treatment was announced some little time ago by Prof. Bacelli, and consists in the intravenous injection of a solution of perchloride of mercury and sodium chloride. The intravenous injection of powerful antiseptics for specific diseases is, of course, not new. Quite recently intravenous injections of formic aldehyde were used, apparently with success, in the treatment of human pulmonary tuberculosis. We have not, up to the present, had access to the actual communication either of Prof. Bacelli or of Dr. Guzzi, who appears to have been the first to actually use the remedy in question; but it appears that the injected fluid consisted of 1 gramme of perchloride of mercury, 75 grammes of sodium chloride and 1 litre of water, and that of this solution first 30, then 50, then 70, and subsequently 100 cubic centimetres were injected. As the body-weight of the animals in question is unknown, an accurate estimation of the dose given is impossible. The ultimate remedial agent is the albuminate of mercury. The addition to the injecting fluid of the sodium chloride renders this substance more soluble, and also tends to prevent the precipitation of proteids by the perchloride, and hence the formation of emboli. The animals treated all appear to have been cured of the disease. From the general standpoint, these results, if accurate, are of interest in that they afford another instance of the possibility, by the intravenous injection of an antiseptic, of destroying, or at any rate influencing, the materies morbi without injuring the host.

A CORRESPONDENT informs us that the tercentenary of Tycho Brahe's death was celebrated in Basle, Switzerland, where Tycho settled for a time and revived interest in astronomical science. The Society of Naturalists of Basle met, with several other scientific societies, on October 23 in the Bernoullianum to listen to a lecture by Prof. Fritz Burckhardt on Tycho in Switzerland. A facsimile was shown of the letter, the original of which is preserved in the university library of Basle, with which Baron Hoffmann introduced Kepler to Tycho.

MR. A. J. EVANS, F.R.S., keeper of the Ashmolean Museum at Oxford, has been elected a corresponding member of the Munich Academy of Sciences.

WE learn from the *British Medical Journal* that on January 1, 1902, the Imperial Leopold Caroline Academy of Sciences, which has its headquarters at Halle, will celebrate the one hundred and fiftieth anniversary of its foundation. The Academy is the oldest scientific society in Germany.

THE seventh annual conference of hop growers will be held at the South-Eastern Agricultural College, Wye, on Wednesday, November 27. Colonel A. M. Brookfield, M.P., will preside, and reports will be presented on experiments conducted during 1901 on the manuring, drying, training and cultivation of hops.

THE adoption of the metric or decimal system of coinage, weights and measures in South Africa was advocated by Mr. Hutchins in a paper read before the South African Philosophical Society on October 2. It was shown that with very slight modifications the present coins and measures could be adapted to the decimal system. At the close of the meeting it was decided that a committee, consisting of Sir David Gill, Dr. Muir, Dr. Beattie, Prof. Thomson, Dr. Crawford, Mr. Littlewood and Mr. Hutchins (with power to add to their number), should prepare a report on the advisability of introducing or legalising the metric system of weights, measures and coinage in South Africa.

MR. J. STIRLING, Government Geologist and Mining Representative of Victoria, gave a lecture at the Imperial Institute on Monday on "Brown Coal-beds of Victoria, their Characters, Extent and Commercial Value." The question of utilising the large deposits of tertiary fuel known to exist in the Latrobe Valley, Gippsland, at Newport near Melbourne, Lal Lal near Ballarat, Dean's Marsh near Geelong, and at other places in Victoria, to commercial advantage in the interests of the State, is of considerable importance at the present time, when each portion of the Australian Commonwealth is taking stock of its natural resources. Geological sections run across the Latrobe Valley from north to south have disclosed the phenomenal thickness of the Morewell beds. A bore put down by the Government at Maryvale, near Morewell town, has proved 780 feet of brown-coal, in beds more than 260 feet in thickness. The chemical analyses of this fuel, taken from the bore at different levels down to 987 feet from the surface, have shown that its heat-giving qualities increase with the depth, there being from 36·75 per cent. of fixed carbon in the upper beds and 48·30 per cent. in the lower. Six hundred square miles of these tertiary brown-coal beds are known to exist in Victoria, of which 300 square miles, with 31,144,390,000 tons of the fuel, occur in the Latrobe Valley. From his intimate knowledge of these brown-coal deposits, and from the recent studies he has made on the Continent of Europe of the methods there adopted of utilising brown-coal by manufacturing it into briquettes, distilling paraffin and oils from it and producing various by-products, for all of which this class of fuel was especially adapted, Mr. Stirling has arrived at the opinion that Victoria possesses the makings of an

important national industry and that the establishment of various other industries round the centres where these brown-coal beds occur is only a question of time.

FROM a paper by Signor S. Cannizzaro in the *Atti dei Lincei* we gather that a movement is on foot in Italy for introducing the teaching of electrochemistry into the polytechnic schools of that country, and that the question has arisen as to whether this teaching should be placed in the hands of physicists or of chemists. In his paper, Signor Cannizzaro quotes the opinions of Oettel, Foerster, Lorenz, Lunge and Weber in support of the opinion that the subject falls within the domain of the chemist rather than that of the electrician.

TWO somewhat closely allied papers on Röntgen rays appear in the *Journal de Physique* for November, one by M. L. Benoist and the other by M. G. Sagnac. In the former the author finds that the general laws of transparency of different kinds of matter for Röntgen rays of different kinds can be reduced to simple forms, a result which is far from being true of other previously known forms of radiation. According to these laws the transparency depends only on the absolute and atomic weights, and it appears possible, when these data are known, to calculate the transparency of any body, however complex, for rays of given quality. On the other hand, the laws may be also taken as the basis of a classification of the rays themselves, and they suggest important applications to practical radiography and chemical analysis.

A NEW extensometer has been designed by Mr. H. T. Bovey for determining the longitudinal extension or compression of any given length of a horizontal beam loaded transversely. It consists essentially of two parallel overlapping steel bars the opposite ends of which rest by knife blades against two points on the specimen to be measured. Between the faces of the two bars is a small roller carrying a mirror. Any extension or compression of the specimen causes relative motion of the bars rotating the roller through a small angle which is readily observed by means of the mirror, the reading being effected by means of an ordinary telescope with cross hairs. In Mr. Bovey's paper, which is published in the *Transactions* of the Royal Society of Canada, experiments are described showing the variations in the position of the neutral surface in wooden beams bent by different loads.

SOME ten years ago the Berlin Meteorological Institute supplied a large number of rain gauges to the various German provinces with the view of supplementing the regular observing stations and of investigating the rainfall conditions. The fourth publication of this very useful series for the provinces of Brandenburg and Pomerania has recently appeared, having been, like the previous ones, officially prepared by Prof. G. Hellmann. The tables contain the average yearly values for 269 stations, and are very clearly represented on a map, showing by various degrees of tinting the differences of rainfall of various districts for each 50 millimetres between 450 and 750 millimetres. The mean annual value for the whole area is about 24 inches. The mean daily maximum falls amount to 1·08 inch, but the absolute daily maxima reach from 2·8 to 3·6 inches, and occasionally considerably higher. Heavy falls are much more frequent in the inland districts than on the coasts, owing to the greater frequency of thunderstorms in the former localities. The longest periods of drought are about thirty days on the coast and forty days inland, and the longest wet periods from twenty-five to thirty days. These valuable discussions may well serve as patterns for such investigations; they are beautifully printed, and issued at the low price of one mark.

IN this country we do not take much note of insect pests which damage violets, but this is not the case in the United States, where large quantites of these flowers are grown under-glass for commercial purposes. In *Bulletin* No. 27 of the Entomological Division of the U.S. Department of Agriculture, Mr. F. H. Chittenden describes a long list of insects deleterious to violets, roses and other garden plants. In the case of the violet, the worst appears to be the so-called "greenhouse leaf-tyer," which is the caterpillar of the moth *Phlyctaenia* (or, as Sir G. F. Hampson calls it, *Pioraea*) *rubigalis*, which eats away large patches from the under side of the leaves. English horticulturists are familiar with a closely allied species, *P. ferrugalis*. Various remedies are suggested for the ravages of these and other pests.

A SHORT time ago mention was made in these notes of a paper by Mr. J. J. Wilkinson on the pharynx of the "rat-tailed maggot," the larva of the fly Eristalis. To the last issue (vol. lxx. part 2) of the *Zeitschrift für Wiss. Zool.*, Dr. B. Wahl, of Graz, contributes an important memoir on the development of the hypodermal tissues of the imago in the same larva. In the same journal, Herr G. Rottmann publishes the first part of the results of his investigations into the development of the lingual ribbon, or radula, of the Mollusca, this part dealing with the cephalopods. Special interest attaches to his account of the growth and replacement of the teeth with which the radula is studded, the process being rendered clear by means of several figures in the text. A third article, by Dr. O. Maas, deals with the reproductive process in the sponges of the genus Tethya, which, as is well known, differ from all other members of the group in taking place by means of germinal buds. In another communication Dr. E. Wasmann completes his account of the parasitic flies recently discovered inhabiting the nests of white ants and named Termitoxenia.

THE *Monthly Review* for November contains an extremely interesting and well-illustrated article, by Mr. T. A. Cook, on the modern thoroughbred, dealing both with its history and its future prospects. From the evidence of contemporary documents, the author shows that the English horse previous to the introduction of the first strain of Arab blood must have been an animal endowed both with speed and endurance, and it was evidently one specially fitted to benefit by the cross in question, which has resulted, through a long and puzzling process, in the evolution of our present thoroughbred stock. Some attempts have been made to show that, because all the pedigrees of this stock can be traced back to Arab sires, the English thoroughbred is the product of Eastern blood alone, but this the author shows to be an untenable view. After noting the marked increase in the size of thoroughbreds since the date of the infusion of the Arab strain, Mr. Cook proceeds to inquire whether short-course two-year-old racing has had a deleterious effect on the endurance and stamina of the breed. On the whole, his conclusions with regard to this point are reassuring, and he notes with satisfaction a tendency at the present day to revert to long-distance racing. Should English thoroughbreds require fresh blood, the Arab strain at the present day would be useless, and it is considered that Australian and New Zealand sires would be most suitable for this purpose. Much stress is laid on the importance of preserving good portraits, and if possible models, of our best thoroughbreds; and it is suggested that when equestrian statues are made a well-known horse should be modelled. It is mentioned that in the statue of Charles I. at Charing Cross the charger is a model of a "great horse" from his Majesty's stables. The article concludes with some observations as to the best conventional mode of drawing running horses.

FROM Queensland we have received the Annual Progress Report of the Geological Survey for 1900, by Mr. W. H. Rands, Government Geologist, together with several detailed

reports by members of his staff. The chief attention of the Survey is appropriately given to questions of economic importance, but those of scientific interest are by no means neglected. Aid has been furnished by Mr. Robert Etheridge, jun., in the determination of a series of fossil corals from Stanwell, near Rockhampton, which prove to be of Permo-Carboniferous types. These are described and figured in *Bulletin* No. 12, together with a paper on the structure of the oolitic limestones by Mr. G. W. Card. The Etheridge and Gilbert goldfields in north-western Queensland are reported on by Mr. Walter E. Cameron. The reefs occur near the border of a mass of granite and lie partly in that rock and partly in adjacent schists. The same geologist has given attention to the artesian water in this northern area to the south of the Gulf of Carpentaria. The water-bearing strata occur at depths which extend to as much as 3000 feet beneath sea-level, and water has been obtained at depths of 2000 feet and upwards, with a yield varying from 100,000 to one million gallons a day. Mr. Cameron also reports on recent developments in the copper-mining industry in the Cloncurry district. The ores occur in the older metamorphic series, and further systematic explorations are strongly recommended. Mr. B. Dunstan describes the anthracitic coal-deposits of the Dawson-Mackenzie region in central Queensland; in the Annual Report of the Geological Survey of Queensland he also refers to the occurrence of rhodochrome and of barklyite (the opaque ruby). Mr. J. Malcolm Maclaren deals with the geology of the Ravenswood gold-field on the borders of the Burdekin River. The rocks comprise schists and altered sandstones of unknown age, quartz-porphyries, granitites and granites. Microscopic sections of some of the rocks are illustrated. The country rock of the reefs is mainly granitic. Mr. Maclaren reports also on the tin mines of the Stannary Hills, Eureka Creek, in North Queensland. The tinstone does not occur in fissure lodes with true walls, but as an impregnation along the bedding-planes of green chloritic slaty shales. Hence he considers that the permanency of the veins may be confidently anticipated. Mr. Lionel C. Ball reports on the Red Queen and Black Diamond gold-mines near Taromeo. The district is regarded as a promising one.

