THURSDAY, APRIL 13, 1911.

PROBLEMS OF SEXUAL AND ASEXUAL REPRODUCTION.

Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. By Prof. E. Korschelt and Prof. K. Heider. Erste und Zweite Auflage, Allgemeiner Theil, Vierte Lieferung. Erste Hälfte. Pp. 167–470. Price 7.50 marks. Zweite Hälfte. Pp. 471–896. Price 11 marks. (Jena: Gustav Fischer, 1910.)

EMBRYOLOGISTS who are already acquainted with the "Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere"—and what embryologist is not?—will welcome with delight the appearance of these further instalments of the "Allgemeiner Theil." No pains have been spared in the preparation of these two volumes, and authors and publishers alike are to be congratulated on their achievement.

In the first the student is introduced to the earliest important phase in the differentiation of the sexually produced individual organism—the formation of those "elementary organs" long since known as the layers of the germ. An admirably lucid account is given of the various types of "gastrulation," or endoderm formation, and this is followed by a description of the development of the mesoderm. The latter part of the treatise is devoted to the study of the peculiarities of these processes in certain special groups, Sponges, Arthropods, and Chordates (Cephalochorda and Urochorda).

It seems almost ungenerous to criticise where the general level of attainment is so high, but we confess that we should have liked to see the Vertebrates included in the last chapter—the method of closure of the blastopore, its relation to the chorda and neural plate are so similar in all these forms—and it is certainly a pity that no attempt has been made to deal with the derivation of the Amniote from the conditions found in Anamnia—a problem long the despair of embryologists, but now happily solved with the help of the Gymnophiona. And we might venture to remark perhaps that Fig. 154A, on p. 248, is incorrect in not exhibiting the bilateral structure of the egg, due to the formation of the gray-crescent on fertilisation. These, however, are matters that hardly mar the excellence of the book.

The second volume makes even more fascinating reading. One by one we are shown, in the groups of the animal kingdom, the details of the mechanism by which a new individual is produced from a bud, processes simple enough in some cases, but often presenting the most amazing complexities, which reach their acme in the Ascidians, while at the same time they defy—notably in Polyzoa and Ascidians again—the rules observed in sexual reproduction, and challenge the observer to frame any formula which will embrace the infinite variety of their behaviour.

But description is but the beginning of embryology, as of any other science, and the baffling problems presented by the germinal layers will assuredly only yield, if at all, to the experimental method. The results which that method has obtained must indeed form the starting point of any discussion, the basis of any theory of the part played by these "elementary organs" in development.

The old germ-layer hypotheses, which all more or less trace their lineage back to Haeckel's famous "Gastræa-Theorie," assume that the stage at which these sets of cells are segregated is of phylogenetic significance, reminiscent of some bygone ancestry, and that there is a general agreement not only in the way in which the layers originate, but also in the structures to which they eventually give rise, as is, of course, necessary for the hypothesis.

And though the authors of this treatise very properly define the germ-layers as the rudiments of definite body tissues in normal development, they are yet concerned to attempt some defence of a position which is no longer tenable.

Even in sexual reproduction there are too many refractory facts: thus, a two-layered condition is not necessarily a separation of endoderm from ectoderm (Placental Mammals, Cestodes, Phylactolæmata), the gut of Cœlenterates is formed in various ways, and so in Vertebrates the roof and floor of the archenteron play varying parts in the formation of that organ, while in those groups in which the egg segments according to the "spiral" type, it is by no means necessary that a cell or cell-group which has a definite place and time of origin in the cleavage system should invariably give rise to the same larval or embryonic part, though, it is true, this usually occurs. The cell 4*d*, for instance, is not always mesoblastic, and even when it does give rise to the mesoblastic bands the destiny of those structures may be variable. In Annelids, the cœlom is developed in them, in certain Mollusca they break up into connective tissue while the (cœlomic) pericardium has another (ectodermal) source.

These are only a few instances. When, however, we turn to the conduct of the layers in budding matters are infinitely worse. In Polyzoa the whole of the alimentary canal is of ectodermal origin; in Turbellarians nervous system and pharynx are mesodermal; in Annelids the pharynx is endodermal, all these organs being in sexual reproduction developed from the ectoderm. In Cephalodiscus the gut is ectodermal instead of being derived from the parental endoderm. In the Tunicata these anomalies attain the perfection of irregularity. The nervous system may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma*, Salps, Doliolidæ). The atrium may be ectodermal (Botryllidæ), endodermal (other Ascidians), or mesodermal (*Pyrosoma*, Salps), while the pharynx may be ectodermal (Botryllidæ, Doliolidæ), or endodermal (other Ascidians).

These facts, as the authors admit, nay insist, are indisputable, and absolutely irreconcilable with the requirements of the ordinary germ-layer theory.

An effort is indeed made to save the situation by minimising the discrepancies that occur in the course of sexual reproduction, and removing the facts of

budding to another category. The writers, in fact, suggest that the phenomena are not coordinate, and that there would have been no difficulty had not "prospective significance" been confounded with "prospective potentiality." That is, it is the peculiarity of a bud to contain sets of cells which have greater capacities than the embryonic layer from which they were derived in the other manner of development. And yet, when it becomes necessary, to find some general expression for the different modes of endoderm formation in Cœlenterates, to deduce them all from some common origin, the "prospective significance" is enlarged until it is big enough to include as much "potentiality" as may be required!

The truth is that the anomalies are of the same order in both kinds of reproduction. In both the germ-layers have greater potentialities than they normally display, and no theory of them can ever be satisfactory that does not offer a general explanation of their origin and differentiation, in the development of the ovum, in budding, and in regeneration.

To the phenomena of the last two kinds the test of experiment has, as yet, scarcely been applied, but we do fortunately know what the internal factors are on which the differentiation of these first-formed embryonic organs in the ovum depends. For experiment has shown us that there are in the cytoplasm of the unsegmented egg-cell certain substances—at least certain regions—the removal of which entails the absence in later development of some particular embryonic or larval structure. The position of these substances in the ovum need not be that in which the corresponding organ eventually appears (the apical sense organ of *Dentalium* depends on something present in the polar lobe of the egg), and the manner in which this heterogeneous cytoplasm is cut up into cells during cleavage is largely irrelevant, the cleavage pattern being alterable, and, further, determined by other, distinct, causes. Hence, though normally these organ-forming stuffs pass into definite cells, though in related forms the cleavage pattern is alike, but not identical, though in related forms the arrangement of the stuffs and the differentiation of the organs is alike but not identical, nevertheless variations in the cleavage unaccompanied by corresponding variations in the cytoplasmic structure (or the converse), necessarily lead to the production, in related forms, of the same organ from a cell which has in cleavage a distinct origin. The illustration applies primarily to "spiral" cleavages—the nephridia of Leeches comes from 4*d*, of Annelids from 2*d*, the pericardium of some Mollusca from ectoderm, of other Mollusca and of Annelids from mesoderm (4*d*), and so on—but, *mutatis mutandis*, may be easily extended to other cases.

In truth, the substances out of which genuinely homologous, that is, phylogenetically homogeneous organs are developed, must be themselves homologous. They exist in the egg antecedent to segmentation and gastrulation, and cannot be created by those processes, in which therefore we look in vain for any absolute criterion of homology.

What experiment has done for the developing ovum it will, we hope, before long accomplish also for the bud and the regenerating organism. Then, but not until then, shall we know what the internal factors of differentiation are in these cases also, and shall be able perhaps to show that the primary—eventually all—the phenomena of their "increase of structure" are determined by the same kind of material (ultimately physical and chemical constitution), as that on which they are dependent in sexual reproduction.

WEBSTER'S NEW INTERNATIONAL DICTIONARY.

Webster's New International Dictionary of the English Language. Based on the International Dictionary of 1890 *and* 1900. *Now completely revised in all Departments, including also a Gazetteer and other Appendices.* Edited by Dr. W. T. Harris and F. S. Allen. Pp. lxxx+2620. (London: G. Bell and Sons, Ltd.; Springfield, Mass, U.S.A.: G. and C. Merriam Company, 1911.) Price 2*l.* 13*s.* 6*d.* net.

THE origin of "Webster" dates from a notable period in the history of works of reference, the second half of the eighteenth century. Noah Webster, a teacher in the United States, entered upon his earliest work of compilation about the same time that "a society of gentlemen in Scotland" were producing the first edition of the *Encyclopaedia Britannica* in Edinburgh. His spelling book appeared in 1783; it doubtless contained the germ of his larger idea, though this was not developed for many years—the first edition of his dictionary only appeared in 1828. Apart from re-issues and supplements (and also, to judge from a warning in the prospectus, pirated editions), there have been two great revisions of the original work before the present one, namely, those of 1864 and 1890. Both in the method of presenting facts and in mechanical construction the "new" revision introduces changes so great as to justify the use of the epithet in every sense, and some of these changes are of much importance and interest to all who have been led by frequent use to formulate views on the right arrangement of works of reference.

In the first place, "Webster" is an "encyclopædic" dictionary, and in the present edition that quality has been not only sustained but brought into greater prominence. At one period in the history of the making of works of reference, strong criticism was directed against the encyclopædic type of dictionary, and on obvious grounds. It was held to be the function of a dictionary exclusively to state and account for, historically and philologically, the origin and meaning of each word, to attempt no disquisition as to its connotation, and to avoid any articulated arrangement of historical, scientific, or other information dependent upon any word as a "heading." This latter function was left to the encyclopædia exclusively. Proper names and place-names were ruled out on the same grounds. On the other hand, the encyclopædia did not trench upon the philological functions of the dictionary, nor even, to any

great extent, upon its explanatory function. But this doctrine gave a secondary place to the consideration of practical utility to the "ordinary reader," and (to put the case on no higher ground) ignored the dependence of the work of reference upon the ordinary reader for any commercial success. After all, commercial success connotes wide utility. The encyclopædic method in a dictionary offers the reader something more than the bare solution of his ignorance of the meaning of any word; it may offer him connotation (in limited doses) as well as denotation; it may assist him, as "Webster" does, by appropriate pictorial illustration.

The encyclopædic method ought not, on one hand, to be used to the exclusion of the philological and other "purer" functions of the dictionary. Nor does the new "Webster" appear to transgress this provision. On the other hand, it is obvious that encyclopædic information must be strictly limited by considerations of space, and this makes exceedingly difficult the judgment of how far it should be included at all. Therefore the following instances (by no means isolated) taken to suggest that the present editors have carried the encyclopædic principle too far, are offered with due diffidence. Under the heading "Geography," after the general definition, there follow the main divisions of the science—mathematical, physical, &c., with their scope explained—very properly. Under "Geology" the same arrangement is given, and the various branches—cosmical, stratigraphical, and the like—are referred to. Then follows:—

"Geology is of comparatively recent development. Its basis as a true science may be said to have been laid by James Hutton (1726–97). It was advanced by the investigations of William Smith (1769–1839), and notably by the teachings of Sir Charles Lyell (1797–1875)."

And so the notice ends. It is submitted that this information, thought it might have formed the introduction for a brief treatise, is, by itself, practically valueless. Take, again, the homely instance (picked at hazard) of the notice on "Football," which defines the difference between the various codes of the game so far as to indicate the allowance or exclusion of the use of the hands, but gives no hint of difference in methods of scoring, or in the numbers of players constituting sides. This is surely a partial, and therefore wrong, application of the encyclopædic method.

Every allowance ought to be made to the editors of a general work of reference in their endeavours to save space. It is therefore possible to condone the method, theoretically indefensible, by which each page of the new dictionary is made up in two parts. In the upper and larger, all words of more common use (within a very wide range) are given in triple-column arrangement. In the lower, obsolete and local words, equivalents, alternatives, uncommon compounds, and the like, calling for only slight reference, are given in an arrangement of six columns of painfully small type. An excellent feature is the printing of an easy reference to the signs used to indicate pronunciation, at the foot of every page. In planning these signs, such eccentricities as inverted letters have been happily avoided.

The illustrations do not reach the mechanical standard of other departments of the book. The coloured plates at the beginning, showing arms and flags of various nations, are indifferent, both in drawing and (at any rate in the impression before us) in colour-register, while many of the cuts illustrating the text are of somewhat archaic cast. A large selection of the latter are repeated at the end of the volume under a series of general headings, such as agriculture, anatomy, antiquities, and the like. The utility of this is not obvious; the classification reveals a certain degree of partiality, and the cuts, crowded together *en masse*, look frankly ugly.

The encyclopædic method has been held to justify, and with reason, the inclusion of a gazetteer and a biographical dictionary among the appendices. The names in these appear to have been methodically chosen. As this feature has been retained from the former issue, we do not entirely follow the editorial judgment in including scriptural, classic, and other proper names, characters of fiction, and the like, in the body of the dictionary. Such arrangement may tend to confusion on the part of the user of the book. On the other hand, he will be the more ready to excuse any difficulty in this direction in consideration of the ease with which any desired letter or section of the work may be found, for the makers have retained the familiar and excellent system of indicating sections by marked indentations in the margin of the pages, so that the closed volume may be opened at any desired place. Finally, it may be said that though the additions to the matter of the work as a whole are so numerous as to have more than doubled the number of entries in the previous edition, and to have added several hundred pages, the bulk of the volume is not seriously increased. Such criticisms as have been offered above are recognised to be mostly upon debatable ground, and it is freely admitted that the new edition does nothing to mar, and much to add to, the established reputation of "Webster."

O. J. R. H.

GLAUCOMA AND ITS CAUSE.

Glaucoma. By Dr. Thomas Henderson. Pp. xv+222. (London: Edward Arnold, 1910.) Price 10*s.* 6*d.* net.

GLAUCOMA is that condition of the eyeball in which the intraocular tension, normally greater than the superincumbent atmospheric pressure by about 20–25 mm. Hg., is pathologically still further increased so as to produce various deleterious results. It has hitherto been generally held that variations in the intraocular pressure are produced by changes in the amount of the fluid contents of the globe; that alterations in the quantity of blood may be considered negligible in this respect; and that such variations as occur affect the lymph of the eye. The lymph is thought to be secreted by the ciliary processes, and to be excreted through the so-called "filtration" angle of the anterior chamber into the venous plexus which goes by the name of the canal of Schlemm. On

this theory the intraocular tension will vary with the relationship of secretion to excretion of lymph. It is clearly a postulate of the theory that some alteration in the volume of the globe occurs under differing internal pressures, though the necessary amount may be so slight as almost to escape the ordinary crude methods of experimental analysis.

Dr. Henderson propounds a theory which is merely the application of the Monro-Kellie doctrine of intracranial pressure to the eye. This theory of intracranial pressure has been proved substantially true by the researches of Mr. Leonard Hill, and Dr. Henderson, postulating the constancy of volume of the eyeball under all pressures, physiological and pathological, embarks upon a bold attempt to make all the arguments fit in the case of the eye. He holds that in the normal eye the total volume is constant, the circulatory system is elastic, and that diffusion takes place between the contained fluids and the return (venous) circulation. Hence the intraocular pressure is equal to the venous pressure of the elastic system. In glaucoma the total volume is fixed, and there is an absence of diffusion between the contained fluids and the return circulation. Hence the fluid and incompressible contents act as a rigid volume, converting the elastic circulatory system into a rigid one. The outflow pressure of a rigid system is always higher than that of a similar elastic system of tubes. Therefore the intraocular pressure is raised, as the lowest circulatory pressure is that of a rigid, not an elastic system. The starting point of the process in glaucoma is held to be sclerosis of the cribriform or pectinate ligament, whereby the diffusion of the aqueous into Schlemm's canal is hindered. The explanation of the success of iridectomy as a cure for the disease is founded upon the fact that wounds of the healthy iris stroma do not cicatrise in the ordinary manner of connective tissues. The aqueous is thus brought into more intimate contact with the iris veins, and is enabled to drain away.

It will be realised from this brief account that the theory is revolutionary in its relation to certain hitherto accepted facts. In some such instances the author has audaciously thrown over the facts. The most striking example of this procedure concerns the anatomy of the ciliary circulation. No one has previously questioned Leber's brilliant researches on the circulation of the eye. Dr. Henderson, from an exhaustive examination of serial sections, asserts that the circulus arteriosus iridis major is not an artery but a vein. Adopting the teleological argument that there is no rhyme or reason for such an abundant arterial supply to so insignificant a structure as the iris, it is an easy step to transform arteries into veins for the benefit of the theory. We do not consider that the examination of serial sections can possibly prove the point conclusively, unless the blood-vessels have been previously injected, as was done in Leber's researches. It may be hoped that Dr. Henderson or others will adopt this more conclusive test.

Dr. Henderson's fundamental postulate, that of the constancy of volume of the eyeball under physiological and pathological pressures, cannot be accepted without reserve. The walls of the eye, though rigid, cannot be regarded as rigid in the same sense as the walls of the cranium. There is experimental evidence to the contrary, notably that afforded by the researches of Koster Gzn. Further, there is positive evidence of vasomotor changes in the intraocular blood-vessels, a fact which militates against the theory.

Moreover, if the intraocular pressure is purely a question of transmitted hydrostatic pressure in the sense of the term as used by Dr. Henderson, why does the pressure fall slowly and gradually when the eyeball is excised? This and other questions will have to be answered satisfactorily before the theory can be adopted. There is no doubt, however, that the author has elaborated an important element of the problem. His work should be read by all physiologists and ophthalmologists, and cannot but prove to be stimulating to thought, and, it may be hoped, to further experimental research.

EXPERIMENTAL THERAPEUTICS.

Einführung in die experimentelle Therapie. By Prof. M. Jacoby. Pp. vii + 180. (Berlin: J. Springer, 1910.) Price 5 marks.

UNTIL the middle of last century therapeutics was a purely clinical study, the physician treating his patients on purely empirical grounds and without any clearly conceived idea of how his measures affected the course of the disease. About fifty years ago the experimental study of the action of drugs was taken up by a number of investigators, and the school of experimental pharmacology succeeded to the ancient study of materia medica. The benefits accruing to medicine from this school are recognised by all who have followed the course of therapeutics in the last half-century; but its members in some degree have stood aloof from the great movement which, beginning with the discovery of pathogenic organisms, has progressed to the discovery of their antidotes in the antitoxins, and to the treatment of disease by these last. The workers on therapeutics who have approached the subject from the bacteriological laboratory have accordingly assumed a new and distinct title for it—experimental therapeutics—and show a tendency to broaden its borders to include such work as that which has culminated in Ehrlich's discovery of the new antisyphilitic specific. Yet the methods followed by Ehrlich are exactly similar in essentials to those of Schmiedeberg or von Mering in their researches on hypnotics; and the fact that the former was seeking a remedy to act on the treponema in the tissues, and the others for a remedy for the over-excited nerve cell, does not seem to justify their subjects being classed under different headings.

The book before us seeks to give a bird's-eye view of the position of the subjects in therapeutics which have recently been investigated experimentally. Beginning with some examples of pharmacological antagonism, the author leads us through the development of the therapeutics of the internal secretions (*Substitutionstherapie*) to the experimental investigations on antiparisiticides; under this he groups the treatment with vaccines, antitoxins, and Ehrlich's

new arsenic compounds. Short chapters are devoted to the therapeutics of tumours, inflammation, blood-diseases, gout, fever, and disturbances of the circulation and digestion so far as these have been determined by experimental methods. It is, of course, impossible to treat this extensive programme exhaustively in 174 pages, and the author seems rather to have aimed at giving a general idea of what is being done to advance therapeutics experimentally with the object of arousing the interest of the students and younger practitioners of medicine in the subject. The book seems well fitted to attain this object, for it is written in an easy style, and deals with some of the most interesting topics in medicine at the present time. On the other hand, the chapters are very unequally written. In some instances pages are devoted to detailed description of surgical methods (pp. 34–36) or of individual experiments, which seem out of place in an introductory handbook, while other subjects are treated too briefly for anyone to follow except the expert; and there is very little attempt made to differentiate the fundamental experiment from the less important or less generally accepted result.

The author tends too often to leave the solid ground for speculations which are often based on experiments which, to say the least, have not yet received general assent. In a book primarily designed for German medical students, perhaps it is right to direct their attention chiefly to authors of their own nationality whose works they can read, but we cannot help thinking that some of the chapters would have been improved by wider reading. For example, the chapter on vaccines might have been rendered more intelligible and also more up-to-date.

The book is not free from serious errors; for example, where (p. 11) it is stated that Hunt found alcohol protects mice against the nitriles; and the antidotal effect of sodium sulphate in barium poisoning is surely due to the barium being precipitated, and not to the restoration of the sodium, as the author supposes (p. 13).

PROJECTIVE GEOMETRY.

Projective Geometry. By Prof. O. Veblen and Prof. J. W. Young. Vol. i. Pp. x+342. (Boston and London: Ginn and Co., 1910.) Price 15*s*. net.

IN the first page of their introduction the authors say:

"The starting-point of any strictly logical treatment of geometry must be a set of undefined elements and relations, and a set of unproved propositions involving them; and from these all other propositions (theorems) are to be derived by the methods of formal logic."

Here, in a nutshell, is the modern mathematician's creed; and it is significant that it should thus appear in a treatise on projective geometry, which at first sight would seem to be one of the most intuitive of the branches of mathematics.

In accordance with the above dictum, the authors give a brief discussion of the axioms of geometry so far as they are required for the purposes of this volume, rightly, we think, deferring the more complete theory of order and continuity to a later stage. Enough, however, is done to make the reader aware of the numerous tacit, and often complex, assumptions made in the ordinary treatment of the subject. For instance, we have an explicit statement of the fundamental postulate:

"If A, B, C are points not all in a line, and D, E are distinct points such that (B, C, D), (C, E, A) are respectively collinear, then there is a point F such that (A, B, F) and (D, E, F) are respectively collinear."

With the help of this and a few other assumptions, a plane is defined in such a way that it can be *proved* that if A, B are any two points in a plane, every point of the line AB is in the plane. No one can fail to see that this is an improvement on the Euclidean definition of a plane, which is a question-begging assumption, based no doubt on the practical tests applied by masons and carpenters.

After this the reader is introduced to the fundamental operations of projection and section, and to the principle of duality. The latter is very properly stated, at the outset, with reference to three-dimensional space: that is, point and plane are correlative terms, not point and line. It is easy enough to deduce the special laws of duality for two-dimensional fields; and the more general form of statement at once brings home to the student the fact that, as a rule, the propositions of projective geometry arrange themselves in sets of four, only one of which need be formally proved. For instance, Pascal's theorem for a conic in a plane leads at once to Brianchon's theorem, and two corresponding theorems for a quadric cone.

Even yet it may be asserted that von Staudt is the great master of projective geometry, much as Gauss is the incomparable arithmetician. It is one of the great merits of this work that the influence of von Staudt's work is so apparent in it. For instance, involution is treated at a comparatively early stage; and this is important for several reasons. In the first place, it simplifies the proofs of many fundamental properties of conics; in the second, it shows the existence of a polar system, in a plane or in space, apart from the assumption of a quadric curve or surface defining it. Ultimately, of course, the best definition of a conic or quadric surface is that it is the locus of self-corresponding points in a polar system. This, with Staudt's theory of imaginary (or complex) elements, permits of the inclusion of "imaginary" conics and quadrics as actually existing things. It is to be hoped that the second volume will contain a sufficient account of Staudt's beautiful theory, which, as a rule, seems to be very imperfectly apprehended. As he unfolds it in the supplements to his "Geometrie der Lage," it is purely geometrical, though no doubt he was led to it by analysis—at least, this seems the most probable assumption.

Among the interesting points of the present volume there is a brief account of Staudt's theory of "throws" (*Würfe*), and his constructions for addition and multiplication. In the latter there is a slight modification, arising from a change in the order of deduction. What is here shown is that if we take any three points

on a line and provisionally label them P(0), P(1), (∞), and if P(x), P(y) are provisional labels of any other two points, then there are projective constructions defining P($x+y$) and P(xy), such that the laws for adding and multiplying labels obey the ordinary laws of algebra, *e.g.* P($x+y$)=P($y+x$), including the limiting cases when x or y, or both, have one of the special values 0, 1, ∞. Hence it follows that from the base points P (0, 1, ∞) we can construct a *rational scale* of points P(r), where r is any rational, positive or negative number. It may be added that these are the only points on the line which can be reached from the base-points by projective constructions, and it would be a good exercise for the student to prove what is not absolutely demonstrated in the book, that this deduction is free from ambiguity; for instance, suppose P(x), P(y), P($x+y$) have each been deduced from the base-points by a chain of projective construction, it is required to prove that *the same point*, P($x+y$), is derivable from P(x) and P(y) by the single operation of addition.

