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## THE STUDY OF CRYSTALS.

(1) *Crystallography and Practical Crystal Measurement.* By Dr. A. E. H. Tutton, F.R.S. Pp. xiv+946, with 3 plates and 720 figures in the text. (London: Macmillan and Co., Ltd., 1911.) Price 30*s.* net.

(2) *Crystals.* By Dr. A. E. H. Tutton, F.R.S. Pp. x+301, with 24 plates and 120 figures in the text. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1911.) Price 5*s.* (The International Scientific Series.)

THE rapid advances which have been made in recent years in our knowledge of crystals, and the increasing number of points at which crystallography comes into contact both with chemistry and physics, render it more than ever desirable that students of these sciences should acquire a sound knowledge of the nature and properties of crystals and an acquaintance with the methods of crystallographic research. In illustration of this it is only necessary to refer on one hand to the work of Pope and Barlow on the relation between valency and crystalline structure, and on the other to that of Lehmann, Vorländer, and others on the remarkable group of bodies forming the so-called "liquid crystals."

Although numerous excellent treatises on crystallography have been published in recent years in Germany and France, in England the number of works devoted to this subject has been very limited, and, until the recent appearance in America of a translation of the optical section of Prof. Groth's well-known book, the only information available on the physical side in English has been that contained in the introductory portions of text-books of mineralogy. There was thus ample room for a new book, and Dr. Tutton's volume on "Crystallography and Practical Crystal Measurement" (1) will be welcomed by all workers in the subject. Although in some respects incomplete, its very full treatment of what are, from the practical point of view, the most important branches, viz. crystal measurement and optics, render it a valuable and important addition to the literature.

The book is essentially a practical one, and is chiefly concerned with the methods of determining the form of crystals and of measuring their various physical constants; but attention is also given to the underlying matters of theory. It is divided into two parts of nearly equal length, dealing respectively with the morphology and the physical properties of crystals.

The practical and theoretical portions of the subject are treated side by side, in successive chapters. Thus, in part i., after a short introduction on the nature of crystals, a description of the method of preparing suitable crystals for measurement is followed by a chapter on the goniometer, and this is at once illustrated by an account of the actual measurement of a crystal of potassium sulphate. The succeeding chapters treat of axes and the law of rationality, zones and the stereographic projection, and the formulæ required in calculation; and the measurements of the crystal previously made are then worked out in detail. An account is next given of the theories of crystals as homogeneous structures, and of crystal symmetry and its thirty-two types. Chapters xi. to xxiv. are devoted to an account of the crystal systems and the various forms possible in each of the thirty-two classes, the discussion of each system being followed by a full account of the measurement and calculation of one or two crystals belonging to it.

Among subjects dealt with in later chapters may be mentioned goniometry at higher temperatures and the change in the angles of crystals on heating, goniometers with two and three circles and the gnomonic projection, the density, volume, and structure of crystals and the calculation of their molecular "distance ratios." Part i. ends with a useful account of Fedorov's theory of cubic and hypohexagonal types, and a short reference to the theory of Pope and Barlow on valency-volumes.

The description of Fedorov's theory and his method of arriving at the correct mode of setting up a crystal in accordance with its structure, is especially noteworthy as containing the first account which has appeared in English of his method of "crystallo-chemical analysis," by means of which it will be possible to identify, after measurement of its crystals and reference to an index, any chemical substance of which the crystalline data have been incorporated in the index. The method is not yet available for general use, but in the hands of Prof. Fedorov it has already proved very successful under numerous tests, and seems likely in the future to prove of great service to the chemist.

In the chapters on crystal axes, zones, and indices, as well as in those on crystalline symmetry, the stereographic projection, &c., proofs have perhaps wisely been omitted; but some explanation of the meaning of the numbers forming a zone-symbol might well have been included.

The second, or physical part of the book (pp. 547–933) is devoted almost entirely to the discussion of the optical properties of crystals and the methods of determining them. The methods of measuring the expansion of crystals by heat and their elastic properties by means of the author's interference-apparatus, are also described, and the last chapter contains a short account of the hardness of crystals, and of liquid crystals, and the use of the "crystallisation microscope." No reference is made, however, to other physical properties, such as pyro-, piezo- and thermo-electricity, and thermal and electric conductivity.

The first eight chapters in this part (pp. 545–680) are occupied with a discussion of the nature of light and the mode of its transmission through crystalline media, while the rest of the optical portion (pp. 681–883) is chiefly devoted to a description of the instruments and operations required for the measurement of the various properties expressible by the form and orientation of the optical ellipsoid. This portion includes detailed directions for the cutting and grinding of prisms and plates, the production of monochromatic light of any desired wave-length, the determination

of the directions of light-vibration in crystal plates, and of refractive indices by means of prisms and by total reflection, and the examination and measurement of interference-figures. Pleochroism and the rotation of the plane of polarisation are also discussed, and there are excellent chapters on the crystallographic microscope and its accessories, with an account of Fedorov's universal stage and the methods due to him and to Becke for the location of the optic axes in a crystal section.

The descriptions are very full, and for the most part clear, but some few points have been noted which seem to call for criticism. Thus, for instance, on p. 585, the mode of construction of the optical ellipsoids on three rectangular axes the lengths of which are made (either directly or inversely) proportional to the values of the refractive indices of the crystal for the vibrations taking place along them, is not made clear at the start; and, moreover, the expression, "the refractive index along" a given direction, which frequently occurs, is ambiguous, and does not seem to be anywhere defined. A slip is noticeable on p. 572, where the wave-front in a crystal is stated in the general case to be an ellipsoid.

The methods and apparatus described throughout the book are principally those of which the author has had personal experience in his well-known researches, and the examples are mostly taken from the same source. The treatment is very detailed and almost unnecessarily circumstantial, and in many places there is a good deal of repetition. Thus, for example, in the seven chapters dealing with crystal calculation, though it is no doubt desirable that the advantage of systematic methods of computation should be impressed upon the student, it was perhaps scarcely necessary to insert the actual working (with a diagram) of every spherical triangle and anharmonic ratio computed; whilst in the physical portion of the book a considerable amount of space might have been saved by the omission of much of the large mass of practical detail, particularly that concerning some of the less readily determinable properties, such as elasticity (of which the account occupies eight pages) and thermal expansion (twenty pages), for which the reader may fairly be expected to consult the original memoirs. A reduction in the size and cost of the book would have been advantageous, as rendering it more accessible and at the same time more useful to the student, who may be apt to be somewhat bewildered by the amount of information provided for him.

The numerous illustrations, which have been mostly drawn by the author or specially engraved for the book, are, with a single exception (Fig. 440), all excellent.

(2) The smaller book is based on a lecture delivered by the author at the meeting of the British Association in Winnipeg in 1909, and is intended for the general reader, to whom it aims at presenting an account of some of the more important properties of crystals—geometrical, physical, and chemical—especially in relation to their molecular structure.

The task of conveying to a reader a clear idea of this somewhat extensive subject within the compass of some 300 pages, without assuming some previous acquaintance with crystals, is no easy one, and the difficulty has been increased by the inclusion of numerous practical experimental details, which, however appropriate in a lecture, are of little use in a book of this kind. In the same way, a very large amount of space (twenty pages) has been devoted to the behaviour of plates of quartz and amethyst in polarised light, some of which might probably have been better utilised for an expansion of other parts of the book which have suffered from undue compression, such as the discussions of interference and of molecular "distance-ratios."

Not a few incorrect or misleading statements have been noticed. Thus, for example, the types of symmetry unrepresented among Sohncke's sixty-five point-systems are not those having no plane of symmetry, as indicated on p. 117, but chiefly those showing hemimorphic character. In chapter v., which deals with crystal-axes and the law of rational indices, the meaning of the axial lengths and the manner in which they are determined by means of the intercepts made by a parametral face are not explained early enough, or with sufficient prominence, and the figures of simple pinacoid forms, with inscribed axes, which illustrate the axes of the various systems, are misleading as to this point. Again, on p. 51, the letters *a*, *b*, *c*, are used to denote the three crystal axes, while on p. 57 (without further explanation) they are used for the unit lengths along these axes. Similarly, on p. 57, the "three numbers [*m*, *n*, *r*] expressing the intercepts" appear to denote the actual lengths of the intercepts, while at the bottom of the following page the intercepts are explained as meaning the multiples of the unit lengths, *a*, *b*, *c*. The meaning of the example on p. 58 is far from clear.