"APPENDIX No. 1—1902" of the Kew *Bulletin of Miscellaneous Information* has been issued. It consists of the usual list of seeds of hardy herbaceous annual and perennial plants and of hardy trees and shrubs, most of which have ripened in Kew during the year 1901. They are offered in exchange with Colonial, Indian, and foreign botanic gardens, as well as with regular correspondents of Kew.

THE Indian Tea Association has issued a report (published in Calcutta) on "Red Rust, a Serious Blight of the Tea-plant," by its scientific officer, Mr. Harold H. Mann. The disease is caused by an alga, *Cephaleuros mycoidea*, which attacks chiefly the leaves, one of the small number of algæ which are morbific parasites on plants. The remedy recommended is spraying with Bordeaux mixture or sulphide of potassium.

THE publication of the weekly *Botanisches Centralblatt* will cease with the close of the present year, when it will have completed its eighty-eighth quarterly volume. The chief editor, Dr. Uhlworm, has been chosen to edit a new international botanical journal, the publication of which was decided on at the recent Congress of Botanists at Geneva, subject to sufficient support being promised in the way of subscriptions.

WE learn from the *Botanical Gazette* that Dr. J. N. Rose has returned from his botanical expedition to Mexico. He has brought back a large collection of plants made chiefly in the States of Mexico, Hidalgo, Vera Cruz, and Pueblo. Considerable collections were made in the high mountains, especially about Pachucha and on Orizaba and Popocatepetl. The collection is especially rich in species of *Oxalis*, a genus which reaches a high development in Mexico.

STATISTICS issued by the Indian Department of Revenue and Agriculture show the mineral production of the Empire from 1891 to 1900. Of salt, about one million tons is annually produced; of saltpetre, about 20,000 tons. The output of coal has increased to more than six million tons. Gold has been produced to the value of about two millions sterling, mostly from Mysore. Burma and Assam have yielded 38,000,000 gallons of petroleum.

THE first number of a new periodical, entitled *Science, Arts, Nature*, has been received from Paris. The journal resembles *La Nature* in scope and typography, and the editor, M. Leon Lefevre, hopes to keep its readers in close touch with movements in science, invention and industry.

A SECOND edition of Mr. A. H. Hiorns's concise and practical manual on "Mixed Metals and Metallic Alloys" has been published by Messrs. Macmillan and Co., Ltd. The book has been completely revised and enlarged so as to include the results of the chief researches on alloys published during the last seven or eight years.

THE results of the Cambridge Anthropological Expedition to Torres Straits will be published in several volumes—probably six—dealing respectively with physical anthropology, physiology and psychology, linguistics, technology, sociology and religion. The first part, just published, belongs to the volume on physiology and psychology, and in it Dr. W. H. R. Rivers deals with vision. We propose to notice the volumes when the series has been completed.

EVIDENCES of Austria's position among leading contributors to scientific knowledge is afforded by the annual volumes published by the Vienna Academy of Sciences. The *Sitzungsberichte* for 1899 are before us, and as they occupy approximately four thousand pages it is clearly impossible to describe the contents. Many of the papers have, however, already been mentioned in these columns, and we need now only express satisfaction at the substantial testimony to scientific activity presented to us by the volumes before us.

THE supplementary list of lantern slides just issued by Messrs. Newton and Co. contains, among other scientific subjects, sets of slides of natural history subjects reproduced from photographs by Mr. Douglas English; photographs of ripples on mercury and water surfaces by Dr. J. H. Vincent; sound waves by Prof. R. W. Wood; photo-micrographs illustrating the morphology of malaria by Dr. H. R. D. Spitta; and photo-micrographs by Dr. J. Leon Williams relating to the microscopic morphology and pathology of the enamel of teeth. To be able to illustrate lectures or lessons with these photographic pictures of natural objects and phenomena should greatly facilitate instruction and create interest in scientific subjects.

NEW editions of two volumes in the well-known Text-Books of Science series have been published by Messrs. Longmans, Green and Co. One is Sir W. de W. Abney's "Treatise on Photography," which contains the essential principles of the science of photography, and should be understood by everyone who aspires to be a successful photographer, whether from a scientific or artistic point of view. The second volume is Prof. W. A. Tilden's "Introduction to the Study of Chemical Philosophy," which has been completely revised and in large part rewritten in order to present the principles of theoretical and systematic chemistry in their modern aspects. The book is one which students of chemistry read with pleasure; because it is a synopsis of the leading principles of chemistry, and profit;

because it leads them to broad and philosophic views. Both books are tenth editions, a fact which shows that they have been appreciated; and doubtless they will maintain their high reputation for some time to come.

MESSRS. BREWSTER, SMITH AND CO. have sent us a pamphlet describing an improved form of sulphuretted hydrogen apparatus. The apparatus, which has been designed by Dr. F. M. Perkin, is so arranged that either a constant supply of the sulphuretted hydrogen gas or a saturated aqueous solution can be obtained. It is well known how rapidly an aqueous solution of sulphuretted hydrogen decomposes and becomes unfit for use. The new apparatus is so arranged that the surface of the solution has always an atmosphere of the gas over it, therefore no oxidisation can take place, and the solution is always saturated. The generating part of the apparatus is a slightly modified form of the apparatus first described by De Koninck, and contains a large supply of acid and of ferrous sulphide, so that when once fitted up it can be used for four or five months without being recharged. In this respect it is certainly an improvement over the "Kipp" apparatus, which requires constant recharging and wastes both of acid and sulphide.

THE additions to the Zoological Society's Gardens during the past week include a Squirrel Monkey (*Chrysothrix sciurea*) from Guiana, presented by Captain W. A. S. Copp; two Lesser White-nosed Monkeys (*Cercopithecus petaurista*) from West Africa, presented by Mr. P. Zaffere; two Laughing Kingfishers (*Dacelo gigantea*), a Black-backed Piping Crow (*Gymnorhina tibicen*) from Australia, presented by Captain Westcott; two Alligators (*Alligator mississippiensis*) from Southern North America, presented by Mr. Percival H. Hancock; a Common Snake (*Tropidonotus natrix*), British, presented by Mr. W. Swan Sonnenschein; a Pluto Monkey (*Cercopithecus leucampyx*) from West Africa, two Marica Gazelles (*Gazella marica*) from Arabia, a Common Roe (*Capreolus caproea albino*), European, deposited; four Lapwings (*Vanellus vulgaris*), European; fifteen American Mud Fish (*Amia calva*), twelve Long-eared Sunfish (*Lepomis auritus*), six Black Bass (*Huro nigricans*) from North America, purchased.

OUR ASTRONOMICAL COLUMN.

THE ANNULAR ECLIPSE OF THE SUN, NOVEMBER 10, 1901.—In the *Comptes rendus* (vol. cxxxiii. p. 768) there is a communication from M. Janssen stating that he has received by telegram notice of the success of the expedition sent to Cairo to observe the recent annular solar eclipse. He had requested M. de la Baume Pluvinel to photograph the spectrum of the solar light grazing the moon's limb; this had been done, and the photographs showed no trace of any absorption which might suggest the presence of a lunar atmosphere. M. Pasteur had obtained large-scale photographs of the sun with granulations. The result of the expedition was therefore to be considered entirely successful.

THE LEONID METEORS, NOVEMBER, 1901.—A telegram to the daily Press through Reuter's agency announces that a considerable number of meteors have been observed in localities where the weather conditions were propitious. Advices from many stations in the United States report more or less brilliant displays of the Leonids as having been seen on Thursday and Friday nights. A steamer from New Orleans reports having seen a great shower near Cape Hatteras early on Friday morning (November 15). The only night on which the sky was at all favourable in London was Thursday, November 14, and on that occasion continual watch was kept by three observers at the Solar Physics Observatory from 11 p.m. to 4 a.m. A few meteors were seen, from twenty to thirty, but nothing in the semblance of a definite shower was presented. Many of the shooting stars seen were very brilliant, but those traced out as being Perseids or Taurids were as numerous as those decidedly radiating from the sickle of Leo, so that probably there was nothing more than is to be seen on any good night for the same interval of time. Several photographic cameras were being exposed in different directions in the hope of recording trails, but without success. The 6-inch prismatic camera was adjusted some distance ahead of the radiant, on the star Pollux (β Geminorum), and a very bright meteor was observed to pass close to the star; but although special care was taken in development, nothing beyond the star spectrum was obtained on the plate.

STRUCTURE OF THE REGION AROUND NOVA PERSEI.—A considerable advance in the knowledge of the surroundings of Nova Persei has resulted from the examination of photographs obtained by Mr. G. W. Ritchey with the 24-inch reflector of the Yerkes Observatory. A reproduction of one of these photographs is given in the *Astrophysical Journal* (vol. xiv. pp. 167–168) in illustration of a short description of the appearances found on examining the negative. This photograph was obtained on the night of September 20, 1901, on a Cramer "Crown" plate of specially high sensitiveness, with an exposure of 3h. 50m.

The first glance at the photograph shows that the false penumbra which has been recorded with refracting telescopes is entirely absent. The image of the Nova is some 20″ in diameter on account of the long exposure, but there is little or no halo of nebulosity immediately about it. Completely surrounding the star, however, is a large elliptical belt of nebulosity some 20′ of arc in diameter, with patches of varying density, the most intense being on the southern half of the ring. These latter are probably identical with the four principal condensations mentioned by Prof. Perrine, the photographs of which with the Crossley reflector of the Lick Observatory show evidence of motion of these constituent portions of the nebula. As much of the finer detail is necessarily lost in reproduction, a drawing is appended showing the structure to be seen on the original negative. This shows the nebula to have a very complex structure, and the question as to whether it is spiral or consists of several annuli with interlacing branches cannot yet be decided. An exceedingly suggestive feature is the existence of two moderately dense wisps of nebulosity, extending from the Nova towards the west, which then curve towards the north and merge into the main convolutions of the nebula. A later circular just received from Kiel contains the important announcements that:—

November 12.—Ritchey states that a photograph obtained at the Yerkes Observatory on November 9 confirms the large motion of the nebula near the Nova.

November 13.—Ritchey finds the nebula surrounding the Nova probably expanding in all directions.

PROPER MOTION OF NOVA PERSEI.—Herr Östen Bergstrand, of Upsala, has computed a preliminary value of the proper motion of Nova Persei from measures obtained from photographs with the astrophotographic refractor at Upsala Observatory. The plates were taken on 1901 March 1, 11, and September 1, 11. The probable yearly proper motion is

$$\text{in R.A.} = \mu = -0\text{s.}\cdot05$$
$$\text{,, Decl.} = \mu' = -0''\cdot7.$$

The deduced mean position of the Nova is given as

$$\left.\begin{array}{l}\text{R.A.} = 3\text{h. } 24\text{m. } 28\cdot16\text{s.} \\ \text{Decl.} = +43^\circ\ 33'\ 54''\cdot0\end{array}\right\} (\text{Epoch } 1901\cdot4.)$$

NEW VARIABLE STARS.—91 (1901) *Velorum*. Mr. A. W. Roberts announces the variability of the star having the position

$$\left.\begin{array}{lrrr} & \text{h.} & \text{m.} & \text{s.} \\ \text{R.A.} = & 10 & 16 & 44 \\ \text{Decl.} = -41^\circ & 43' & \cdot8 & \end{array}\right\} (1875).$$

The changes observed indicate that the star is of the Algol type, with the following elements:—

Variation in brightness = 10·0–10·9 magnitude.
Period... ... ... = 1d. 20h. 30m. 2s.

92 (1901) *Coronae Australis*. The same observer also records as variable the star having the following position

$$\left.\begin{array}{lrrr} & \text{h.} & \text{m.} & \text{s.} \\ \text{R.A.} = & 18 & 32 & 45 \\ \text{Decl.} = -37^\circ & 35' & \cdot8 & \end{array}\right\} (1875).$$

Variation in brightness = 8·0–9·0 magnitude.
Period... ... ... = about 185 days.