The net result of these considerations may be put (among other ways) in the following form. Suppose we have a tetrahedral frame of lines with a point given on each line distinct from the two vertices of the tetrahedron which it contains. Then on each of the six lines we can construct a rational scale, and hence, by projective constructions alone, arrive at all points which can be defined by four rational homogeneous coordinates. This rational projective space is not continuous: to fill up the lacuna, it will be necessary to assume the existence of one linear continuum of points, and apparently this will be also sufficient.

Staudt, on the other hand, gives his constructions as the definitions of the addition and multiplication of throws; and because the laws of algebra are satisfied, he deduces the possibility of assigning numerical values to throws. On the whole, Staudt's procedure seems the more scientific, but it is not a matter of much importance.

A propos of involutions, attention may be directed to the proposition on p. 223: "Any projectivity in a one-dimensional form may be obtained as the product of two involutions." This is very interesting, because it shows that although involution is, in the first instance, a derivative idea (as a special case of projective correspondence) it may ultimately be regarded as elementary.

To indicate how far this volume proceeds, it will be sufficient to say that chapter x. deals with pairs and pencils of conics in a plane, and gives the typical algebraic forms according to the elementary divisors of the discriminant; while the next, and final, chapter is on families of lines, and treats briefly of ruled quadrics, line coordinates, and linear congruences and complexes. It might, by the way, interest applied mathematicians to point out that if we suppose a unit force acting along a given line, the six homogeneous coordinates of the line may be taken to be proportional to the moments of the force about the edges of the tetrahedron of reference.

G. B. M.

THE NEW PSYCHOLOGY.

Manual of Mental and Physical Tests: a Book of Directions compiled with special Reference to the Experimental Study of School Children in the Laboratory or Class-room. By Prof. G. M. Whipple. Pp. xix+534. (Baltimore, U.S.A.: Warwick and York, inc., 1910.)

IS psychology to rank among the exact sciences? This is the question which is at once raised when we look into Prof. Whipple's volume. We are reminded of Kant's famous pronouncement that psychology never could be a science, because it was impossible either to apply mathematics to its problems or to perform experiments upon the minds of others. Kant's dictum is a classical instance of the danger of prophesying the impossible. In the book before us the mathematical treatment of mental measurements is discussed in the third chapter, and the rest of the volume is made up of more or less happily devised experiments upon the minds and bodies of other people.

Yet nobody knows better than the author himself how relatively slight actual accomplishment has been. The contrast between the position of the psychologist and that of the doctor, for example, is very great. An insurance company will decide quite serious financial questions on the report of a medical man whose tests give sufficiently good *average* results for their purpose. But the psychologist has not yet achieved a position of such confidence. He deals with far subtler problems, and it is no fault of his that we have not yet begun to consult him on the future of our children. He frankly confesses that he is not ready to render such positive service; and whilst on one hand we may fairly congratulate ourselves on the fact that a serious attempt is being made to arrive at a better understanding of mental phenomena, it would, on the other hand, in Dr. Whipple's words, be wrong to speak

"as if a science of mental tests had already been achieved. . . . To make such an assertion is surely misleading, for . . . there is, at the present time, scarcely a single mental list that can be applied unequivocally as a pyschical measuring-rod."

There is no general agreement about procedure, and in many cases psychologists do not know exactly what it is they are measuring, such is the "astounding complexity, variety, and delicacy of form of our psychical nature."

It would, nevertheless, ill become professional students of the older sciences to speak in contemptuous terms of a younger brother who is so conscious of his own shortcomings. Psychology may have long to wait for its Newton, but in the meantime the effort to collect facts in a scientific way should surely meet with every possible encouragement. The "man in the street" has long recognised the existence of differences in the mental characteristics of his friends. He accepts them in much the same spirit as folk regarded the weather, until the meteorologist began that painstaking collection of data which is just beginning to bear scientific fruit. We have more words to describe these personal differences than we have for

the discussion of weather variations, but popular analyses are proverbially unsound, and the psychologist has in recent years attacked this problem of individual differences with vigour, ingenuity, and insight.

It is as presenting a survey of work in this direction that Prof. Whipple's book is to be regarded. Hitherto nothing of the kind has been available, and the author has rendered a capital service to English workers in this field by compiling from widely extended sources such mental tests as have been used with more or less success in the study of children. The tests are arranged in the order of the simplicity of the psychical processes involved. Beginning with those which concern physical and motor capacity, they pass through those which measure the various forms of sensory acuity, to others which deal with attention, memory, suggestibility, and close with the Binet-Simon tests of intellectual development. Each test is accompanied by a critical survey of work already done in regard to it, and an exhaustive bibliography. As a mere index to the literature of this branch of psychology, the book is of the greatest value. J. A. GREEN.

CULTIVATION OF THE LAND.

To Work a Grass Holding at a Living Profit, and the Cheap Cottage Problem. By H. B. M. Buchanan. Pp. vi+102. (London: Constable and Co., Ltd., 1910.) Price 1*s.* net.

FEW movements of recent years have attracted greater interest than the migration from town to country that now plays so large a part in the life of the village community. Not only does the well-to-do man live further out into the country, but the humbler town-dweller is being enticed out; and the agricultural labourer, instead of drifting off unheeded to the town, finds all sorts of inducements held out to him to remain where he is. Small holdings are one of the most important developments of this movement, and they are encouraged with the twofold object of getting more produce out of the land and of bringing up the next generation in the country rather than in the unhealthier conditions of the town. It is arguable that the small holding is, *per se*, uneconomical, since the small holder cannot have the intelligence of the good farmer, or he would long ago have become a large holder; but there can be no difference of opinion as to the desirability of raising the next generation in the country. This social aspect of the question has to be kept in view in dealing with the rather bulky literature that has grown up on the subject.

Mr. Buchanan has taken an honourable part in fostering the new movement. He has studied small holdings from within, having made some on his own estate and carefully watched their development. Two classes of small holders he considers are likely to succeed: experienced people who supplement the profits of the holding by outside employment; and colonies working on cooperative lines directed by skilled supervision. The basis of their work must be the cultivation of the land; they are not likely to succeed in raising poultry, geese, cows, &c., on purchased food, however profitable the expert may find the business. And the weak link in all our cultivation is, in Mr. Buchanan's view, the management of our grass land. To this problem, therefore, he devotes a considerable amount of attention.

Grass presents a more difficult set of problems than any other crop. It is left down permanently; seeds of all kinds blow on to the ground, and may, if they can, germinate and grow, and finally oust some of the grass previously there. There is, in fact, a constant competition for existence among the various plants, and, in general, the poorer the soil, the larger the number of plants present. Artificial manuring, mowing, grazing, and grazing supplemented by concentrated foodstuffs, all modify the conditions obtaining, and favour some species that develop to the exclusion of others. The farmer's problem is to adopt those methods of treatment that shall in the shortest time and at the least cost enable the species he wants to crowd out those he does not want. In a certain empirical way, methods are known that will more or less do this, and Mr. Buchanan sets them out clearly and concisely.

The cheap cottage problem is intimately bound up with the small holding movement. The very large landowner may be prepared to put up cottages and let them at a rent that brings in little or no interest on the outlay, but Mr. Buchanan does not think these "charity cottages," as he calls them, will solve the problem. He gives plans and specifications of cottages at 500*l.* the pair that are suitable and comfortable, but as the rent has to be 4*s.* 6*d.* a week to make the outlay profitable, he arranges that a garden and pigsty can be included, the profits of which shall pay the rent. Suitable hints are given to the cultivator, and also to the owner of the estate.

The book will be found very interesting and suggestive not only to those concerned in small holdings, but also to the cultivator and to those engaged in agricultural education work E. J. R.

NEW BOOKS ON CHEMISTRY.

(1) *Introduction to Practical Organic Chemistry, including Qualitative and Quantitative Analysis and Preparations.* By Dr. A. M. Kellas. Pp. viii+204. (London: H. Frowde and Hodder and Stoughton, 1910.) Price 3*s.* 6*d.* net.

(2) *New Reduction Methods in Volumetric Analysis.* A Monograph. By Prof. E. Knecht and Eva Hibbert. Pp. x+108. (London: Longmans, Green, and Co., 1910.) Price 3*s.* net.

(3) *Introduction to General Chemistry.* By Prof. J. T. Stoddard. Pp. xviii+432. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* net.

(1) THE "Introduction to Practical Organic Chemistry" is divided into six sections. The first section deals with qualitative tests, the second with general laboratory operations; the third with preparations, the fourth and fifth with the analysis of specific compounds, and the sixth with ultimate organic analysis and molecular weight determinations.

Though the book contains very little that is original either in matter or arrangement (unless in its special adaptation to the syllabuses of certain examining bodies), there is, on the other hand, nothing which calls for adverse criticism. The laboratory operations are such as have appeared in half a dozen books on the subject. They are clearly and fully described and illustrated. There is also a useful appendix containing details of practical work presented for the preliminary science examination, part ii., of London University. We should be very sorry to follow the author in advising students wishing to carry the subject further to make an extended study of Lassar-Cohn's "Arbeitsmethoden" or Meyer's "Konstitutionsermittelung," both of them ponderous and useful, but incomparably dull and formidable, books of reference. Apart from this the book may be safely recommended to all students of practical organic chemistry.

(2) Dr. Knecht has collected in the form of a small monograph his various papers on the use of titanous chloride as a volumetric reagent. His method is so well known among analysts, and especially colour chemists, as to require no description, and its value has been fully recognised. The present volume should serve to extend its use by bringing it to the notice of a larger public, and by emphasising its remarkably wide application. Titanous salts, it may be added, are readily procurable, so that there is no obstacle in the way of their employment.

(3) "C'est le premier pas qui coute" is probably truer of text-books of chemistry than of other sciences. It is because authors will assume that chemistry is an exact science and that its principles are capable of precise definition that the opening chapters are frequently so unsatisfactory. To begin with definitions and generalisations is to court contradictions and inconsistencies at every turn. Here we have a volume by an obviously thoughtful and careful writer who attempts to define chemical and physical change. "These [physical] properties are always the same in all specimens of the same substance, whatever its source, when they are examined under the same condition," yet a few paragraphs further on we are told that the same metal may occur in a bright metallic or dull pulverulent form. Again, whilst cautiously stating that every *definite* chemical compound always contains the same elements in the proportion by weight, he says nothing about *indefinite* compounds, and adds rather recklessly that "with this constancy of composition goes a similar constancy in all of the properties which characterise the compound."

When the author has safely extricated himself from the rocks and shoals of his introductory chapters, he gets into smooth water, and the remainder of the book is plain sailing. We presume that "the first year's course" mentioned in the preface has reference to the college student; for it is certainly not a book for a beginner. The absence of all diagrams and experimental details and the use of technical terms without explanation would soon lead him into a labyrinth of difficulties.

J. B. C.

OUR BOOK SHELF.

British Ferns and their Varieties. By C. T. Druery. Pp. xi+458. (London: G. Routledge and Sons, Ltd.; New York: E. P. Dutton and Co., n.d.) Price 7*s.* 6*d.* net.

THE author of this book, who is well known as an enthusiast in the study and cultivation of British ferns, has succeeded in producing a work very useful to all fern-lovers. Hitherto it has been a matter of great difficulty for anyone to discover what name has been applied to a given form of any British fern, unless he has had access to some standard collection for comparison. This difficulty will now be greatly reduced by reference to the illustrations in this book, which consist of 40 coloured plates, 96 nature prints, and 819 others.

The first sixty pages are devoted to general considerations, such as the life-history of ferns, culture (including hybridisation), types of variation, and fern foes. The attempt to write these introductory chapters in popular language has, as is usual in such cases, resulted in some words being used in a sense differing from that in which they are applied in scientific works. For instance, on p. 15 the oosphere is referred to as "the incipient seed," and the antherozoids are stated to be "truly vegetative"; and on p. 27 the young plants are by preference termed "seedlings."

The remainder of the book contains detailed accounts of the British species, with short notes on their varieties and forms. The nomenclature usually adopted in British books has been retained on the ground that this work is intended "rather for the practical amateur than for the scientific botanist"; it is to be regretted, however, that synonyms are almost entirely omitted, even in the case of such a familiar one as *Nephrodium filix-mas*. The mixture of Latin and English names printed in the same type leaves one in doubt as to whether the final word forms part of the plant-name or is that of its describer or raiser, *e.g.* "*Pteris aquilina crispa cristata Druery*" (p. 221); in the case of *Polystichum pulcherrimum* (p. 211), these names are said to refer to the finder.

The wonderful variation in our native ferns is strikingly brought out in this book, which should stimulate many to become students of this very interesting group of plants, and to assist in solving the problems connected with variation.

C. H. W.

Motor Car Hill-Climbing Chart. To Show the Speed at which a given Motor Car can Climb any given Hill—to Show also the Gear upon which it can do so—and the Engine Speed in Revolutions per Minute. (London: Edward Stanford, n.d.) Price 1*s.* 6*d.* net.

THE "Motor Car Hill-Climbing Chart" consists of a card 5½ by 3½ inches, on the face of which there is a sliding card. The sliding card has a square hole in it covered by a transparent sheet. On this is drawn a brown curve representing the resistance due to average road and wind resistances at different speeds. Through the window three other curves, the forms of which have been determined by experiment, may be seen. These are of different colours, and are adapted to suit one each of the three gears. The sliding card can be set by means of a scale to a position corresponding to any gradient up or down. Then the intersection of the brown curve with one or other of the other curves shows which gear should be used, what speed the car should go, and the r.p.m. of the engine when the car is in good order. If the curves have been produced by experiment with the particular car, no doubt useful results will be obtained, and that most conveniently, but until all cars are alike it is difficult to see what use it will be on somebody else's car.

The Gyroscope: An Experimental Study. From Spinning-Top to Mono-Rail. By V. E. Johnson. Pp. 52. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1911.) Price 1s. 6d. net.

THIS is an admirable little book suitable from every point of view as a present for a boy with a mechanical turn of mind. As the extended title indicates, the properties of the gyroscope are illustrated by a series of experiments, always with a view to its application to a mono rail car. The reader is expected to be able to drill holes in metal and tap threads in them and perform simple constructional operations. He is thus encouraged to prepare his own apparatus and make each experiment as he goes along.

The originality of some of the experiments and the conclusions to be drawn from them, the home-made gyroscope, with the flywheel of a sewing machine as centre feature, and the general scheme of the book are all excellent, and any boy who works through the examples will find himself imperceptibly acquiring the gyroscopic sense, and he will greatly enjoy the process. One of the later devices illustrated is an electrically-driven monorail and gyrostat, for further details of which the reader is referred to the number of *The Model Engineer* in which it was first described. No doubt this is the apparatus that was shown at work at the last exhibition organised by *The Model Engineer*. C. V. B.

Simple Lessons in Nature Study. By J. O'Neill. Pp. 122. (London: Blackie and Son, Ltd., n.d.) Price 1s. net.

THIS book comprises about twenty-five lessons on plant characters and ten referring to animals; buds, the work of leaves, the dandelion, birds, the hedgehog, talks on tadpoles, are a few of the subjects discussed. It has been prepared for the use of teachers; as such it has no obvious merit, because it cannot be said to present simple facts and natural inferences in any new light, nor does it penetrate sufficiently deeply into the subject to impart the knowledge required for teaching.

Aphorisms and Reflections from the Works of T. H. Huxley. Selected by Henrietta A. Huxley. Pp. 86. (London: Watts and Co., 1911.) Price 6d.

MESSRS. WATTS AND CO. have issued these aphorisms and reflections of Huxley for the Rationalist Press Association, Ltd., by permission of Messrs. Macmillan and Co., Ltd. The price at which the book is now obtainable will, it is to be hoped, make Huxley's clear thinking and lucid expression known to a new circle of readers and send many of them to the complete works from which the apothegms are selected.

The Flight of Birds. By Giovanni A. Borelli. Pp. x+40. (London: For the Aëronautical Society of Great Britain by King, Sell, and Olding, Ltd., 1911.) Price 1s. net.

WE have here a translation of the section called "De Volatu" in the first volume of Borelli's "De Motu Animalium," first published in Rome in 1680–81. This is the first time this part of the seventeenth-century classic has been translated into English. The booklet will make an appeal to all who are interested in the conquest of the air.

Life Histories of Familiar Plants. By John J. Ward. Pp. xx+204. (London: Cassell & Co., Ltd., 1911.) Price 3s. 6d.

THIS popular edition of a book which appeared in 1908 should prove of service to teachers of nature-study and field botany. The first edition was reviewed in these columns on May 20, 1909 (vol. lxxx., p. 344), and the present issue remains unchanged.

LETTERS TO THE EDITOR.

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

The Fox and the Fleas.

THE belief that the fox rids himself of fleas by the device to which Prof. Hughes has directed attention in NATURE is a long-established one. This is shown by the following passage from Allan Ramsay's "Gentle Shepherd," which appeared in the year 1725:—

> "As fast as flaes skip to the tate o' woo,
> Whilk slee tod lowrie hauds without his mow,
> When he to drown them and his hips to cool,
> In summer days slides backwards in a pool."

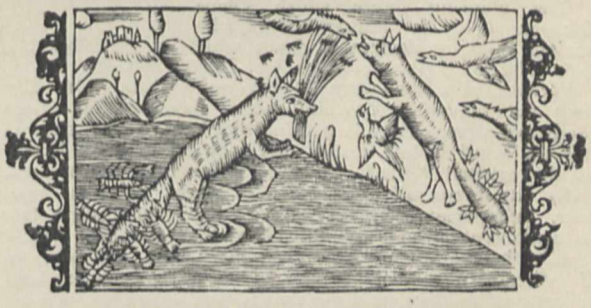
The language is the variety of English which prevailed, and of course still prevails, in North Britain. "Tate o' woo" means tuft of wool, "slee tod lowrie" means the sly fox, and "hauds without his mow," holds outside his mouth. A. N. MELDRUM.

Hamilton, N.B., April 10.

REFERRING to the letter of Prof. McKenny Hughes on the fox and the fleas, in NATURE of March 23, may I be allowed to say that I heard exactly the same story, several times over, in my youth, which means about fifty years ago? I must confess that I thought it had originated somewhere in Gascony, the home of Cyrano of Bergerac. It seems now to turn out to be true. If really authenticated, as Mr. T. Day appears to suppose it, it would be worth while to make its exact authentication known, as it may be looked upon as a most prominent proof of reasoning on the part of an animal.

Paris, March 24. T. S. GREY.

MANY years ago a few friends were chatting in Kirkby Lonsdale Vicarage, and one of us remarked that almost everybody had within his own knowledge some story that he could not expect his friends to believe. The vicar (Henry Ware, afterwards Bishop of Barrow) told us his story. He was coming out of the vicarage with Archdeacon Evans and the parish clerk, when they saw in the lime avenue in front of them a chaffinch fluttering up and down with the tip of its wing attached to one of the long pendulous twigs of a lime tree. The clerk got steps and a hook or something by which he pulled it down, and they found that the bird's wing was stuck, as they thought, by the honey dew to the leaf, while the play of the twig never let it get sufficient lateral pull to disengage it.



De dolofo ingenio Vulpium.

My story was that, when I was a boy, walking home along the banks of the Bawddwr, which was then frozen over, I saw a trout through the clear ice and took a shot at it with a stone. The stone made a small hole in the ice, through which the trout jumped out. I thought that the pressure on the ice due to the impact caused an uprush of water, which caught the trout as he darted away and carried him out head first.

It may not have been altogether the honey dew that stuck the bird's wing to the leaf, and the mechanics of my trout's leap may be better explained, but the stories are true.

So in the often repeated and much discussed story of

the sea-serpent: whether we refer what was seen to long lines of ducks now dropping out of sight in the trough of the wave, now rising in thick coil over its crest; or to water-logged baulks of timber with seaweed hanging like a mane about the ends, which were protruded or submerged with the rise and fall of the waves; or whether we accept Günther's explanation of the best authenticated case on record, which he described as a sperm whale attacked by an octopus, the dimensions of which he calculated from known examples; we admit the stories and discuss only the explanations, which in these last cited cases must differ so much.

So for Mr. Day's story of the fox and the fleas; we may examine it from several points of view. If it is a true natural history story it is extremely improbable that Mr. Day's was the first and only recorded fox who showed this instinct, or, as Samuel Butler would call it, "memory"; and, thanks to many friends, I can give more or less clear references to previous observations of the same kind. Mr. Nichols tells me that he has heard it mentioned as a story current among Celtic people—likely enough, as they are chiefly pastoral and close observers of natural phenomena. Mr. Grey in his letter, which by your courtesy I have seen, thinks he remembers it as belonging to Gascony. But the most important contribution to the discussion, so far, is a reference sent by my friend and pupil Mr. Frank Barclay, which I have verified in the university library.

Olaus Magnus, writing in 1555, says:—

"Praeterea cùm pulices habet, fasciculum mollis foeni ore accipit pilis involutum, seque paulatim posterius inchoando in aquam mergit, ac totum corpus, ut pulices aquam fugientes, ad caput ascendant. Deinde caput immergit, ut in foenum fugiant; quo facto, foenum relinquit in aqua, et mox enatat."

Besides, when he has fleas he takes in his mouth a bundle of soft hay rolled up in hair, and gradually immerses himself in the water back end first, and then his whole body, so that the fleas, trying to escape from the water, may creep up to his head. Then he draws his head under water that the fleas may be driven to take refuge in the hay, and when this has been done he lets the hay go in the water, and forthwith swims out.

The amusing figure which Olaus Magnus gives in illustration of the various cunning devices of foxes which he describes has been admirably reproduced by Mr. Edwin Wilson.

Foenum pilis involutum is not quite clear. Mr. Day does not remember anything about hay, and in Olaus Magnus's picture there is nothing like hair or wool shown; but the word is late Latin, and may be used as loosely as the modern "pile," which is either hair or the soft, fluffy nap taken off the surface of cloth. That is, however, unimportant. But I was given an interesting fact in corroboration of the probability that the fleas would readily betake themselves to wool. Miss Parsons, of Horseheath, a shrewd observer of natural phenomena and collector of folklore, told me that it was a common opinion among farm people that if poultry and poultry houses were infested by fleas the best way to get rid of them was to drive a flock of sheep among them, as every flea would take to the wool.

There is another point to be considered—I do not know that a fox is an animal much troubled by fleas. It may be that the curious procedure on the part of Mr. Day's fox was not a thing of common occurrence, but only when the animal had the misfortune to be suddenly attacked by an abnormal number; for great swarms of fleas do suddenly appear, not only on certain individuals or groups of animals, but on walls and wooden partitions. Some of your readers will remember the story of Dr. Michael Foster's dog and the fleas, which he carried in from a wall outside the house. I have myself seen the wooden frame of a hot-bed covered with them, and sometimes a hedgehog carries an enormous number.

A fox's calling takes him occasionally to hen houses, and commonly to earths frequented by hedgehogs, and he might therefore sometimes have to take strong measures to get rid of the excessive number of fleas he had carried from such places.

Mr. Day vouches for the truth of the story as I gave it in your issue of March 23, except that the hurdles and straw were put up to shelter him and his father, and not to protect sheep and lambs, for it was in July (1843).

The fox went into a deep part of the small stream that runs by Mob's Hall into the Rhee or Cam near Thistly-ground Farm, about a mile west of Guilden Morden.

T. McKENNY HUGHES.

Ravensworth, Brooklands Avenue, Cambridge.

The Radiation producing Aurora Borealis.

As is well known, Prof. Birkeland has put forward the hypothesis that aurora borealis and magnetic disturbances are due to an "electric radiation" coming from the sun. The numerous observations, partly from the regions near the auroral zone, treated by Birkeland in his work "The Norwegian Aurora Polaris Expedition, 1902–1903," as well as the theoretical work by Prof. Störmer, have shown that this hypothesis in a very satisfactory way accounts

for the characteristic properties of aurora and magnetic disturbances, as well as regards occurrence as with respect to distribution in space relative to the earth.

The phenomena of aurora and magnetic storms, however, show a great variety of forms, and further knowledge will be required until we are able to follow every single phenomenon into details. From the point of view of Birkeland's hypothesis, it will be the next step to determine more definitely the properties of those "electric rays" which in the various cases produce the aurora and magnetic storms.

From the position of the auroral zone, Birkeland has already (*Comptes rendus*, 1910) estimated the average stiffness of the rays as measured by their deviation in a magnetic field, and he found that the rays are ten times as stiff as ordinary α rays.

The question would now naturally suggest itself, Is the "electric radiation" of the type of β rays consisting of corpuscles or of the type of α rays consisting of atoms? It is my intention in this note to direct attention to certain points which may guide us regarding this question.