There are numerous admirable illustrations of growing crystals, and a good coloured plate of crystals in polarised light, which have been reproduced from the author's own photographs.

It is to be feared that the book will scarcely be intelligible to a general reader without some previous knowledge of the subject, but the student who is already familiar with the elements of crystallography may find much in it that is interesting and suggestive.

H. L. B.

## THE GEOGRAPHICAL BASIS OF HISTORY.

*A Historical Geography of the British Colonies.* Vol. v., Canada. Part iii., Geographical. By J. D. Rogers. Pp. viii+302. Vol. v., part iv., Newfoundland. By J. D. Rogers. Pp. xii+274. (Oxford: The Clarendon Press, 1911.) Price 4*s*. 6*d*. each vol.

TWO more volumes of Sir Charles Lucas's valuable "Historical Geography of the British Colonies" have appeared, in which Canada and Newfoundland are described. The Canadian volume deals with the geography, but the historical aspect is still largely to the fore. No general account of the whole region occurs, in which the principal characteristics of this portion of the North American continent is given, but we are introduced at once to the far north land and

the story of its discovery and exploration. The extreme eastern portion, Nova Scotia, is next treated, and its character and development are traced step by step from its first settlement at the beginning of the seventeenth century until the present time, when its greatest activity centres in the city of Halifax.

Joining this eastern region to central portions of the Dominion is the important province of New Brunswick, which unites the estuary of the St. Lawrence to the Atlantic coast of the Bay of Fundy, and provides Quebec with valuable southern lines of communication without passing into the territory of the United States. To the north of the St. Lawrence lies a barren region between it and Hudson Bay, of which the development has been restricted to Labrador, its eastern coast, and even here resident fishermen and traders, with a thousand or two Eskimos, make up the population. Quebec and Ontario are the two centres about which the history of the middle eastern portion of Canada centres, and in each the story of a steadily advancing utilisation of the land's resources is unfolded. The prairie lands of the middle west are described in their different categories with their natural features and resources, and we see the gradual opening up of the region by the early hunters, who, from Canada and from Hudson Bay in the first instance, were followed later by settlers along the same water routes.

At the present day the grouping of the immigrants of different nationalities along the various railway lines furnishes an interesting case of special geographical distribution of new settlements. The far west, and the north-west, where settlement is still pressing into unopened regions, present a different problem from the last, since the great ranges of the west cover a vast tract of country.

A final essay deals with the civilisation of the far west. Within this moderate compass we have a most complete account of the entrance into this vast region of immigrant peoples from the east, their gradual establishment, and their utilisation of its resources. Their movements largely controlled by the physical features of its surface are well described, and their relation to these features is brought out. A most valuable aid to the student is the ample references which are given throughout, and these show what an immense amount of research Mr. Rogers has devoted to the subject. The geographical descriptions of the various regions contain a considerable amount of geological information, but they might usefully have been carried further in describing the land features, and the part that the different erosive agencies have played and are playing in modelling the surface of the land, for much relating to the human occupation is closely concerned with these. The whole question of relief is but lightly dealt with, and might have advantageously been shown cartographically.

The volume which deals with Newfoundland shows a similar wealth of historical reference and research, presenting with great clearness the gradual development of the colony of fishermen which grew up by itself alongside other fishermen who came yearly to fish, but returned without establishing themselves there. The wealth of the fishing industry has hindered the development of the colony's resources, and kept human activity close to the sea coast and the innumerable creeks which indent it. The long Anglo-French duel is discussed in detail, with ample references to all authorities, and is followed by an instructive chapter on the progress which has taken place by land between 1818 and 1910 in developing the natural resources of the interior. The historical aspect is naturally predominant, but a rather fuller treatment of the land surface and its special character would have been a useful introduction to the history of the colony. H. G. L.

## ALBINISM.

*A Monograph on Albinism in Man.* By Karl Pearson, F.R.S., E. Nettleship, and C. H. Usher. Part i., text, pp. viii+266; atlas, plates A—Z and AA—ZZ. (Department of Applied Mathematics, University College, University of London: Drapers' Company Research Memoirs, Biometric Series, vi.) (London: Dulau and Co., Ltd., 1911.) Price, part i., text and atlas, 35*s.* net.

THIS is the first part of a monograph on albinism which promises to be the most complete presentation, as yet produced, of what is known on this interesting subject. The subject of abnormal pigmentation is important, not only in itself, but also because its elucidation is certain to throw a great deal of light on the still more important question of normal pigmentation.

In the present volume, the authors deal with the history and geographical distribution of albinism, the albinotic skin, leucoderma, and partial albinism; in subsequent volumes they propose to deal with the albinotic eye and the albinotic hair in man and in the lower animals. The atlases accompanying the present and subsequent volumes contain numerous illustrations of albinotic subjects, maps, pedigrees, &c.

Though an enormous amount of labour has been expended in collecting the materials for this volume, we are somewhat surprised, after having read it, to find how little is definitely known about the subject. Taking the question of the geographical distribution of albinism, there appears to be only two countries in Europe, namely, Norway and Italy, in which anything approaching an exact census of the number of albinos in the population has been taken. In the former country the proportion is given as 1 in 10,000, and in the latter 1 in 20,000. It would be very dangerous to rely on these figures as showing a real difference in the susceptiblity of the Nordic and Mediterranean races of Europe.

The chapter on the albinotic skin contains a very complete account of the more recent investigations that have been made to ascertain the nature and origin of the pigment of the skin. We find, however, that the leading authorities on this question are still so much at variance that it is impossible to come to any decisive opinion. We have, on one hand,

Ehrmann's theory, that the material which is converted into melanotic pigment springs from the blood, being, indeed, hæmoglobin which is converted into melanotic pigment by the vital processes of the melanoblasts; and that the pigment is transferred by protoplasmic flow along protoplasmic threads. On the other hand, Meirowsky contends that the epidermal cells themselves can produce pigment, especially under the influence of light, and that the hæmoglobin and migratory melanoblast theory has been completely exploded. Neither microscopic nor biochemical investigation has led to any decisive conclusion on this question. Both sides of the controversy are fairly and fully stated in this part of the monograph.

The remaining chapters deal with leucoderma and partial albinism. Leucoderma is defined as an acquired disease characterised by the presence of progressive white patches with convex borders surrounded by increased pigmentation. It is regarded, by the authors, as the essential pathological pigmentation change wherein is seen albinism in the making, and from this point of view its study is of great importance. Interesting suggestions as to the cause of leucoderma have been made by Beigel, who maintains that it is largely due to modified nerve action, produced by shock, illness, severe chill, or other nerve upset; and by Forel, who offers some evidence that it may be sometimes due to race mixture. Many excellent portraits of leucodermous subjects are contained in the atlas.

In the chapter on partial albinism, the nature and origin of piebaldism is discussed. It is noted that in some cases at least piebaldism is hereditary even as to the position of spots.

Numerous cases are cited and described of leucoderma, piebalds, and spotlings.

This valuable monograph will clear the ground and suggest new lines of research, and the remaining parts will be eagerly awaited.

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## *SUSPENSION BRIDGES.*

*Ponts Suspendus.* By G. Leinekugel le Cocq. Tome i., Ponts Suspendus Flexibles et Semi-Rigides. Pp. xiv+374. Tome ii., Ponts Suspendus Rigides. Pp. 330. (Paris: I. Doin et Fils, 1911.) Price, 2 vols., 10 francs.