93 (1901) *Sagittae.* Herr F. Schwab, of Ilmenau, announces variability in the star B.D. + 19°·3975 :—

	h.	m.	s.	
R.A. =	19	14	26	(1900).
Decl. = +19°	25′	·4		

The variability is of the Algol type. Normally the star is about 6·5 magnitude, decreasing to nearly 9·0 magnitude, remaining here for some time and then rapidly increasing. At present there are not sufficient observations for stating a value for the period, but the light curve is similar to that of U Cephei, period 17 days. The last observed minimum was November 1 at 6·30 G.M.T. (*Astronomische Nachrichten*, Bd. 157, No. 3748).

DETERMINATION OF ORBITAL ELEMENTS.—In the *Astronomical Journal* (vol. xxii. No. 510, pp. 43–52) Mr. F. C. Moulton gives a general analysis of a method of determining the elements of orbits of all excentricities from the data supplied by three observations of position, and illustrative examples of the application of the equations derived to the cases of elliptic and parabolic orbits.

THE INTERNATIONAL MEETING OF PHYSIOLOGISTS AT TURIN.

THE fifth Triennial International Congress of Physiologists, which met at Turin in September, was the largest meeting of the kind that has assembled. The fine Institute of Physiology, under the direction of Prof. Angelo Mosso and belonging to the University, was put at the disposal of the Congress. In the neighbouring Institute of Histology was installed a museum for the exhibition of apparatus and preparations pertaining to physiology. The collection was extensive and important.

The number of communications announced for the sessions of the Congress was large enough to necessitate the institution of special accessory sittings. Sections were formed for Chemical Physiology and for Psycho-physiology. It is impossible in the space at our disposal to even mention all the material brought before the Congress, or to deal with any of the contributions fully. Preference was rightly given to communications illustrated by actual experiment or by actual preparations. A fuller verbal report has appeared in a special issue of the *Archives Italiennes de Biologie* (tome xxxvi. fasc. i.)

Among the communications coming under the head of Chemical Physiology the following may be noted.

Dr. Victor Henri (Paris) reported observations on the law of the quantitative action of sucrase. If a represent the quantity of saccharose at outset, and x the quantity inverted in a period equal to t, the action does not proceed in conformity with the logarithmic law admitted by authors, $K = \frac{1}{t} \log \frac{a}{a-x}$. The value of K does not remain constant during the reaction. The law in accordance with which the reaction proceeds corresponds with a formula, $K_1 = \frac{1}{t} \log \frac{a+x}{a-x}$. The *constant of inversion* K_1 varies with the concentration of the solution of saccharose a. The product aK_1 increases with a for weak concentrations (below 5 per cent.); it remains constant for concentrations of medium strength (5 per cent. to 25 per cent.) and diminishes when a increases above 25 per cent. The fact of having acted several hours and of being in a solution laden with invert sugar does not exert appreciable influence upon the activity of the sucrase.

Dr. Frederic S. Lee (New York) reported observations made by himself and Dr. C. C. Harrold on the influence of the ingestion of sugar upon *rigor mortis*. The prolonged administration of phloridzin to fasting cats causes the muscles to pass into *rigor* within a few minutes after death. If before death dextrose be given to such phloridzinised animals, the oncoming of *rigor* is delayed. The absence of carbohydrate from the muscle favours development of *rigor mortis*; it is, on the other hand, unfavourable to contraction.

Dr. F. S. Locke (London) demonstrated by a striking experiment the action of dextrose upon the activity of the mammalian heart. The heart removed from a freshly killed rabbit was washed free from blood and suspended freely, and arrangement made for recording its contractions by means of a lever attached to the apex. Kept at a temperature of 35° C., and fed with a modified Ringer's fluid, the contractions gradually grew feeble and ultimately very weak. If then oxygen under pressure were introduced into the fluid feeding the coronary arteries, the beats rapidly increased and remained good for an hour or so, and then once more diminished and failed. Dextrose then added to the feeding fluid to the extent of 1 per cent. restored the beat once more and it continued with hardly noticeable failure for ten hours or so. The beating fails at once if for the dextrose in the feeding fluid the oxygenated Ringer solution without any dextrose is substituted; but the beat is at once restored on returning again to the sugared fluid. Sucrose, lævulose and other sugars as yet tried fail to give evidence of this restorative power. The author must be congratulated upon the able and complete manner in which he demonstrated these important facts.

Prof. Albertoni (Bologna) communicated observations on absorption of various sugars from the stomach and intestine. The sugars (glucose, saccharose, lactose) were not absorbed in the ratio of their osmotic tensions. The absorption of lactose, whether in low tension or high tension solutions, was always less than for glucose or saccharose. In the intestine he always found a fluid of higher osmotic tension than the blood. During the absorption of sugar he found a slight increase of the osmotic tension of the blood.

Prof. Röhmann (Breslau) brought forward observations on the absorption of sugars from the intestine. Equal quantities of equally concentrated solutions of hexoses (glucose, galactose, mannose, fructose, and of pentoses (arabinose and xylose) placed in the small intestine (Vella's fistula) showed at the end of an hour loss by absorption of the different stereoisomeric sugars to very different extents. The absorption is, therefore, dependent, not only on the osmotic tension, but also on the configuration of the molecule of the sugar. The absorption of the disaccharides (saccharose, lactose and maltose) was further studied in respect to the extent to which their cleavage into monosaccharides went forward. It was found that a considerable though variable proportion of these disaccharides was absorbed without cleavage occurring in the intestinal canal. But an extract of the intestinal *mucosa* could produce the cleavage; probably the portion absorbed without being split up later underwent cleavage in the mucosa itself.

Dr. Nicloux (Paris) had studied the conditions of passage of carbonic oxide from the blood of the mother to that of the fœtus. He had employed for the determination of the quantities of the gas in the blood an accurate and delicate method elaborated in his previous experiments. When the percentage of CO in the air respired by the mother lay between $\frac{1}{10000}$ and $\frac{1}{1000}$, the quantities in the blood of mother and fœtus increased *pari passu* with increase of the percentage in the air respired, and the percentage in the fœtal blood was sensibly the same as in the maternal. With a percentage of above $\frac{1}{1000}$ of the gas in the respired air the identity of the percentage in the fœtal and maternal blood disappeared. This indicated a dissociation of the carboxy-hæmoglobin of the maternal blood at the placenta as a condition of passage across it. A simple experiment supports this view. A carp is placed in water to which has been added some oxycarbonated blood (dog's). The blood of the fish comes to contain a percentage of CO six or seven times greater than that of the medium of immersion. The animal shows no toxic effect from the immersion.

Dr. Pugliese (Bologna) had with Prof. Aducco found that the addition of sodium chloride to the water taken by fasting animals considerably increased their resistance to inanition. When the tissues of animals as similar as possible in other respects, but in the one case having water only, in the other salt and water, were analysed, the tissues under the latter condition were found to contain relatively the more water. Also the amount of water daily excreted by the animals receiving salt water was less than the amount of water excreted by those receiving water without salt.

Prof. A. Walther (St. Petersburg) demonstrated the action of Pawlow's *enterokinase* on fresh pancreatic juice as tested by digestion of measured quantities of fibrin. The conversion of the zymogen in the fresh juice into trypsin is not an oxidation process, for the *enterokinase* does not give the reactions of the oxidases, nor can the zymogen in the juice be rendered active by oxidising agents. The zymogen in the pancreatic juice is therefore not the same substance as Heidenhain's zymogen in extracts of the gland-tissue. The action of the *enterokinase* upon the zymogen is probably a hydrolytic one. From the fresh pancreatic juice a proteid (globulin?) can be precipitated

which has extraordinary tryptic but no amylolytic power; but the amylolytic power of the juice remains in the juice after removal of the tryptic proteid.

Dr. O. Cohnheim (Heidelberg) reported experiments on the disappearance of peptones placed under the influence of the intestinal *mucosa*. The peptones were not changed to albumin, but were split up into crystalloid cleavage products. This cleavage was accomplished by a ferment *erepsin* produced by the intestine, and active on peptone but not on albumin.

Drs. Delezenne and Drouin (Paris) had investigated the question of the origin of the pepsin which is secreted in urine. They found that that pepsin might have either or both of two sources, α, the pepsin secreted by the stomach and presumably reabsorbed, β, the pepsin known to exist in the muscles, salivary and other glands and organs. The authors demonstrated that the urinary pepsin had its origin in the gastric pepsin, and was obtained by reabsorption of that pepsin from the stomach itself. (1) In the dog after removal of the stomach, never under any condition of nutrition or in any digestive period is any proteolytic ferment whatever detectable in the urine. (2) In the dog after establishment of a gastric fistula and the prevention of the entrance of gastric juice into the intestine, the urine, as usual, contains pepsin. (3) In the dog after exsection of the stomach, the introduction of gastric juice into the intestine fails to result in the appearance of pepsin in the urine.

Dr. Drouin (Paris) had made observations to test the part played by the spleen (Schiff, Herzen) in pancreatic digestion. He had, in the dog, united the œsophagus to the duodenum and converted the stomach into an independent *cul-de-sac* opening on the surface by a fistula. Thus he eliminated gastric digestion altogether and left pancreatic action the chief *rôle* in digestion. He had then excised the spleen. The excision produced no appreciable difference in the assimilative powers, digestive activity or general well-being of the animal. The removal of the spleen seemed, further, in no way to alter the quality or quantity of the juice secreted by the fistulous stomach.

Prof. Gley (Paris) gave a *résumé* of his experiments and conclusions regarding the *rôle* and mutual interdependence of the thyroid and the parathyroid glands. The evidence was both chemical and histological. He regarded the parathyroids as complemental in function and structure to the main thyroid. He referred to the work done recently by Mr. Walter Edmunds (London), and a fuller summary of his communication can be found in an admirable article published by Prof. Gley recently in the English medical journals.

Prof. V. Ducceschi (Rome) communicated researches dealing with aromatic groups in the proteid molecule. Cinnamic acid could be obtained from egg-albumin and serum-albumin by a method which did not in that way split up tyrosin. It came probably from the aromatic group whence proceed in the putrefaction of some proteids phenylacetic and phenylpropionic acids; probably that group is phenyl-α-amidopropionic acid. From 500 grm. of egg-albumin, 2 grm. of β-phenylacrylic acid (cinnamic acid) are obtained.

Among other communications given in this section were those dealing with the speed of absorption and of elimination of acetylene gas by the organism (Prof. Ugolino Mosso, Genoa), the presence of lower homologues of caffeine and theobromine in certain plants (Prof. Albanese, Pavia), the pharmacodynamic action of acetyl chloride (Prof. Spineanu, Bucharest), the formation of fat in the animal body (Prof. Boruttau, Göttingen), the diastatic action of human saliva (Dr. Oehl, Pavia), the osmotic tension of milk, urine and amniotic fluid (Drs. Vicarelli and Cappori, Turin), electromotive changes observed in solutions of oxalic acid under exposure to light (Dr. Querton, Brussels), the fatty components in lecithin (Dr. Henriquez, Copenhagen), the influence of intestinal absorption on the diurnal curve of output of urea (Dr. Slosse, Brussels), the microchemistry of the cell (Dr. R. Kohn, Prague), a method for determination of the acidity of the gastric juice (Levi and Lolli, Modena), hæmolysmometry (Dr. E. Buffa, Turin).

Electrophysiology was represented, as regards special communications to the meetings of the Congress, chiefly by the papers of Profs. Boruttan, Fano, Herzen, Mislawski, Waller, Wedenskii and Weiss. The first named (Göttingen) demonstrated capillary-electrometer photograms of the action current of the frog's nerve obtained during strychnine tetanus. The frequency of the rhythm was about eight times per second, and the relative slowness of the curve was explicable by the imperfect synchronism of the course of the individual waves. Prof. Boruttan could not accept Sir J. B. Sanderson's suggested explanation of these strychnine oscillations of the electrometer line, and proposed to call them pseudotetanic. He finally entered upon the question of the proper functional rhythm of the nerve-cell.

Prof. Herzen (Lausanne) dealt with the separation of the action-current of nerve from the functional "impulse" of nerve. He appealed to, among other data, that of Boruttan's strychnine experiment, in which, from a partially dried nerve trunk incapable of transmitting the impulses from the strychnised centres to the limb-muscles, the transmission of the action-current was still demonstrably obtainable.