As is well known, the law governing the absorption of the rays by matter is very different for the two types. The α rays penetrate matter in nearly straight-lined orbits, and only a very small fraction is scattered to any appreciable amount. The velocity of the α particle gradually diminishes as the particle passes through matter, and for a certain velocity it loses its power of ionising the mole-

cules of a gas and to produce photochemical action. The number of ions produced per unit length along the path of the α particle has its maximum very near the point where it loses its ionising power. The β particles, however, are almost completely scattered in the first thin layer of matter, and inside it the radiation broadens out in all directions, and any trace of the direction of the impinging rays is soon lost.

In the aurora, according to Birkeland's theory, we are actually examining the luminosity produced when the electric radiation strikes the upper strata of the atmosphere, and from the form and structure of the luminosity we should be able to examine the way in which the solar radiation is absorbed by matter.

One of the most conspicuous forms of aurora are the draperies, of which an illustration is given in the accompanying figure. We notice the straight-lined structure. That the draperies are formed by something coming towards the earth from outside will be evident to all who have witnessed their formation. On March 27, 1910, the writer had the opportunity of examining a most brilliant aurora from the mountains of "Jotunheimen." Brilliant draperies were formed, and they could be seen actually falling down in the direction of the streamers, one bundle adding itself to another in rapid succession so as to form long spirals and bands. Now the structure of the luminosity is just as would be expected if the draperies were formed by a type of rays showing an absorption like that found for the α rays. Looking at the luminosity along the transverse streamers, we shall always notice that the intensity gradually increases downwards, but stops all of a sudden, just as it is found for the ionisation produced by an α particle along its path.

I do not mean to say that it is exactly α rays or charged helium atoms which produce draperies, but I think that the similarity in absorption strongly points to a similarity in type of radiation—in other words, that the rays producing the draperies are of atomic size and carry an electric charge.

The fact that the draperies occur mostly on the evening and night side of the earth should, according to the law of the magnetic deflection, require a negative charge of the rays; but such rays may well be possible, for, as we know, Sir J. J. Thomson has found that accompanying the positive rays in a vacuum tube there are other rays formed by atoms, but carrying a negative charge.

In view of the fact that a number of the same spectral lines are found in the corona and the aurora spectrum, which belong to the rare gases, it would be natural to suppose that these inert gases, *e.g.* argon, neon, xenon, krypton, helium, and possibly coronium, are forming the carriers of the "electric radiation" producing the draperies.

The existence of such radiation does not in any way exclude the existence of corpuscular rays; these may be the cause of the auroral "arch," which has just the diffuse appearance to be expected from the law of absorption of the β rays. Further, the magnetic disturbances may to a great extent be due to radiation of the β-ray type.

L. VEGARD.

University of Christiania, March 16.

The Velocity of Earth Movements caused by the Messina Earthquake.

I AM deeply indebted to Prof. J. Milne, F.R.S., who, in NATURE of March 23, did me the honour of directing the attention of scientific men to my memoir on the velocity of earth movements caused by the Messina earthquake. As the notice contains some remarks on my work which require a little explanation, I beg to be permitted to state my views here.

According to some seismologists, the position of the hypocentre is at the intersection of an asymptote to Schmidt's hodograph, with a vertical ordinate drawn through its apex. It seems to me, therefore, that the absence of any measurable flexure in the curves may really mean that the hypocentre of the Messina earthquake was very shallow. That is, however, a matter of opinion about which seismologists can easily be divided, and I have no desire to insist on this subject.

Prof. Milne assumes that I divided the large-wave phase of the seismograms into three parts, called L_1, L_2, L_3, being L_1 the commencement of maximum motion, L_2 the maximum movement itself, and L_3 the phase which travels the slowest. He adds that if this is to be accepted as a definite and recognisable phase in a seismogram, there seems to be no reason why we should not also accept many other phases, which may be indicated by the letters L_4, L_5, L_6, &c. The remark is of interest, but I deserve neither praise nor blame for the division of the large-wave portion of seismological registrations. Prof. Milne well knows that the division of the principal portion of a seismogram into six groups was done by Prof. Omori, analysing the registrations obtained at Tokio, and such a division is now accepted by almost all seismologists. In my memoir, L_1 indicates the commencement of the initial phase; L_2 and L_3 are respectively the commencements of the slow-period and of the quick-period phases of the principal portion of the registrations, according to Prof. Omori's division.

Instead of considering as a whole the large-wave phase, which involves some uncertainty (as often the commencement of the principal portion is assumed to be on Omori's initial phase and at other times the commencement of the same principal portion is referred to the slow-period phase), I tried to distinguish in all seismograms the first three groups of the large-wave phase, L_1, L_2, L_3. I am not dissatisfied at having done this, because I have obtained some results which I think are not without importance for physical seismology.

I conclude by expressing my warmest thanks to Prof. Milne for his notice and for the valuable article on the necessity of restoring the Messina Observatory contributed by him to NATURE of February 16.

Messina, March 30. G. B. RIZZO.

FROM THE NIGER TO THE NILE ACROSS AFRICA.[1]

DR. KARL KUMM (whom, from the indirect statements made in his book, we take to be of Swiss origin, and who now seems to be for all practical purposes an Englishman) assisted to found the Sudan United Mission in 1907–8. This mission was expressly intended to work in the Nigerian and Egyptian Sudan to counteract the Moslem advance, and Christianise the pagan tribes of negroes not as yet influenced by the Muhammadan religion. His previous acquaintance with Africa (according to the statements made in his "exordium") has been considerable. In 1899 he had visited "the southern oases of the Libyan Desert," and had travelled a considerable distance on the way to Darfur. In 1901 he travelled in Nubia. In 1904 he journeyed from Tripoli southwards into the mountainous region north of Fezzan and studied the Hausa language. In 1904–5 he led an expedition of investigation into northern Nigeria. In the two following years he visited America and South Africa to arouse interest in his mission and secure data as to the advance of Islam in the direction of the Zambezi. On his return from South Africa he visited Portuguese East Africa, Mombasa, and made a hasty journey to Uganda.

In October, 1908, he left Liverpool with seven missionaries of the newly formed Sudan United Mission to visit or to found mission stations in northern Nigeria, and establish a home for freed slaves. He further intended, if practicable, to cross Africa along the border-line between Islam and paganism.

The book under review is the result of this last journey, which extended from Forcados, at the mouth of the Niger, along the course of the Benue to the Musgu country on the Shari, thence up the Shari River to Fort Archambault, and from that point along the line of water-parting (more or less) between the Shari, the Congo, and the Nile. He emerged into some-

[1] "From Hausaland to Egypt, through the Sudan." By Dr. H. Karl W. Kumm. Pp. xiv+324. (London: Constable and Co., Ltd., 1910.) Price 16*s.* net.

thing like civilisation at Shambi, on the White Nile, midway between Lado and Fashoda. From Lado he descended the White Nile to Khartum, and thence journeyed home through Egypt. From the point of view of travel and endurance, it was the latest and not the least noticeable crossing of Africa; though to the thinking of the present reviewer, one of the most remarkable achievements in crossing Africa was that accomplished by Mr. Walter Savage Landor a few years ago. This last-named traveller, in ordinary clothes and an ordinary hat and boots, armed with a walking-stick, and attended by one or two faithful Somalis (as a nucleus), quietly walked the greater part of the way across Africa at its very broadest, from east to west, from Somaliland to Senegambia. Mr. Landor would seem to have been somewhat shabbily treated by the geographical societies of the world in the relatively slight recognition which followed his feat. Apparently the reason for this is the same cause as that of the somewhat unkindly reviews of Dr. Karl Kumm's book, which have recently appeared in one or two journals, namely, that the mere traversing of Africa on foot, or by any other means of progression available, counts for very little unless such a journey is accompanied by the gathering of new and important information regarding the geology, geography, zoology, botany, or anthropology of the country traversed.

FIG. 1.—A Sara-Kabba woman carrying a plate in her lips. From "From Hausaland to Egypt."

No doubt there is some excuse for this point of view. But without reopening for the moment the question of Mr. Landor, the disparagement of Dr. Kumm's book seems a little harsh. *La plus belle fille ne peut donner que ce qu'elle a.* Dr. Kumm, perhaps, is most noteworthy (from the point of view of a biologist) as a collector of butterflies and moths. He managed to bring home 250 specimens of Lepidoptera, which have been named at the British Museum, and these are illustrated in the work under review by a selection of noteworthy forms very beautifully produced in colour, apparently by photography. So far as can be gathered from the book, none of these forms is completely new to science, but not a few of them are new as objects of wonder or beauty to the average reader.

A little further information is given regarding the zoology of these southern Sudan regions. A pair of horns of the variety of the Cape buffalo, found in the Shari valley and Lake Chad regions, illustrates the local Chad race of buffalo, known to us, however, since the early part of the nineteenth century. Dr. Kumm mentions that the young buffaloes of this variety are red in the colour of their hair, but become perfectly black when full grown. From the Shari valley he brought back the portion of the skull of a giraffe, showing in the two principal ossicones the beginnings of an embranchment, a most interesting feature as evidencing the latent tendency in this group (with which, perhaps, the Pronghorn is very distantly allied) which led in Miocene times to such results as the extraordinary branched antlers of the Sivatherium. This same Shari giraffe exhibited an exceptional development of the ossicone on the nasal bones between the eyes. Instead of being a mere bump, it rises to a considerable knob with an attenuated stem. Dr. Kumm also shot a rhinoceros in the Shari valley, an interesting fact as serving with other scanty information to show that the range of the rhinoceros does extend across west Central Africa to western Nigeria. Until recently, no proof had been advanced to show that the rhinoceros (unlike the zebra) was found west of the White Nile; though there is, of course, the tradition that the Romans, in their abortive expedition to Lake Chad about the year 21 A.D., entered a region on the outskirts of the Sahara Desert which swarmed with "unicorns." Dr. Kumm also thinks that he has discovered a new species or variety of crocodile, in which the bluish-black markings on the scales (present in the Nile and Slender-nosed crocodiles) have an exaggerated development, and form regular, blackish, vertical bands round the body. But this discovery is only an assertion backed up by a sketch from memory.

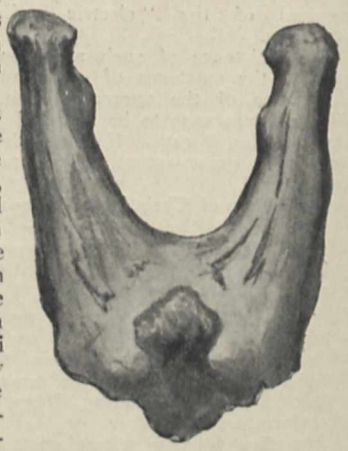


FIG. 2.—Horns of Shari-Chad Giraffe. From "From Hausaland to Egypt."

In Appendix A, Dr. Kumm gives some proverbs from the Beri-beri language, but we are not told (so far as I can gather) what is the geographical location of this speech. He supplies, further, a vocabulary of Bagirmi words, which, in view of Barth's admirable study of that language, is not a striking novelty. His vocabulary of Sara is more useful, though that speech of the very heart of Africa has already been illustrated by the French. Quite new, or at any rate, very nearly so, are his vocabularies of Nilim and Korbal of the Shari region. He also gives a few words of Sango, a language of the Upper Mubangi. The photographs illustrating the book are for the

most part of only tolerable interest and appositeness; the drawings which supplement the photographs are exceedingly bad: one wonders that the publishers could have inserted such. Amongst the more interesting illustrations is that of a Sara-Kabba woman, with her lips expanded artificially into something like a duck's beak. This method of deforming the lips seems to be a very old one amongst the negro race, and to have existed in ancient times in the westernmost parts of Nigeria. From the very heart of Africa, where Dr. Kumm came across it, it extends sporadically to the region between the Albert Nyanza and the Upper Congo; then, after another long gap in distance, reappears in parts of German East Africa, and attains a notable development (described by Livingstone) in the regions between Lake Nyasa and the coast.

Dr. Kumm gives a chapter on the anthropology of the Sudan tribes, which contains some new information, and especially some interesting illustrations of the many different methods of skin mutilation on the face (cicatrisation). He writes, however, much too freely about "Bantu," ascribing to the Bantu group of African people many tribes which have absolutely nothing to do with that language family. Although the conventional "Bantu" physical type is associated mostly with peoples of the Upper Congo of the lake regions and of South Africa who happen to speak Bantu languages, it is also to be met with elsewhere in West and Central Africa amongst tribes quite outside the Bantu language field. It short, it is better to drop the use of the term for any other but linguistic classifications.

H. H. JOHNSTON.

THE NĀGAS OF MANIPUR.[1]

THE monograph before us, descriptive of the Nāgas (included in the Tibeto-Burman group of races), is issued by the Government, Eastern Bengal, as one of the series which already includes volumes on the Khasis, Meitheis, Mikirs, and Garos. Mr. Hodson's survey extends only to the branch of the tribe settled in Manipur, numbering about 100,000 out of a total population of 162,000 in British India.

As regards social organisation, the clan, an aggregation of households, forms the permanent political unit, the tribe being only a group of clans with little or no solidarity. The only tribal bond appears in the enforcement of common taboos of food and seclusion, and in the rule that a man must not marry a woman whose speech differs from his own. This is due to the inhospitable character of the land and to the ferocity of its inhabitants, facts which also affect the linguistics. As Dr. Grierson has shown, this type of monosyllabic language, possessing no literature, with a floating pronunciation, and a number of loosely used prefixes and suffixes, being necessarily subject to rapid change, emigrants settled at a comparatively short distance develop a dialect unintelligible to members of the parent village. This absence of tribal organisation adds greatly to the difficulty of bringing these wild highlanders under control.

The Nāgas combine with a fairly advanced material culture many barbaric practices. While part of their farming is on the Jhum system, that is to say, the periodical burning of patches of jungle and sowing the seed in the ashes, they also possess terraced fields

Photo. *E. J. Mitchell.*

Mao Nāgas. From "The Nāga Tribes of Manipur.

[1] "The Nāga Tribes of Manipur." By T. C. Hodson Pp. xiii+212. (London: Macmillan and Co., Ltd. 1911.) Price 8*s.* 6*d.* net.

irrigated with water brought from considerable distances along skilfully aligned channels. They demarcate their village boundaries and recognise rights of property in land. They are skilled in weaving, make fairly good pottery, extract salt from brine wells, work up imported iron into weapons and implements, and are adepts in mat and basket weaving. Still, in spite of these advances towards civilisation, they practised up to quite recent times the brutal custom of head-hunting. As connected with their funereal rites this may be piacular, propitiatory, or both. It seems reasonable to suppose that, like the Wa of Burma, they procure heads in the hope that the soul of the victim will accompany his skull, and that when hung up in the house of its possessor this will act as a guardian against the powers of evil, the skull of a stranger being preferred, because the ghost does not know its way about, and is less likely to wander. Mr. Hodson has done good service in pointing out how the custom is connected with the blood feud, with funerary rites and eschatological beliefs, and that it has a social side as a proof of fitness for initiation into the tribe. Hence it is often encouraged by women, who laugh at young men appearing at the village festivals without the decoration which marks the successful warrior.

Mr. Hodson's careful review of the tribal and village customs, particularly the institution of taboos and the use of the communal house for males, superstitions, and religious beliefs, a survey largely based on personal intercourse with the tribe, forms an important contribution to the ethnology of India.

THE PENNY: A SUGGESTION.

DEAR old penny! You have been with me all my life. You were the first present I ever had, and when I was young your potentiality was great. You would buy everything a boy required—peg-tops, jam tarts, kites, marbles, or a bun. As I grew older I recognised that your purchasing power did not keep pace with my desires. Still, you do something—you give me a paper, a box of matches, or carry me long distances on trams or buses. With two or three pennies in my pocket I feel armed against emergencies. You will dry an urchin's tears or give comfort to a beggar. You have been and still remain a friend to young and old.

But with all your virtues you have still some drawbacks. I think you are susceptible of great improvement.

The ordinary person likes you in twos or threes, but in quantity he calls you "coppers." When in this form, the young lady in the shop frequently apologises —not for you so much, as for her inability to represent you by some other coin.

Forty-eight coppers, so says the law, weigh one pound; but nobody, whatever his vocation may be, cares to carry a pound, whether it be represented by forty-eight pennies or a lump of brass in his pocket. Not only would they weigh him down, but possibly they might spoil his figure. From the legal definition you should weigh one-third of an ounce, or 145·8333 grains. The latter number frightens me; it is indefinite and without end. It means nothing for common use. To carry about a weight which cannot be used to weigh anything in particular, not even a letter, is not practical. It is silly. If our penny could be made to weigh a little bit less but remain commensurable with an ounce, even if a hole was bored through its centre to reduce its weight, which would tell you what it was by its feel, the Chancellor of the Exchequer would, by the saving in metal, certainly be possessed of wealth equal to the fees of many Baronetcies. The public would have less load to carry, and rich and poor would have in their pockets a useful standard of weight.

As I am now finding fault, let me next ask whether you measure anything in particular. In your modern form, so far as I know, there is as little respectability in your dimensions as in your weight.

A penny is one out of a number of little discs that can be economically stamped out of a sheet of bronze. We are told that a bit of metal goes through rolls, which are so wonderfully adjusted that the resultant strips or "fillets" do not vary more than 1/10,000 part of an inch in their thickness. This suggests that the authors of the penny wished it to possess an accuracy bordering on the supernatural. But the subsequent punching, pressing, and milling has apparently done much to destroy their good intentions.

When you, little penny, entered the world, you were bright and shiny, with all the lustre, and colour of burnished gold; but your guinea-like look never lasted more than a few short weeks. You quickly became the microbic-covered old brown copper. You look round, you are supposed to be round, but are you really round?

Many times per day somebody or other wishes to draw a circle, puts you on a piece of paper, and scratches a pencil round your edge. Now and then the housewife puts you on a piece of linen to mark out buttonholes or points for decoration. The results look excellent, and satisfy many purposes, but a pair of callipers show that you have more than one diameter. The least diameter of our world runs from the north pole to the south, but if the north pole of a penny is Britannia's head and the fringes of her skirts the south, this is your longest diameter. Poor old penny, your dimensions have been made opposite to those of the world in which you circulate. The world is world-shaped, and you are penny-shaped. You only possess an average diameter, which is not an inch or an inch and a quarter, neither does it appear to be related to any everyday unit of linear measure. Your dimensions, like your weight, suggest an oversight on the part of your creators. You are lopsided and measure nothing in particular.

As you exist at the present day you measure a tiny little bit more than one inch and one-fifth. Why "the tiny little bit" exists, I and my friends connected with minting cannot tell. Knock it off, and the Exchequer would increase its capital without extra taxation, and five pennies would measure exactly six inches.

But reformation should go still farther, and the diameter of a penny, if possible, be made to measure something more definite by itself. If the halfpenny, which does measure one inch, stands in the way, do not disgrace it, but reduce it to another standard.

Our poor dumb friend, not only because it neither possesses a useful weight or measure, has been compelled to take a back place in numismatic competitions, but it has had to put up with a bit of extra weight in the form of an inscription. On one side of our penny we see a statement in abbreviated Latin which tells us that the Ruling Monarch is a defender of the faith. With this the penny gives us something to think about both day and night, and to many the statement may be regarded as in keeping with its weight and measure. On the reverse, we see a brave-looking, long-limbed lady sitting on a chariot, one wheel of which appears to be elliptical. I have been quite curious about this personage, and with the help of a magnifying glass have compared her face as shown on pennies and halfpennies. As a result of my examination I conclude there are at least two types of Britannia. The aristocratic, with a Grecian nose, and the democratic, with a *nez retroussé*. Possibly

the differences may be due to pressing, punching, or to wear and tear.

Therefore you are, dear old penny, from my point of view simply a token, without definite weight, definite dimensions, and with a variable expression.

The Spanish "penny" is marked ten grammes, and it also reads 100 pieces make one kilo. The "halfpenny" weighs 5 grammes, and, like the larger coin, is largely used for purposes of weighing. These coins also have useful dimensions.

If Britannia could be induced to sit a little more forward on her shield, with this and other slight adjustments, the penny would have a definite centre of gravity, and be of use as a plumb-bob, or as a pendulum in our board schools. With properly spaced milling on its edge, pennies could be used by Boy Scouts as angle measurers or rough protractors. When drawing plans, with one penny, and another to buy a compass, he could tell the time, or without a compass and with a watch he would know his bearings. With a piece of thread, a pebble for a weight, and a penny a clinometer could be made.

Whether any of these suggestions could possibly be carried out in practice remains for the consideration of the controllers of our coinage. A penny has had an up and down time of it. It has been altered often, and why not once again. The Romans possibly were too proud to accept small change, which, when handed to them, they flicked off the counter with the back of a finger, remarking "Romanus sum." At all events Roman coins seem to have been scattered over countries where Romans once resided, and now their coins are among the most common evidences of their former occupation. Six hundred years ago, when the penny was made of silver, it would pay a wage or buy a horse. Now it is only a little brown token. If the Chancellor of the Exchequer could see how to cut off "the little bit," make "the little hole" and use a less expensive metal the penny would be reincarnated, become the admiration of the world, taxation would be relieved, and Lloyd George worshipped. But do not forget to treat other tokens as you would the penny. Make them more cheaply and increase their usefulness.

JOHN MILNE.

THE BRITISH SCIENCE GUILD.

THE fifth annual meeting of the guild was held at the Mansion House on April 7, under the presidency of the Lord Mayor. There was a fairly good attendance, and the number of well-known leaders in the field of technical and scientific education was large. Sir William White presented the annual report, and referred to the progress made during the year in various directions. Of the special activities of the guild, he mentioned the work of the subcommittees upon agricultural education, the proposed museum at South Kensington for the physical and mechanical sciences, medical education, and the relation of the Imperial College of Science and Technology with the University of London. From the annual report itself we learn that committees have also been investigating the problems involved in the conservation of natural sources of energy and the coordination of charitable effort. The guild has further benefited science and the community by its successful action in regard to the site of the Solar Physics Observatory; the existence of the science section at the Japan-British Exhibition, and the inclusion of a similar section in the plans for the forthcoming Coronation Exhibition, are also in large measure due to the guild's influence.

The features of the year's progress which Sir William White emphasised were the improved attitude of the Government towards agricultural research, and the greater readiness of Government departments generally to seek the advice of highly qualified men of science. In certain instances this readiness led to the appointment of consultative committees, which were acting in an advisory capacity to several departments. At the same time, Prof. R. A. Gregory's report showed how much more was being done in other countries to promote research. The organisation of the Canadian Committee has made good progress, and its first annual report has been issued. The spread of evening classes and the movement in favour of continued education are hopeful indications of the public recognition of the value of technical instruction.

Lord Haldane thought that the technical education which was at present being given in England was underrated. In higher education, in the application of science to industry, Germany had marked features which we did not possess; but evening schools and classes connected with the universities or great technical colleges were little known in Germany. Technical teaching had developed in a very striking way in London and throughout the United Kingdom. It was not without result. The quality of British goods commanded the respect of the world. Science was present in every corner of the Sheffield factories in which engines of war—offensive and defensive—were being constructed. Our Government was a very unscientific-looking machine, but it was being substantially and rapidly improved every year. There was far more intercommunication between various Government offices than was generally supposed. He hoped to see remarkable developments before long in the domain of public health.

We cannot refrain from expressing our regret that Lord Haldane should have dwelt so strongly on the merits of our evening-class system without qualifying his praise of this system by some mention of its inevitable shortcomings. The Technical Education Committee of the guild views the matter in a different light. This committee presented a very valuable report, and we quote from the last sentences preceding the recommendations which it contains:—

> Most of the technical instruction carried on in Great Britain is evening-class work. The committee, however, are strongly of opinion that day work is of infinitely greater value than work done in the evenings, when neither instructor nor student can possibly be at their best; consequently, evening work cannot be compared for thoroughness and efficiency with such day-class work as is done in the German, and in some of our higher, technical institutes. *Until this is recognised, it is impossible for this country to expect to compete technically with other countries.* (The italics are our own.)

There are valuable contributions appended to this committee's report by Dr. H. T. Bovey, Prof. Meldola, Dr. Pohl, Prof. Gregory, and Prof. Perry. The last-named awards an overdue meed of praise to the too-belittled work of the Science and Art Department, and has a word of encouragement for workers in evening classes, but he adds a strong appeal to employers to allow apprentices to attend science classes "*during the regular working hours*" (the italics are Prof. Perry's). It is evident from these reports that the guild is doing more than interest public men and impress them with the importance of scientific method, for through its committees it is doing the spade-work essential to the conversion of aspiration into practice. It is to be regretted, however, that no mention is made of the Education (Choice of Employment) Act which was passed in November, 1910. Though this may appear to be a very modest piece of legislation, it may well prove to be the starting point of national and

local systems for fulfilling one of the great aims of the guild, viz., organising the training of the youth of the country for industries and citizenship.