THESE two volumes form part of the "Encyclopædia of Science," published under the direction of Dr. Toulouse, and of the subdivision dealing with applied science and engineering, the general editorship of which was entrusted to Prof. D'Ocagne, of l'École des Ponts et Chaussées. The first volume treats of flexible and semi-rigid, and the second of rigid suspension bridges.

In the first two chapters of vol. i. the author gives a brief history of suspension bridges, with short accounts of some of the more famous of them, and some notes on the different systems of construction adopted in practice; the rest of this volume is devoted to analytical investigations of the various problems which have to be solved by the designer of flexible and semi-rigid suspension bridges. M. Leinekugel le Cocq deals first with cables employed in the aërial transport of minerals and other materials across ravines in mountainous districts, and for similar work in connection with the erection of bridges across rivers, where the conditions render the construction of staging impossible, as was the case with the bridge across the Zambezi, just below the famous falls, and shows how to determine the length and maximum stresses in such cables when the necessary data are known.

Cables for suspension bridges are then considered; on pp. 88 and 89 the author gives tables showing the relation between dip and span for a number of suspension bridges in Europe and America, and adds some notes as to the methods of constructing such cables, and as to the physical properties of the steel suitable for their manufacture. The deformations produced by temperature changes and by unequal loading are then fully discussed, the formulæ obtained being illustrated by the case of the Williamsburg bridge and others. The effect produced by supporting the cables from two piers of different height, and the design and stresses in the suspension links, are then taken up. The next section of this volume is occupied with a discussion of the methods adopted to increase the rigidity of suspension bridges and thus overcome the serious practical inconveniences which ensue when a suspension bridge is supported only by the principal cables; the treatment of this important problem is very thorough and complete. The first volume concludes with some notes on the construction of the bridge platform, and on the action of the wind upon such bridges.

In an introduction to vol. ii., the author points out that the design of flexible and semi-rigid suspension bridges requires but little knowledge of higher applied mathematics, while, on the other hand, the problems encountered in the design of rigid suspension bridges can only be solved by those who are well equipped on the mathematical side; hence, while examples of the former class of bridge are numerous, the rigid type is only occasionally met with. The first chapter treats of three-hinged, rigid suspension bridges; general principles are first considered, both analytical and graphical solutions are discussed, and full explanations are given as to the method of determining the lengths, stresses, &c., in the bracing and struts between the upper and lower members of such bridges. Illustrative examples selected are the bridge at Pittsburg over the Monongahela, and a bridge near Villefranche on an electric railway line in South France. In the second chapter hinged bridges, with the platform supported by oblique chains, are dealt with, the illustrations of this class being the transporter bridges at Nantes and Marseilles. The concluding chapter is devoted to various important details, such as anchorages and saddles. In the form of an appendix, the author has reprinted the official regulations as to working loads, stresses, &c., in steel bridges, which must be adopted when designing such structures in France and other Continental countries, and also a bibliography of the subject, which should prove of service to engineers engaged in this branch of bridge design.

T. H. B.

## THEORY OF ALGEBRAIC NUMBERS.

*Introduction à la Théorie des Nombres Algébriques.* By Prof. J. Sommer. Edition Française revue et augmentée. Traduit de l'Allemand par Prof. A. Lévy. Pp. x+376. (Paris: A. Hermann et Fils, 1911.) Price 15 francs.

THIS book is a French translation of the work on algebraic numbers by Dr. J. Sommer, professor of the Technical High School of Danzig. It is an elementary exposition designed to be an introduction to the researches of modern German mathematicians, particularly of David Hilbert, whose masterly *résumé* in "Jahrsbericht der deutschen Mathematiker Vereinigung, 1895," is likely to be regarded as a classic. Gauss was the first to enlarge the field of the higher arithmetic by including therein numbers of the form $a+b\sqrt{-1}$. This led to a beautiful theory in the development of which he was followed by Dirichlet, Kummer, Dedekind, and Kronecker, to mention only a few of the most important and successful investigators. The results included extensions and generalisations of many theorems of the higher arithmetic, and in particular of the theorem of quadratic reciprocity. The modern theory of algebraic numbers involves a further extension of the domain of numbers in that every root of an irreducible algebraic equation with rational coefficients is said to be an algebraic number. For a given degree $n$ of such an equation the *corpus* of such numbers comprises every rational function of such roots. When $n$ is 2 we have the quadratic corpus which involves the irrationality $\sqrt{m}$, $m$ being a given integer, not a perfect square, which defines the corpus. This book treats the domain of these numbers with some completeness (pp. 16–183).

The difficult subject of "ideal numbers," an invention of Kummer, is introduced lucidly, and subsequently well handled. The reader is then brought to the chapter entitled, "Applications of the Theory of the Quadratic Corpus," and will there find the most interesting part of the book. One of these applications is to the world-famous "last theorem" of Fermat, which asserts the insolubility in integers of the equation

$$x^n+y^n=z^n,$$

when $n$ is an integer superior to 2. The proofs when $n$ is 3, 5, 11, or 14 resulted from the attacks of Euler, Legendre, and Dirichlet, while Kummer, utilising his ideal numbers, established the theorem for all prime values of $n$ less than 100. The theorem as asserted by Fermat still awaits proof. The next application is to the theory of quadratic forms in the higher arithmetic of integers. The theory of the extended domain is shown to involve remarkable extensions of theory in the restricted domains which were initially handled with so much success by Gauss. The remaining chapters are on the "Cubic Corpus," and the "Relative Corpus," the latter a notion due to Hilbert somewhat analogous to the ideal numbers of Kummer.

The field of pure mathematics into which Dr. Sommer's book gives an insight has been somewhat neglected in France, and in England it is correct to say that nothing of any moment has been accomplished. German mathematicians have shown it to be a singularly attractive and fruitful if recondite subject of thought. Now that the field is brought closer to the view of English mathematicians it may be that they will take more interest in it.

The work, though on the whole well produced, is marred by many misprints in the early pages. On p. 41 there are six misprints, on p. 42 four, &c. It is a pity that difficulties already considerable should be thus increased. P. A. M.

## THE RESOURCES OF BRITISH WEST AFRICA.

*The Agricultural and Forest Products of British West Africa.* By G. C. Dudgeon. Pp. x+170, with five maps. (Imperial Institute Handbooks.) (London: John Murray, 1911.) Price 5*s.* net.

THIS book forms the introductory volume of a series to be known as the "Imperial Institute Series of Handbooks to the Commercial Resources of the Tropics, with Special Reference to British West Africa." The handbooks will be edited by Prof. W. R. Dunstan, F.R.S., and will be issued under the authority of the Secretary of State for the Colonies.

Mr. Dudgeon was for several years Inspector of Agriculture in British West Africa, and in that capacity visited annually the five colonies and protectorates which together form that territory. He writes therefore with full knowledge of the conditions under which agriculture and forestry are carried on there.

The five dependencies are dealt with in geographical order, commencing with Gambia to the west, and finishing with northern Nigeria to the east. By way of introduction to the section on each country, the salient facts regarding area, population, habits and disposition of the natives, and the peculiarities of the climate and soil are set out, followed by a brief account of whatever local attempts are being made to improve native methods. The improvement of native agriculture is largely a question of better tillage and the introduction of a proper rotation of crops, and from this point of view Mr. Dudgeon's brief but careful descriptions of the implements in use by the natives are of value. The greater part of each section is, however, occupied by descriptions of the principal crops, more detailed reference to any particular crop being reserved for the section relating to the dependency in which that crop is predominant; thus, under Gambia there is a good account of groundnut cultivation, and under the Gold Coast there is an excellent summary of the present position of the flourishing cocoa industry of that colony. These matters will, however, receive detailed attention in subsequent books of the series, and the author rightly confines himself in this volume to giving the reader a general idea of the agricultural and forest resources of each country and of the means whereby these may be most surely and safely developed.