Dr. Waller (London) gave in two complemental reports a well-illustrated demonstrational *résumé* of the more recent of his work on the electric response of living matter, both plant and animal, to general and to adequate stimuli. New points were added to those already familiar to English students of the question. A comprehensive search has been undertaken into the distributional width of the existence of this "reaction of vitality" which he regards as coextensive with life itself.

Among points established by him were the following:—Mechanical excitation of a petiole renders the excited part electropositive to the unexcited. The illuminated part of a leaf is electropositive to an unilluminated. Electric stimulation of uninjured vegetable tissues is followed by an electrical response which is abolished at high and low temperatures, by anæsthetic vapours, and in consequence of strong electric excitation. A general relation between magnitude of response and "vitality" of plant or plant organ is noticeable, the stronger the "vitality" the greater the voltage of the response. This in seeds is confirmed by subsequent germination. Plant tissues when submitted to stimulation of uniform magnitude at regular intervals exhibit the characteristic changes known in animal physiology as "peripheral fatigue" and "recovery," "staircase effect" and summation. In consequence of one or more strong induction currents, the electrical conductivity of living plant tissues is greatly augmented. Among his observations upon animal tissues may be cited the following. The skin of the cat's foot gives an electrical response to excitation of the sciatic nerve; this current is ingoing, it has a latent period of about three seconds and an E.M.F. of a hundredth of a volt. In the skin of the frog's foot it can be shown that atropin abolishes this indirect response to excitation of the nerve. The electrical response of healthy excised human skin to electrical excitation of both directions is outgoing. Human skin continues to exhibit the outgoing response characteristic of the living state for 1-10 days after excision. Immersion in hot water at once destroys irrecoverably the power of the skin to respond. The electrical response of the skin and of the eyeball to direct excitation is comparable with similar effects witnessed in electrical organs.

Dr. Weiss (Paris) showed that if two successive electric stimuli be applied to a nerve at the same point of the nerve, the direction of the electric currents applied is important in determining the summation of the stimuli. If the electric stimuli are both of the same direction and occur within the duration of the latent period, the effect of the one is demonstrably added to the effect of the other. If they are, however, of opposite direction the stronger of the two is alone effective, at least if the weaker is subliminal it produces no obvious effect. That is, if the stronger of the stimuli is of just liminal value it remains of just liminal value whether preceded or followed by the weaker of opposite direction. The addition to it of the weaker in nowise changes the result produced by the stronger on the nerve.

Prof. Wedenski (St. Petersburg) drew attention to observations, conducted in his laboratory, indicating the fundamental similarity of inhibition of nerve to narcosis of nerve. He maintained that all general excitants of nerve exhibit three successive phases of influence upon nerve—a phase in which the rhythm of the excitation exhibits modification in the rhythm of the response, a phase in which there is a depression of conductivity of the excited state, a phase of depression of all response to excitation.

Prof. Vitzou (Bucharest) gave an account of experiments instituted to test the supposed inexcitability of the grey matter of the spinal cord to artificial stimuli. He claimed that his experiments demonstrate that the spinal grey matter, like the cerebral grey matter, is excitable by faradic currents.

Prof. Mislawski (Kasan) gave a communication upon the negative variation of reflex action. Du Bois Reymond's discovery

of the negative variation of strychnine convulsion, and Grützner's of that accompanying the spinal reflexes of the frog had shown the way to an electric examination of reflex action. His own observations exemplified how strictly the electric propagation through the reflex cell-chain conformed with the direction laid down by the Bell law of root-conduction. The electrical discharge in the reflex action he found to be an irregular one compounded of an irregular series of individual discharges.

Closely connected with such communications as these was a large group that may be classed as neurological. Prof. Langley (Cambridge) has begun an attempt to determine the group reactions to drugs and blood conditions of the different neurons which make up the nervous system. He demonstrated the stimulating action of nicotin on the neurons of the superior cervical ganglion in testimony of his view that that drug alters the cell-bodies (perikarya) of that ganglion. Since the suggestion of Carl Huber (Ann Arbor, U.S.A.) it has been customary to suppose that the incidence of action of nicotin in the sympathetic ganglia lies at the terminal fibrils of the preganglion neurons. Langley finds that if the preganglionic fibres are cut and allowed time for regeneration the local application of nicotin to the ganglion still produces its normal stimulating effect. Nicotin applied to a ganglion of the sympathetic chain causes erection of hairs only in the region supplied by the ganglion: if it stimulated the preganglionic nerve-endings axon-reflexes would move the hairs in other regions. Nicotin probably does not paralyse spinal ganglion cells; it does not stop the passage of impulses through the bipolar cells of the spinal ganglion of the skate. The erection of the hairs of the cat which occurs after asphyxia does not occur if the sympathetic pilomotor nerve-cells have been separated from the spinal cord; this blood stimulus acts, therefore, on the intraspinal pilomotor cells. Prof. Langley also spoke, in illustration of the same theme, of the effects of suprarenal extract on a number of tissues and organs where he had examined its action. His new results, together with others previously ascertained, showed that in all cases the extract produces an effect of the same kind as that produced by stimulation of the sympathetic nerve, and not like that produced by a cranial or sacral autonomic nerve. Notwithstanding this the action of the extract appears to be directly upon the tissue, not upon the sympathetic nerve-endings; thus it produces pallor and secretion of the submaxillary gland, and this after degeneration of the post-ganglionic fibres of the cervical sympathetic. The inhibitory effect of the vagus upon the cardiac sphincter of the stomach was demonstrated to the meeting.

Prof. Langendorff (Rostock) reported upon restoration of function which had occurred 105 days after total extirpation of the superior cervical ganglion of the cat. The signs of paralysis in the eye had then nearly passed off; they returned at once on section of the sympathetic nerve in the neck. Electrical excitation of the upper end of the cut nerve-trunk gave strong dilatation of the pupil, and palpebral fissure and retraction of *membrana nictitans*. Microscopical examination failed to reveal any reappearance or regeneration of the ganglion, but the sympathetic fibres must have found their way to their appropriate end-stations.

Dr. Bottazzi (Florence) reported observations on the innervation of the viscera in certain crustacea and in elasmobranchs. His communication was illustrated by a number of anatomical preparations and photograms showing the disposition of the nerve-trunks and the structure of the ganglia.

Dr. Marenghi (Pavia) demonstrated rabbits in which he had performed—as in one case was proved to the meeting by autopsy of an animal—intracranial section of the optic nerve, and still found persistence of reaction of the pupil to light and shade. The reaction was feeble and sluggish, but indubitable.

Prof. Flechsig (Leipzic) gave a very complete demonstration of preparations recording the history of the myelinisation of the nerve-fibres of the human brain. He described at considerable length, with the aid of projected slides, his views regarding the functional arrangement of different areas of the cortex cerebri. Cortical fields to the number of thirty-six, uniform in extent and distribution in different individual brains, can be mapped out by the myelogenetic method. These fields are divisible chronologically into three groups: primary 1–10, intermediate 11–31, terminal 32–36. The primary fields included the seats of cortical representation of all the senses. The myelinisation in each of the fields begins fairly contemporaneously throughout it and does not begin from a single point in it; neither the size of the nerve-fibres nor the vascularity of the tissue conditions the myelinisation of the area. Each primary field possesses a couple of well-defined conjugated tracts, one proceeding to it—cortico-petal and the earlier to myelinate—the other proceeding from it—corticofugal and the later to myelinate. The primary fields possess each a corticofugal tract which proceeds to regions non-cortical. The intermediate and terminal fields possess no such "projection" tracts. Prof. Flechsig regards both the cingulum and the fasciculus longitudinalis inferior as projection tracts from two of his primary fields; he believes, as Prof. W. H. Thompson has previously urged, that the latter tract connects the cortical visual field with the *corpus geniculatum laterale*. The intermediate fields, on the other hand, are rich in long association fibres leading to connection with other regions of the cerebral cortex.

Drs. Z. Treves (Turin) and A. Aggazzotti (Turin) reported the interesting results of an attempt to train the flight of a pigeon whose cerebral hemispheres had been removed. The bird, with another whose hemispheres were similarly removed at the same time, was allowed at first to remain, as pigeons after ablation of the hemispheres do, perched almost motionless on their wooden perch. The top of the perch offered an area some five centimetres by four. After some days it was removed from the top of the perch and placed about five centimetres from it, and was pushed towards it and in various ways incited to fly up to it. In fifteen days it began to take a short but fairly perfect flight to the perch-top. The distance was increased gradually by five centimetre increments. In five months' time by daily training the distance of flight had been extended to about eight metres. Sometimes the course of the flight was straight, often it was not so. Resting places were introduced sometimes not in a direct line to the perch in the cage. In six months' time progress had been made so far that the bird when thrown into air in a direction away from the cage orientated itself promptly and turned its flight in that direction. In nine months' time the bird flew regularly and well to the perch in the cage from any quarter of the room and when started in any direction. It, however, never once flew down from, or indeed left, its perch of its own accord, nor did it ever feed itself. From Turin it was taken to Modena for a fortnight and made to learn other exercises. On being brought back to Turin and liberated in its room it at once flew back to its cage and mounted its platform. It seemed to possess memory. The companion bird, to whom no training was given, at the end of nine months did not, when placed close to its perch and incited to fly to it, respond by flight, nor could it of itself, when placed just outside the cage, fly into the cage. Both birds retained throughout the strange huddled appearance and attitude characteristic of the pigeon after removal of the cerebral hemispheres.

Dr. A. S. Grünbaum and Prof. Sherrington (Liverpool) demonstrated a number of brains and cord-sections of anthropoid apes on which they had been investigating points in the physiology of the "motor area." Both excitation, by faradic electricity, and ablation had been employed. In view of the near approach of these brains to the configuration of the human it became obvious that the determination of the topography of the excitable and other areas must be in them of considerable practical importance to the study of human cerebral disease. They had at outset of their work been surprised to meet with results at variance with the topography generally accepted as probably obtaining in man. It had to be remembered, however, that the generally accepted topography was based chiefly on results obtained in the lower, not in the higher, apes, and that of the anthropoid apes only a single species, and that by a single specimen only, had previously been laid under experimental contribution. Their own experiments, embracing observations upon a series of chimpanzees as well as on the orang and the gorilla, were completely unanimous in denying any extension of the "motor region" to the surface behind the Rolandic fissure. Nor had they found the fissures in the motor region inexcitable, as had been asserted for the cortex of the orang, or that the motor region of the anthropoid required faradic currents much stronger than those required for the lower monkeys. A number of details were shown and dealt with in the communication, account of which limits of space preclude our here doing justice to. A chimpanzee taken to the Congress for actual demonstration of the excitation effects became ill on the journey and succumbed before experiment could be undertaken. We may remark that the research showed more clearly

than evidence hitherto accessible that in the motor region of these complexly folded higher brains the cortical fissures do not coincide with functional boundaries in the cortex, and that they do not, indeed, bear any accurately constant relation whatsoever to the functional topography. They are, with the exception of the Rolandic fissure itself, quite insecure landmarks to the details of the spatial arrangement of the functional "centres."

Prof. Nicolaides (Athens) demonstrated to the meeting two dogs in which he had performed bilateral vagotomy several months previously. He pointed out the remarkable subsidence of the symptoms that had occurred. His results, especially in regard to recovery from dyspnœic attacks, had, he contended, been considerably more favourable than those obtained by Pawlow.

Dr. Bayliss (London) gave an excellent demonstration of the antidrome vascular dilatation obtainable from the posterior spinal roots of the nerves of the pelvic limb. The excitation may be electrical, mechanical, chemical or thermal. The experiments leave no doubt that the vascular dilatation is brought about by impulses passing centrifugally along fibres of the sensory nerve-root, which, like the other fibres of that root, have their perikarya in the root-ganglion outside the cord. The fibres do not enter the sympathetic system, but proceed direct to the limb. Reflex vaso-dilatation of the limb can be produced after extirpation of the abdominal sympathetic, *i.e.* after all the vaso-constrictors have been removed; this dilatation must therefore be by means of vaso-dilator nerves which go to the limb through the hindmost three lumbar and first sacral nerves. Similarly, vaso-dilator fibres pass to the forelimb by the hindmost three cervical and first thoracic nerves.