We hope that Lord Haldane will add the influence of his personal prestige to the authority of the president of the British Science Guild, so that the need of developing a *higher quality* of technical education in this country may be impressed upon local administrators and the general public. No better text for a discourse upon this theme need be sought than the sentence quoted so appropriately in the annual report from one of the last public utterances of King Edward VII. :—

As time goes on, I feel more and more convinced that the prosperity, even the very safety and existence, of our country depend on the quality of the scientific and technical training of those who are to guide and control our industries.

G. F. D.

The following gentlemen were elected as vice-presidents of the Guild at the annual meeting:—the American Ambassador, Sir Thomas Barlow, K.C.V.O., F.R.S., Sir Lauder Brunton, Bart., F.R.S., Sir Ernest Shackleton, C.V.O., and Major O'Meara, R.E., C.M.G.

The membership of the Guild, including the Canadian Branch, has increased from 793 at the end of 1907 to 872 at the end of 1910; of these, 28 are life fellows, 58 fellows subscribing annually, and 425 life members. In addition to these, there are 7 members belonging to the Australian Branch, of whom 5 are life members.

The following were elected to form the executive committee for 1911–12; the names of new members are printed in italics:—*President*, Rt. Hon. Viscount Haldane, K.C., F.R.S.; *hon. treasurer*, Rt. Hon. Lord Avebury, P.C., F.R.S.; *hon. assist. treasurer*, Lady Lockyer; *vice-presidents, Sir Thomas Barlow, K.C.V.O., F.R.S.*, Sir David Gill, K.C.B., F.R.S.; *chairman of committees*, Sir Norman Lockyer, K.C.B., F.R.S.; *vice-chairmen of committees*, Sir Hugh Bell, Bart., Hon. Sir John Cockburn, K.C.M.G., Prof. Meldola, F.R.S., Sir William Ramsay, K.C.B., F.R.S., Mr. F. Verney; *other members, Mr. Wm. Phipson Beale, K.C., M.P.*, Dr. G. T. Beilby, F.R.S., Dr. Bovey, F.R.S., Sir Edward Brabrook, C.B., *Mr. Harold Cox, Prof. Farmer, F.R.S., Sir Luke Fildes, R.A.*, Surgeon-General Sir A. Keogh, K.C.B., Prof. A. Liversidge, F.R.S., Mr. A. Mosely, C.M.G., Mr. C. Freeman Murray, Prof. J. Perry, F.R.S., Sir Boverton Redwood, Mrs. W. N. Shaw, Mr. Carmichael Thomas, Dr. A. D. Waller, F.R.S., Colonel Sir John Young, C.V.O.; *hon. secretaries*, Sir Alex. Pedler, C.I.E., F.R.S., Dr. F. Mollwo Perkin.

NOTES.

DR. L. A. BAUER, director of the Department Terrestrial Magnetism of the Carnegie Institution of Washington, sailed from Vancouver, B.C., on March 24 on a trip of inspection of the non-magnetic yacht *Carnegie* at Colombo, Ceylon, where she is due to arrive some time in June next. *En route* Dr. Bauer will call at the magnetic observatories at Melbourne and Christchurch.

WE regret to see the announcement, in *The Times*, of the death of Mr. Charles du Bois Larbalestier, a leading authority on lichens, to whom the last edition of Leighton's "Lichen Flora" was dedicated; and also of Mr. J. S. Slater, for many years principal of the Civil Engineering College, Sibpur, near Calcutta.

THE following have been elected by H.H. the Prince of Monaco the members of the first council of the new Institute of Human Palæontology in Paris:—MM. Salomon Reinach, Boule, Verneau, Cartailhac, Capitan, Villeneuve, for France; Sir Ray Lankester for the British Isles; Prof. von Luschan for Germany; Prof. Hoernes for Austria-Hungary; Prof. Issel for Italy, and Prof. G. Retzius for the Scandinavian countries.

DR. S. F. EMMONS, an American geologist of distinction, died at Washington on March 28. He was born in Boston in 1841, and, after graduating at Harvard, studied at the Schools of Mines in Paris and Freiberg. He had been connected with the U.S. Geological Survey since 1867, and was a prolific author of geological publications, especially reports on explorations in the Rocky Mountains and Colorado.

DR. D. MAWSON, whose paper on the Australasian Antarctic Expedition, read before the Royal Geographical Society on Monday, appears elsewhere in this issue, announced to the society, towards the close of his address, that the Commonwealth Parliament will probably be asked by the Government to vote a sum of 20,000*l.* towards the expenses of the expedition. The council of the Royal Geographical Society has decided to contribute the sum of 500*l.* to the expedition.

DR. J. S. FLETT has been appointed to succeed Dr. J. Horne, F.R.S., as assistant in Scotland to the director of the Geological Survey. Dr. Flett is a graduate of Edinburgh University, where he was Baxter Scholar, Falconer Fellow in Geology, and a Heriot Research Fellow. He was for four years lecturer on petrology in the University, and in 1901 joined the Geological Survey. In 1903 he was appointed petrographer to the Survey. After the West Indian eruptions in 1901, he was sent out with Dr. Tempest Anderson by the Royal Society of London to report on the volcanic phenomena. He has published many scientific papers dealing principally with the volcanic and metamorphic rocks of the British Isles, and he has contributed largely to the memoirs of the Geological Survey, not only on Scotland, but also on Cornwall and Devon. For scientific research he was awarded the Neill medal by the Royal Society of Edinburgh (1902) and the Bigsby medal by the Geological Society of London (1909).

THE Walker prize of the Royal College of Surgeons, founded to encourage investigation into the pathology and therapeutics of cancer, has been awarded to Dr. E. F. Bashford, general superintendent and director of the laboratory of the Imperial Cancer Research Fund of London. The value of the prize is 100*l.* The Cartwright prize, consisting of the Cartwright medal and 70*l.*, has been awarded to Mr. H. P. Pickerill, professor of dentistry and director of the dental school at the University of Otago, New Zealand, for his essay on "The Prevention of Dental Caries." The Jacksonian prize has been awarded to Mr. K. Macfarlane Walker, of St. Bartholomew's Hospital, for his essay on "Tuberculous Disease of the Urinary Bladder and Male Genital Organs."

ALL the necessary arrangements have now been made by the General Post Office and the postal authorities abroad for a prolonged series of long-distance tests over the new submarine telephone cable which, as already stated in these columns, has been laid between Dover and Cap Grisnez. The tests will take place between various provincial towns in England and towns in Holland, Germany, and Switzerland, and it is expected that our foreign telephone service will be very greatly extended in consequence. No public service, however, will be offered until 90 per cent. of the test calls have proved successful. When this fact has been ascertained, there is no reason why, under ordinary conditions, speech over the line should not be quite distinct. There must, however, always be the chance that gales and blizzards may cause interruptions on the land lines, as these in most cases are still carried overhead.

ON Wednesday, April 5, a very interesting exhibition was held at the Natural History Museum, South Kensington, when all the subscribers to the British Ornithologists' Union Expedition to Dutch New Guinea were invited to inspect the first collections of mammals and birds. The expedition is still attempting to reach the Snow Mountains, but it will be remembered that two members of the party, Mr. W. Goodfellow, the leader, and Mr. G. C. Shortridge, have been invalided home. The latter brought with him a large zoological collection, including about 1100 birds and 100 mammals. These have now been examined, and though procured at a comparatively low elevation (none having been obtained above 21,000 feet), the birds especially are of the greatest value and rarity. Quite a number were hitherto unrepresented in the national collection, while some five or six appear to be new to science. One of the most notable acquisitions is a magnificent bird of paradise (*Xanthomelus ardens*), which is yellow, with an orange-scarlet head and tippet. A small series of this fine bird was sent home, including adults of both sexes and a male in immature plumage. Among the novelties we may specially mention two brilliantly coloured parrots belonging to the genera Cyclopsittacus and Aprosmictus, likewise a beautiful fruit-pigeon of the genus Ptilopus. The collections were much admired, especially the many brilliantly coloured species to be found among the birds of paradise, parrots, kingfishers, rollers, pittas, &c. The mammals, though less showy, were also of great interest, while the drawings by Mr. Shortridge of bows and arrows, stone axes and clubs, paddles, &c., were much admired. The ethnological collection has not yet arrived, but is sure to prove of special interest.

IT has been commonly taken for granted that a convenient and effectual way of encouraging scientific research is by the foundation and endowment of prizes for investigations dealing with specified subjects. The results published in the *Rendiconti* of the Lombardy Institution, xliv. (2), 1, recently received, seem to indicate that such endowments not infrequently fail to accomplish the desired object. The institution offered seven prizes for scientific subjects, one medal for industry, one for agriculture, a prize for commercial success, and others for economical, philosophical, literary, and forensic subjects. The industrial medal was awarded to one of three competitors, and for the Brambilla commercial prize eighteen firms competed, nine of which received awards and medals; but only two awards were made for work in science, and none in agriculture. These results are the more remarkable in view of the subjects on which dissertations were presented. The competitors for the agricultural medal seem to have introduced substantial improvements in cheese-making, based on a scientific study of bacteriology, but were apparently disqualified because their process had not met with such universal adoption that further recognition was unnecessary. The prize founded for the cure of pellagra seems to have been unawarded, in spite of researches of considerable scientific value having been made in connection with this disease. But the most remarkable fact is that a prize offered for improvements in dirigible balloons has now remained unawarded for three consecutive years. At a time when aërial navigation has made its greatest progress, it should surely have been possible to find many Italian aviators or aëronauts worthy of a prize founded long before the days of aviation.

AN exceptionally long spell of easterly and northerly winds has prevailed over the whole of the British Islands, continuing for four weeks with the exception of a break or two lasting only for a few hours, and there have only been four days to April 11 at Greenwich since March 4 with the temperature in excess of the average. The day temperatures were low in March, but the nights were often fairly warm, with the result that the mean temperature for the month was in good agreement with the average. Since April set in, the cold has intensified, and the day temperatures have been remarkably low for the time of year. At Greenwich the maximum shade temperature on April 5 was 36·1°, and on April 6 38·0°. The observations at Greenwich since 1841 only show one day with the maximum temperature below 40°, a reading of 36·3° being recorded on April 19, 1849. The lowest minimum temperature at Greenwich during the recent cold spell was 26·7° on April 6; this is not remarkably low and has been occasionally equalled of recent years. The mean temperature for the week ending April 8 was 37·9°, and apparently the Greenwich observations only yield one period of seven days in April with so low a temperature since 1841, the mean for the week ending April 10, 1888, being 36·4°. The mean of the maximum or day readings for the week ending April 8 this year is 43·1°, whilst for the specially cold week ending April 10, 1888, it was 44·1°, so that the recent cold spell is the coldest on record for April so far as the maximum temperatures are concerned. The summary of the weather for the week ending April 8 this year, just issued by the Meteorological Office, shows that the mean temperature for the period was much below the average over the whole of the British Islands. The coldest district was the south-east of England, where the mean for the week was 36·9°, which is 8·3° below the average of the past twenty-five years. The deficit amounted to nearly 7° in the east and south-west of England and in the Channel Islands, and to 6·4° in the Midland counties. During the middle of the week the thermometer remained abnormally low over the eastern and southern counties of England, barely exceeding 32° at a few places, and at Tunbridge Wells on April 5 the highest temperature was 31°. The lowest minima, recorded on April 5 or 6, ranged from 17° in the east of Scotland and 20° in the west of Scotland, to 26° in the north-east and north-west of England. Snow was of frequent occurrence in nearly all parts of the kingdom.

IN *Man* for April Mr. W. L. H. Duckworth describes a skull of the second Neolithic period found in a mound at Tsangli in Thessaly, and now deposited in the Cambridge Museum. In form it is mesaticephalic, and a deep incesura subincutalis reduces the height of the mandible in front. This last character is almost the only distinctive feature of the specimen. If, as may be inferred from its association with objects of undoubted antiquity, this specimen is of ancient date, it proves the existence of a highly evolved type of cranial form in Thessaly at this early period, modern examples indicating that the more usual form of skull in this part of Greece is longer and narrower than at the earlier period.

MR. H. ST. GEORGE GRAY, in his report of the third season's work at the Maumbury Rings, records some additional discoveries. The remains now disinterred include two skeletons of the Romano-British period, with two of later date. We have as yet no certain knowledge of the age of the surrounding embankment, which cannot be fixed without further excavation. Socket-holes indicate the position of the railing erected for the protection of the spectators, and at the bottom of the arena some most interesting ceramic remains were unearthed, establishing the fact that the shafts date from the Neolithic period. The pottery consists of pieces of a rude vessel, black in

colour, with a dull red-brick tinge on the exterior only. It was imperfectly fired, and was composed of flint, quartz, and bone, but without any trace of chalk, calcite, or any form of limestone.

AMONG the pressing wants for the study of the evolution of human culture in these islands is the establishment of a folk-museum to contain the numerous archaic implements and utensils still to be found in the more secluded parts of the country, but which are now rapidly disappearing. The Pitt Rivers Museum at Oxford does something to fill this gap in our collections, and if its accommodation and resources could be increased, the work of forming and arranging such a collection could not be placed in better hands than those of its present curator, Mr. H. Balfour. Mr. J. Edge-Partington, in the April number of *Man*, illustrates the abundance of such material by describing, with drawings, a series of such primitive domestic implements and vessels collected from farmhouses in North Wales, where they are rapidly disappearing from use. Many of these are of a very primitive type, such as the collar used to control rams in the rutting season, curious spades and knives, a dish used for the dipping of rush lights, and a grooved rolling-pin for making oat cakes.

The Bio-Chemical Journal for March (vol. v., Nos. 8 and 9) contains a memorial notice of Dr. Christian A. Herter, of New York, who recently died at the early age of forty-five. His greatest work was his study of the complex elusive diseases set up by the development of an abnormal bacterial flora in the intestinal canal.

A CHART containing the essential features required for the description and identification of bacterial species has been issued by a committee of the Society of American Bacteriologists, consisting of Messrs. Chester, Gorham, and Erwin Smith. The chart is a most comprehensive one, and includes a glossary of terms; it deserves the serious consideration of all bacteriologists.

No. 39 of the Scientific Memoirs of the Government of India is by Lieut.-Colonel Sutherland, and discusses in much detail the applicability to medico-legal practice in India of the biochemical tests for the origin of blood stains. As regards the precipitin test, the age of the blood stain, at least up to twenty-seven months, makes no difference in the applicability of the test.

THE report of Dr. Bashford, the delegate of his Majesty's Government to the second International Conference on Cancer Research, held at Paris in October last, has recently been issued. Among other subjects he directs attention to a paper dealing with certain tumours occurring in the sugar-beet and allied plants. These tumours can be grafted on to other healthy plants, and no causative parasite can be detected in them. From their general biological behaviour it appears justifiable to assign to them in the vegetable kingdom a position analogous to that occupied by cancer in the animal kingdom.

THE fatality of fractures of the leg and of lobar pneumonia as deduced from hospital mortality rates, 1751–1901, is the subject of a statistical study by Messrs. Greenwood, jun., and Candy (Journ. Roy. Statistical Soc., lxxiv., part iv., 1911). It seems that the fatality of lobar or ordinary pneumonia has changed little during the last fifty years, the fatality of compound fractures of the leg has steadily diminished down to the present time, and the fatality of simple fractures of the leg diminished greatly and steadily down to fifty years ago, but since then the change has not been regular. The curious point is brought out that cases of simple fracture in the old days were kept in hospital often for months, and sometimes for much longer, and the patients frequently developed bedsores and an unhealthy condition, which resulted in death.

IN a recent short paper (*Parasitology*, vol. iii., No. 3, 1910), Dr. A. E. Shipley records five species of pentastomids from various Indian and African reptiles, including a new species of Porocephalus from the tortoise *Kachuga lineata*. The most interesting fact in the paper, however, is the occurrence in the pharynx of an Indian crocodile, captured on the mouth of the river Hooghly, of *Linguatula subtriquetra*, a parasite hitherto known only from the American *Caiman sclerops*.

No. 6 of the fourth volume of the Records of the Indian Museum is devoted to a revision, by Miss G. Ricardo, of the Oriental gad-flies of the genus Tabanus. No fewer than forty new species, including one from Celebes (which the author excludes from the Oriental region) and three from other regions, are described in the monograph; on the other hand, a large number of reputed species are relegated to synonyms.

THE Rugby School Natural History Society, of which we have received the report for 1910, is to be congratulated on a marked increase in the number of its members, of which the total is now 425. The activity of the various sections has been, on the whole, well maintained, while some of them have exhibited remarkable energy and enthusiasm in their work. An interesting innovation in the present report is a record of the scientific work of old members of the society.

A CONTRIBUTION to our knowledge of the modern reptile fauna of Africa is made by Mr. F. Siebenrock in vol. cxix., part vii., of the *Sitzber. k. Akademie der Wissenschaften*, Vienna, who describes, with four plates, a large collection of chelonians made by Messrs. Pöck and Brunnthaler in the south and south-west. Eleven species—none new—are recorded, of which *Homopus boulengeri* and *Testudo bergeri* are figured. Special attention is directed to a series of *T. oculifera*, which is regarded as of importance in connection with the evolution of the colour-pattern. In the author's opinion, this species and *T. geometrica* constitute in this respect a subgroup phylogenetically distinct from the other members of the same group.

SCALES of fishes brought home by Dr. F. Hatch from the Ecca Shales, near Ladysmith, of which an account is given by Dr. Smith Woodward in part ii. of the second volume of the Annals of the Natal Museum (pp. 229–31), are of interest as affording further evidence of the existence of an abundant fauna of Palæoniscidæ in southern Africa during early Mesozoic and late Palæozoic times. Scales of the same general type have been previously obtained from the Karu formation of the Cape and the Permo-Carboniferous of Rhodesia and Nyasaland. The last-named were referred by Dr. Traquair in the Quart. Journ. Geol. Soc. for 1910 to Colobodus, while the Rhodesian and the new Natal specimens represent the genus Acrolepis, of which there may be two species.

The Times of March 27 devotes an article to the wild fauna of South Africa in connection with the forthcoming display in the Zoological Society's Gardens in Regent's Park of a representative series of South African animals, to be called the King's collection. The collection, which already includes a large number of species, is to be presented to his Majesty in commemoration alike of his Coronation and of the establishment of the Union of South Africa. According to the latest information from the

Cape, the animals are being drafted to various ports previous to their shipment for this country. It is unfortunate that a southern seal recently received at the gardens, which is to be included in the African collection, is alluded to in the article as Ross's seal (*Ommatophoca rossi*) of the Antarctic, whereas it is really, as pointed out by Mr. Pocock in *The Field* of April 1, a young specimen of the sea-elephant or elephant seal (*Macrorhinus leoninus*). It was obtained from the Crozets, and is the first living example of its kind received in the gardens, and probably in Europe. The young animal is very like Ommatophoca, having a short, blunt muzzle and very large eyes.

In an article published in *The Fortnightly Review* for April, Mr. F. G. Aflalo records his impressions of the London Zoological Gardens on paying his first visit after a three years' absence from England. His impressions are altogether satisfactory, and he especially commends the removal of the society's offices to the gardens, as the result of which the whole establishment is under the immediate eye and control of the secretary. It is added that, "as a result of this new control, we have the evidences of success on all sides, not merely in the condition and housing of the animals, but also in the higher birth-rate, lower death-rate, and increase in the number of both fellows and visitors to the gardens." Commendation is also accorded to the systematic plan on which the whole laying-out of the gardens is being remodelled, so far as existing buildings will permit, and the erection of new buildings and the construction of new enclosures with the view of a striking and picturesque general effect. Such changes must, however, of necessity be slow and gradual, as their cost is great. With its distinctly unfavourable conditions of climate and soil, the "New Zoo" cannot hope to rival in all respects similar establishments situated under sunnier skies, but, nevertheless, it "has overcome many obstacles, climatic and otherwise, and the result is something of a triumph."

The annual report for 1909 issued by the director of the Sydney Botanic Gardens and Government Domains contains a few illustrations, one of which provides a view of the Centennial Park and another illustrates a clump of trees of *Casuarina glauca* in the botanic gardens. The cultivation of succulents is receiving special attention, and an extensive planting of palms in the domain is recorded. Among the noteworthy plants under cultivation mention is made of *Beilschmiedia Tarairi*, a New Zealand silver-leaved tree, analogous to the copper beech; an Australian natural hybrid, *Brachychiton populneo-acerifolius*; and two native plants, a white-flowered composite, *Olearia Flocktoni* and *Drymophila Moorei* (Liliaceæ). The publications emanating from the department include parts of the Forest Flora and several pamphlets on useful Australian plants.

Partly for the purpose of comparison with the working of the forests of *Pinus longifolia* in the North-west Provinces of India, a description of the State pine forests of Landes and Gironde in France is contributed to *The Indian Forester* (December, 1910). The area of sand dune converted into forest amounts to 200,000 acres, and, in addition, there is a littoral dune and protective wooded belt of one quarter of that area. The dunes are controlled by fascines and plantations of marram grass. *Pinus maritima* is grown as a pure crop for timber and resin under a rotation varying from sixty to seventy-five years. The species seeds freely from about an age of twelve years. Tapping for resin begins on trees about thirty-five years old, and proceeds until the tree is cut down. Details of tapping, the instruments used, and distillation are given.

In plant hybrids raised by crossing *Œnothera biennis* and *Œ. muricata*, Prof. H. de Vries has observed some distinct features, which are indicated in a preliminary paper published in the *Biologisches Centralblatt* (February 15). In the first instance, the reciprocal hybrids *bm*, *mb*, are distinct from each other and from their parents, although clearly resembling the parent from which pollen was taken. The two resulting hybrids were then reciprocally crossed, $bm \times mb$, $mb \times bm$, when the former lost all traces of the species *muricata* and the latter all traces of *biennis*. The conclusions are formulated that for these two species the pollen cells bear special characters not shared by the egg cells, and that the characters of the grandfather cannot be transmitted through the mother nor those of the grandmother through the father. Similar results, *i.e.* dominance of the male parent and elimination of the characters of the female parent, were obtained when either of these species was crossed with allied species.

It may not be generally known that the annual lists of "Geological Literature added to the Geological Society's Library" (Burlington House, London) can be purchased by the public. The issue for 1910 includes books and papers received up to December 31 in 1909, and the subject-index enables a reader to refer to the geological work of the whole year under almost any heading that may be in his mind. We see, for instance, that eighteen authors have written on Colorado, ten on laterites, and five on Natica. The list is especially important as an index to the geological journals of the world.

Mr. P. Macnair has prepared an "Introduction to the Study of Rocks" as a guide to the rock-collections in Kelvingrove Museum, Glasgow (1911, price 3*d*.). It is well illustrated by photographs of rocks in the field, in hand-specimens, and in thin slices. The rock-forming minerals are also described, with figures of characteristic forms. Objection may be taken to the description of quartz and calcite as hexagonal, and to ilmenite as a "ferriferous titanite"; but the notices of the minerals and rocks are clear and adequate. Numerous drawings of sections of Scottish rocks are included in the text, and the book is distinctly attractive as an introduction to petrography.

For the benefit of teachers of geography in the State, a series of chapters dealing with the geography of Ohio State, by Mr. F. Carney, are appearing in the Bulletin of Denison University. Those treating of transport, glaciation, and the economic mineral products, provide useful summaries of information relating especially to Ohio.

Prof. Huntington, in the February number of the Bulletin of the American Geographical Society, describes the Karst country of southern Asia Minor, where to the south and west of Konia many of the streams end in dark, deep pools, in which the water sinks slowly underground. Much of the country, and especially the great plain of Axylon to the east of Konia, is too dry to be fruitful unless artificially supplied with water. Considerable work is being done whereby the waters of lake Bey Shehir (Kirili Göl) will be diverted, by means of a canal, from the lower lake of Kara Viren, where much is now lost, and will be carried through the Charsbembeh gorge to the plain below, where it is expected to put about 350 square miles under irrigation when the canal is opened by the end of 1912.

In the *Revue générale des Sciences* for March 15, M. F. Diénert discusses the report of the commission which has

investigated the floods of the Seine valley in 1910, and made recommendations to mitigate the disastrous effects of future ones. The predictions of the Hydrometric Service were, on the whole, very correct, but the coincidence of flood waves in different tributaries, and the reduction of the effective channel by bridge piers, quays, and floating structures resulted in widespread inundation of the city. Three works were recommended by the commission, each of which would entail considerable outlay, but one at least, to take a branch from the river Marne by Claye to Epinay, would be of considerable economic value also. The other projects, to widen the left branch of the Seine and to deepen it between Suresnes and Bongival, will also receive a further study.