It is clear from this book that the two chief obstacles encountered in the agricultural development of British West Africa are the lack of transport facilities and the ignorance and conservatism of the native population. The first of these obstacles is

being gradually surmounted by the provision of roads and railways, and the most recent enterprise of this kind, when finished, will connect by rail Kano, on the edge of the Sahara, with Baro, on the Niger, and Lagos, on the coast, and thus open out an immense area of land, much of which, it is believed, will be suitable for growing cotton of the type required in Lancashire mills. The second obstacle is more difficult to deal with, but there are indications in Mr. Dudgeon's book that advance is being made. Progress in this particular direction can only be accomplished by the provision of agricultural departments, staffed by men who are not only skilled agriculturists by training and education, but possess, in addition, administrative and managing abilities of a high order, and are capable of exercising initiative in face of great natural difficulties. It is fortunate for British West Africa that the days seem to be over when governmental assistance to tropical agriculture consisted merely in the provision of a botanical garden, and that the tendency in British West Africa at least, in recent years, has been to replace such institutions by properly equipped and staffed departments of agriculture, with their necessary complement of experimental stations.

Mr. Dudgeon avoids technicalities as far as possible, and for that reason this book will probably appeal, not only to the tropical agriculturist, but also to the Colonial official, whose interest in these matters it is most important to enlist.

The volume contains five clearly printed and useful coloured maps of the areas dealt with, and is well illustrated by reproductions of photographs of tropical crops and typical native industries.

## OUR BOOK SHELF.

*Modern Science Reader, with Special Reference to Chemistry.* Edited by Prof. Robert M. Bird. Pp. viii+323. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* net.

IN this country "Readers" are usually intended for young children. In the States the use of "Readers" extends to a later period of study, and in the present instance the book provides a course for "college men" and general readers. It is a compilation of reprints of modern papers and professional addresses, and is the first volume of a series which, it is hoped, will broaden the outlook of the undergraduates for whom it is intended. In every instance, the authors and publishers of the original papers have consented to their republication in this handy form. The selection of subjects has been made with a judicious regard for the taste of the reading public, and as the authors include Crookes, Lodge, Remsen, and Madame Curie, the readers are provided with stimulating fare.

We think that there is a risk that the title "Reader" may militate against the circulation of the book in England. It would be a pity if this should prove to be the case, as all the subjects are worthy of study, and they are very skilfully treated by men who add to eminence as investigators the power of presenting the results of investigation in an attractive, intelligible form. Perhaps the most formidable, though not the least interesting, of the articles is Dr. Howell's address on activators, kinoses, and hormones.

The book concludes with suggestions for additional reading, such as are usually given here to university extension students. Indeed, the book is well suited to those who reap profit from the more advanced extension classes, and is likely to interest a rather wide circle of readers. It would be a good book for a school science library, as it is trustworthy as well as stimulating. Most of the articles made their first appearance within the last three or four years.

(1) *Gardens shown to the Children.* By Janet H. Kelman and Olive Allen. Described by J. A. Henderson. Pp. xii+100+32 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price 2*s.* 6*d.* net. (Shown to the Children series.)

(2) *Roses.* By H. R. Darlington. Pp. xiii+193+8 coloured plates. (London and Edinburgh: T. C. and E. C. Jack, n.d.) Price, double vol., 2*s.* 6*d.* net. (Present-day Gardening series.)

(1) As we all know, the love of flowers is with nearly every child almost a passion; there was no need of a book to create or develop that. The object of the authors of this work has been rather to teach children to take an interest in the methods of cultivation, and, by pictures, to broaden their knowledge of hardy plants in general. To write down to the child's mind on such a subject as gardening is no easy task, but if we imagine the authors' audience to be limited to children who have reached their 'teens, we think they may be congratulated on having accomplished it very well. They give sound cultural directions couched in simple, direct language without putting on the omniscient, patronising air that so many authors of serious children's books think it essential to assume. There are thirty-two coloured plates, some of which are very good considering the price of the work; others are decidedly painful—to the adult eye at any rate. But, after all, the best critic of the book is an intelligent member of the particular audience to whom it is addressed. We put our copy into the hands of such a one during the recent holidays, and his opinion, expressed in vigorous schoolboy idiom, was, when translated, found to be distinctly favourable.

(2) The work on "Roses," by Mr. H. R. Darlington, admirably maintains the high standard set by previous authors in this useful series of gardening books. The book is in the nature of a double number, and the price is slightly increased, but no rosarian will grumble at that. The author gives very excellent directions for the propagation, management, and care generally of roses. Especially useful will be found lists of roses for different purposes and situations. There is a pleasant chapter by Mrs. Darlington on "Fragrance in Roses." A rose without fragrance is without half its charm; yet, a short time ago, as one ascertained for oneself at the big rose shows, it seemed as if that half was in fair way of being lost in the rose-raiser's quest for colour and form. Happily the claims of fragrance are being again admitted. The coloured illustrations are some of the best examples of colour-photography hitherto published in this series.

*Elementary Integrals: a Short Table.* Compiled by Dr. T. J. I'a. Bromwich, F.R.S. Pp. 38. (Cambridge: Bowes and Bowes; London: Macmillan and Co., Ltd.; Glasgow: James Maclehose and Sons, 1911.) Price 1*s.* net.

THIS is a very compact and serviceable *vade mecum*, suitable both for students of physics and for those who are in the earlier stages of pure mathematics; and it is arranged on a system which ought to make its owner able to find quickly anything that it contains.

The work throughout is very elegant, especially in the treatment of integrals involving quadratic irra-

tionalities, and there are various instructive notes. Stimulation is provided, for example, by the inclusion of some simple pseudo-elliptic integrals, and those who are familiar with Abel's theorem will see frequent traces of its application. Practical ends are served by the inclusion of Simpson's rule and the theory of the planimeter, and a sufficient number of examples for practice is given throughout.

The actual limits of the table are best seen from the section on definite integrals. Here we have, for instance, $\int_0^\infty e^{-ax}\cos bx\,dx$, but not $\int_0^\infty \sin ax.dx/x$. From his position at Cambridge, Mr. Bromwich has no doubt been able to fix the line at the most appropriate place; in a table of this sort it is not very easy to decide where to stop. G. B. M.

## 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 Value of the "External" Degrees of the University of London.

IT is often the case that a system, whether of Government or of social custom, passes muster until its shortcomings are brought to light by some specific instance of hardship or injustice. The reform introduced in the constitution and government of the University of London, due to the report of the Commissioners of 1898, was devised to remedy alleged shortcomings in the system of awarding degrees on examinations alone; and the "internal" side of the University was then constituted, in which the teachers were given considerable (but in the opinion of the writer, insufficient) control over teaching and examinations. In spite of the fact that purely "external" examinations (*i.e.* examinations in which the teacher takes no part) were unknown, save in London, in China (the system has since that time been altered there), and in New Zealand and in India (the latter two countries having copied the system in vogue in the University of London), it was resolved that this "external" system should be continued; it has ever since formed one of the divisions of the University.

It is a matter of common knowledge that this course has not made either for peace or for efficiency; and at the present moment Lord Haldane's commission is reconsidering the whole question of university education in London. It is rumoured that their decision may involve complete separation of the "internal" and "external" sides of the university. I wish here to give reasons why the "external" side of the university should not be perpetuated, and I base them upon an instance where flagrant injustice has been done to a late student of University College, Mr. F. P. Burt, whose permission I possess to make known the facts connected with his candidature for the D.Sc. degree in chemistry.

At a meeting which took place some years ago of representatives of the Sorbonne (the University of Paris) and of the University of London, I, among others, was asked to give a short address. I ventured then to point out that out of 100 candidates for an external examination, 25, on an average, were undoubtedly "passes"; 25, equally indisputably failures; but as regards the remaining 50 it was a matter of good luck if they passed, or of bad luck if they failed. I suggested that as an excuse for persistence in a system involving such haphazard results the well-known gambling spirit of the English was satisfied; they like to take a risk of the kind.

My remarks may have been somewhat exaggerated; I will not insist on the proportions; but it is indubitably the case that no proper judgment can be formed on the fitness of a candidate to pass which is based solely on the verdict of external examiners reading written papers. The number of candidates at such examinations is very large; the physical strain to the examiner in reading and "marking" hundreds of papers in a comparatively short time is immense, and with the best will in the world he cannot act fairly. I speak from ample experience, both in London and elsewhere.