Dr. Bocci (Siena) showed tracings demonstrating the diminution in the excitability to electric stimuli of the nerves of the frog produced by destruction of the spinal cord.

Dr. S. A. Dontas (Athens) demonstrated the different character and the greater degree of mechanical elasticity possessed by a muscle before than after poisoning by curare.

Drs. Negro and Z. Treves (Turin) demonstrated graphic records of the willed muscular contractions performed by a patient suffering from Parkinson's disease (*Paralysis agitans*). These records showed that the oscillations which, as Schäfer and v. Kries have shown, normally characterise willed contractions and normally succeed at a rate of 10–12 per second in the patient with *morbus Parkinsonii*, occur at a rhythm of only 5–6 per second.

Dr. Demoor (Brussels) showed preparations illustrating some remarkable sequelæ to trepanning in young animals. The brain had been in some way injured at the operations, yet at the end of about five months wasting of the body with epileptiform seizures ensues and death soon follows. The cells of the cerebral cortex are found to be in a condition of chromolysis with a moniliform degeneration of their dendrites.

Other communications dealt with the differential reaction of muscle and nerve (Mdlle. Joteyko, Brussels), graduation of the effects of fatigue (Mdlle. Joteyko, Brussels), the *rôle* in respiration of the sensory nerves of the diaphragm (Mislawski, Kasan), cerebellar tonus (A. Moscucci, Siena), the coordination of antagonistic muscles (Victor Henri, Paris), the phenomenon of Bell (C. Negro, Turin), conditions favourable and unfavourable to hypnosis in the frog (M. Stefanowska, Brussels). Among contributions to method may be mentioned Dr. Treves's improvements in the ergograph of Mosso, Dr. Broca's (Paris) apparatus for obtaining constant condenser discharges at any desired rate of frequency, and Dr. Corona's ingenious trephining instrument.

Among communications dealing with muscle may be cited Dr. F. S. Lee's (New York) observations with Dr. W. Salant on the influence of doses of alcohol upon the contractions of the directly excited isolated muscles of the frog. It was found that alcohol in minute doses seemed to favour the response of the muscle, in larger doses it was obviously deleterious. Dr. J. Demoor (Brussels) demonstrated his method and some of his results upon the dissociation of contraction and conduction in the muscle of the frog. The muscle is surrounded with plaster of Paris for half its length. The electrodes being placed on the free part of the muscle, a series of contractions in that free part is provoked and repeated to the production of fatigue. The plaster is then broken from the other half of the muscle and that half is found to be quite unaffected by fatigue. If the stimulating current be applied to the part within the mould instead of to that outside, the latter contracts in response to the stimulation and can be reduced to inexcitability by fatigue. But the part inside the mould, although it has served as conductor to the fatigued part, is found to have remained inappreciably affected by fatigue. Prof. Huerthle (Breslau) demonstrated a series of remarkable microphotograms of muscle fibre at rest and in contraction, examined under illumination by homogeneous light and by plane polarised light with an analyser.

Prof. Langendorff (Rostock) had examined the direction and speed of the conduction of the contraction-wave over the heart by applying to the surface of the isolated and artificially fed cat's heart two rheoscopic muscle-nerve preparations from the frog. The two preparations were 2 to 3 centimetres apart. The wave of negativity was found to sweep usually—if heart were beating well—from the base toward the apex, at a speed of 2 metres per second. If the heart were beating badly it might be as slowly propagated as ½ metre per second.

Prof. Blix (Lund) demonstrated apparatus devised for myothermal experiments on excised frog muscle; and apparatus for a similar purpose was also demonstrated by Dr. Bürker (Tubingen). Prof. Blix also showed a new form of induction excitator used by him in his more recent work on the summation of twitches.

Dr. Negro (Turin) demonstrated a fine series of microscopical specimens displaying the motor end-plates in mammalian and reptilian muscle-fibres.

Prof. Grützner (Tubingen) communicated the results of an investigation he had conducted upon the movements of the contents of the stomach and the regional distribution of the acidity of the semi-fluid mass of food occupying the cavity of the organ. The method employed had been rapid removal and freezing of the viscus and then its examination by frozen sections cut in various planes. When solid or semi-solid food is taken, that which is later introduced is always found toward the centre of the cavity of the organ. The contents of the pyloric end were always well acidified throughout, those of the cardiac end only in the layers nearest to the mucosa. The movements of the stomach seem to result in the food being deposited in layers upon the surface of the mucosa and that layer next to the mucosa being shifted toward the pylorus.

Prof. Zuntz (Berlin) described the methods employed by himself and his four colleagues, Caspari, Waldenburg, Lœwy and Kohner, in their recent research into the chemical metabolism of the body at high altitudes, namely on Monte Rosa. Dr. v. Schrötter (Vienna) reported his observations of some of the physiological phenomena attending a balloon ascent to an altitude of 7500 metres.

Of experiments dealing with the circulation, a large number were demonstrated. Prof. Hürthle (Breslau) demonstrated his new Stromuhr in action on the living animal, also a number of the graphic records obtained by it. These proved (1) increase in speed of flow of the blood in the carotid, produced by compression of the opposite carotid, (2) increase by section of the vago-sympathetic, (3) slowing of the blood stream in the crural artery as a result of tetanisation of the limb muscles by stimulation of their nerves, (4) the blood stream in the arteries as measured by the volume of blood flowing along the channel in a given time increases, not in simple proportion to increase of the arterial pressure, but in much greater ratio, *e.g.* blood pressure 87 mm. Hg., stream volume 400 mm^3., b. press. 131 mm. Hg., stream volume 1000 mm^3., b. press. 161 mm. Hg., stream volume 1500 mm^3.

Dr. T. G. Brodie (London) demonstrated a new method for investigation of effect of drugs on the mammalian heart. The mean pressure against which the heart works is kept constant and the work determined by the product of the output and of the mean pressure. An automatically working "Stromuhr" registers the output. Of the results obtained, especially noteworthy were those concerning anæsthetics. Chloroform depressed the working capacity vastly more than did ether or ethylene chloride. Suprarenal extract much increased the amount of work performed by the heart, as also its rate of beat. Suprarenal extract acts as an antidote to chloroform. If administered before chloroform it is found that the heart can withstand much larger doses of chloroform. Moreover, a heart deeply injured by chloroform will rapidly and completely recover if suprarenal extract be administered. It had in the course of the research been constantly found that the heart was very sensitive to the blood of different mammalian species, thus the heart of the dog went quickly into fibrillar incoordination unless fed with dog's blood; ox blood and other kinds of blood acting deleteriously at once. Dr. Brodie also showed his apparatus for the recording of the lung volume. He employs a plethysmographic method,

which he demonstrated in use. Dr. Dixon (Cambridge) is his collaborator in the research not yet completed, for which the apparatus was designed.

Prof. Fano (Florence) described at some length a series of electrometer photograms registering electromotive phenomena of the heart beat. The photographic records shown in illustration of several new points he brought forward were particularly fine specimens of what such records can be in the hands of the skilful.

Prof. Moussu (Alfort) had studied the lymph flow in the limbs of the larger animals (horse, ox, &c.) during physiological repose and inaction, and then under conditions of local vaso-constriction and vasodilatation and under those of general augmentation of blood pressure and of copious venous depletion. He had further observed the lymph flow under the influence of muscular work and under conditions of great activity of the tissues in general. A very large series of observations was presented in a number of tables together with diagrams of the apparatus employed for measuring the quantities of mechanical work given by the animals in certain of the experiments dealing with the effect of muscular activity. The conclusions arrived at were (1) that the lymph is not the simple product of a transudation from the blood plasma through the capillary wall under the mechanical pressure of the blood-circulation; (2) that filtration is always quite a minor factor in the production of lymph; (3) that the lymph is mainly a product of the tissues comparable to a secretion from them; (4) that the quantity of its production is in direct relation to the functional activity of the tissues; (5) that the peripheral (limb) lymphatic apparatus is in large measure an apparatus for excretion.

Prof. Stirling (Manchester) demonstrated his simple and successful method of injecting the sublingual lymph-sac of the frog and of applying drugs to the muscles related to it. Fluid, *e.g.* solution, of Berlin blue is injected under slight pressure into the dorsal lymph-sac and finds its way to the sac below the tongue. Excellent anatomical preparations are thus obtainable; drugs, *e.g.* veratrin, may thus be applied directly to the hyoglossus *in situ*.

Prof. Kemp (Illinois) on behalf of Miss Calhoun and himself made an interesting communication upon blood-platelets and their relation to coagulation of the blood-plasma. After thorough control of the method for fixing the platelets they attempted their methodic enumeration. The number varied between 961,500 and 730,000 per cub. mill. in man; a larger number than they found in dogs. The authors confirmed Bizzozero's observation that if the blood of the living dog be reduced to an incoagulable condition by repeated "whippings" and reinjections the incoagulable blood contains no platelets. But it contains some, though few, leucocytes. The authors find that in normal clotting the blood-platelets break down, the leucocytes do not. The fibrin filaments radiate from disintegrating blood-platelets at the nodes of the network they form.

Prof. Hédon (Montpellier) showed that the hæmolytic glucosides are more globulicidal in saline solutions than in serum. Substances therefore exist in the serum that may be regarded as protecting the red corpuscles against the toxicity of these glycosides. A little serum added to the water in which they are swimming protects tadpoles against the toxicity of glycosides (saponine, cyclamine) that are otherwise violently poisonous for them. Similarly, acid sodium phosphate protects the red corpuscles from the action of solanine and protects fish if added to the water of the aquarium.

The large attendance of active workers in the field of sense-organ physiology and in pyscho-physiology was a notable feature of the Congress, and the communications made upon those subjects were numerous. Dr. Tschermak (Halle) gave a lucid account of interesting and exact work upon the extent of the binocular field of vision in various vertebrate types. Prof. Hensen (Kiel) demonstrated experiments in evidence of an accommodation mechanism for the ear. Prof. Cavazzani (Ferrara) demonstrated an instrument for the estimation of the visual purple. Dr. Sante de Sanctis (Rome) reported the results of prolonged researches upon the depth of sleep. The stimulus required to break sleep was found usually to be greatest in the first half of the second hour. The increase of stimulus required to pass from provocation of a subconscious reaction to actual waking amounted on an average to three degrees of the scale of the Griessbach æsthesiometer. Prof. Osawa (Tokio) described observations indicating that most monkeys are right-handed, only a few left-handed; that birds, on the other hand, are usually left-footed. Drs. Broca and Sulzer (Paris) communicated a research into the latent period for visual acuity. Dr. S. Vaschide (Paris) had made numerous measurements of the simple reaction time for olfactory sensations. Dr. Marco Treves (Turin) reported observations on the thermo-esthesiometry of the various mucous membranes accessible to external examination. The sensitivity was in all cases found to be markedly less than is that possessed by the skin. The mucosa of the urethra and of the cervix uteri were quite incapable of heat and cold sensations, and even the cautery excited only slight, and that painful, sensation from them.

Dr. Kiesow (Turin) brought forward observations proving that the laryngeal aspect of the epiglottis is endowed with sentiency for taste, and so also the greater part of the mucosa lining the interior of the larynx itself. The whole of the soft palate (but not the hard palate) and the back of the pharynx were found endowed with taste. On the other hand, taste sensations could not be evoked from the uvula, the tonsils, the anterior or posterior pillars of the fauces. In regard to other species of sense, the uvula, tonsils and pillars of the fauces were found to be very defective in regard to touch and temperature stimuli, but fairly responsive as regards "painful"; the combination of sense-organs is in this respect almost the converse of that obtaining on inner surface of the cheek. Dr. Kiesow gave further communications upon the "temperature spots" of the skin. He laid stress upon the considerable amount of evidence that the "cold spots" lie much nearer the surface of the skin than do the "hot spots." Regarding the topographical distribution of the spots, his own very extensive observations differed in no important respect from those of Blix and Goldscheider, but in detail agreed better with those of the former, although he did find the cold spots rather more sparse than had Blix.

Dr. Kiesow also brought forward an important result for which his observations on "touch spots" gave basis, namely, that the value of the median threshold of the touch spot is within narrow limits practically the same for all touch spots the whole body-surface over. This is in strong contrast to the wide variation which the median threshold for pain exhibits. This discovery is of much significance for the analysis of spatial perception.