THE meteorologist of the Commonwealth of Australia has published his annual rain map of Australia for the year 1910, in which he shows that the coast lands in the south-west, almost the whole of the State of South Australia, or the States of South Australia and Queensland, northern New South Wales, and eastern Victoria received a rainfall above the average in 1910. This was especially so in the northern territory of South Australia, where the heavy fall was due to the activity of the monsoon rain influences. The difference between the actual fall in 1910 and the normal in some cases is very striking, showing frequently an increase of 50 per cent. The lowest rainfall, under 5 inches, was in central Western Australia. The highest, about 180 inches, was on the coast of Queensland half-way between Cook Town and Townsville. The district near Zeehan (Tas.) received above 100 inches.

"THE Supposed Cold of Winter Anticyclones" is the title of a useful note by Mr. W. H. Dines in *Symons's Meteorological Magazine* for March. In an interesting summary of the weather of January, in the magazine of the previous month, reference was made to the striking exception to the old dogma that high barometric pressure in winter is almost invariably associated with persistent frost. Mr. Dines, who some years ago assailed that idea in the Quarterly Journal of the Royal Meteorological Society, now points out, *inter alia*, that during the 50 years 1841–90, the Greenwich records show 74 periods of frost. Out of these, 20 (with 216 days of frost) occurred with the mean of the barometer below 29·80 inches, and 13 (giving 93 days) with a mean above 30·20 inches. Every frost noted for severity or length had occurred in the low-pressure series. Also at Christiania, Berlin, and Geneva no connection between the monthly winter means of the height of the barometer and of the temperature is shown. The statement in question is still made in some text-books, and may possibly be true in drier countries, *e.g.* in Asia and North America. Kite and balloon observations have shown that the air a few thousand feet high during an anticyclone is unduly warm.

THE climatology of 1910 is discussed in the usual annual summary which MM. Flammarion and Loisel contribute to the February number of *L'Astronomie*. The discussion is based on the daily observations made at the Juvisy Observatory, and the different results, in addition to being plotted all on one chart, are compared with the analogous monthly, seasonal, and yearly results registered during the past twenty-five years. The year 1910 was almost entirely a bad one from the weather point of view. An abnormally low barometer, which beat the minimum record for December, was accompanied by excessive humidity and rainfall, the number of rainy days (212) exceeding that of any year since 1893, while the amount of rain was 818·4 mm., or 275·9 mm. above the annual mean; its partition among the seasons was also abnormal. Although the mean temperature was the highest since 1906, the spring and summer were deficient in sunshine, there being 1555 hours spread over the 301 days on which sunshine was recorded; in 1909, 1970 hours were recorded for 300 days. In consequence of this state of sunless, cold humidity, the vine, wheat, and other crops met with disaster, and, as a "comet" year, 1910 compared very unfavourably with the legendary years 1811 and 1858.

AN abstract of the first three of the lectures on "Radiant Energy and Matter," which Sir J. J. Thomson is delivering at the Royal Institution, will be found in *The Electrician* for March 24. The first lecture dealt with the measurement of radiant energy and the laws which have been found to connect the energy radiated with the temperature of the radiating body. The second dealt with the pressure which radiation exerts on the body on which it falls, and the applications of the results of experimental and theoretical work on this subject to cosmical problems. The third dealt with the visible radiations, their production by fire-flies and by illuminating engineers, and their perception by the human eye.

IN the March number of *Terrestrial Magnetism and Atmospheric Electricity*, Mr. J. A. Fleming, of the department of terrestrial magnetism of the Carnegie Institution, describes two new types of magnetometer which have been constructed for land observations in districts more or less difficult of access. The first is a theodolite magnetometer for astronomical work and the determination of declination and horizontal force, the second is a universal instrument for astronomical work, declination, horizontal force, dip, and by Lloyd's method total intensity. In both cases the magnet system consists of a long and a short magnet each embedded in a brass cylinder of a standard size. The suspension is of phosphor bronze strip. The first instrument is built on the usual lines, but the reduction of size has necessitated changes of details. The second departs considerably from the traditional form owing to the combination of a dip circle with the deflection magnetometer. The two instruments, packed in their cases, weigh 11 and 13 kilograms respectively, and the degree of accuracy obtained by means of them is about the same as that secured with the older and much heavier instruments.

MESSRS. ADAM HILGER, LTD., have sent us a copy of their new general catalogue, which should be in the hands of every worker in the ever-widening field of spectroscopic research. Not only are a large number of spectrographs figured and described, their special features and adaptability for various purposes are carefully explained, so that the book is something more than a mere catalogue. One of the many features to which the firm pay special attention is the quartz-spectrograph, with which we know excellent results have been obtained. These are now made in a large variety of forms, some of which are easily convertible, so that their action can be modified to suit the special end in view. An ultra-violet stellar spectrograph, giving a spectrum 50 mm. in length from λ 3000 to λ 8000, is quoted at 53*l.*, and with its large angular aperture should prove a very effective instrument. A wedge spectrograph for technical use, designed by Dr. Mees for the rapid and permanent recording of absorption, transmission, and sensitivity curves, is sold, with the necessary accessories, at 17*l.* The catalogue also contains figures and descriptions of many accessories—gratings, slits, tubes, &c.—and of several special pieces of apparatus, such as

the echelon, the Fabry and Perot interferometer, &c. Those workers wishing to learn more of the latest forms of these special apparatuses should get section B of the catalogue, issued separately, in which, in addition to the descriptions, figures, and prices, complete bibliographies concerning them are given.

WE have received the new edition of the "Descriptive List of Photographic Dry Plates, Filters, and Safelight Screens" manufactured by Messrs. Wratten and Wainwright, Ltd. (Croydon). The firm have recently installed apparatus for the critical examination of the effect of colour screens upon definition, a matter too often left to chance. With regard to the plates, &c., prepared specially for all kinds of scientific work, we notice specific statements as to those best adapted for photographing various parts of the spectrum, and the "high resolution plates," for which a "limiting separation of about 1/150th mm." is claimed, as against a separating power equal to about 1/40th mm. for ordinary plates. These special plates are slow panchromatic plates.

OUR ASTRONOMICAL COLUMN.

DETONATING METEOR IN MESSINA.—On Monday evening, April 10, at 7 p.m., people at Messina noticed a brilliant illumination of the sky, succeeded in about three minutes by four loud explosions like artillery discharges. The idea was that one of the ammunition magazines in a fort had exploded, but telegraphic despatches from Palermo, Catania, and Reggio di Calabria announce that a similar phenomenon had been remarked there, and that it had its derivation from a large bolide or some other meteoric disturbance. The interval of three minutes between the flash and sounds show that the disruption of the fireball occurred at a distance of about forty miles from the observer at Messina. More information is awaited. At other stations the object may have approached much nearer, if it did not, indeed, shower some of its disintegrated fragments to the ground. April 10 is a rather special date for large fireballs; it has furnished many fine specimens in past years.

HALLEY'S COMET.—Writing to the *Astronomische Nachrichten* (No. 4489), M. Antoniadi shows that whilst Prof. Eginitis recorded the tail of Halley's comet as being directed towards the sun at 6h. 40m. (G.M.T.) on May 20, 1910, five observers who saw it at various short intervals before that time, and five who saw it after, recorded the tail as directed from the sun; only twenty-nine minutes separated the times of observation at Sonnwendstein and Athens, the former being 7h. 9m. (G.M.T.). Mr. Evershed, observing at Kodaikánal about 2h. (G.M.T.) on May 20, saw no trace of a tail directed towards the sun, although he looked specially for it.

The same number of the *Astronomische Nachrichten* contains a long series of observations of the comet made at Besançon (December 10, 1909, to June 29, 1910) and at Berlin (December 16 to June 10); M. Chofardet reproduces a drawing showing the magnificent fan which preceded the sharp nucleus on May 27.

CIRCULATION IN THE SOLAR ATMOSPHERE.—From an examination of 3323 prominences shown on photographs taken between January, 1904, and December, 1910, with the Rumford spectroheliograph at the Yerkes Observatory, Dr. Slocum has derived some valuable data concerning the circulatory currents in the solar chromosphere; the light of the H calcium line was always employed. Of the total examined, 1094 prominences, either by their shapes or movements, indicate a horizontal current, and as the average height to which these extended was 0·7′, or 30,000 km., the results represent the average poleward components of the solar atmospheric circulation from the lower surface of the chromosphere up to that height. Dr. Slocum finds that in middle latitudes there is a tendency for movement towards the poles, and in high latitudes a tendency towards the equator; near the equator the motion is practically negligible. The contrast between the two tendencies is greater in the northern hemisphere in the ratio of at least 2 : 1.

Among the earlier plates there were few which afforded data from which the velocities of the motions could be determined, but during the past year suitable plates for this purpose have been taken regularly. There is some difficulty in determining which of the observed movements may be ascribed to systematic circulation and which to local explosive outbursts, but ten selected cases give velocities of from 0·5 km. to 10 km. per second for the component of the circulatory movement which is perpendicular to the line of sight; one detached cloud, floating at an elevation of 442″, or 320,000 km., showed a velocity of 50 km. per second. Dr. Slocum points out that these results are not necessarily a contradiction to those obtained by Dr. St. John, who failed to detect any currents of appreciable velocity parallel to the solar surface; the two researches deal with different levels in the solar atmosphere. He further suggests that as his results depict the movements at an average height of 30,000 km., they probably apply to an upper current analogous to terrestrial anti-trades; a later discussion to deal with the different levels is promised (*Astrophysical Journal*, vol. xxxiii., No. 2, p. 108).

THE POPULARISATION OF ASTRONOMY.—From *The Yorkshire Weekly Post* for April 8 we learn that the excellent idea of out-of-door astronomical talks has also been suggested by Mr. J. H. Elgie as a useful item in the programme of the Leeds Astronomical Society. For the past three weeks the society has been waiting, in vain, for a favourable sky so that they might hold the proposed Saturday evening meeting. Such meetings, open to the public, might easily be organised, and would probably do a great deal to dissipate the lamentable ignorance concerning the stars which is so frequently displayed by the general public.

THE ANTWERP ASTRONOMICAL SOCIETY.—Among the many interesting matters recorded in the sixth annual report (1910) of the Antwerp Astronomical Society, it is of interest to learn that the society's observatory is being very generally used by a large number of students in the local schools, who, under the guidance of their tutors, visit the observatory and have the equipment, &c., explained to them. A new communal observatory is to be placed on the top of a school which is in course of erection in the city. An analysis of the observing weather during 1910, made by M. Felix de Roy, is also of interest. Of the 365 days in 1910, observations of the sun were possible on 269 days, and night observations were possible on 142; for 1909 the figures were 292 and 151; in 1908 there were 156 good nights; in 1907, 145; and in 1906, 102.

SPECTROSCOPIC BINARIES.—The Journal of the Royal Astronomical Society (Canada, vol. iv., No. 6) contains the orbits of the spectroscopic binaries 93 Leonis and ε Ursæ Minoris as determined by Messrs. J. B. Cannon and J. S. Plaskett, respectively, from plates taken at the Dominion Observatory, Ottawa.

Mr. Cannon made two determinations, using micrometer measures in the first and the comparator in the second, and, judging from the probable errors of an average plate, there is but little difference between the two methods; fainter spectra may be measured with the micrometer than in the comparator, but with poor lines for measurement the latter instrument probably affords a better agreement among the measures. The period of 93 Leonis is found to be 71·7 days, and the eccentricity of the orbit is very small.

For ε Ursæ Minoris Mr. Plaskett finds a period of 39·482 days, a range of velocities of 63 km. per sec., and a small eccentricity; the velocity of the system is −11·398 km. per sec.

EXPERIMENTS WITH COAL DUST IN FRENCH COLLIERIES.

SOON after the dangers due to the presence of coal dust began to be realised in this country, and, as a consequence, regulations regarding the composition and methods of employing explosives in dusty mines had been added to the Statute-book, the number of great explosions occurring within a given time underwent such a remarkable diminution that for several years it seemed almost as if they were about to cease altogether. But a partial

recrudescence having set in later, it became apparent to those who were watching the course of events that complete immunity could not be attained until measures were adopted for dealing with the coal dust in the haulage roads, as well as at the points at which blasting shots were about to be fired. It was equally apparent that no far-reaching legislative action such as this could be taken unless the mining community, which had hitherto regarded the dangers of coal dust as more or less hypothetical, could be convinced of their reality, by ocular demonstration on a large and imposing scale. Accordingly, when called upon to give evidence before the Royal Commission on Mines some years ago, the present writer and others recommended the construction at Government expense, at an estimated cost of 10,000*l.*, of a large apparatus to be used for this purpose. It is, perhaps, needless to remark that the Treasury declined to find the money, just as they had, some twenty-nine years ago, declined to find 5000*l.* for the construction of a similar gallery, 500 feet long by 6 feet in diameter, intended to be used for the same educative purpose, when asked to do so by the Royal Commission on Accidents in Mines, for one of the members of which (Sir W. Thomas Lewis) the present writer had obtained tenders.

The suicidal blindness of this kind of policy from a national point of view must surely be becoming apparent. It was at this juncture that the Mining Association of Great Britain stepped in and erected the experimental gallery at Altofts Colliery, which has been already described in a previous review (NATURE, February 9, vol. lxxxv., p. 487).

When it was recognised in France that the explosion at Courrières Collieries, which claimed more than 1100 victims in 1906, was due to coal dust alone, the opposition which the Commission du Grisou had, up to that time, maintained against the coal-dust theory was effectually crushed, and it became necessary for those responsible for the safety of French mines either to accept the data regarding the behaviour of, and means of dealing with, coal dust already accumulated in other countries, or to accumulate quasi-original data of their own. The opportunity of adopting the latter alternative presented itself when the Comité Central des Houillères de France agreed to find a capital sum of 14,000*l.* wherewith to provide experimental appliances, and an annual income of 3000*l.* a year for current expenses as long as the experiments are continued.

The appliances which have been set up at Liévin Collieries in France are similar to, and intended to serve the same purposes as, those at Altofts and other experimental stations.

The experiments are being conducted by M. Taffanel, a member of the Corps des Mines, who has issued consecutively a number of very clear and able reports, describing the appliances, the methods of using them, and the results obtained with them.

In attempting, in his first report, to justify the attitude of antagonism to the coal-dust theory which his colleagues had just abandoned, he essays to throw a dart at the work of the present writer, but the weapon, having the form of a boomerang, naturally descends upon the unhappy heads of those he is trying to protect. It could not well be otherwise, for his subsequent voluminous descriptions of the mode of occurrence of a coal-dust explosion, the functions of the condensed and expanded waves and the position of the flame in the former, the influence of the weight of dust in a given volume of air, its fineness, the proportion of volatile matter contained in it, and the presence of more or less inert matter and moisture, had all been anticipated in the work in question; so that his own contributions to the subject, when divested of a vast amount of prolixity and a great array of numerical data, much of which is of doubtful, and most of only hypothetical value, largely partake of the nature of plagiarism.

Numerical data obtained by means of experiments of this kind are of no practical value except in so far as they can assist us in devising means for putting an end to great explosions. Thus, as it is known that the flame of an explosion in a mine can ascend to the top of a damp or wet shaft 900 or 1000 feet deep, it is not of the least importance to know whether an explosion in an experimental gallery can or cannot leap across a dustless zone a few hundred feet in width, and raise and ignite coal dust lying at its farther side. It is equally unimportant to know with what velocity the flame travels in, or what particular pressure is exerted by, an explosion of dust of greater or less fineness, or containing more or less volatile matter, since we are absolutely powerless to regulate any one of these conditions in a dusty mine, and know that an explosion, once begun in it, will spread as far as there is coal dust to maintain it.

In further attempting to cover the retreat of his comrades, M. Taffanel pleads that they had no previous experience of coal-dust explosions in France before the one at Courrières Collieries. But the present writer has a lively recollection of reading the accounts of two great explosions at the Jabin pits in France, which occurred one after the other within a short period of time, some thirty or more years ago, and of making a mental note at the time that, judging by the phenomena as described, they were both due to coal dust and not to firedamp, as was then announced. Again, surely M. Taffanel does not now seriously contend that the four great explosions, Chatelus, 1887, Verpilleux, 1889, Pelissier, 1890, and Manufacture, 1891, were attributable to any other agent than coal dust.

We frankly agree with M. Taffanel that his countrymen are, as a rule, in the van of progress; that although they did not originate the method of measuring the proportion of firedamp in the air by means of the firedamp cap (*for this see* Proc. Roy. Soc., vol. xxiv., pp. 361 to 367), they have produced an excellent lamp for the purpose; and that their appliances and regulations for dealing with firedamp, and for blasting, are amongst the most perfect in existence, and we heartily congratulate him and them upon the results of these measures. But *qui s'excuse s'accuse*: and the mere fact that they have been able to perfect their methods of dealing with firedamp makes it all the more regrettable that they so resolutely refused to believe in the dangers of coal dust, since it is practically certain that had they lent their powerful aid to the solution of that question from the beginning, it would have been settled long ago, and at least two Royal Commissions which examined the subject successively in this country would have been saved the ignominy of making halting and half-hearted suggestions for grappling with it.

The first series of M. Taffanel's experiments was made with an auxiliary apparatus consisting of two pieces of sheet-iron pipe, each 25 feet long by 2 feet in diameter, placed side by side and connected to each other at each end by short pipes of the same diameter. The air was made to circulate through this system by means of a fan working at the middle point of one of the longer pipes with sufficient rapidity to keep fine dust suspended in it, and shots were fired from a cannon into the dust-laden air from one end or the other of the second long pipe. By this means it was ascertained that dust containing 11·3 per cent. of volatile matter (ash and moisture deducted) could not be ignited by the explosion of a half cartridge of gelatine dynamite fired electrically from the cannon without tamping, but that dust containing 15·4 per cent. and up to 53·2 per cent. could be invariably ignited when the air contained a minimum weight of 138 grammes per cubic metre of that with 15·4 per cent. and 40 grammes per cubic metre of that with 53·2 per cent., and similarly an intermediate weight for an intermediate proportion of volatile matter.

The second series of experiments was made with the same apparatus (the shots being fired in the direction of the air current), one set to ascertain the effect of varying the weight of the explosive, the other to determine the effect of mixing the coal dust with slate dust. The coal dust employed was prepared with Liévin coal containing 29 to 30 per cent. of volatile matter and 3 to 5 per cent. of ash, and of such a degree of fineness that only 5 per cent. of it was unable to pass through the sieve with 5625 meshes per square centimetre.

By these experiments it was ascertained, first, that a certain minimum weight of explosive was sufficient to produce ignition, and that increasing that weight made little or no difference in the length of the resulting coal-dust flame; and, secondly, that the addition of slate dust to the coal dust reduced the velocity of propagation of the flame, although inflammable clouds were obtained with as much as 62 per cent. of slate dust, and it seemed doubtful whether under certain conditions propagation would not take place with as much as 78 per cent.

These results are to some extent in keeping with those obtained by the present writer on June 5, 1896, when he made the first experiments of this kind with mixtures of combustible (in that case lycopodium) dust and inert dusts (chloride of calcium, dry clay, common salt) at University College, Cardiff, in the presence of Mr. Robson, then Chief Inspector of Mines for the South Wales district, and Mr. Vaughan Nash.

The third series of experiments was made with the principal gallery, which in 1908 was 71 yards long, in 1909 was lengthened to 250 yards, and in 1910 to 328 yards. The first 33 yards of its length is constructed with ferro-concrete specially strengthened with steel joists. Its form is trapezoidal in cross-section, and its internal dimensions are 6 feet high, 4 feet 7 inches wide at the top, and 5 feet 3 inches wide at the bottom. This shape and these dimensions were chosen with the object of assimilating its interior to that of a roadway in a mine, and the similarity is still further accentuated by means of props and caps set up at the usual distances apart in its interior. In its final form, so far as one can gather from the descriptions, the remainder of the gallery is constituted by a sheet-iron cylinder, 6 feet in diameter, with one of its ends abutting against one end of the ferro-concrete section and its other end open.

Two massive stone walls, one on each side of the free end of the ferro-concrete part of the gallery, extend backwards from the latter to a distance of 10 or 12 feet, and constitute supports to a vertical barrier of strong wooden beams, with which that end is closed. The cannon from which charges of explosive are fired for the purpose of igniting mixtures of firedamp and air, or of raising and igniting coal dust in the interior of the gallery, can be fired horizontally at any desired height in the vertical centre-line of the latter, with its muzzle extending through a hole in, and flush with the inner face of, the wooden barrier. Its bore is 2 inches in diameter and 23½ inches deep, and, except where specially mentioned to be otherwise, its axis was placed at a height of 2 feet above the floor. The explosive employed was gelatine dynamite fired without tamping by means of an electric fuse, and the minimum weight of charge that assured propagation of the coal-dust flame under ordinary conditions was 160 grammes.

A branch gallery built of masonry, connected at right angles to the main gallery at a distance of about 17 feet from its closed end, serves the purpose of a channel, through which air can be blown, by means of a ventilating fan, into and through that gallery, and also affords a means of ingress to and egress from it.

When an explosion is about to be produced, the connection between the main and branch galleries is cut off by closing a strong door at their point of junction.

There are twelve plate-glass windows about the middle height of the ferro-concrete part of the gallery, through which the progress of flame in its interior can be seen from a distance. Its cylindrical prolongation, on the other hand, is embedded in the centre of a mass of debris, like a railway embankment, about 6 feet high by 12 feet wide at the top, and with sloping sides.

The coal dust employed in the experiments is obtained by grinding coal as it comes from the mine, first in a ball-mill, and secondly in an Alsing pulveriser. The degree of fineness attained in the latter depends upon the length of time during which the grinding is continued.

After having been first granulated in the ball-mill and then ground in the Alsing pulveriser for the length of time named below, the following proportions of Liévin coal are arrested by a sieve of brass wire with 5625 meshes per square centimetre,[1] viz. :—

Time	Per cent remaining on seive
0 minute	72·5
15 ,, ...	35·0
30 ,, ...	12·5
45 ,, ...	3·5
60 ,, ...	1·5

Some analyses of the same coal employed in the experiments are as follows :—

	Per cent.	Per cent.	Per cent.
Volatile matter (including moisture) ...	28·00	25·07	29·50
Ash	8·57	12·16	5·97
Volatile matter (exclusive of ash ...	30·60	29·30	31·40

The weighed quantity of dust employed in each experiment was scattered uniformly over the floor of the gallery by hand; that remaining unconsumed after the experiment was partly swept, partly blown out, by means of a strong current of air from the fan; and when it was desired specially to cleanse the gallery, jets of compressed air were employed for the purpose.

When it was desired to effect the ignition of the dust by means of an explosion of firedamp and air, part of the gallery next the wooden barrier was isolated by means of a paper diaphragm in exactly the same way as was first done for the same purpose in the Royal Society gallery of 1880–1, and afterwards in the Prussian gallery of 1884, and the gas and air already mixed was introduced into it in exactly the same way as an accurately measured quantity of firedamp was introduced into the isolated part of the Royal Society gallery, in which it was mixed with the air by being drawn into the centre and expelled from the periphery, of a rapidly revolving fan in the interior of the gallery itself.

The apparatus employed for measuring pressures is of the "crusher type," such as is employed in testing explosives. It consists of a cylinder, containing a hollow piston with a block of lead in its interior, and a small steel ball interposed between the block of lead and a fixed support. The pressure acts on the piston which presses the lead against the steel ball, and the latter, being prevented from moving by the fixed support, penetrates the lead to a greater or less depth. In spite of the extreme accuracy with which it is professed that the depressions produced in the lead block can be measured, a more clumsy and probably inaccurate method of measuring the comparatively small pressures here requiring to be dealt with could hardly well be imagined.

The appliance for measuring velocity, which consists of a counter marking fifths of a second, started at the moment the explosion commences and stopped by an observer when the flame appears at the end of the gallery, the length of which for this series of experiments appears to have been 65 metres only, seems to be hardly less trustworthy than the pressure recorder.

On the other hand, the flasks for collecting samples of the products of combustion immediately after the passage of the flame, from which the air had been extracted beforehand, and into which nothing could enter until a sealed glass tube which communicated with their interior had been broken by a detonator ignited by the flame of the explosion, seem to be satisfactory.

The firedamp employed in some of the experiments was obtained from the pit near at hand, stored in a gasometer, and mixed with air in the proportion of 9 or 10 per cent. before being introduced into the isolated part of the gallery in the manner already indicated.