For higher degrees, such as the Doctorate, it is within the discretion of the Senate to appoint examiners *ad hoc*, for it is not to be expected that the official examiners shall always be able to form an accurate judgment on the matter of a thesis of a special nature. This, however, the Senate does not always do on the "external" side; on the "internal" side, the services of a special examiner are rarely, or never, dispensed with.

While in 1858, when the degrees of the University of London were thrown open to all applicants, solely on an examinational test, with no restrictions (except in the faculty of medicine) as to how they had acquired their knowledge, some excuse might have been found for this course; but the spread of education, and the existence all over the country of teaching institutions where advanced instruction may be obtained, and in many cases where degrees are awarded, has rendered it practically unnecessary to provide for the "private" student. Indeed, in the faculty of science at least, very few students present themselves for examination who have not received training at some public institution, and many of them have received degrees elsewhere.

Mr. F. P. Burt, whom I mentioned before, was a student in University College, Bristol. He subsequently prosecuted a research, begun there, in the laboratories of University College, London. Having completed this research, he sent it to the University as an *external* student, without having consulted any members of the London staff. My position in connection with him is therefore merely that of an outside member of the public; I am in no way responsible for his thesis.

This thesis was received by the University last spring, and Mr. Burt was informed by the University authorities that it had not been accepted as qualifying for the degree. To those who knew the work, the refusal was so extraordinary that I sent copies of the thesis, which dealt with the atomic weights of nitrogen and sulphur, to three gentlemen, one of whom is a member of the International Commission on Atomic Weights, who publish an annual table, printed in all the leading chemical journals, stamped with their authority. It is their function to read and examine critically all the work on the subject done during each year, and to assign a value to it in drawing up their table of these constants. This gentleman, Prof. Ostwald, late of Leipzig, is, it may be taken, particularly qualified to judge of such work as that of Mr. Burt. The second referee was Prof. Th. W. Richards, of Harvard University, well known for his work on atomic weights; and the third, Prof. Guye, of Geneva, who has special experience of the kind of work done by Mr. Burt, and who is also a leading authority. I now give a translation of Prof. Guye's letter; he is himself a graduate of Paris:—

"*Geneva, June* 22, 1911.

"Sir William Ramsay has called my attention to the researches of Mr. Burt. I was already acquainted with them, through having followed them closely as they appeared. A fresh study of them has confirmed me in the opinion that they place Mr. Burt among the small number of experimenters capable of carrying out satisfactorily chemical researches of high precision. This opinion is derived from his researches on helium and neon, and on those on sulphide of nitrogen; they present very great experimental difficulties, which have been admirably surmounted, so much so that they form a very important contribution to the recent determinations of atomic weights. Work of this kind ought to be greatly encouraged, for it forms a particularly stable foundation in fixing the values of atomic weights. I hold the opinion that the memoir on the ratio of N to S would assuredly be accepted as a thesis for the doctorate in Swiss and in French universities.

"(*Signed*) PH. A. GUYE."

Prof. Ostwald also wrote a letter, of which the following is a translation:—

"*Gross Bothen, Saxony.*

"The collected works of Mr. F. P. Burt show him to be an experimenter who knows what to aim at and how to arrive at results. He appears to be already sufficiently mature to occupy a position which demands the services

of an independent investigator. Had his work 'On the Relative Atomic Weights of Nitrogen and Sulphur' been presented in Leipzig, I should gladly have accepted it, not only as a doctor's dissertation, but also as a sufficient qualification for the position of university lecturer (Privatdozent).

"(*Signed*) WILHELM OSTWALD."

Prof. Th. W. Richards wrote:—

"The investigations of Mr. F. P. Burt seem to me to present many points of interest, and to indicate a high order of experimental ability. In view of the fact that a large proportion of the work was done by Mr. Burt himself, even when he was assisted by collaborators, the sum total of his papers appears to me to present more than the equivalent of a thesis for the doctor's degree in the best universities in America. It must be remembered, however, that a thesis is only a part of our requirement.

"(*Signed*) THEO. W. RICHARDS."

Copies of these letters were sent to the Senate of the University of London in July, 1911, together with a letter, the last sentence of which is:—"Since it appears to me (and my opinion is shared by Profs. Dixon and Collie) that an error of judgment has been made in Mr. Burt's case, we would respectfully urge you to reconsider his claims."

On October 18, 1911, the Senate passed the following resolution:—

"That, having considered the communication from Sir William Ramsay of July 10, 1911, and having heard a report from the examiners, the Senate are not prepared to vary the decision at which they have arrived."

As it was impossible to believe that the Senate attached more importance to the decision of their examiners on the merits of the thesis than to the verdict of special experts, the inference was obvious that they considered that the work, or a sufficient proportion of it, had not been done by the candidate. Perhaps this view was partly justified by the terms in which Mr. Burt had thanked all those to whom he supposed himself indebted during the progress of his research; his expressions were, to say the least, generous.

The Regulation for External Students (Blue Book, Univ. of Lond. Calendar, p. 294) is:—"If the Dissertation or Thesis be approved by the Examiners, the Candidate shall be required to present himself . . . to be further tested either orally or practically, or by printed papers, or by all these methods. . . ." But in certain circumstances the candidate may be exempted.

It was therefore within the powers of the examiners to have interviewed the candidate, to have asked him the nature of the assistance which he acknowledged, and to have obtained from him the names of the persons assisting him, and, should his word have been doubted, to have written to them inquiring as to the extent and nature of the help given. This was not done. Hence it appeared necessary to obtain from all those who knew of Mr. Burt's research testimony as to the share they had had in it. Prof. Travers, Prof. Usher, Prof. Francis, and Dr. Whytlaw Gray all testified most emphatically that the share which they had borne in the work was insignificant, and that the work was in every sense of the word original. Prof. Dixon, in whose laboratory Mr. Burt is now assistant, although not having been in contact with Mr. Burt during the progress of his thesis research, voluntarily wrote to me expressing the opinion that work in which Mr. Burt is at present engaged is being done "in a masterly manner," and that he has "no doubt as to the capacity, manipulative skill, foresight, and patience which Burt possesses to carry out such work."

Copies of these letters were sent to the Senate on November 27, 1911, and they were again requested to reconsider their decision not to admit Mr. Burt "to be further tested." On January 25, 1912, the Senate resolved:—"That the Senate decline to reopen the question of the rejection of the D.Sc. candidate referred to."

After this final refusal no course remains but to make public the facts of the case. And this I do, not so much in justice to Mr. Burt, but in order to raise the much larger question as to whether it is proper that a system in which such injustice can be perpetrated should continue to exist. I am led to understand that complaints are not infrequent that candidates of undoubted merit, not only in the faculty of science, but in other faculties, have had their theses rejected without sufficient reason. There is one instance, at least, of a thesis which, after summary rejection, was subsequently published in book form, and which received the highest encomiums from the Press and from private persons of eminence in the subject treated. On the "internal" side of the University I am unaware of any complaint having been made, for much more care is bestowed; and besides, the teachers, who are also examiners, are acquainted with the candidates' abilities from frequent personal communication, and often from daily contact.

There can be no doubt that such miscarriages of justice are to be attributed, at least in part, to the growth of the University. With few candidates some sort of acquaintance on the part of the examiners with their merits is possible, but with increase of numbers control becomes impossible. Moreover, there is a growing reluctance on the part of men of established reputation to accept the post of examiners; the work is hurried, it is badly paid, and it is a thankless task. The fact is that the day of "external" examinations is past; the system is an anachronism; and I think that the case which has been presented furnishes an irrefutable argument why that system should be abandoned. A degree is in essence a testimonial; and a testimonial from a corporate body depends for its value on the eminence of the persons capable of forming a judgment on the merits of the graduate and on their opportunities for forming a correct judgment. Where the examiners are not eminent, and where the opportunity of forming a judgment has not been given or has not been taken, the degree is worthless, and the corporate body awarding it should cease to exist.