Among those present, in addition to those mentioned above, were Profs. Aducco (Pisa), Albanese (Pavia), Albertoni (Bologna), Axenfeld (Perugia), de Burgh Birch (Leeds), Bohr (Copenhagen), Bowditch (Boston), Chauveau (Paris), v. Cyon (Territet), Dastre (Paris), Dupuy (Paris), Ebbinghaus (Breslau), Einthoven (Leyden), Fano (Florence), Foster (Cambridge), Fredericq (Liege), Gad (Prague), Gaule (Zurich), Gley (Paris), Golgi (Pavia), O. S. F. Grünbaum (London), Héger (Brussels), Henriquez (Copenhagen), Hering (Prague), Hopkins (Cambridge), Johansson (Stockholm), Kossel (Heidelberg), Kronecker (Berne), Laulanié (Toulouse), Lépine (Lyons), Lombard (Ann Arbor, U.S.A.), Luciani (Rome), Marey (Paris), Nicolaides (Athens), Oehrwall (Upsala), Onimus (Munich), Osawa (Tokio), Perroncito (Turin), Physalix (Paris), Prévost (Geneva), Querton (Brussels), Sergi (Rome), Shore (Cambridge), Sowton (Liverpool), Stafford (Nottingham), Starling (London), Stefani (Padua), Stirling (Manchester), v. Tarchanow (St. Petersburg), Thompson (Belfast), Tigerstedt (Helsingfors), Toulouse (Paris), Tschermak (Halle), v. Uexkull (Naples), Verworn (Göttengen), Vintsgau (Innsbrück), Welby (London). The Congress was more numerously attended than any previous one. The courtesy and hospitality of their Italian colleagues will always remain a memory with the members present. The Italian committee consisted of Profs. Aducco, Cavazzani, Corona, Fano, Luciani, Angelo Mosso, Patrizi, Sertoli and Stefani. Drs. Treves and Herlitzka proved indefatigable local secretaries. The Italian language was an official language for the Congress, and it was formally decided that it should henceforth remain so.

ON A LATE PLEISTOCENE DEPOSIT CONTAINING MAMMOTH.

AMONG the districts in which there is a fair probability of obtaining satisfactory evidence as to the sequence of events which have occurred since the glacial episode, there is none more promising than the northern part of East Anglia, nor is there any region where the history of that early post-Glacial age, if it could be clearly made out, would throw light upon so many vexed questions in geology.

It is therefore very desirable that any new bit of evidence bearing upon the case should be placed on record, and, from this point of view, a discovery recently made at Didlington Hall seems to be of value, especially as the conditions which it indicates are exceptional in the district and the facies of the animal remains found is unusual. The bones and shells were carefully collected by Lady Amherst and are now preserved in the museum at the Hall.

Didlington Hall is built on the margin of an extensive bed of Boulder Clay, into which the river has cut back, forming a cliff which now rises from 26 feet, the level of the water in the lake, to about 38 feet above ordnance datum. It is no longer seen as a cliff just here, because the original form of the ground has been much modified by natural and artificial operations. Down the valley, however, this cliff forms a well-marked feature along the right bank, but up stream it is generally softened down into a gentle slope. Owing to the overlap of the artificial soil and rainwash near the Hall, nothing was known of the character of the marginal deposits of the river until, in carrying out some alterations in the boat-house, it was found necessary to cut off and dry a portion of the bed of the lake and remove some of the clay close to the original bank.

The lowest part of the bed was full of large stones out of the Boulder Clay, most of them covered with glacial striæ. With them were the bones of large animals which had probably been also washed in from the bank in floods. It appeared to be a deposit thrown down in an embayed curve of the river, perhaps even cut off from the stream so as to form a pond or "broad." The velocity of the stream cannot have been great, for the rest of the deposit consisted of fine blue mud and the shells were well preserved, as were also the plant remains, though these were very fragmentary. There were, moreover, no signs of sorting by water in any part of the deposit exposed, which was not more than 18 inches or two feet in thickness. The river must have been diverted or its velocity somehow checked and this small patch left as a record of some of its latest efforts in this part of the valley.

This clay was covered by a few feet of later deposits from the existing lake, and was penetrated by the roots of water lilies and other aquatic plants.

The following shells were found in it and determined by Mrs. McKenny Hughes:—*Sphaerium Corneum*, Linn., *Pisidium amnicum*, Müll., *P. fontinale*, Drap., *Unio sp.* fragments only, *Bythinia tentaculata*, Linn., *Valvata piscinalis*, Müll., *Planorbis carinatus*, Müll., *Limnaea peregra*, Müll. (several varieties), *L. auricularia*, Linn. (and varieties), *L. stagnalis*, Linn., *L. palustris?* Müll., *Succinea putris*, Linn., *Helix* (*Fruticicola*) *hispida*, Linn., *H.* (*Xerophila*) *Ericetorum*, Müll., *Pupa marginata*, Drap. The larger animals were:—*Elephas primigenius*, *Equus caballus*, *Bos longifrons*. *Cervus elaphus* of very large size has been found in a similar deposit in the immediate neighbourhood.

We notice the absence of the older forms of Bos, viz. *Bison priscus* and *Bos Urus*; whereas a strain of *Bos longifrons* occurs here, though it has never been found associated with the mammoth in the gravels.

Bos longifrons has not yet been satisfactorily described. There is certainly a larger and a smaller variety in the peat of both Ireland and England, but whether they were wild or all domesticated or derived from a domesticated breed is not clear.

It may be that further search would yield some of the forms whose absence we remark, but the evidence, so far as it goes, points to the Didlington Clay being more recent than the gravels in which the mammoth occurs elsewhere in East Anglia. It might be, of course, that it was made up of the washings of earlier deposits of various age, but there is nothing in the condition of the mammoth bones to suggest that they are not of the same age as the other remains found here. Moreover, several consecutive vertebræ of the mammoth found together in their natural order prove that the ligaments had not perished when the bones were buried in the clay.

Some of the bones, especially those of horse, were grooved and striated in such a manner as to remind one of ice action, and of course the close proximity of the Boulder Clay suggested the possibility of their being derived from it; while we have to bear in mind also the probability of the agency of river ice at a later period.

On the other hand, similar striæ on the bones found in other sections in East Anglia have undoubtedly been caused by settlements in the stony mass by which the gravel has been squeezed against and even into the inside of the bones while the process of decomposition was going on. This fact and the occurrence of similar striæ on the bones of saurians in Jurassic clays throw great doubt upon the inference that the scratches on the Didlington bones are due to any kind of ice action. None of the plant remains have been determined.

There is much evidence in favour of the view that after that not so very remote yet very exceptional episode, in which glacial conditions prevailed over this area, the whole of the district stood at a higher level. Then the basin of the Wash and its tributaries was re-excavated and extended, and a considerable resultant river found its way into the sea through the chalk escarpment between Hunstanton and Skegness. Into this river the Wissey and other streams of west Norfolk found their way. Some time later the area was depressed, and the rivers, which had descended with considerable force, especially in times of flood, were met by the tides at higher and higher points as their valleys gradually sank to sea-level. But this was not a sudden or even a rapid change, and the species of plants and animals disappeared by degrees as the conditions became unsuited for them. The Didlington Clay belongs to this period of changing conditions and is a late Pleistocene formation laid down after the arrival of *Bos longifrons*, but before the mammoth had ceased to inhabit, or at any rate to be a visitor in, the district.

Almost all the remains of the earlier Pleistocene times have been obtained from sands and gravels of a torrential character, and we have seldom had any opportunity of examining the embayed corners where they have been preserved in fine mud. This is partly due to the fact that the sand and gravel are of commercial value, but the mud is only excavated to get at something below it, as, for instance, at the marl for cement, or the gault for bricks, or, as in the case to which attention is now called, where the excavations were made for a new boat-house which exposed this blue river clay at Didlington Hall.

But another, and perhaps the more common, reason is that it was generally near the mouths of the sinking river valleys which have been since submerged and buried under later deposits that the velocity of the stream was checked so as to allow of the deposition of fine mud instead of sand and gravel.

T. MCKENNY HUGHES.

SOME SEASONAL VARIATIONS IN THE BRITISH ISLES.

IN a paper just published by the Royal Society[1] attention is directed to a peculiarity in the seasonal variation of temperature in the British Isles disclosed by the resolution into harmonic components of the curves of day to day variation derived from the 25-year means of the 24-hourly readings at Kew, Falmouth, Aberdeen and Valencia. The peculiarity in question is the second harmonic component which is represented by a curve with two maxima and two minima in the year. In the 25-year curves for each of the observatories the maxima of the second components come within four days on either side of January 31 and August 1 respectively, and the minima are in the first week of May and November. They represent a temperature effect which exaggerates the height and shortens by nearly two weeks the duration of the summer portion of the compound curve; it also moderates the depth and lengthens by an equal amount the duration of the winter portion. The effect has a range of nearly 3° F. at Kew in the 25-year mean curve, out of a whole range of 24° F. Its magnitude at the other stations is approximately the same fraction of the whole range at those stations. It is much larger in curves for single years at Kew, but the epoch varies somewhat. It is called meteorological, as distinguished from planetary, because in the mean curves for the Continental stations Vienna and Agra it is quite different either in magnitude, or epoch, or both.

An attempt is made to account for this peculiarity by the prevalence of winds from different quarters at different times of the year. The mean temperatures of 3288 successive days (nine years) at Kew are grouped according to wind direction from eight compass points or, more strictly speaking, according to the direction at right angles to barometric gradient. The method

[1] "On the Seasonal Variation of Atmospheric Temperature in the British Isles and its Relation to Wind-direction, with a Note on the Effect of Sea Temperature on the Seasonal Variation of Air Temperature." By W. N. Shaw, F.R.S., and R. Waley Cohen. Read before the Royal Society, June 20.

of reference of the temperatures is unusual. The temperature for any day is not referred to the ascertained 25-year mean for that day, but to the corresponding point of the first component in the harmonic resolution of the 25-year curve, and it is the differences from this standard which are considered. To obtain trustworthy means for the several winds the differences for each ten days of the year or for each month are grouped, and the winds are also grouped according to their average annual effect upon temperature, which is tabulated in the paper. Thus N., N.E., and E. winds (E., S.E. and S. gradients) are grouped as "cold winds," S., S.W. and W. winds as "warm," and N.W. and S.E. as "temperate."

A series of diagrams exhibits the results obtained, and it is noteworthy that the chief characteristics of the peculiarity which it is sought to explain, viz. maxima of warming effect in January and July with maxima of cooling effect in May and November, are traceable in different ways in the temperature curves for separate winds and still more markedly in those for the groups of winds. Thus the peculiarity is only partly attributable to the prevalence of warm or cold winds; part is due to a similar peculiarity in the seasonal variation of temperature of the individual winds themselves. Thus the May minimum is shown to be due partly to the special prevalence of "cold winds" and partly to the relative coldness of those winds at that season: the corresponding November minimum is attributed to the prevalence of "temperate winds" and the exceptional coldness of those winds at that period of the year. The July maximum corresponds to the exceptional warmth of the usually cold or temperate groups of winds and the January maximum corresponds especially to the frequency of occurrence of "warm winds."

The half-yearly component of the variation of temperature in individual winds remains unexplained, but the following facts are noted in connection with it: first, a similar effect is found in the temperature variation of sea-water at stations surrounding these islands and, secondly, a similar second order component with similar epoch is found in the seasonal variation of the barometric gradient between London and Valencia and still more conspicuously in the barometric gradient between London and Aberdeen.

The data as to the relation between wind, or gradient, and temperature have been obtained for Kew only.

The paper also contains an account of the variation of temperature with the type of weather prevailing, whether cyclonic or anticyclonic, and it is shown that the effect in question cannot be ascribed to the differences of frequency of these types at different seasons.

To the paper is appended a note on the effect of sea temperature upon the seasonal variation of air temperature. In this an attempt is made, by the application of the principle of the vector composition of sine curves of the same period but with different epochs, to resolve a resultant annual temperature oscillation into components corresponding to the "original oscillation" and the superposed effect of sea or land. By the application of the principle in the case of Kew, it is shown that the amplitude of the "original oscillation" at Kew cannot be less than 5·3° F. and the effect of the surrounding sea corresponds to an oscillation which cannot exceed 8·3° F. in amplitude. The resultant oscillation at Kew ought, however, to be resolved into three components—the original component, that due to the surrounding land and that due to the sea; but there are not sufficient data to determine them directly.