Of all the explosives tested, dynamite was found to produce coal-dust explosions with the greatest facility. It was found that the explosion of 8 cubic metres (282½ cubic feet) of a mixture of firedamp and air, when ignited by means of 100 grammes of black powder, easily gave rise to a coal-dust explosion under favourable conditions; but that under less favourable conditions the superposition of a firedamp explosion upon that of dynamite actually diminished the chances of propagation. M. Taffanel's attempt to explain this phenomenon, by supposing that the large quantities of carbon dioxide and water vapour projected into the dusty atmosphere in consequence of the combustion of the firedamp are responsible for this result, is altogether erroneous. The true explanation is that the expanded wave, following after the condensed wave in the *cul-de-sac* constituted by the little gallery, overtakes and extinguishes the flame. The present writer observed the same phenomenon in his smaller Royal Society gallery of 1877–8, and succeeded in destroying the expanded wave and securing free propagation of the coal-dust explosion on every occasion by providing a flap-valve, opening inwards only, at the closed end of the gallery, through which air was drawn with sudden violence an instant after the firedamp mixture had exploded; and he has no doubt that M. Taffanel would have exactly

[1] Comite Central des Houillères de France Station d'Essais de Liévin-Troisième Serie d'Essais, p. 9 (1910).

the same experience if he provided either a similar valve or a reservoir of air of sufficient capacity near the closed end of the *cul-de-sac* (such as exists in the form of branch workings in most mines), from which air could expand and thus wholly or partially destroy the vacuum. If he arranged his experiment in this way, he would have no difficulty in securing propagation by means of a firedamp explosion ignited by a spark, much less by 100 grammes of dynamite.

Many other points of importance might be referred to with advantage, but space would fail us were we to attempt to go further in this place, and the final remark we would make in regard to this series of experiments is that the water employed in damping the dust, which forms globules on the surface of the latter, does not appear to have been applied in the form of an exceedingly fine spray, repeated several times, in succession, with a short interval between each application, and we venture to think that if this had been done the results would have been different from those actually experienced.

The fourth series of experiments was made with the gallery lengthened to 230 metres (251½ yards), although the whole length was not always employed. For the first 32½ yards the form of the gallery was trapezoidal, with a lining of cement, the remainder cylindrical, with a lining of wood and with a floor. The coal dust was prepared from Liévin coal, with 29 to 31 per cent. of volatile matter and 6 to 12 per cent. of ash. The slate dust employed in some of the experiments was obtained from the pit. It contained 9 per cent. of volatile matter and 87 per cent. of ash, and was mixed with marly chalk, clay, siliceous sand, and boiler-furnace cinders. Mixtures of coal dust and inert dust were prepared by grinding them together. The mixture was simply spread uniformly on the floor and not stirred up mechanically before the explosion. The charge employed in creating the explosions consisted of 240 grammes of gelatine dynamite untamped and fired electrically, the axis of the cannon being 15¾ inches above the floor.

Fine dust was spread to a distance of 16½ feet in front of the cannon to insure ignition, but beyond that point coarser dusts ground for a quarter or half hour and even grains were employed.

Some explosions effected with half-hour dust were very violent, traversing the whole length of the gallery in 1½ seconds, with increasing velocity, which exceeded 1100 yards per second at the orifice, while the pressure, which was 28½ lb. per square inch for most of the distance, increased to between 42½ lb. to 71 lb. per square inch at 45 metres from the orifice, and to 156½ lb. per square inch at 11 yards from the orifice. With 900 grammes per cubic metre of quarter-hour dust, the flame traversed the gallery in 1·23 seconds, and the pressure attained 224 lb. per square inch at 10 metres from the orifice.

With a deposit of coal dust containing up to 33 per cent. of slate dust the coal dust was exploded, and the explosion was capable of becoming violent.

Passing over the experiments with dustless, watered and shale dust zones, and those made with obstacles of various heights, placed on the floor and on shelves at the sides of the gallery, we come to what are the most novel, and perhaps also the most interesting, of all the experiments, namely, the efficient results obtained in the way of arresting even violent explosions by placing loose, easily displaced cinders, or, *mutatis mutandis*, half-round sheet-iron tanks 40 inches long by 8 inches in diameter, filled with water on transverse planks one metre apart just under the roof of the gallery. It is to be hoped that these two methods of arresting explosions will be the object of further successful experiments, and it is not improbable that, after all, we may owe to France a debt of gratitude for pointing out a simple and efficacious means of effecting the object which all of us are so anxious to attain. May the present writer suggest in conclusion that possibly appliances of the nature of extincteurs or fire extinguishers, put into operation by the blast which precedes the flame of an explosion acting upon a movable vane which would open the passage for the escape of their contents, might be used instead of open troughs filled with water? The former would possess the indubitable advantage that they would retain their efficiency intact for any length of time; whereas the latter would require constant attention in the way of cleaning and refilling them. W. GALLOWAY.

THE INSTITUTION OF NAVAL ARCHITECTS.

THE spring meetings of the Institution of Naval Architects opened on Wednesday, April 5, at the rooms of the Royal Society of Arts. Owing to the death of Earl Cawdor, president of the institution, the chair was taken by Sir W. H. White, who announced that the council recommended the election of the Marquis of Bristol as president. The grant of a Royal Charter of Incorporation has received the Royal assent. The celebration of the jubilee of the institution, postponed from last year, will take the form of an International Congress on Naval Architecture and Marine Engineering, opening on July 4.

Fourteen papers were read and discussed. The problem of size in battleships was dealt with by Prof. J. J. Welch. Among other points raised in this paper is the contention that large dimensions expose a greater target to attack, a contention which must now be expanded to include the additional menace of missiles from dirigibles or aëroplanes. Assuming the attack to be delivered from a height of one mile, and therefore reasonably out of range of high-angle fire, a hollow bomb carrying 100lb. of explosive would take about twenty seconds to reach the water level, and would then have a striking velocity of about 500 feet per second. In twenty seconds a ship would change position some 540 feet, supposing her to be proceeding at 16 knots, and the probabilities of such a vessel being struck from above would be decreased if, at the moment of discharge of airship weapon, her helm were put hard over. The time, however, would not suffice to allow the vessel to sweep clear of her previous track before the missile reached water level, although the exposed area of deck in that track would be very much smaller than before. The difficulties associated with correctly judging speeds of battleships from the height named, and making proper allowance for cross wind currents, &c., combine to render a hit very uncertain if a single missile only is employed. It is stated, however, that arrangements are being made for dropping a number of such missiles from a single dirigible, in which case this form of attack would become a serious menace. It seems reasonable to suppose that the best protection from such attacks will be found in the counter-attacks by the same type of air-ship, associated with high-angle gun fire from the vessel attacked.

The Hon. C. A. Parsons and Mr. R. J. Walker gave the results of twelve months' experience with the geared turbines fitted to the cargo steamer *Vespasian*. In this vessel, the reduction of speed ratio of 20 to 1 is obtained by means of a spur wheel and pinion having double helical teeth. The vessel has now steamed 20,000 miles, and inspection shows that the wear in the teeth so far seems to be a negligible quantity. With the view of experimenting with different qualities of steel, a pinion of chrome nickel steel of tensile strength 55 tons per square inch, elastic limit 38 tons, and an elongation of 20 per cent. in a length of two inches, was tried and removed after two voyages. The corners of some of the teeth were found to be fractured, probably owing to irregular machining and to the material being too brittle. The original pinions were of mild chrome nickel steel of tensile strength 37 to 38 tons per square inch, and an elastic limit of 32 tons per square inch. These were replaced and have now carried the vessel more than 18,000 miles. A very noticeable feature has been the absence of racing of the engines under conditions when the propeller has been entirely out of the water. It is very difficult to observe any acceleration in the speed of the engines without the aid of a sensitive tachometer. This is owing to the very great angular momentum of the turbine.

Mr. G. S. Baker contributed a fully illustrated description of the National Experimental Tank and its equipment, including the model-making apparatus.

The whole of Thursday morning was taken up by a paper on Diesel engines for sea-going vessels, by Mr. J. T. Milton, of Lloyd's Register, a paper which provoked a very interesting discussion. Inducement to forsake the steam engine for ordinary sea-going vessels will be mainly the question of fuel economy. Even this important point would not of itself warrant a change to a new type of engine unless equal certainty of continuous efficiency on the voyages to be undertaken was provided, that is, as little risk of accident to machinery and as great facility for using temporary expedients for reaching port in case of break-

down of part of the machinery. There must also be a prospect of a reasonable cost of upkeep. Leaving warships out of account, oil fuel is only used on shipboard in those cases where the natural advantages render its use more economical than coal, and by vessels which trade regularly to ports where supplies can be obtained. For the ordinary cargo steamer which has to seek employment all over the globe, coal is still the necessary fuel.

The Diesel engine for marine purposes is made in three forms, viz., as a four-stroke cycle single-acting engine, a two-stroke cycle single-acting engine, and a two-stroke cycle double-acting engine. An auxiliary air compressor capable of producing a pressure of about 700lb. per square inch is required. The author has examined the turning moment diagrams of different arrangements of cylinders, and shows that a four-stroke cycle engine with twelve cylinders, a two-stroke with six cylinders, and a double-acting with three cylinders give fairly uniform Forsion moments, the ratio of maximum to mean being not greater than 1·15. With these numbers of cylinders there is nothing further to be desired regarding steadiness of motion. The Diesel marine engine should be Diesel only as regards the cylinders and their accessories, and should be of the ordinary marine type as regards all the rest of the engine. The question of the auxiliary machinery required is fully discussed in the paper.

Dr. Diesel stated in the discussion that any kind of oil may now be used in these engines, and that the use of the two-stroke cycle may be assumed in future for marine purposes. Some 250 vessels are now fitted or to be fitted with Diesel engines, a large number of these being submarines. The use of Diesel engines in submarines has so extended their radius of action as no longer to limit their use for coast defence merely. About 1000 horse-power is the largest power obtained from one cylinder up to the present, the cylinder being of the two-stroke double-acting type. Some makers are prepared to give higher powers from one cylinder.

Messrs. Richardson, Westgarth and Co., of Middlesbrough, are now constructing a set of single-screw Diesel engines of 1000 horse-power for a 3200-ton ship to the order of Lord Furness. These will be of slow-running type. The Anglo-Saxon Petroleum Co. have on order a single-screw vessel of 4250 tons to be fitted with 1100 horse-power Diesel engines, to be built by an Amsterdam firm.

Considerations affecting local strength calculations form the subject of a paper by Mr. J. Montgomerie. It is a truism that there is no such thing in the calculations dealing with the strength of ships as an actual quantitative stress in tons per square inch. "To design a ship from first principles" is a phrase which is often used in a sense implying far too much. All calculations of the strength of ships are comparative. Structural arrangements of vessels which have stood the test of experience are taken, and are compared and contrasted with those proposed in any given case, or a corresponding arrangement is derived from them which shall be satisfactory in the case being dealt with. It is of importance to eliminate, so far as possible, errors lying at the root of the comparison. For example, the comparison of a beam of symmetrical section with another of unsymmetrical section by use of the ordinary beam formulæ may produce very large errors. Again, errors often arise through want of proper consideration in cases of combined normal and shearing stresses. The effect of altered flexibility in a proposed arrangement often causes an entire change in the basis of comparison, and is generally uniformly neglected. Recent experimental work by Lilly on columns and Bach on flat plates was referred to. In connection with the latter subject comparatively little is known experimentally for rectangular plates fixed at the edges, and Dr. Thearle announced that the committee of Lloyd's Register had made a pecuniary grant to the author of the paper to assist in enabling further experiments to be carried out.

The acceleration in front of a propeller is the subject of a paper, in which Dr. R. E. Froude resists the inroad which a propulsion paper read by Prof. Henderson last year makes upon Dr. Froude's paper of 1889. The principal purpose of the latter was to prove from hydrodynamic theory that, in so far as the fluid acceleration by which thrust is satisfied may be treated as external to the propeller, one-half of that acceleration must take place before the propeller in obedience to defect of pressure in front of it, and the other half after it, in obedience to excess of pressure behind it. Prof. Henderson's paper of last year purports to prove, also from theory, that the precedent acceleration cannot possibly contribute to thrust. In the present paper Dr. Froude reasserts his theory, together with such further considerations as appear to be called for by Prof. Henderson's paper.

Herr H. Frahm contributes a paper giving the results of trials at sea of his anti-rolling tanks. Reference has already been made to Frahm's arrangement in NATURE. When in full action, the tanks on the ss. *Ypiranga* and *Corcovado* exert a turning moment of 2790 foot-tons, thus counteracting wave impulses of equal turning moment. In order to obtain equal efficiency in damping out rolling, the same turning moment ought also to be exerted by any other anti-rolling device, such as a gyroscope, which might be fitted to these ships. It is doubtful if it will be possible to develop the gyroscope sufficiently. The ss. *General* (13,620 tons loaded displacement), of the German East African line, started on her maiden trip at the beginning of March. When crossing the Bay of Biscay, she encountered a storm which made her roll 14° on either side when the tanks were out of action. This was reduced by 7° or 8° when the small fore tank was put into action, and with both tanks in action, the rolling was reduced to 3° in either direction. A large working model was shown in the library of the Royal Society of Arts. The ship was set rolling in a tank by means of an electromotor, operating on the model by means of a very flexible flat spring. The model showed very clearly the efficiency of Frahm's tanks in reducing rolling.

Prof. E. G. Coker describes his optical method of investigating stress in plates of variable sections, and gives some applications to ship's plating. The method has been already noted in NATURE, and it may be now added that the author has developed a method of obtaining the stresses quantitatively. This may be done by subjecting a standard test-piece to such a degree of pull or push that the colour produced agrees with that at a desired point in the body under examination. Or by a method modified so as to get rid of the necessary judgment in matching colours; this modified method may be used in all cases of pull or push stresses, and consists in arranging a simple pull or push member in the same field of view as, and immediately in front of, the object under examination. To determine the stress at any point, the reference member is loaded until the original dark field produced by the optical arrangement reappears. When this happens, the stress in the reference member is the same as that at the point considered, and no correction is required for the alteration in thickness produced by the stress, since both test pieces are in exactly the same condition.

STATE SURVEYS.[1]

THE true economy of executing land measurement of the highest precision as a control upon more detailed work, which can then be done more quickly and at less cost, is now generally admitted, and wherever the area is large such control work is carried out by a central administration for the use and assistance of local surveys. Methods will vary in different areas and with the special object in view, but such coordinated work on a large scale has great advantages over small scattered areas in which work is carried on independently.

(1) The operations of the Survey of India during the twelvemonth ending September 30, 1909, are described in the report which has just been issued. Primary triangulation was carried on in Beluchistan, Kashmir, and Burma over an area of 9600 square miles, besides a certain amount of building and selecting station; the average triangular of three groups completed were 0·41″, 0·6″, and 0·47″. The 10-foot standard bar A having returned from Sèvres, whither it had been sent in 1908 for comparison with the international metre, was recompared with the secondary standard bar of the Survey, and the results show that it is

[1] (1) "General Report on the operations of the Survey of India." By Col. F. B. Longe, R.E. (Calcutta, 1910.)
(2) United States Geological Survey, Washington. Bulletins 434, 437. Spirit Levelling, 1896 to 1909.
Bulletin 440. Results of Triangulation and Primary Traverse, 1906-8.

improbable that any change took place in its length between the time that it left India and its return from Sèvres, so that the value of bar A, viz. 3047·996 mm. at 62° F. in terms of the international metre, is thoroughly trustworthy. Pendulum work was carried on in the western tracts of the Sátpurá hills and the Vindhyan plateau as an investigation of the variation of gravity in the northern portion of peninsular India, and at seven stations, situated at from 750 feet to 2100 feet above sea-level, excesses of gravity were found. At twenty-eight stations above 750 feet hitherto observed gravity has never been in excess, so that dissimilar conditions in peninsular and extra-peninsular regions seems to be indicated. Subsequent seasons' work is being extended over Rajputana and the Sátpurá hills to the Gangetic plain. Tidal records from nine stations, Moulmein being one which was re-established, and nearly 1100 miles of double levelling, occupied a portion of the staff, while the Magnetic Survey working in Burma completed the preliminary survey with a total of 1255 stations.

Some specially disturbed areas were surveyed in detail, and this work is being continued. Heavy prolonged rain at Dehra Dun eventually forced its way into the magnetograph room, and, rising within an inch of the top of the driving-clock pillar, necessitated the removal of the instruments on August 15, which were replaced a month later. The Topographical and Forest Surveys also completed the survey of a large area of country. In cartographic work, the results of the reorganisation of the drawing, engraving, and printing branches which was carried out since 1906 are now to be seen, and the publication of standard map-sheets has kept pace with the survey and drawing, besides there being a considerable increase in outturn. A specimen sheet of the 1 : 1,000,000 map, the strategical map of India, is given, containing the region round Bombay; roads, railways, and boundaries are strongly brought out, but the relief is shown by shading, which renders main features prominent, and by comparatively few inscribed altitudes.

(2) The Bulletins of the United States Geological Survey, which deal with higher surveying, furnish the final results of work done in the field after all corrections have been applied. The numbers stamped on the bench marks in the field represent the elevations to the nearest foot above mean sea-level as determined by unadjusted levels in the field, and those who require a higher accuracy than 2 feet must consult these bulletins or apply to the offices of the Survey. The levelling is classified as precise or primary according to the accuracy of method and precision of the instruments employed, and lines are run both forward and backward in the former case, but in one direction only in the latter. The allowable limits of error in feet are respectively $0{\cdot}017\sqrt{D}$ and $0{\cdot}05\sqrt{D}$, where D is the distance in miles. In the bulletins the position of each bench mark is described and its altitude given to 0·001 foot for both classes of work.

The results of triangulation and primary traverse are likewise given in periodical bulletins, which not only give the description of each station, its mark and reference mark, and geographical position, but also the azimuth, back azimuth, and the logarithm of the distance from it in metres of all points observed from it. An interesting map of the United States is included showing the astronomic location and primary control up to January 1, 1909. While much has been accomplished, large areas remain along the 101st meridian, in the Southern States, and many other parts to be completed.

THE STANDARDISATION OF COLOURS.

UNDER the title of "International Rules for the Specification of Colours," Mr. Hans-Jacob Möller has reprinted an essay by him from the Journal of the Danish Apothecaries' Association (*Archiv for Pharmaci og Chemi*, November 14, 1910) showing the importance of having an international scheme of colours so as to enable reference to be made to a definite tint on a definite scale, and recommending as the most useful and most practical scheme of the kind that drawn up by Klincksieck and Valette, a scheme based upon the original system drawn up by Chevreul. There can be no doubt that such a colour scheme, recognised throughout the scientific world, would be of great practical value. For example, to take a very obvious instance, a large number of chemical reactions in connection with organic substances, such as dye-stuffs, depend upon colour changes, and if it was possible to describe these colour changes in accurate language, it would be of great practical value to the chemist.

When we come to the departments of pigments and of dye-stuffs, it is obvious that there, too, a definite recognised colour scheme would be of great practical value. It would, however, probably be better, if once a colour scheme was decided upon, that it should be reproduced in some permanent material such as coloured glass, so as to give a definite standard for reference at any future time, as a colour scheme which is merely lithographically printed may alter owing to fading of the colours, and if an attempt is made to repeat it, it is seldom that pigments can be twice reproduced with exactly the same tint.

On the other hand, an attempt to refer to definite lines on the spectrum is difficult in practice, as the use of the spectrum in this way for the matching of colours is not very easy, and it is not a satisfactory method. Mr. Möller does not refer to Lovibond's work on this subject and his scheme of coloured glasses. The present writer has found the Lovibond tintometer most useful and capable of very accurate matching, though the Lovibond standards are purely arbitrary. An arbitrary scheme seems the only possible one, and therefore, as Lovibond has devoted so much ingenious labour to the making and matching of his coloured glasses, there is a great deal to be said for defining tints by means of his tintometer, such a tintometer being kept as a standard of reference. Whatever may be determined, however, as the best practical solution of this question, it is certainly time that something of the nature of an international colour scheme be adopted, so that there should be no difficulty in referring to a definite scale and number in describing any colour.

A. P. LAURIE.

DIET AND DEVELOPMENT.[1]

THE main impression left by a perusal of this exhaustive report upon the diets of labour convicts in Bengal jails, referred to below, is that the Indian Government has been well served in this matter, and has now in its possession advice derived so judiciously from soundly organised and ably conducted investigations as to justify what, on weaker evidence, might have seemed a parsimonious procedure, namely, some limitation of the too ample dietaries of these prisoners. The author may be said to have proved that their vegetarian diet, such as is the common food of the native population, has been provided in quantity so large as to escape digestion. No one will find reason to doubt his statement that this undigested material gives occasion to various forms of distressing trouble whilst in disordered transit through the alimentary canal of its consumers; not that this point is new, but that the condition has been very definitely shown as existing in this special and important case.

It would seem that, prior to this investigation, the diets had been arranged so as apparently to display the same "protein value" as a European diet. In the effort of imitating the heavy labour diet of English prisons with combinations of the native food-stuffs, meals of extraordinary bulk have been provided. Whereas, when added in small quantity to the varied constituents of a European meal, similar food-stuffs may yield so much as 80 per cent. of their contained protein for absorption into the tissues of the body, the author has shown that often no more than 50 per cent. is absorbed from them when found as the main constituents of a bulky meal, and this notwithstanding the fact that bulky meals are characteristic of the district, if to a somewhat smaller degree than within its jails. He has also proved that a certain ascertained diminution in this bulk, accompanied by an apparent diminution in the protein value of the diet, is always the

1 "Investigations on Bengal Jail Dietaries, with Some Observations on the Influence of Dietary on the Physical Development and Well-being of the People of Bengal." By Capt. D. McCay, I.M.S. Pp. iv+226+15 charts. (Calcutta: Government Printing Office, 1910.) Price Rs. 2.6 on 4*s.* 3*d.*

(Scientific Memoirs by Officers of the Medical and Sanitary Department of the Government of India, New Series, No. 37.)

cause of an actual increase in the amount of protein absorbed, and has shown that some improvement in condition attends this alteration. His work promises, therefore, to be in a very real sense of economical value to the Government, indicating a better maintenance of health on wisely diminished rations. This statement also applies to his study of the salt requirements of these diets, which lead him to the conclusion that more salt is supplied than is useful, and that the excess is detrimental.

The author has carefully studied changes following an increased absorption of protein from the diet, and presents an admirable case for discussion alongside the valued contributions of Chittenden. He has enlarged his presentation of this case by reference to the habits of the different native races within his view. According to him, these races may be arranged in a series, in which virile characteristics vary directly with the protein value of the diet, and are greatest where, as amongst flesh-eaters, this value is at a maximum. Carnivorous man sets to his work with zest, and is prepared to labour strenuously, and, if need arise, fight for life. The vegetarian spends a gloomy existence, embarrassed by an internal tangle of cellulose, and is swept off by feebly resisted disease. Some of the evidence offered in support of this contention is not of the same value as that in the remainder of the report, but it is highly interesting, and has been usefully published.

Prof. McCay is to be congratulated upon a report that should be found in every library of physiological literature. The opportunities provided by such a systematic observation of human beings under very precise control are great, and have been well utilised.

J. S. MACDONALD.

RECENT PROGRESS IN AËRONAUTICS.[1]

THE sudden development of the art of flying which has come upon the world during the last few years may be classed as one of the most extraordinary events in the world's history. We have had far-reaching inventions introduced before, such as the railway, the telegraph, the telephone, the motor-car, and many others, but all these have gradually developed, have sprung from small beginnings, and often it seemed doubtful whether they would ever develop into utility of real importance. With the flying machine it is different. True it is that the advent of such an apparatus has been foreseen, not merely for some years, but for centuries. The inception is very old. Like the sailor's story to his incredulous grandmother of the flying-fish, so a hundred years ago no one would have been dumbfounded if one had prophesied that men would fly, although one would have been accused of talking nonsense had one foretold that we could talk along a wire hundreds of miles long, see bullets embedded in the lungs, or be able to reproduce a song sung by one departed. We dare not at present hazard a guess as to what the flying-machine may eventually develop into. There are still those who think it will never be much more than a curiosity, but there are others who believe it will soon become our usual mode of travel, and that railways, steamboats, and motor-cars will have to take quite a back place in comparison.

My object to-night is not to give a full history of the navigation of the air. That is getting into a big subject that would occupy a long time to properly relate. Nor is this to be a very technical lecture; I propose now merely to refer to the latest developments—to trace some lines of thought which I hope may serve as a basis on which my hearers may build more solid structures for the improvement of the navigation of the air.

Aërial machines have been classed under two headings, known as lighter-than-air and heavier-than-air. I do not purpose going very deeply into the question of the first class, because I am inclined to think it is a subject of comparatively little importance, the latter having made such very much greater progress of late, and being able to effect almost all that the dirigible is designed to do and with greater ease and efficiency, that it seems likely to entirely oust the former.

A few words, however, on gas-borne vessels may be desirable to point out how they have been evolved, and in which direction improvements may be looked for, should their development be considered advantageous.

[1] Paper read before the Junior Institution of Engineers on April 11, by Major B. Baden-Powell.

Balloons.