W. RAMSAY.

University College, Gower Street, London, W.C.

## Are Eyes ever Autophanous?

THOSE who read Colonel Herschel's letter in NATURE of January 18 may be interested in some observations which I made during the summer upon the sight and eyes of cats. Whereas in men and monkeys the retina is backed by black pigment, as a photographer backs a plate when his camera is to be directed towards a window, in almost all other mammals it rests on a brightly burnished layer of cellular or fibrous tissue, the tapetum. It is this mirror which throws the light back to an observer who stands between the animal and the source of light. The eye is at the same time a camera focussed to form an image of the observer on its sensitive screen and a lantern focussed to project light upon the observer. Such an arrangement appears to a photographer fatal to the formation of an image sharp in line and dot.

Many explanations of the function of the tapetum have been offered, but none, to my thinking, satisfactory. To me it has long seemed that its only purpose can be to render the eye sensitive to movement, as distinguished from form. I studied my cats as they hunted field-mice. One of them would crouch for hours in front of a hedge. Seated at a moderate distance, I was able on several occasions to see the catch, a single spring in the direction of the mouse, whether it moved at the spot at which the cat appeared to be staring or considerably to one side or the other of the axis of her head. For movement her vision was perfect. If, as she roamed about the lawn, a daddy-longlegs shook a blade of grass, she sprang towards it. But to stationary objects she paid scant attention. In various places I fixed a dead mouse in as natural an attitude as I could make it assume with the aid of wires and wooden pegs. If the cat passed close to it she would stop to smell it, perhaps to pat it, but she never showed any sign of regarding it as something to be caught. In hunting for birds, on the other hand, her whole method was reversed. Cautiously climbing, she would study a dead leaf with the utmost care, afraid to move lest she should disturb a possible victim.

It seemed to me that the upper and lower halves of the retina functioned in different ways. I therefore examined the eyes of several cats. When perfectly fresh, the interior of the eyeball, seen under a dissecting microscope, is one of the most marvellously beautiful obects that can be conceived. The opalescent retina rests on a silver mirror

mottled with gold. The surface of the mirror is raised in low ridges, which radiate outwards from the centre in waving lines, like the sun's rays on the Japanese flag. After a few minutes' exposure to air or water a film of metallic green and blue invades the silver. But the tapetum does not line the whole of the back of the eye. It is bounded by a sharp irregular line which crosses the wall of the globe horizontally, about 1 mm. below the level of its equator. The lower portion of the retina, a little less than a quarter sphere, is backed, as it is everywhere in the human eye, by dense black pigment. Colonel Herschel observes that a man's eye does not gleam.

In a superbly illustrated monograph published in the Philosophical Transactions of the Royal Society Dr. Lindsay Johnson pictured the eyes of a great number of the animals in the Zoological Gardens as he saw them with an ophthalmoscope. With the exception of monkeys, the elephant, rhinoceros, and hyrax, all terrestrial mammals are provided with a tapetum. The exceptions are significant. In monkeys, as in ourselves, the retina shows a "yellow spot." They trust to direct vision with its minute discrimination of detail. They move their eyes with great rapidity towards the objects which they wish to examine. Such rapid movement is incompatible with extreme sensitiveness to the movements of external objects. A cat does not move its eyes. It moves its head. Of hyrax I have nothing to say, but the elephant and the rhinoceros stand alone amongst Herbivora. They alone are indifferent to the movements of lurking enemies—great cats and snakes. They do not need to sacrifice visual precision, as it must be sacrificed in animals in which the retina is backed by a mirror, in favour of a capacity of detecting movement.

I have examined the eyes of a considerable number of animals, and find that the disposition of the tapetum, considered in its relation to the habits of the animal, is in all cases in harmony with the view as to its purpose which I have here expressed. I am also prepared to give an explanation of the optics of its relation to the retina, but for this or for special illustrations I must not trespass upon your space. ALEX HILL.

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COLONEL HERSCHEL'S letter in NATURE of January 18, followed by that of Mr. Hunt, have no doubt interested others besides myself. I do not think that there is any reason to suppose that any animal's eyes are "autophanous," however general the belief to the contrary may be among those not given to accurate observation. I can add to the list of the apparently autophanous the spring-haas in South Africa and the common English mouse. I generally encourage a few of the latter, and at the present time three have taken up their abode with me in Victoria Street. There is a regulator clock standing $1\frac{5}{8}$ inches away from the wall, and about 6 feet high. I put a little food on the top of the clock, and sometimes behind the clock not quite so high, and in other awkward places. The mice jump on to the skirting board, and there spread themselves out sideways so as to stretch the $1\frac{5}{8}$ inches, and then proceed to go up at an angle of about 40°, climbing, so to speak, a staircase that is not there, and then when this brings them to the side of the clock they turn over in a nimble way with a jump, not always successfully, and negotiate the next flight, and so zigzag to the goal. I often watch these quite close, holding a metallic filament electric light with shade, so that they are fully illuminated and I am in shade. So long as I am quiet or move slowly, doing nothing spasmodically, they take no notice. I have even prodded and moved the food they were eating with the slide of a long rule, which seemed to perplex rather than frighten them. They do not seem to hear loud noises or singing provided they do not contain S, K, or other sudden sounds, even though I am not a yard away. A few days ago while writing I heard one at work on some bread about 4 feet from the ground, when, to see him better without getting up, I focussed the filaments of the electric lamp upon him with a large reading-glass. The mouse did not seem in the least frightened, but stared at the lens a short time, and then I saw his eyes shining with a pale ruby, or rather spinel, colour, and was reminded of Colonel Herschel's letter.

The same action which makes animals' eyes appear "autophanous" is seen in far greater perfection in that invaluable little instrument called the reflex light, now used in large numbers to protect the bicyclist from being run down by a motor-car at night. The bicyclist's lamp, of course, is useless, as its light in the road is outshone by that of the motor-lamps, and the lamp itself is generally not directly visible from behind. The bicycle and rider, too, are often by no means conspicuous objects, and the danger of being run down is a real one. To meet this, the reflex light has been invented. It may be considered to be a glorified cat's eye. All that is visible from the outside is a ruby bull's-eye lens, but inside, in the principal focus of this lens, there is placed a concave silvered reflector of half the focal length, *i.e.* the bull's-eye is at its centre of curvature. Any strong light shining upon the bull's eye is therefore brought to a focus on the surface of the mirror, and whether the light is directly in front of the lens, or on one side even to a surprising degree, the focussed light falls normally upon a portion of the reflector, which sends it back to the lens, and so in a parallel beam in the direction from which it came. The driver of the car and his lamps subtend so small an angle at a distance of, say, 200 yards, or very much less, that the reflected light is seen by the driver like a red lamp. The committee of the Associated Automobile Clubs were so impressed with the value of this device that the technical committee of the Royal Automobile Club, of which I am a member, examined and tested the reflex light, and they issued a certificate endorsing the claims made for it. There is a feeling that every cart in the country should carry one, which, unlike ordinary lamps, would entail no trouble or running expense, and would be free from all risk of fire. This reflex light beats any cat's eye or other animal's eye, but it is not autophanous.

C. V. BOYS.

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THE experiments described by Colonel Herschel in NATURE of January 18 illustrate the reflecting power of animals' eyes, and give no support to the general view that the eyes of cats and dogs "shine in the dark," that is, in the absence of any external source of luminosity. The principle of the experiments is illustrated by the Reflex Lamp commonly fixed at the back of the frame of a bicycle in rural districts. This is not really a lamp, but a bull's-eye of ruby glass about 2 inches in diameter, fixed with the convex surface directed behind the bicycle. When a carriage or motor is approaching the bicycle from behind, its lamps illuminate the bull's-eye, and the reflection is so clear that the driver knows a cyclist is in front of him long before the rider or the machine can be seen. The candle-light used in ordinary carriage lamps enables the Reflex Lamp to be visible at a distance of a hundred yards or so on a dark night. The conditions are precisely similar to those described by Colonel Herschel, the only difference being that a glass convex lens takes the place of the animals' eyes. R. A. G.