Application is also made of the same principles to the resolution of the temperature variation at Scilly and at a station in Siberia. The numerical results are not to be regarded as final on account of the inadequacy of the data used.

RESEARCH IN UNIVERSITY EDUCATION.

THE development of higher education in the direction of research was the keynote of the address delivered by Prof. J. G. Macgregor, F.R.S., at the University of Edinburgh on October 15, in opening the Natural Philosophy Class as the late Prof. Tait's successor. Research methods should be used in education from the Kindergarten to the University; because the spirit of self-help, of inquiry and of inventiveness which they encourage is at the foundation of all progress in science and industry. When science began to be studied in our schools and colleges about forty years ago, the schoolmen of the day followed, with few exceptions, the methods which they used in teaching the humanities. Lectures and books provided the material and examinations the test of retentivity. The system was fundamentally wrong when applied to science though sound for studies of literature. Investigation is necessary in both cases if progress is to be made, but, as Prof. Macgregor remarks, "while in science the outfit of the laboratory consists of apparatus and tools, in language it consists of the text and the lexicon."

The neglect of the spirit of research in the study of science is largely responsible for the want of public sympathy with work of investigation and the inadequacy of provision made for it. Nations like those of America and Germany which have recognised that research is not only an educational discipline but exercises a powerful influence upon industrial development, now take the initiative where we were once the leaders. Formerly, it was necessary for the young American to go to Germany to obtain the pioneer spirit, but the need no longer exists, for the leading universities of the United States have been remodelled on modern lines. In Great Britain the conservative spirit prevails and has prevented the course of university development demanded by the requirements of the age. The characteristic attitudes of the German, American and British peoples are as old as the prophets, from whom Prof. Macgregor derives an appropriate illustration.

"The German," he remarks, "may be said to have sought wisdom for her own sake as being more precious than rubies, and he is finding now that she has length of days in her right hand, and in her left riches and honour. The American, though he sought her not, heard her crying at the gates: I, Wisdom, dwell with prudence and find out knowledge of witty inventions; and having heeded her cry, he too is reaping his reward. We Britons have neither sought her for her own sake nor heeded her cry, but have said to ourselves: There is no new thing under the sun. He that increaseth knowledge increaseth sorrow, and much study is a weariness to the flesh. The sleep of the labouring man is sweet. Yet a little more sleep, a little more slumber, a little more folding of the hands in sleep. And now we fear that poverty is coming as one that travelleth, and want as an armed man."

It is the duty of those of us who are awake to national necessities to exert ourselves in the endeavour to arouse the British people to action, and our political leaders to a sense of responsibility for future welfare. More liberal provision must be made for the increase of knowledge, and men who devote themselves to research must be prized as highly as those who have contributed in other ways to the progress of the nation. There must be increase of funds and increase of freedom in the universities and the guiding principle of the work must be research. Prof. Macgregor emphasises these points in the following concluding part of his address.

Research is costly. It means increased teaching staff and adequate provision of all the requisite appliances. Much good work, it is true, may be done with a comparatively small outfit; but to obtain the best result, the outfit, if not lavish, must at any rate be generous. And as the importance of research by students has never been recognised amongst us, the present outfit is meagre.

It will perhaps occur to most of you that the princely gift of 2,000,000*l.* which Mr. Carnegie has made to the Scottish people for reducing the cost of the higher education and increasing its efficiency may be drawn upon for the present purpose, and may be sufficient. Doubtless it will be drawn upon, but it will certainly not be sufficient. When we think of the number of colleges which are to be assisted, and of the number of different departments in each, we see at once that the amount which any one department may expect to receive must be comparatively small. The moiety of the Carnegie fund which is devoted to equipment would build, equip and maintain perhaps about twenty laboratories of the more expensive kind such as are required in the various sciences and in their numerous applications. It becomes obvious, therefore, both how munificent a gift the Scottish people have received, and, since each university ought to possess many of these laboratories, how inadequate it is for the introduction of research study into the various departments of university work.

In Germany the nation itself provides for research, and does so generously, because it is, and has long been, an investigating nation. We are not; and if we introduce research into our universities it will be because, like the Americans, we have

come to recognise its educational and industrial importance. It will be individuals who will lead in this recognition; and we must therefore rely, as the Americans have done, mainly on the public spirit of citizens. The reports of the United States Commissioner of Education show that there has been in recent years a steady increase, year by year, both in the benefactions and in the Government grants which the universities and colleges have received, culminating in 1898-9 (the date of the latest report) in benefactions amounting to 4,400,000*l.* for that one year, and Government grants amounting to 1,500,000*l.*—facts which fully explain how it is that the great universities, which, of course, have been receiving the lion's share, have been able to build up, in a comparatively short time, well-equipped research schools in many departments of study. If we are to do the same, we must not rest satisfied with the equipment which the Carnegie fund can provide, but must supplement it with a liberality which, if not individually so princely as Mr. Carnegie's, will collectively exceed it in amount.

And here let me suggest that the endowment of research in Natural Philosophy in this university might well form the first instance of such enlightened liberality. Tait needs no effort of ours for the perpetuation of his name. By his scientific work he has raised for himself, as a distinguished leader in the advancement of knowledge, a more lasting monument than any that we could erect. But of his services to the University and the State there is no memorial. There are thousands of his students who have drunk from the well of his inspiration and been made stronger men by the draught. There are tens of thousands of his fellow-citizens whose pride in the Scottish metropolis has received new justification from his whole-souled devotion to its maintenance as a centre of light and leading. Is it too much to expect that they should found a research laboratory bearing his name, and thus appropriately mark their appreciation of a great Scotsman who showed by the exercise of his own creative power that Britain at least shares in the intellectual leadership of the world, and by the cultivation of creative power in his students did what he could to maintain her industrial leadership as well?

There would be little advantage in the possession of research funds, however, without full freedom to use them; and at present they could be used only to a limited extent. Research work is recognised in our universities as qualifying for certain high degrees, so high that no one is supposed to be fitted for them until five years have elapsed from the date of his having become a Master of Arts or a Bachelor of Science, so high consequently that they are taken only by the few. It is not recognised as qualifying for the M.A. and B.Sc. degrees themselves, and any time which may be spent by an undergraduate in investigation is thus condemned by our regulations to be, so far as the degree is concerned, "time elaborately thrown away." Nor is it easy to gain full freedom to teach by research; for when we ask how the recognition of research study in the undergraduate courses is to be obtained, we find that changes in regulations can be made only with the concurrence of the Scottish Universities Committee of the Privy Council, and that it is hopeless to expect the concurrence of this Committee unless it is asked for by at least two universities. It will at once be obvious that the advocate of reform has an arduous task. For he must persuade in succession his own university, a second university, and the Privy Council Committee. And this procedure is requisite, not merely to secure the desired recognition of research study, but to carry out any large measure of reform. It has obviously been devised with the object of preventing hasty and ill-considered change on the part of any of our universities, and any change whatever which does not commend itself to more than one. It may be admitted at once that it is admirably suited to the purpose; for if we think of the correspondence involved in the advocacy of any reform, the iteration and reiteration of argumentation, the button-holing, perhaps even the lobbying and "log-rolling," it becomes apparent that no better system could be devised to dampen the enthusiasm of the reformer and to perpetuate things as they are.

It is perhaps improper in one who has only recently joined your staff of teachers, and may not be fully acquainted with the advantages of the organisation referred to, to express any decided opinion about it. But, as an old student, who for years has been watching the course of his Alma Mater from afar, and is thus in a position to let you see yourselves as others see you, I may allow myself to say that the Ordinances of the Scottish Universities Commission and the authority of the Privy Council Committee seem to me to be millstones about the necks of the Scottish universities, which, unless the universities have a supernatural buoyancy, must sink them lower and lower relatively to the progressive universities of the world.

The most important condition of the steady progress of the German university has been the *Lehrfreiheit*, and the corollary insisted upon by the universities and recognised by the State, that when the best available teachers have been selected they must be supposed to know better than any external committee what is to be taught and how the teaching is to be done, and that consequently they must be free to regulate and modify their teaching as knowledge advances and as methods are improved.

And, similarly, one essential condition of the progress of the American university has been its autonomy. Johns Hopkins University, non-existent twenty-five years ago, is to-day one of the leading universities of the world, because it put at its head a talented educational reformer and gave him a free hand; and in consequence of a similar policy, Harvard, in the last quarter of a century, has been transformed from being a leading American university to being a leading world's university. These two great institutions work on quite different lines. Had either required to persuade the other of the value of its organisation and then to persuade a Committee of Congress, it is safe to assert that the extraordinary development which both have exhibited would never have occurred.

The question of the relation of the universities to the Privy Council Committee, of the advantages of individual as opposed to collective development, of the kinds of change which ought to be capable of being made from within, and the kinds which ought to be submitted to an external tribunal—these are questions of too great complexity to be discussed in the last paragraphs of an address. But when the introduction of research work into the undergraduate courses is found to be among the reforms which must wait for collective action and the consent of an external body, it becomes obvious, I think, that the line between changes which may be made from within and changes which require approval from without has been so drawn as to hamper unduly the development of our universities, and that it requires to be redrawn in the spirit of progress.

Meantime, as to the particular change which I am advocating to-day, we need not despair. Reform in this direction is in the air. Under the stress of the national industrial crisis and the growing conviction that something must be wrong in our educational system, those educationists who have long advocated it are securing to-day an attention such as they have never before received. And when we find the Chancellor of the University of Birmingham, a leading Cabinet Minister, eager to introduce research into his university, and the chairman of the Educational Section of the British Association, our Minister of Education, as eager to introduce it into his schools, we are encouraged to hope that at no distant date the movement may be fully developed which was inaugurated in this university through the profound educational insight of Prof. Tait, and that all our universities may be enabled to exert the stimulating influence that schools of the higher education should do, not merely on industrial development, but on all forms of progressive activity.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Financial Board has published a proposal that the University should purchase some six acres of land belonging to Downing College, and adjoining the new buildings for geology and botany. The site is practically the only one now available for the extension of the museums, and it will, if not secured by the University, be divided up by new streets for ordinary building purposes. The price is about 25,000*l.*, which, in the absence of benefactions, will have to be raised by loan.

Dr. Anningson, Dr. Collingridge, Prof. Woodhead, Mr. J. E. Purvis and Dr. Tatham have been appointed University examiners in sanitary science.

At a meeting held under the auspices of the Philosophical Society on November 18, it was decided to invite the British Association to visit Cambridge in 1904 or 1905.

MR. CARNEGIE has announced that he will give 400,000*l.* more to Pittsburg, half to the Carnegie Institute and half to the new technical school, the building of which will shortly be commenced.

FROM the Report of the Somerset County Education Committee we learn that an experimental farm has been established under the auspices of the committee at Bickenhall, near Taunton, where systematic observations are made and experiments conducted on the breeding, feeding and produce of farm animals, more especially those usually found on a dairy farm. Experiments are also made on the production of various crops.

THE annual meeting of the Association of Headmasters of Higher Grade Schools and Schools of Science was held on Friday last at the rooms of the Society of Arts. Mr. E. J. Cox, Headmaster of the George Dixon Higher Grade School, Birmingham, delivered his presidential address, taking for his subject the recent return of the Board of Education, which gives statistics relating to schools of science in connection with board schools and certain conclusions which have been drawn from the return by a section of the Press. Mr. Cox, and the association over which he presides, maintain that these schools of science are providing a thorough and suitable preparation for boys who will later proceed to workshops and factories. Judging by the remarkable unanimity of the reports of the inspectors of the Board of Education, South Kensington, it may certainly be said that these schools provide the best preparation for the later work of the technical school to be obtained in this country. It is to be hoped that future legislation will provide a place in the national system of education for schools of this character, since they effectually ensure that the brightest children of the elementary schools shall receive practical instruction in the methods of science. It is a hopeful sign for the future of English education that several representatives of different trade societies were present at the meeting and showed by their speeches that they understood the value of a knowledge of science to all engaged in manufacture.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Astronomical Society, November 8.—Dr. J. W. L. Glaisher, president, in the chair.—Mr. S. A. Saunder read a paper on the determination of selenographic positions and the measurement of lunar photographs. This was a second paper on the subject, dealing with the determination of a first group of standard points on the moon, by measures made at the telescope and on photographs. Prof. Turner said this was a work in which those could assist who possessed telescopes of moderate aperture, as it had been found that very large apertures were unsuited for measures of the lunar surface.—Father Sidgreaves read a paper on the spectrum of Nova Persei from February 28 to April 26; with an appendix, dealing with its spectrum in August and September. Photographs were shown of the spectrum taken at Stonyhurst on August 27 and September 5, when it had become a bright-line spectrum, some of the lines remaining very broad and well defined.—Mr. A. R. Hinks gave an account of the experimental reduction of some photographs of Eros made at Cambridge Observatory for the determination of solar parallax; he explained the methods employed and gave some preliminary results.—Mr. H. C. Plummer read a paper on periodic orbits in the neighbourhood of centres of libration.—Mr. Bellamy read his paper on the place of the variable star RU Herculis and the neighbouring stars from photographic measures.—Prof. W. W. Campbell, Prof. J. Scheiner and M. Ch. Trépied were elected associates of the Society.