First we have to consider that simple contrivance the balloon, by means of which men have, for the last century and a quarter, been able to rise in the atmosphere and drift with the wind wheresoever it listeth. It is a remarkable fact that, notwithstanding the great hopes it raised in early days, scarcely any improvement has been made in this contrivance during a hundred years of practice. This refers to the simple balloon. Almost immediately after its invention suggestions were made to form it as a long vessel and propel it with screws, and though to-day we have the practicable dirigible balloon, it is probable that no invention has been longer in developing. Step by step it has grown from the ideas of Meusnier, through the crude machines of Giffard, de Lôme, Tissandier, to the first successful vessel, that designed by Colonel Renard, nearly thirty years ago. Though much progress has been made since, it has always been slow.

Santos Dumont evoked much public interest with his little vessels; Count Zeppelin certainly made a big step forward with his large rigid-framed leviathans, while Parseval, Gross, Julliot, and others have further developed the invention. From Giffard's steam engine of 3 horse-power to the 500-horse motor of the Siemens-Schuckert, every variety of engine has been tried, continually increasing in power.

Nor does it appear that any very revolutionary advancement is likely to be effected in the future with dirigibles. We may hope to go on making each vessel a little better than the last, much in the way in which steamships have progressed.

Undoubtedly the main path along which improvement is possible and desirable is that of speed. So long as an aërial machine is only able to progress at a rate not much above that at which the wind usually blows, it is bound to be very dependent on the ever changeful weather. A dirigible can never be considered really practical (in this country at least) until it is capable of travelling at, say, 40 miles an hour. This is a speed not yet attained by any dirigible. The wind at one or two thousand feet up frequently blows at 30 miles an hour, and not only must we be able to make head against this, but we ought to be able to progress fully 10 to 20 miles in the teeth of it. Now, considering for the moment solely the lighter-than-air machine, given a certain weight of engines, since buoyancy is dependent on displacement, we cannot make the vessel any smaller if it is to lift the weight. In order to increase its speed, then, presuming the shape and the surface and fittings to be such as to offer a minimum of resistance, there seem but two possible means. One is to make engines more powerful for their weight, and progress in this line seems moving rapidly. The other is to increase the size of the gas-holder. As the volume is enlarged the lifting power (and hence ability to carry more powerful engines) is increased at a greater rate than is the cross-section and surface, and consequent resistance. So we get the tendency to construct huge machines ever growing larger. This size, however, is one of the greatest practical drawbacks to the employment of such vessels. It is true there is plenty of room in the sky, and if the machines had to remain always aloft there might be no difficulty. But to be of use they must come to earth, and the enormous bulk has to be held stationary against any wind that may happen to blow. This is exceedingly difficult, and necessitates the use of sheltered harbours and sheds to house these monstrous structures, which implies vast expense.

There is, however, yet another means by which it may be possible to increase the speed without adding to the bulk. It is one that has often been suggested, several times tried on a large scale, but does not seem to show signs of general application. I refer to the use of horizontally disposed surfaces known as aëroplanes. If we have an apparatus travelling at, say, 30 miles an hour, and we add such devices, it will be found that they give a very considerable extra lift, and this may be utilised for raising an extra weight of engines. By adding to the propulsive power we both increase the speed, and thereby

the lift, which enables us to carry still further weight of engines, and so *ad infinitum*. This soon leads us on into another kind of appliance, for if we then want to increase our speed further, all we have to do is to reduce the resistance. This can now easily be done by lessening the size of the gasholder. Having thus gained more speed and got more lift out of our aëroplanes, we can still further curtail the volume, and so we go on until we find we have no gas left, and yet our machine progresses at a greater rate than ever! Therefore, why start with the troublesome gas bag at all!

Aëroplanes.

Six years ago such a thing as a real flying machine was unheard of. We had seen Maxim's great structure running along its rail. We had rumours of Ader having done something in secret in France. We had read of Langley's steam-driven model going for three-quarters of a mile. But it was in 1905 that accounts began to leak out of real flights having been accomplished by the Brothers Wright in America. In the following year Santos Dumont gave the first public demonstrations of a man being lifted off the ground by such an apparatus. In 1907 Farman made a number of short flights up to about half a mile; Blériot and Esnault-Pelterie also made some "hops." It was not until 1908, however, that anything approaching real flight was shown to the world, when Henry Farman and Delagrange accomplished what was considered extraordinary performances on a Voisin machine, and when later in that year Wilbur Wright set up his machine in France, while his brother Orville flew (with such unfortunate results) in America; the introduction of practical flight may then be said to have come about.

In order to realise the great progress in the art of flying from that period to now, some two years and a half, I may quote the "records" accomplished:—

	Duration in the air. Hrs. Mins.	Distance travelled. Miles.	Altitude attained. Feet.	Speed Miles per hour.
1905 ...	0 36	24	—	40
1906 ...	—	¼	—	25·8
1907 ...	0 ¾	½	19	33·7
1908 ...	2 20	77½	328	40·5
1909 ...	4 17	145	1,560	48
1910 ...	8 12	365	10,500	65·5

During 1909 much progress was made. In England, Cody made some creditable flights; in America, Glenn Curtis, McCurdy, and others; while in France quite a number of aviators budded forth. In 1910 all records were beaten out and out, and very much was accomplished.

It is thus evident that immense progress has been accomplished in flying. Now let us turn to the machine itself and see in what essentials it has been improved. A vast variety of machines have been built and even tried, but of those differing much from what we may call the standard types, very few have accomplished any success.

I take as the standard types the Wright (with large elevators and no tail), the Farman or Voisin (with small elevator and big tail), and the Blériot monoplane (with no elevator in front, but tail behind); most other machines are but modifications of them.

Wright Type.—The original Wright machine has undergone three important modifications, which render the latest pattern a completely distinct type from the first machine. First, wheels have been applied, so that it is now capable of rising directly off the ground after a preliminary run, and is not dependent, as it originally was, on being drawn along a rail by falling weights, so as to give it an initial impulse. Secondly, a horizontal tail has been added, which has greatly improved the inherent fore and aft stability. Finally, the front biplane elevator, which seemed so essential a feature, has been done away with. A machine of smaller area has also been produced, the span being only 22 feet, or nearly half the dimensions of the original machine. It is now reported that the Wrights are building a machine to carry eight people in a closed carriage, with a 100 horse-power motor.

The Cody biplane is very similar in general design to the original Wright, at first having no tail (though one has been added recently), the main difference being that it has only a single propeller, and has ailerons placed between the planes at the outer ends to effect the same as the warping of the Wright planes. The details of arrangement of the frame and wheels are somewhat different, and the elevator in front consists of two independent planes side by side. It is a large machine, having a span of 46½ feet, and the upper planes being 8½ feet above the lower.

Voisin and Farman.—To follow up the development of the Henry Farman and Voisin types, the two must be taken together, since the former was but a modification of the latter.

The first successful Voisin machine consisted of a biplane divided into "cells" by vertical walls. The span was about 34 feet. It had one biplane elevator and a very large cellular tail. The latter was soon reduced in size to a span of 8 feet.

The Henry Farman biplane, which was evolved from the Voisin type, the main difference being the omission of vertical planes and the addition of flaps for transverse control, has not altered very materially. The size of the box tail has gradually been reduced, and in the latest machines the upper plane is made wider than the lower by the addition of extensions. Both H. Farman and Grahame White have recently tried machines of much smaller area. The former has planes of 150 square feet each, and has lifted at the rate of 6½ lb. per square foot. There are a number of other machines of similar build. The Curtiss differs in having ailerons instead of flaps, but the Maurice Farman, the Sommer, the Bristol, and the Howard Wright differ only in small details.

Blériot.—The Blériot monoplane, which underwent a great variety of modifications to start with, has now settled down into the well-known type with a span of about 30 feet, with a fixed tail behind fitted with inclinable planes on each end. The latest type of two-seater is of 36-foot span, with a trailing flap tail.

The *Antoinette* monoplane is not very different in its general characteristics. It is much larger, and the "aspect ratio" or plan of the wings shows a greater span for length. Flaps are attached to the trail of the outer ends of the planes, and a fixed horizontal tail, or "empennage," is arranged at the end of the body.

Santos Dumont's *Demoiselle* monoplane is much the same type as the Blériot, but has always been of smaller size. Other features are that the man is underneath, and the engine is placed on top of the planes, so as to raise the centre of gravity, which would otherwise be very low, and to be able to couple the 6½-feet diameter propeller direct to the shaft.

Other Types.—Other types of successful machines include the Breguet, which, though a biplane, has all the other characteristics of a monoplane, viz. propeller in front of all, with the engine behind it, fish-shaped body, and cruciform tail behind. This has proved very satisfactory, having recently taken up as many as twelve people. A new pattern of Bristol is of similar design.

The Dunne biplane and monoplane, with redan-shaped planes and no elevator or tail, for which a large degree of automatic stability is claimed, have achieved considerable success.

The *Valkyrie* monoplane, which may be considered as a separate type, having its elevator, as well as a small fixed plane, in front, and the propeller behind the main planes, has also done well.

Taking a general view of the recent developments, we are confronted with strange anomalies. Some inventors, such as the Wrights, have discarded the front elevator, though this does not seem to prove it undesirable, for others have adopted it. While some Farmans have been improved by the addition of more surface, yet small machines of nearly half the area have proved highly satisfactory.

One of the most surprising results of a study of these changes in design is that it seems possible to alter the disposition of the surfaces of a machine in quite a marked manner, and yet there is but little difference apparent in the ability to fly. It becomes very puzzling to the mathematician and theorist who wishes to investigate the subject, and to ascertain the whys and wherefores, when he reads of areas being reduced without detriment, of eight and even twelve men being carried on a machine designed

to carry only one or two, of a machine fitted with a 50 horse-power engine flying faster than one almost exactly similar having a 100 horse-power engine. It all seems to show how very little we know of the principles which underlie the matter, and how much really careful experiment and research are needed if we are to go by anything more than rule of thumb.

Now that a certain amount of experience has been gained, we can get at some idea as to which type of machine is generally pronounced the most satisfactory. It is perhaps curious that two types so different as the Farman biplane and the Blériot monoplane have performed so similarly, and there does not seem to be any decided preference among flying men between the two. The following figures of the machines on which certificates had been gained in France last year give some idea of the popularity :—

93 Blériot monoplane, 81 H. Farman biplane, 37 Antoinette monoplane, 30 Sommer biplane, 26 Voisin biplane, 16 Wright biplane, 15 Hanriot monoplane, 9 M. Farman biplane, 20 on other biplanes, 17 on other monoplanes (besides 10 others not specified), that is, 162 monoplanes and 182 biplanes.

Of British-owned machines, according to Jane's "All the World's Airships," there are (or *were* five months ago) :—

34 Blériot, 14 H. Farman, 6 Voisin, 8 Wright's, 5 Sommer, 4 Antoinette, 1 Demoiselle (besides small numbers of various English makes).

This list is, however, not very trustworthy as an indication, as many of these machines have scarcely been tried, and many others (not included) have done good service during the last four or five months.

Automatic Stability.—A great deal has been said and written on this subject. Before practical flight had been attained, it was often thought that it would be necessary to apply some controlling mechanism actuated by a pendulum or gyroscope, so that when the machine tilted over it would be automatically forced back. Practice has shown that such an arrangement is quite unnecessary. We still hear of projects of this nature, but it is evident, not only from the performances of actual machines in the hands of expert aviators, but also from uncontrolled models, that a properly designed and properly balanced machine is quite stable by itself.

Motors.—The subject of motors for aërial work is perhaps rather beyond the scope of this paper, but since so much depends upon the motive power—indeed, the advent of the successful aëroplane may be said to have been entirely due to the invention of the petrol engine—I must refer briefly to it.

The chief notable feature in this line is the very general adoption of the Gnome rotary motor. This peculiar engine, which, of course, consists of seven cylinders radiating from a central shaft, which spin round forming a fly-wheel, and very efficiently cooling themselves by their rapid motion through the air, was at first looked upon as an impracticable freak. In 1909, however, it was fitted to several machines, and at once proved itself trustworthy and superior to all other motors for the purpose. Recently quite a number of engines of somewhat similar design have been brought out, and some of them, such as the Buckman, seem likely to prove even more efficient.

Meanwhile, several British-built engines of more ordinary design have come to the fore, notably the Green, with four water-cooled vertical cylinders, the N.E.C., a two-stroke motor, and the E.N.V., and several others, but for one reason or another these do not seem to be so popular with practical aviators.

Future Developments.—It is, of course, extremely difficult to foresee in which direction aëroplanes are likely to develop. There is, however, here again one of those what I may call "reciprocal" situations such as I have referred to with regard to balloons. The tendency seems to be to make the planes smaller. By this decrease the weight is lessened as well as the resistance. By lessening the resistance the machine should travel farther, and the decrease of weight of planes should enable a heavier and more powerful engine to be carried, and thus speed again increased. By travelling faster we obtain more lift, and can therefore further cut down the size of the planes. So we go on, making the machines smaller and the speed faster; and who can say where the limit may be?

Other types of machines have often been suggested, notably those of the wing-flapping species, and those with vertically acting screws. Seeing the success which has attended the simple aëroplane, I think it is doubtful if any other form will supersede it, but I have long been of opinion that some combination may prove advantageous. For instance, it is possible to arrange for vertically thrusting screws to assist in starting the machine, and it seems quite probable that a propeller on the flapping-wing principle may prove highly efficient.

THE AUSTRALASIAN ANTARCTIC EXPEDITION.[1]

AUSTRALIA and New Zealand have always been anxious for further knowledge of the great frozen continent lying to the southward of them. Because the Ross sea area is more conveniently situated to the south geographic pole, most expeditions to the Australian quadrant have wintered there. This has led to the neglect of the great coast-line westward of Cape Adare. Our information regarding it is very fragmentary, and for the most part untrustworthy. Properly equipped, an expedition to this region should have no difficulty in achieving great geographical successes. In the words of Dr. H. R. Mill, "It is time, at any rate, that someone should revisit the lands discovered by Biscoe, Balleny, D'Urville, and Wilkes. . . ."

Lying within wireless telegraphic distance of our borders, this region has a special call upon Australians. Alive to the value of scientific data there massed waiting to be collected, I have ardently sought for an opportunity to reap the harvest. Captain Scott's programme was too full with the determined efforts in view, upon the south geographical pole and King Edward VII. Land, to accede to my request to be landed this year with a party at Cape Adare. It was then that Sir Ernest Shackleton proposed to raise the necessary funds, and, with myself in charge of the scientific work, to attack the whole coast-line between Cape Adare and Gauss Berg. The plans were published in the Press on March 19, 1910, and repeated later in the year. Eventually Sir Ernest Shackleton handed over command to me.

Until the last fifteen years, though touched upon as early as 1820, only about seven expeditions, excepting whalers in the areas south of America, have come within sight of the continent. It was not until 1898 that the first Antarctic night had been experienced; even to the present day but four expeditions have wintered on the continent, and their contributions refer only to isolated spots of the 8000 miles, more or less, of coast-line. It is gratifying to note the successes which have attended recent assaults upon the unknown, and we can confidently look forward to the complete unravelling of the broader features and secrets of Antarctica within the next three years.

The Antarctic Continent.

Conclusions of any but local value based on the data available are obviously liable to prove in error, but will always serve a useful purpose in directing the attention of explorers to possible contingencies. The inadequacy of the data available is comprehended when we find, based upon them, several entirely different views regarding the geomorphology of the South Polar region. There is, nevertheless, a general agreement regarding the seaward limits of the land and the permanently attached ice. That is to say, we can now guess approximately the limits of southward navigation—where ships must be brought up either by land or barrier ice. Assuredly considerable portions of this coast-line are no more than barrier ice—marginal shelf-ice of great thickness—which in the recent past may have been of greater seaward extent, and in the future may retreat even hundreds of miles before the rocky coast-line is revealed. These barriers originated from the land glaciers, and are partly aground, partly afloat. It appears probable that the immense thickness of nearly 2000 feet is sometimes reached. In such cases the barrier ice, though afloat,

[1] From a paper read before the Royal Geographical Society, on April 10, by Dr. Douglas Mawson.

plays the *rôle* of land, and is charted as the margin of the continent.

Concerning the topography of the interior, all is speculation except in the vicinity of Captain Scott's and Sir Ernest Shackleton's exploits.

Thus it is that some hold the view of a continuous high land from Graham's Land to South Victoria Land—a continuation of the Andean chain; others regard the possibility of a great trough-subsidence, continuous from the Ross sea to the Weddell sea, isolating an eastern and a western Antarctica. Yet another view is that Enderby Land is part of a third isolated mass. There are many grounds in support of the existence of a trough between the Victoria Land massif and the Andean continuation of Graham's Land. Granted its existence, it will be still uncertain whether this depression sinks below sea-level, or is merely a topographical feature of the land. The existence of a passage below sea-level appears quite unlikely to me. Nordenskjöld and Gunnar Anderson have shown how the highlands of Graham's Land must be regarded as a continuation of the Andes. Possibly, further to the westward, this folding has been responsible for land trending towards King Edward VII. Land, the presence of which has been inferred by Charcot, and does not participate in the piling up of the mighty ranges which girdle the south geographic pole.

This may ultimately prove to be correct, for the geology of Victoria Land corresponds with that of Australia and Tasmania, whilst, in the same region, Andean types are represented further to the eastward amongst the Pacific islands.

Another point of correspondence is that South Victoria Land is elevated *en bloc*, and not subject to the contortions of folding illustrated in the Andes. I am not by any means the first to entertain this idea of an inverted South America. According to it, the highlands of Graham's Land are continuous with the mountain ranges of South Victoria Land. To the westward of this main range there is a great plateau, in part as much as about 10,000 feet in height, eventually sloping to the Indian and Atlantic oceans. Eastwards, on the Pacific side of the range, there is a precipitous scarp. We have no means, as yet, of telling whether this lower area is barrier ice with occasional islands, or is extensive undulating land.

Between Gauss Berg and Graham's Land, on the Atlantic ocean side, it is likely that most of the sea-front will be occupied by barrier ice; Enderby and Kemp lands, therefore, may be no more than islands.

The consanguinity of the lavas of Gauss Berg and the Ross sea downthrow area is suggestive of a similar downthrow in the direction of the former; it is possible, therefore, that a considerable indentation lies west of Gauss Berg.

According to present views, the Antarctic continent has an area of about five million square miles, the major part of which is a plateau of great height. Geographers are generally agreed, at any rate, that the main land mass of the Antarctic regions lies in the Australian Quadrant. This has been independently arrived at from theoretical considerations by Mr. E. A. Reeves, who has discussed the subject of distribution of land and sea as judged by the deflection of the lines of magnetic force.

Glimpses only of the past history of Antarctica are yet known—fragments gleaned from the analysis of scientific data to hand. We know that there were periods when ice was almost unknown, when great formations of water-deposited beds accumulated, associated with coal-bearing strata; these beds have their exact prototypes in Tasmania—in fact, where Tasmania leaves off South Victoria Land begins. We believe that in not long geologically remote times the intervening 1500 miles became engulfed; this conclusion is arrived at by an entirely separate line of argument proceeding from the evidence supplied by fossil and living forms of life.

Australian and New Zealand types show a remarkable affinity with those of South America and South Africa. This striking similarity in variety and range is exemplified not only in the bird life and mammalia, but also in the crustacea, amphipoda, mollusca, galaxias, and others. The similarity extends to the flora also. To the casual observer the connection is most noticeable in regard to the birds and mammals. We find parrots and struthius birds of the ostrich type common in these southern lands. Considering the marsupial mammalia, such occur at the present day in the Australian region and in Central and South America. Of the two sub-orders, Polyprotodontia and Diprotodontia, into which the marsupialia are divided, the Diprotodontia, which are the more primitive, are essentially Australian, as shown by the abundance of their fossil remains. The fact, however, that a representative of this class is now living in South America is strong evidence of a land connection, unless an independent and convergent process of evolution is regarded as possible. Further, the fossil evidence is absolutely in favour of a continuity between South America and Australia—as, for instance, may be mentioned amongst the extinct marsupial fauna of Patagonia, the Prothylacinus, which is essentially identical with the Tasmanian tiger. All this evidence confirms the theory of connection between the southern lands by way of Antarctica.

On the other hand, there is no line of argument founded on fact which can be urged to support the view of immigration by way of Asia. Suppose, for instance, that the marsupial fauna had come to Australia from Asia; then we should expect to find the types most numerous and most generalised in Northern Australia and Asia. Identically opposite is the case, and in the whole of Asia no living or fossil marsupial has ever been found.

The evidence is conclusive, therefore, in the minds of men of science, that in the not long (geologically) past there existed a habitable Antarctic continent with rays stretching up to meet with what are now Tasmania, South America, New Zealand, and South Africa. With regard to the relative dates at which these countries became severed from the southern continent, the evidence shows that with South Africa was the earliest and loosest. New Zealand, though possessing many of the features of Antarctic flora and fauna, never received a marsupial population, and its final separation is thereby allocated to the early Tertiary times. Australia, then separated by the formation of Bass strait, and more recently Tasmania and South America, have become isolated by the engulfment, due to diastrophism of the land bridges connecting both with the Antarctic continent.

Much of the strata of Southern Australia are composed of the *débris* of this lost land. To the south of Australia, where now is ocean, were highlands, providing an abundance of material shed northward into what were then lowlands and marine areas. Volcanic activity on a large scale, remaining even to the present day in isolated spots, attended the separation of these land masses. Finally, an ice age of almost unprecedented severity overwhelmed the residual Antarctic continent, and swept every trace of life into the southern ocean.

The Plans of the Australian Expedition.

We hope to have a complement of fifty men—ship and land party—and proceed south from Australia about the close of this year. Practically every member of the land party will be a specialist in a particular branch of science. Most of the recruiting will be amongst the graduates of the universities of Australia and New Zealand.

It is our intention to land several parties with stores and huts, to winter between Cape Adare and Gauss Berg, and the ship will return to Australia and New Zealand for the winter, though not remaining idle. It had been our intention of dropping a few men at Cape Adare, for that is the easiest and most accessible landing on the Antarctic continent. The facilities there afforded of coal and stores left by Borchgrevinck's expedition would have further simplified matters. In the light of recent events, of course this must be eliminated from our programme. It is our special desire to accomplish a complete coast survey between the two points mentioned, and complete the magnetic charting of the region north of the south magnetic pole. The several wintering stations will simultaneously despatch coastal sledging parties on either hand, thus dividing up the task. A special journey will be made inland from our main base on the north coast to the south magnetic pole, thus completing, in conjunction with the former journey in which I participated, the crossing of that corner of South Victoria Land. For the rest, without entering into details, I may say that no branch of science will be neglected.

Before Australian meteorology is placed on a final basis—before the causes are known which produce the effects

observed—much more requires to be known regarding the circulation of the atmosphere in high southern latitudes. There are no other portions of our globe, excepting equatorial regions themselves, which influence so greatly the climate of the southern hemisphere than the Antarctic continent. It is a vast refrigerator condensing warm moist overhead currents from the equator and speeding them back at sea-level, frequently with hurricane velocity, much to the consternation of Australian shipping. All such irregularities in the regular anticyclonic cycle can be predicted by an observing station on the coast of Antarctica, southward of Australia. That the regular phases of barometric pressure in the Antarctic regions are the dominating causes that affect the climates of the southern temperate regions cannot be denied, and by their study we shall become more capable of predicting weather for Australia.

It is very desirable that a permanent meteorological station in connection with Australia and New Zealand be erected either at Adelie Land or to the west of it.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—As an outcome of the recent increase in rate aid granted by the City Council, the University has drawn up a scheme for bringing facilities for higher education within the reach of the poorest scholars who may have the requisite ability. Twelve entrance scholarships, tenable for four years, are offered for competition at the forthcoming matriculation and intermediate examinations in July and June respectively. Candidates must have been resident within the city boundaries for at least one year, and must have attended one of the schools in that area. Competitors must reach such a standard as, in the opinion of the University, offers a reasonable prospect of a successful or distinguished career. Competitors may further apply for an annual grant (not exceeding 30*l.*) towards maintenance, on the ground that they are unable to avail themselves of such scholarships without a maintenance grant in addition. It will be interesting to see to what extent the maintenance grants increase the number of suitable candidates, for hitherto the number of entrance scholarships has been in excess of the number of properly qualified applicants.

IT is officially announced that Dr. Theobald Smith will be the Harvard exchange professor at Berlin University during the academic year of 1911–12. Dr. Smith has held in succession the chairs of applied zoology and comparative pathology at Harvard, and is a member of the board of directors of the Rockefeller Institute for Medical Research.

THE Council of the City and Guilds of London Institute has elected Dr. E. Frankland Armstrong a fellow of the institute (F.C.G.I.), in recognition of his original research work and his contribution to the advancement of the industry, in which he has been engaged since he gained the associateship of the institute at the close of his regular course at the City and Guilds Central Technical College in 1903.