January 27.

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### Glazed Frost; a Reminiscence.

MR. HARDING'S letter (NATURE, January 25, p. 414) reminds me of an experience which, in view of the rarity of the phenomenon, may be of sufficient interest to place upon record in these columns, although the newspapers of the period—the sixties of last century—duly noted the occurrence. It must, I think, have been in 1866 or 1867 (date and year uncertain) that I had occasion to go from the West to the East End of London. Starting upon my journey about 10 p.m., it began to rain soon after I left the house in Bayswater, and I opened an umbrella, which, to my surprise, became stiffer and heavier every moment, and was found on examination to be so thickly glazed over with ice that it was impossible to close it. At the same time the pavements and roadway were also becoming uniformly glazed; pedestrian movement was most difficult, and all horse traffic was suspended. Although an experience of some forty-five years ago, the impression left upon my memory is still vivid—the ludicrous sight of people carrying ponderous and rigidly frozen umbrellas which they could not close, the stream of skaters down Oxford Street

and Holborn, and the silence due to the absence of vehicles, all came to mind on reading Mr. Harding's letter. It took me on that occasion more than four hours to perform a journey of about two miles, and progression was only made possible by encasing my boots in the folds of a woollen scarf which I was wearing at the time, which I took off and cut into two portions for the purpose. There was no viaduct at that time, and Holborn Hill interposed serious difficulties.

The explanation of the phenomenon is no doubt that given in "The Observer's Handbook" quoted by Mr. Harding, viz. the sudden freezing of supercooled water drops on shock. In connection with this explanation there naturally arises the question as to the particular conditions which admit of supercooling without actual conversion into hail. Clearly these conditions are but rarely complied with. The actual date could no doubt be found by hunting through newspaper files, but there must be many Londoners now living who can remember the occasion.

January 26. R. MELDOLA.

## The Radiating Power of Air.

IT has been assumed in investigations of atmospheric radiation that the values of the radiating power obtained in laboratory experiments are comparable with the values obtained from meteorological observations, and agreement between values obtained by the two methods has been quoted as evidence of the accuracy of the determinations. In an investigation of the problem from the meteorological side, I discovered that the quantities used to represent the radiating power were different in the two cases, and the distinction is important.

In the meteorological method, if $\theta$ is the temperature of the air at time $t$ during the night, values of $\alpha$, $\theta_0$ are found to satisfy approximately the equation

$$\frac{d\theta}{dt} = -\alpha(\theta - \theta_0) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

and $\alpha\rho c$ is taken to represent the radiating power of the air, where $c$ is specific heat, 0·239, and $\rho$ is density.

If the radiation from a horizontal layer of air 1 cm. thick is $f(\theta)$ per unit area from each face, the absorption by it will be $2f(\theta')$ per unit volume if its surroundings are at temperature $\theta'$. In that case

$$\rho c\frac{d\theta}{dt} = -2\,[f(\theta) - f(\theta')]$$
$$= -2\,(\theta - \theta')\,\frac{\partial f}{\partial \theta} - \text{higher powers of } (\theta - \theta') \quad . \quad . \quad (2)$$

and by comparison with (1) it is seen that

$$\alpha\rho c = 2\frac{\partial f}{\partial \theta},\ \theta_0 = \theta'.$$

Now, in laboratory experiments on the radiation of air, the quantity measured is the excess of the radiation per unit area from one face of a column or layer of hot air over the corresponding radiation from a column or layer of cold air, and this quantity, reduced to 1° C. difference of temperature for a layer 1 cm. thick, is denoted by $h$, and is used to represent the radiating power. Clearly $h = \frac{\partial f}{\partial \theta}$ and *consequently* $\alpha\rho c = 2h$, *and not* $h$, *as hitherto assumed.* If in the laboratory experiments the radiation emitted by the layer in a direction perpendicular to its face is compared with that emitted normally by a black surface, the value of $h$ will be only $\frac{1}{2}\frac{\partial f}{\partial \theta}$ or $\frac{1}{4}\alpha\rho c$, since the ratio of the total radiation to the normal radiation is $\pi$ for the black surface but $2\pi$ for a thin layer of air.

The confusion arose from the fact that $h$ and $\alpha\rho c$ were taken to represent the rate at which air is losing heat by radiation to surroundings 1° C. colder, but while in the case of $\alpha\rho c$ the radiation in all directions was taken into account implicitly, in the case of $h$ the necessary adjustment was not made. E. GOLD.

4 Hurst Close, Hampstead Garden Suburb, N.W.

## Microscope Stands.

A LENGTHENED experience in the use of the microscope impels me to ask you to allow me to take exception to one of the statements made by the writer of the article on microscope stands which appears in NATURE of January 11. Referring to the circular rotating and centring stage of the better class of Continental stands, the writer says, "the use of which for anything but petrology it is difficult to guess."

After working for upwards of thirty years with an English stand, and, especially during the latter part of that time, constantly feeling the desirability of a rotating stage, I decided three years ago upon the purchase of a new stand, and the circular rotating stage was the feature that led me to decide upon one of Continental manufacture, after carefully considering the merits of two of English manufacture. If well made, the rotating stage is of great utility. If one wishes to examine, and especially to draw, say, one of a number of scattered Ophiurid or Echinoid plutei, it is a great convenience to be able to bring its sagittal plane into a vertical position in the field of view, and, as I know from much irritating experience, this is seldom possible on a fixed rectangular stage provided with mechanical adjustments, or even a sliding bar.

What is really needed to make the rotating stage of the Continental microscope much more efficient is a removable sliding bar, upon which it would be possible to support a $3 \times 1\frac{1}{2}$ inch slip, so that a series of sections mounted upon it might be examined carefully with the microscope in an inclined position. The rotating stage of a high-class stand by one of the foremost English makers, now before me, is provided with such a bar, which slides in a groove cut in the stage; but its utility for the purpose indicated above is nullified by the projecting heads of two screws which hold together parts of the mechanical adjustments, and the whole instrument is little more than an ornament on my work-table.

I have never found any use for the excentric rotating movement below the Abbe condenser, and especially for the cylinder diaphragm, which, I suppose, is a sop thrown by Continental makers to those teachers who, in my student days, derided the use of any form of substage illuminator. In my opinion the expense incurred in the manufacture of these redundances might with great advantage to workers like myself be devoted to the improvement of the stage on the lines I have indicated.

H. C. CHADWICK.

The Biological Station, Port Erin, January 26.

## Meteor-showers.

THE following meteor-showers become due in February. The epochs are arranged according to the times of the principal maxima:—

Epoch February 4, 3h. 30m. (G.M.T.), fifth order of magnitude. Principal maximum, February 3, 8h. 55m.; secondary maxima, February 3, 3h. 40m. and 20h. 20m.

Epoch February 3, 9h. 30m., nineteenth order of magnitude. Principal maximum, February 4, 21h. 15m.; secondary maxima, February 4, 11h. 25m., and February 6, 6h. 50m.

Epoch February 9, 4h., twenty-first order of magnitude. Principal maximum, February 10, 8h. 40m.; secondary maxima, February 10, 1h. 30m., and February 11, 8h. 25m.

Epoch February 13, 11h., fifth order of magnitude. Principal maximum, February 12, 13h. 45m.; secondary maxima, February 11, 22h. 30m., and February 13, 10h. 45m.

Epoch February 14, 11h. 30m., thirty-third order of magnitude. Principal maximum, February 15, 22h. 45m.; secondary maxima, February 14, 11h. 35m., February 15, 15h. 30m., and February 16, 7h.

Epoch February 16, 8h., approximately tenth order of magnitude. Principal maximum, February 17, oh. 30m.; secondary maximum, February 17, 15h. 40m.

Epoch February 19, 1h., approximately thirteenth order of magnitude. Principal maximum, February 18, 5h. 40m.; secondary maxima, February 18h., 3h. 40m., and February 18, 18h. 55m.