Linnean Society, November 7.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. W. Botting Hemsley, F.R.S., on behalf of the Director of the Royal Gardens, Kew, exhibited the following specimens:—(1) A West Australian umbelliferous shrub, *Siebera deflexa*, which produces tubers, called *Yuke* by the aborigines, who eat them both raw and cooked. Many shrubs in dry countries form large tuberous stocks from which annual stems spring; but the tubers of *Siebera deflexa* grow in strings showing no trace of eyes or buds, but scars where stems may have been detached. Whether independent plants spring from the separate tubers is a question which remains to be determined. (2) Germinating seeds of *Araucaria Bidwillii*, received from Grahamstown. The peculiarity in the germination is that there are two distinct stages; in the first stage the radicle emerges from the shell of the seed, eventually bringing out the petioles of the cotyledons and the axis of the plantlet. The radicle grows into a carrot-shaped woody body, from which the petioles of the cotyledons disarticulate, leaving a few minute rudimentary leaves forming the point of the plumule. After some weeks the second stage begins with the elongation of the plumule, which eventually becomes the trunk of the tree. It appears that the second stage may be delayed a considerable time without loss of vitality. The germination of the seeds of *Araucaria Bidwillii* had been previously observed, and the process has been described and illustrated in Regel's "Gartenflora," 1865, p. 103; but the two stages of growth escaped notice. Another peculiarity is there pointed out: each seed contained two or more embryos, which germinated and grew so that 164 plants were raised from seventy-five seeds. *Araucaria Bidwillii* is the *Bunya-bunya* of Queensland, and the seeds were formerly an importaut article of food of the Australian aborigines. (3) A drawing of *Archidendron solomonensis*, a new pluricarpellary leguminous tree, native of the Solomon Islands, where it was discovered by Archdeacon Comins. In this instance there were three ripe pods developed from one flower; and it was explained that in the flowering stage there were usually eight carpels; but they probably rarely, if ever, all reach maturity. The genus Archidendron was founded on an Australian species, and since then several other species have been discovered in New Guinea and the adjacent islands. (4) A selection of South African species of Helichrysum showing the great diversity in habit, foliage and flowers displayed by this very large genus of Compositæ.—Dr. Rendle showed germinating seeds of *Crinum longifolium*, received from Mr. E. A. Bowles, as an example of the so-called bulbiform seeds which characterise this and some other allied genera of Amaryllideæ.—The president directed attention to a specimen of *Luzula nivea* from a cultivated plant of unusual dimensions.—Mr. Cecil Warburton, on behalf of Miss Alice Embleton and himself, read a paper on the life-history of the black currant gall-mite, *Eriophyes* (*Phytoptus*) *ribis*, hitherto very imperfectly known, and dealt particularly with its behaviour during the migration-period, which lasted from the middle of May to the middle of June. Its natural enemies and its relation to the red currant plant were also discussed.—Mr. C. B. Clarke, F.R.S., communicated some notes on the types of species of Carex in Boott's Herbarium.

CAMBRIDGE.

Philosophical Society, October 28.—Mr. J. Larmor, vice-president, in the chair.—Prof. A. Macalister was elected president for the session 1901–2.—Notes on minerals from the Lengenbach Binnenthal, with an analysis by Mr. H. Jackson, by Mr. R. H. Solly (see vol. lxiv. p. 577, October 10).—Some remarks on the notion of number, by Dr. Hobson.—The Hall effect in gases at low pressures, by Mr. H. A. Wilson. The experiments described in this paper were undertaken with the object of detecting and investigating the Hall effect in the positive column of the ordinary electric discharge at low pressures. A vacuum tube was constructed having two small electrodes 6·5 millimetres apart, attached to a stopper ground into a side tube, joined on at right angles to the main discharge tube. By rotating the stopper the two small electrodes could be made to lie both in the same equipotential surface of the positive column. The difference of potential between these electrodes was measured by means of a quadrant electrometer, and the stopper was turned until the electrometer deflection was zero. A magnetic field was then applied perpendicular to the line joining the two small electrodes and to the direction of the discharge. It was found that the field produced a difference of potential between the small electrodes which appeared to be a true Hall effect and was proportional to the magnetic field. In the uniform positive column this transverse potential gradient was found to be nearly independent of the current through the tube and inversely proportional to the pressure of the air in the tube. At 1 millimetre pressure the difference between the velocities of the negative and positive ions due to one volt per cm. was found to be $14 \times 10^4 \frac{\text{cms.}}{\text{sec.}}$.—On some problems in electric convection, by Mr. G. T. Walker. The paper deals with problems involving the motion of electrified particles through dielectrics which are themselves in motion relative to the ether. It is shown that if space on one side of an infinite plane be occupied by a dielectric and this medium be moving at right angles to its bounding plane, the determination of the electric and magnetic forces due to a point-charge possessed of a velocity

in the same direction can be effected: the images are moving point-charges. Attention is drawn to the inequality of the action and reaction in some of these cases, and the results are shown to be consistent with expressions obtained for the energy of the field.—On some phenomena connected with the combination of hydrogen and chlorine under the influence of light, by Mr. P. V. Bevan. When light of sufficient intensity acts on a mixture of hydrogen and chlorine in equal proportions the first effect observed is an increase in the volume of the mixture. This is shown to be due to a rise in temperature caused by the heat evolved in the formation of hydrochloric acid. It is also shown that the fall in temperature of the gas mixture to that of the surrounding medium accounts for the observed decrease in volume after light ceases to act on the mixture.

MANCHESTER.

Literary and Philosophical Society, November 12.—Mr. Charles Bailey, president, in the chair.—Mr. W. B. Faraday showed a stone adze, one of several similar implements which have been found, from time to time, near Leek. He suggested a comparison with the Eolithic stone implements which were recently shown to the Society by Mr. R. D. Darbyshire.—Dr. Charles H. Lees described the Hampson air-liquefying apparatus presented to the physical laboratories of the Owens College by Sir Henry E. Roscoe. After explaining the principle on which the action of the apparatus depends, and describing the experiments of Joule and Thomson which led to the discovery of that principle, Dr. Lees gave a *résumé* of the present state of knowledge of the properties of liquid air and of other bodies when cooled down to the temperature of liquid air.

PARIS.

Academy of Sciences, November 11.—M. Bouquet de la Grye in the chair.—Extract from a letter of M. Jansson, noting the successful results of the eclipse expedition at Cairo (see p. 62).—On a new method of manipulating liquefied gas in sealed tubes, by M. Henri Moissan. Since solid carbonic acid can now be readily obtained, experiments were made with various liquids as solvents to see what temperatures could be reached, the evaporation being increased by a current of dry air. Of the liquids tried, methyl and ethyl alcohols, methyl chloride, aldehyde, acetic ether and acetone, the last named proved to be the best, a temperature of $-98°$ C. being obtained by its means. If the current of dry air is previously cooled to $-80°$, the second mixture of acetone and carbon dioxide reaches $-110°$ C. Details are then given of the best method of storing pure gases in the liquid form in sealed tubes, and of the precautions necessary.—On the action of the metal ammoniums upon hydrogen sulphide, by M. Henri Moissan. At a temperature between $-75°$ and $-70°$ liquid sulphuretted hydrogen reacts upon lithium-ammonium, giving a sulphide of lithium-ammonia and free hydrogen. The molecule $(NH_4)_n$, if it is produced in this reaction, is not stable at this low temperature and splits up into ammonia and hydrogen. The reaction with calcium-ammonium is similar.—On the origin of the starch in the grain of wheat, by MM. P. P. Dehérain and C. Dupont.—On the absence of electric displacement during the movement of a mass of air in a magnetic field, by M. R. Blondlot. The experiments described were undertaken with a view of deciding between two opposed theories. It was found that in air there is no displacement; this is contrary to the theory of Hertz on the electrodynamics of bodies in motion, but is in agreement with the theory of H. A. Lorentz.—On rational differential equations, by M. Edmond Maillet.—On the number of roots common to several equations, by M. A. Davidoglou.—A new method for the study of microphonic currents, by M. A. Blondel. The amplitude of the oscillations is increased by a suitable resonator, and a bifilar oscillograph used giving deviations of several millimetres for one milliampere. A diagram of the curves obtained with the five vowels accompanies the paper.—On the formation of ozone, by M. A. Chassy. A given volume of oxygen was submitted in an ozoniser to a current of known intensity. It was found that the law of increase of ozone was the same whatever the intensity of the electric current. A feeble current always produced the same effect as an intense current, provided that it acted over a time sufficiently long, or that the flow of the gas was sufficiently slow.—The application to man of the regeneration of confined air by means of sodium peroxide, by MM. A. Desgrez and V. Balthazard. A description of the improvements in detail of an apparatus previously described.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 21.

ROYAL SOCIETY, at 4.30.—On Skin-currents. Part II. Observations on Cats: Dr. Waller, F.R.S.—The New Biological Test for Blood in relation to Zoological Classification: Dr. G. H. F. Nuttall.—On the Inheritance of the Mental Characteristics in Man: Prof. K. Pearson, F.R.S.—Observations on the Cerebral Cortex of the Ape (Preliminary Communication): A. S. F. Grünbaum and Prof. Sherrington, F.R.S.—On the Process of Hair Turning White: Prof. E. Metchinkoff, For.Mem.R.S.

LINNEAN SOCIETY, at 8.—Report on the Botanical Publications of the United Kingdom as a Part of the International Catalogue of Scientific Literature: B. Daydon Jackson.

CHEMICAL SOCIETY, at 8.—On the Oxidation of Sulphurous Acid to Dithionic Acid by Metallic Oxides: H. C. H. Carpenter.—Optically Active β-hydroxybutyric Acids: A. McKenzie.—On the Hydrochloride of Thiocarbamide: H. P. Stevens.—The Constituents of the Essential Oil of *Asarum Canadense*: F. B. Power and F. H. Lees.—Note on the Reduction of Trinitrobenzene and Trinitrotoluene with Hydrogen Sulphide: J. B. Cohen and H. D. Dakin.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presidential Address.

FRIDAY, NOVEMBER 22.

PHYSICAL SOCIETY, at 5.—(1) Multiple Transmission Fixed Arm Spectroscopes; (2) On the Measurement of Young's Modulus: Prof. W. Cassie.—Notes on Gas Thermometry, Part II.: Dr. P. Chappuis.

MONDAY, NOVEMBER 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.

SOCIETY OF ARTS, at 8.—Chemistry of Confectioners' Materials and Processes: William Jago.

INSTITUTE OF ACTUARIES, at 5.30.—The Case for Census Reform: G. H. Ryan.

TUESDAY, NOVEMBER 26.

ANTHROPOLOGICAL INSTITUTE, at 8.30.—Exhibition of Palæolithic Implements from Savernake: E. Willett.—Exhibition of "Totem" Stones, collected by the Hon. A. Herbert: N. W. Thomas.—Dwarf Flints from the Sand Mounds of Samthorpe: Rev. R. F. Gatty.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Train Resistance: John A. S. Aspinall.

WEDNESDAY, NOVEMBER 27.

SOCIETY OF ARTS, at 8.—Leather for Bookbinding: Dr. J. Gordon Parker.

THURSDAY, NOVEMBER 28.

ROYAL SOCIETY, at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.

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