THE University Extension Board of the University of London has arranged a training course for lecturers to be delivered in the University buildings, South Kensington, in the Easter term. The course will consist of four lectures by Prof. John Adams on "The Art of Lecturing," four lectures by Dr. H. H. Hulbert on "The Delivery of Lectures," and six meetings for practical work. Each member of the class will have an opportunity of delivering a trial lecture, and will have the advantage of the criticism of Prof. Adams as regards material and arrangement, and by Dr. Hulbert as regards delivery.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society April 6.—Sir Archibald Geikie, K.C.B., president, in the chair.—Hon. R. J. **Strutt**: The Bakerian lecture. A chemically active modification of nitrogen produced by the electric discharge. The leading facts established are:—(1) That pure nitrogen, from whatever source, subjected at a low pressure to the jar discharge, undergoes some modification which causes it to glow for a short time after it has been sucked away from the discharge. (2) The glow which is emitted while the gas returns to its normal condition is not destroyed by the removal of ions. It is weakened by heating, intensified by cooling. This seems to favour the view that it is due to the recombination of dissociated atoms. (3) The modified nitrogen acts on ordinary phosphorus, combining with it, and at the same time forming much red phosphorus. (4) It combines with sodium and also with mercury at a gentle heat (say 150° C.), forming in the latter case an explosive compound, and in each case developing the line spectrum of the metal concerned. It also develops the line spectra of other metals, probably combining with them. (5) It develops the band spectra of compounds, when these are vaporised in it, giving in many cases spectra of substances too unstable to be examined at the temperature of the Bunsen flame. (6) It attacks acetylene, and substances like ethyl iodide or chloroform, setting the halogen free when there is one, and combining with the carbon to form cyanogen. This is proved by the brilliant cyanogen spectrum produced, and by direct chemical tests, such as formation of Prussian blue. (7) It attacks nitric oxide, with formation, strangely enough, of nitrogen peroxide, a more oxidised substance. —A. **Holmes**: The association of lead with uranium in rock-minerals, and its application to the measurement of geological time.—Prof. E. T. **Whittaker**: The dynamical value of the molecular systems which emit spectra of the banded type. It is now widely believed that when the spectrum emitted by a luminous body is of the banded type, the small vibrators which give rise to the radiation are the molecules of the substance, as distinguished from atoms or ions. This result is applied in the main body of the paper in order to suggest a dynamical system, which is formed of two members in the same way as a diatomic molecule may be supposed to be formed of two atoms, and which has free periods of vibration related to each other by the same formula as holds in the case of banded spectra. This formula presents a certain peculiarity, in that the frequency of vibration occurs in it linearly, whereas in the equation for determining the free periods of dynamical systems in general the frequency enters by its square. It is shown that from this peculiarity in the radiation of a molecule certain inferences may be drawn regarding the dynamical character of the connection between the atoms within the molecule. It is shown that a somewhat modified mechanism would emit radiations connected by the same law as that which Balmer found for the hydrogen lines.

Royal Meteorological Society, March 15.—Dr. H. N. Dickson, president, in the chair.—Prof. H. H. **Turner**: What can we learn from rainfall records? The "periodogram" method has been applied under the superintendence of Prof. Schuster and the lecturer to the rainfall records of Padua (175 years) and Greenwich (90 years), besides Klagenfurt and Oxford (50 years), all periods between 20 months and 5 months having been examined, as well as some others. The resulting indications are not very positive, but include several features well worth further study, especially in the Greenwich rainfall, where periodicities of 597 days and 150 days (possibly a quarter of the former) seem to be fairly persistent, as well as a short one of 25 days; but these are not reproduced in the Padua records, at any rate not exactly. There are doubtful periods of 591 days and 147 days, which again are possibly related by the ratio 4 to 1. (The shorter periods near 25 days have not been investigated, as daily records are required.) It is possible that the periodicities change slowly with the latitude, in a manner suggested by the cloud belts on Jupiter.

Geological Society, March 22.—Prof. W. W. Watts, F.R.S., president, in the chair.—Dr. A. S. **Woodward**: Some mammalian teeth from the Wealden of Hastings. Mr. Charles Dawson has obtained two imperfect molars, apparently of Plagiaulax, from beds of grit in the Wealden near Hastings, and his associates in the work of exploration, Messrs. P. Teilhard de Chardin and Félix Pelletier, have found a well-preserved multituberculate molar of the form named Dipriodon by Marsh. These specimens are described.—A. **Wade**: Some observations on the Eastern Desert of Egypt, with considerations bearing upon the

origin of the British Trias. Phenomena observed in the Eastern Desert of Egypt, bordering the Gulf of Suez, are described. The origin of the mounds of igneous débris which flank the coastal hill-ranges is discussed. The distances to which fragments of igneous rock derived from these hills have travelled in Egypt are shown. The shore-sands are dealt with, and their origin ascribed to the breaking down of local rocks. In the marly beds connected with the shore-deposits, tiny dolomite-rhombs, similar to those found by Dr. Cullis in the Keuper Marls, are present. Some effects of wind-blown sand are detailed. The alteration of the calcium carbonate in recent shell-beds to gypsum is noted, and its significance with regard to the origin of gypsum-beds is pointed out. The characters of the massive older gypsum- and rock-salt deposits are described, together with the distribution and lithological changes in the beds when traced across the area. The origin of the gypsum series is connected with inland salt-lake conditions, and the evidence suggests that these conditions were contemporaneous with the Oligocene continental period in Egypt, and with the formation of the beds of the Fayûm in the Western Desert.—H. **Bolton**: Faunal horizons in the Bristol coalfield. The existence of faunal horizons at the collieries in the Bristol and Gloucestershire area, and in the Radstock area, has been determined. A measured section has been examined in detail, and four faunal horizons discovered. In every case the fauna was marine in character, and the series are all characterised by a fauna agreeing with the typical fauna of the Lower Coal Measures of the coal-fields of the Midlands, and of Lancashire and Yorkshire. Species of Carbonicola are rare, while the cephalopod and fish fauna is poor. The second series of the Upper Coal Measures has yielded *Lingula mytiloides*, several species of ostracods, four species of Anthracomya, and scales of *Strepsodus sauroides*. *Coelacanthus elegans* has been found in the first series. In the Bristol coalfield the marine fauna undergoes no marked change in its upward range. Insect-wings referred to the genus Genentomum have been found at one horizon, while the rare phyllopod, *Leaia leidyii*, var. *salteriana*, hitherto only known from the Lower Carboniferous of Fifeshire, was found in abundance. The total number of species now recorded from the Bristol coalfield amounts to seventy-four.

Mineralogical Society, March 21.—Prof. W. J. Lewis, F.R.S., president, in the chair.—Prof. W. J. **Lewis**: Mr. Solly's observation of wiltshireite in 1903. Wiltshireite is identical with the mineral which Mr. Solly exhibited and described before the society, November 17, 1903, and subsequently named rathite α, but of which no complete description has yet been published.—R. H. **Solly**: Two new minerals from the Binnenthal, Switzerland. Both are probably sulpharsenites of lead, being lead-grey in colour and giving a chocolate-coloured streak; one, which is rhombohedral-diplohedral, and has an angle 111 : 100 = 38° 18′, is probably isomorphous with trechmannite, while the other may be orthorhombic, the angle 100 : 110 being 58° 18′, but no measurable end faces were observed.—J. B. **Scrivenor**: Notes on cassiterite in the Malay Peninsula. Cassiterite from a mine at Gopeng contains ilmenite and magnetite, and is attracted by the magnet; it also occurs mixed with tourmaline pseudomorphic after an hexagonal mineral, probably quartz.—Arthur **Russell**: Notes on the occurrence of dundasite in Derbyshire and co. Galway, and of bertrandite in Cornwall. Dundasite was discovered at Mill Close mine, Wensley, Derbyshire, as snow-white spheres associated with greenockite, fluor, cerussite, calamine, &c., and at Clements lead mine, Carrowgarriff, near Maam, co. Galway, associated with allophane and cerussite, and bertrandite was found in platy crystals on old specimens of blende from Wheal Vor, Breage, Cornwall, and as trillings, measuring up to 4 mm. in length, on a specimen from Wheal Metal, Breage, Cornwall, which had been presented as albite to the British Museum in 1870; in the latter case the crystals were similar to those from Pisek, Bohemia, described by C. Vrba.—Dr. J. **Drugman**: Quartz-twinning. The possible varieties of twinning of quartz were discussed, with special reference to the rhombohedron type, a specimen of which was exhibited.—T. V. **Barker**: Crystallographic notes. Two new forms found on crystals of inosite confirm the hypohexagonal type of symmetry suggested by Fedorow. The rhombohedral modification of potassium nitrate, unlike sodium nitrate, does not arrange itself regularly when deposited on a cleavage piece of calcite; the crystals are very unstable, and rapidly pass into the ordinary orthorhombic form. A parallel growth of calcium chromate on the isomorphous mineral gypsum was obtained. New forms have been observed on urea nitrate which enabled the axial ratio $b : c$ for the first time to be calculated; the crystals have large birefringence, and, when grown in a drop, are nearly always twinned.

Physical Society, March 24.—Prof. H. L. Callendar F.R.S., president, in the chair.—Dr. H. F. **Haworth**: (1) A sensitive thermo-regulator; (2) experiments on the measurement of electrolytic resistance using alternating currents. The "thermo-regulator" consists of a toluene thermometer with mercury platinum contacts in a capillary tube; these contacts operate, through a Siemens telegraph relay, an electromagnetic switch, which cuts in or out the heating circuit. On account of the very small current required to operate the relay, a fine capillary may be used, so ensuring a high magnification with low thermal capacity. Experiments were also shown illustrating the ease with which a bridge containing an electrolytic cell could be balanced by placing a variable self-induction in series with the cell and adjusting it and the resistance of the bridge simultaneously, as in Wien's experiments, except that a vibration galvanometer was used in place of the optical telephone originally employed by Wien. The author's deduction from his experiments was that the resistance of an electrolyte varies with the frequency of the alternating E.M.F. applied.—Prof. G. W. O. **Howe**: Oscillatory currents in coupled circuits. A demonstration was given by means of a double projection oscillograph of the currents in coupled oscillatory circuits. Each circuit consisted of a condenser, an air-ore choking coil, and a strip of the oscillograph. The condenser in the primary circuit was charged and discharged by means of a commutator on the spindle of the oscillograph motor. The two circuits may be taken to represent the condenser circuit and the aërial of a wireless telegraph sending apparatus, the frequency being two or three hundred instead of a million. The currents in the two circuits can be studied, and every change due to a variation in the damping of either circuit or in the coupling between the two circuits can be followed. This was illustrated by a series of typical photographic records. A third oscillatory circuit may be taken to represent a wave-meter, and used to plot resonance curves, from which the damping can be calculated, as is commonly done in radio-telegraphic work. Here, however, we have the great advantage of knowing the damping accurately, and thus being able to check the resonance curve results under various conditions. By altering the connections, the conditions of the quenched spark sending apparatus, as used by Max Wien, Lepel, &c., was represented. Here the primary circuit is opened at the first moment that all the energy has been transferred to the secondary circuit, and no further beats or spark-gap losses occur. Results were given showing that the oscillograph can be used to find the losses in condensers at various frequencies by discharging the condensers through inductances of known resistance.—Prof. G. W. O. **Howe**: Some radio-telegraphic apparatus in use at the City and Guilds College. The wireless telegraphic receiving apparatus was shown connected up to the aërial, which is 260 feet high. A transformer specially designed for experimental work at long wave-lengths was shown. By means of a Brown telephone relay and special trumpets fitted to the telephone receiver, the time signals and messages sent out from Norddeich and from the Eiffel Tower can be plainly heard anywhere in the lecture theatre. The various types of receiving apparatus in use at the college were shown.

Zoological Society, April 4.—Dr. Henry Woodward F.R.S., vice-president, in the chair.—Dr. H. B. **Fantham** and Dr. Annie **Porter**: Diseased bees and combs infected with a minute pathogenic protozoal parasite, apparently the same as *Nosema apis* found by Zander and Doflein in diseased bees in Bavaria. Microscopic preparations and drawings of the parasite, *N. apis*, were also shown, as

well as healthy bees and combs in contrast. The material was obtained from Cambridgeshire and Hertfordshire in March. The infected combs were brown in colour instead of the normal yellow, while the infected bees suffered from a sort of dry dysentery, which rapidly proved fatal. The pathogenic agent of this dry dystentery, *N. apis*, formed thousands of minute spores, which fouled the hive, while infection was probably spread to new hives by hungry, weakly bees attempting to enter healthy hives. The spores, about 2 to 3 μ by 4 to 6 μ, were the resistant and cross-infective stages of the protozoon. The parasite *N. apis* was closely allied to that of pébrine, the silk-worm disease due to *N. bombycis*. The trophozoite and pansporoblast stages of *N. apis* had been observed, as well as some spores with polar filaments extruded. Like *N. bombycis*, the bee-parasite was possibly capable of hereditary infection, as infected bee-larvæ had been found. The only certain destructive agent of the microsporidian spores was fire, and all infected bees and hives, and any débris therefrom, should be most carefully burned. In the opinion of the exhibitors, the microsporidian parasite *N. apis* had been responsible for much of the bee-disease recorded in this country since 1906, especially in 1906, 1907, and 1911. The exhibitors first noticed the parasite in 1906 in diseased bees obtained from the Isle of Wight; its full significance was grasped in 1907, but owing to the difficulty of obtaining material the exhibitors' results were not published. As much attention was now being directed to "bee-disease," the exhibitors briefly recorded their observations. It was not asserted that microsporidiosis was the only disease of bees current in Great Britain at present, as Dr. Malden had investigated a bacillary infection in bees. Microsporidiosis had probably been introduced from the Continent into British apiaries.—Dr. R. T. **Leiper**: Nematode parasites obtained from animals in the Zoological Gardens during the year ending November, 1910. The collection contained a number of new forms, of which a systematic account will be published later. Among the more interesting of the known forms were *Rictularia plagiostoma* from a palm-civet, a number of species of Polydelphis from various pythons, *Dicheilomena horrida* from the South American ostrich, and *Dictyocaulus filaria* from the lungs of sheep. From the observations it appeared that the change of food and general conditions obtaining in the gardens were unfavourable to the continued existence of the intestinal parasites an animal may harbour on its admission. The number of cases of auto- and re-infection during captivity was strikingly small, and bore testimony to the cleanly surroundings in which the animals were kept. In four cases only was there evidence of the occurrence of accumulative infection in the gardens:—(1) a number of giant toads died from lung infection with *Rhabdias bufonis*; (2) the wolves appeared to be heavily infected with *Ascaris canis*; (3) a sheep died from pneumonic condition resulting from an intense infection with *Dictyocaulus filaria*; (4) the tortoises had oxyuriasis. In all these cases repeated infection undoubtedly had followed from contamination of food and drink with fæces containing eggs of the parasite. The infection could be eliminated by steam sterilisation of the cages, or still more easily by changing the species of animal living in the particular paddocks or cages, for helminthes were often peculiarly selective as regards their hosts, and those flourishing in one animal sometimes found it impossible to continue their life even in closely allied forms.—F. E. **Beddard**: Some mammalian tapeworms collected from animals which had died in the society's gardens. This collection was the result of nearly two years' examination of a very large number of animals, but did not contain a very large number of species. Tapeworms were by no means so common as other parasitic worms, particularly nematodes, which were the most abundant among the animals in the gardens.—J. A. **Mörch**: The natural history of whalebone whales. The paper directed attention to, and threw light upon, some of the problems connected with the migrations of the larger Cetacea.

Linnean Society, April 6.—Dr. D. H. Scott, F.R.S., president, in the chair.—Miss Sarah M. **Baker**: The brown seaweeds of the salt-marsh.—Conjoint communication on the genus Salicornia. (1) Dr. C. E. **Moss**: A history of the genus from Linnæus, "Species Plantarum," ed. 1, 1753, to the present time; (2) E. G. **Salisbury**: An exposition of the characters of the species comprised in the genus; (3) Dr. Ethel **de Fraine**: The anatomy of certain species in the genus.

PARIS.

Academy of Sciences, April 3.—M. Armand Gautier in the chair.—F. **Henneguy**: Experimental parthenogenesis in the Amphibia. The eggs of the frog (*Rana fusca*) were caused to develop parthenogenetically by simple puncture, following the method suggested by M. Bataillon. Comparison batches of eggs were impregnated in the ordinary way. Out of a large number of the punctured eggs, four only became normal tadpoles, and these were smaller than the tadpoles from the comparison batch.—**Albert I., Prince of Monaco**: The twelfth campaign of *Princesse Alice II.*—Sir J. J. Thomson was elected a correspondant for the section of physics in the place of H. Lorentz, elected foreign associate.—Th. **De Donder**: Jacobi's multiplier.—M. **Devaux-Charbonnel**: The direct measurement of diminution of loudness, and of the characteristic of telephone lines.—Victor **Henri** and Samuel **Lifchitz**: The kinematographical study of the displacements of ultra-microscopic particles produced by very rapid sound shocks. The action was shown to be a mechanical one, and to be independent of the electrical charge on the particles.—Paul **Lebeau**: The formula of uranium carbide. Analyses of some ingots of uranium containing carbon showed a percentage of the latter higher than would correspond with the Ur_2C_3 of Moissan. Castings were then prepared containing various proportions of uranium and carbon. Metallographic examination proved all of these to consist of a single carbide with varying amounts of graphite. It was found necessary to considerably modify the analytical method used by Moissan in the analyses of these compounds, and the true formula of the carbide was found to be UrC_2.—M. **Driot**: Mercury oxychlorides. Four oxychlorides, $HgCl_2.3HgO$, $HgCl_2.2HgO$, $HgCl_2.HgO$, and $2HgCl_2.HgO$, have been isolated, and each of these exists in one form only.—E. E. **Blaise** and L. **Picard**: The mode of formation of ethyl chloroethoxyacetate; the use of this ester in the synthesis of the α-acid alcohols. An attempt to prepare the chloride $(C_2H_5.O)_2CH.CO.Cl$ failed, a molecular transposition taking place, and the compound $C_2H_5.O.CHCl.CO_2C_2H_5$ being produced.—P. **Lemoult**: The new series of leucobases and colouring matters derived from diphenylethylene.—G. **André**: The conservation of the salt material in an annual plant: distribution of the fixed elements.—P. A. **Dangeard**: The conditions of chlorophyll assimilation in the Cyanophyceæ.—Jean **Bonnet**: Nuclear fusions without sexual character.—M. **Vermorel** and E. **Dantony**: The increase in the moistening power of anticryptogamic solutions for spraying.—E. **Kayser**: Researches on the juice of beer yeast.—L. **Bordas**: The intestinal cæcum and the rectal glands of the Lepidoptera.—P. **Chaussé**: Experimental tuberculosis in the dog. Under normal conditions, the latent mesenteric tuberculosis experimentally produced in the dog completely disappears from the system in 200 days.—L. **Cayeux**: The marine deposits resting on the middle Miocene in Crete.—Alphonse **Berget**: The exact determination of the salinity of sea water by the measurement of the index of refraction. The refractometer was modified to read the index to 0·00001, and the relation between refractive index and concentration of salt was shown experimentally to be linear.

CAPE TOWN.

Royal Society of South Africa, March 15.—Dr. H. H. W. Pearson, vice-president, in the chair.—Dr. Thos. **Muir**: Sylvester's and other unisignants. Unisignant is the name given to a peculiar class of multilinear functions which though expressible as determinants are quite unlike the latter functions in their properties, having, for example, in their final development nothing but positive terms. Probably the first instance of such a function was observed by Sylvester. The object of the present paper is to throw fresh light on Sylvester's work by bringing it into the same field of view with certain recent investigations of a more

general character about to appear in *The Quarterly Journal of Mathematics*.—R. T. A. **Innes**: Upon the fourth order perturbations in the motions of Satellites III. and IV. of Jupiter. The author recomputes and practically confirms the values of certain long-period inequalities in the longitude of the third great satellite of Jupiter originally discovered by the late M. de Haerdtl. These inequalities are due to the near approach of commensurability of the mean motions of the III. and IV. satellites; seven times the mean motion of IV. being nearly equal to three times that of III, so that although these inequalities depend on the 4th powers of the eccentricities they exceed the limit of II. adopted in Prof. Sampson's "New Tables of the Great Satellites of Jupiter, 1910." The inequalities in the motion of IV. are now computed for the first time. In the sum these inequalities will at times amount to about 8″ in the longitude of III. and 10″ in that of IV.—C. L. **Biden**: The funeral ceremonies of the Hottentots. The Hottentots have their medical men who treat patients during illness. Like most South African tribes, witchcraft is practised by these medicine men, and the sick are told that their enemies, bad relatives, and bad neighbours are the cause of illness. In the event of death following, the medicine man attributes the disaster to the bad influence of certain parties, actually naming the persons he thinks concerned. Formerly these responsible persons were put to death; now it leads to much hatred and personal feeling among the Hottentots. Immediately after death they prepare for the funeral. A grave is dug by means of a gemsbok horn and a roughly made wooden shovel. The ceremonial is then described. After the funeral a dance is held, and festivities are indulged in all through the night. For a few weeks the male relatives of the deceased go to the grave every morning before sunrise, quite naked, and pray to the "taas" (ghost). After that time they suppose that the ghost has left the grave and has entered an animal called by them "thas" jackal. This animal they assert has never been caught, and it can only be killed by a silver bullet.—Prof. W. A. D. **Rudge**: The meteorites in the Bloemfontein Museum. The paper contains an account of the meteorites in the Bloemfontein Museum. There are two fragments of the Kroonstadt fall of 1877. These apparently consist of a tough fibrous mass of iron-nickel alloy, with an aggregation round it of fine particles of silica (asmanite?) troilite pyrites, and apparently felspar. The larger meteorite which fell at Winburg, 1881, contains 94 per cent. of iron and 2 per cent. of nickel. The nickel is confined to a few veins which run through the mass of the meteorite. From these veins crystals of the alloy can be separated by dilute sulphuric acid in which the alloy is insoluble. These crystals seem to be skeleton forms built up of triangular plates, the interstices being filled up with amorphous carbon. The iron is very soft, but patches of hardness occur. The "Widmanstatten" lines are not so well developed as in most iron meteorites, probably due to the nickel being located in veins instead of disseminated throughout the whole mass. The weight of this meteorite was about 50 kilogrammes, and it is markedly magnetic, having a number of poles. The alloy of nickel and iron retains its susceptibility up to a dull red heat.—J. R. **Sutton**: Seismographic record of the South African earthquake of October, 1910. The extent of the movement of the horizontal pendulum during the quake was about one-half its average daily E.W. oscillation.—James **Moir**: (1) Colloidal gold and purple of Cassius. Description of behaviour of chloroauric acid dissolved in 200,000 parts of water towards a number of reducing agents. The coloration produced by pure stannous chloride $SnCl_2$ is not purple of Cassius, but a brown of remarkable stability, which the author shows is not due to extreme fineness of division, and which may be colloidal aurous chloride. Purple of Cassius results when $SnCl_2$ and an oxidant with loosely bound oxygen are employed. The tin in the purple is shown to be merely a vehicle for finely divided gold, the shade varying from pink to indigo according to the rapidity of formation, the first division being obtained by the slow reducing action of glycerol. (2) Some remarkable oxidation products of benzidene. An investigation of the beautiful blue products obtained from benzidene by certain processes of oxidation, such as the blood test. The products obtained by the action of chromic acid and of ferricyanide are shown to be the chromate and ferricyanide respectively of diphenoquinone-diamine $NH:C_6H_4:C_6H_4:NH$, but the latter is an extremely reactive substance and polymerises easily to very insoluble substances of the aminoazo-dye class. Benzidine is the sole reduction-product of the blue substances as freshly prepared. The violet azo-dye appears to be $NH_2.C_{12}H_8.N:N.C_{12}H_8.NH_2$.—H. W. **Tarbutt**: The Egyptian influence on Rhodesia ruin builders, or *vice versa*. The object of this note is to show that MacIver's statement that the Rhodesian ruins are of native origin does not seem too improbable, if the articles found in or about the Rhodesian ruins are compared with similar articles of Egyptian primitive art. The author contends that the very resemblance between them is not confined to one or two articles, but to almost everything that has been found, and illustrations comparing the Rhodesian and Egyptian objects are given to support the theory.

DIARY OF SOCIETIES.

WEDNESDAY, APRIL 19.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Variations in the English Climate during the 30 years, 1881–1910: W. Marriott.—(1) The Value of the Two-theodolite Method for determining Vertical Air-motion; (2) An Automatic Valve for Pilot Balloons: Captain C. H. Ley.

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