Epoch February 20, 7h., fifteenth order of magnitude.

Principal maximum, February 20, 12h. 20m.; secondary maxima, February 20, 17h., February 22, 7h. 45m., and 16h. 30m.

Epoch February 26, 3h. 30m., approximately fourteenth order of magnitude. Principal maximum, February 24, 7h. 50m.; secondary maximum, February 24, 22h. 50m.

Epoch February 26, 14h., fourteenth order of magnitude. Principal maximum, February 25, 23h. 20m.; secondary maximum, February 24, 9h. 50m.

Epoch February 27, 23h., approximately sixth order of magnitude. Principal maximum, February 28, 6h.; secondary maximum, February 29, 9h.

Epoch February 27, 14h. 30m., third order of magnitude. Principal maximum, February 29, 6h. 30m.; secondary maxima, February 27, 23h., and February 28, 12h. 40m.

There is a considerable number of meteor-showers in February, but the meteoric activity of the month is, in general, not so intense as in January. The most important epochs in the foregoing list are the second and the last five.

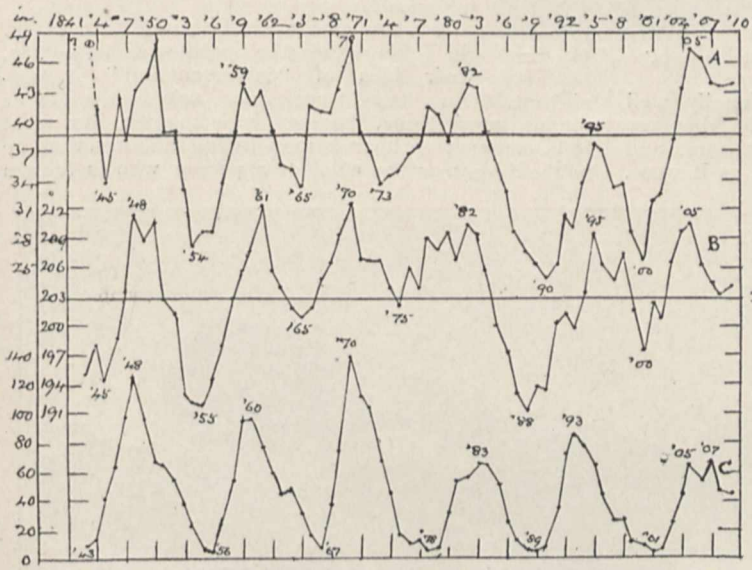
JOHN R. HENRY.

January 29.

## The Question of Sun-spot Influence.

IN a paper to the *Meteorologische Zeitschrift* (September, 1911), Dr. Magelssen, dealing with sun-spot influence on temperature, finds this influence, at Christiania, &c., most apparent in the winter half of the year. This is borne out, I think, by the data for Greenwich.

We might approach the matter thus: Taking the six maxima and six minima since 1841, and confining attention to the groups "max. 1, 2" and "min. 1, 2," let us ask how many warm Januarys, Februarys, &c., there were in those years (eighteen in either case). The most pronounced contrast (between maximum and minimum groups) thus comes out in the early part of the year, and (localising further) in the pair February-March.




A. Rainfall, Rothesay, February-March; smoothed, with sums of 5.
B. Mean temp. Greenwich " " "
C. Sun-spot curve.

If, now, we take the annual values of mean temperature for February-March, and smooth the series by simple addition of the groups 1841–5, 1842–6, and so on, (this is sufficient), we get the curve B in the diagram.

Now, if we handle the monthly *data* of Rothesay rainfall in the same way, a maximum contrast comes out, similarly, in the early part of the year. Then, taking the annual amounts for February-March, and smoothing with sums of five, we have the curve A.

Below is the sun-spot curve, and it is remarkable, I think, to find things so far apart as Rothesay rainfall and Greenwich temperature in the February-March group presenting so much correspondence with each other and with the undulations of the sun-spot curve.

(The first point of the curve A I have marked as doubtful, for reasons I need not here enter into.)

ALEX. B. MACDOWALL.

## The Occurrence of Peripatus on the North-East Frontier of India.

THE following extract from a letter just received from Mr. S. W. Kemp, zoologist with the Abor Expedition, will, I think, be of interest to the readers of NATURE, as it announces the first discovery of the Prototracheata in what may properly be called Continental Asia. The latter is dated Rotung, December 20, 1911:—

"Yesterday I toiled up to Kalek (3800 feet). . . . On my return Hodgart, Mr. Kemp's assistant, rushed up with Peripatus in a tin, caught about 20 yards from me—one adult and two young. . . . This morning we toiled for about four hours and got nine or ten more adults and a number of young. They occur over an area of about 30 square yards, and apparently nowhere else. The camp is made on an old Abor clearing. Prior to our occupation it was scrub jungle about 6 to 8 feet high, with a few large trees, mostly jack-fruit, interspersed. The scrub has been cut all round the camp, and on the north side, at the top of the steep bank dropping down to the Dihong River, Peripatus is found under large stones in comparatively dry earth."

Mr. Kemp has as yet no opportunity of examining his specimens in a systematic manner; it will be of great interest from a geographical point of view to discover their genus in a restricted sense.

N. ANNANDALE.

Indian Museum, Calcutta, January 11.

## Amphibian Faunas of South Africa and Madagascar.

IN reference to the question raised by the reviewer (NATURE, December 14, 1911) of my paper on the amphibian faunas of South Africa and Madagascar (Annals Transvaal Museum, April, 1911), the distribution of the genus Rana suggests that it originated in the Old World some time subsequent to the isolation of Madagascar and the disruption of the Brazil-West African land bridge, its passage to the New World being effected by a more northern bridge, probably the Bering Straits connection. The other Ranid genera of central and tropical America are unknown to me, but, judging from the descriptions, they form quite an isolated group, and if genetically related to the Old World Ranidæ had their origin, not in the specialised genus Rana, but in a more primitive Ranid stock which entered the New World by the Brazil-West African bridge.

JOHN HEWITT.

Albany Museum, Grahamstown, South Africa, January 4.

## A Bright Fireball.

ON December 17, 1911, shortly after 5 p.m., while watching the dying glories of one of the loveliest sunsets I have ever seen, I saw a meteor fall in the west and burst into about twenty most brilliant balls, like an exploding rocket. I estimate that it appeared when about 20° above the horizon, and traversed perhaps 5° before bursting. It left a vertical and broad streak of white light on the sky, which very slowly became deflected from the perpendicular to the N.W., and when at about an angle of 45° it faded gradually into two patches of white cloud, which ultimately assumed a horizontal position. These retained their pale white colour until after the other clouds had become quite dark, and they did not disappear until they were obscured by some of these clouds passing over them. It was seen from Beni-Hassan on the Nile, 167 miles south of Cairo, from the deck of one of Cook's steamers.

Aswan, Upper Egypt, January 19. J. C. C.

## AN ADAPTIVE PEOPLE.[1]

THE British Protectorate of Uganda has the distinction of possessing one of the most perfect types of a barbarous people to be found in the world.

FIG. 1.—Drums of office. From "The Baganda."

The Baganda are a Bantu race, exceptionally well built and healthy. Courteous and sociable, they are to a remarkable degree exempt from social vices and perversions. They have "gone straight," as it were, while other races of the same level have gone crooked. Their only weakness seems to have been one frequently resulting from religious fervour, namely, a predilection for human sacrifice. Their physical evolution similarly has been free from perversions; they have not, as so many barbarians have done, tampered with their bodies, and they practise no form of cutting, scarification, or mutilation. Intellectually they are remarkable for an extraordinary faculty of imitation, "especially in all kinds of mechanism. Give a man time to examine an object, and he will apprehend the mode of its construction, and will go and produce one so much like it that it is often well-nigh impossible to tell which is the original. Chairs, tables, shoes, &c., have each in their turn been closely copied. This power of reproduction extends to house-building in all its details; thus there are numbers of houses made of sun-dried bricks, with iron roofs, which the natives themselves have built and completed without any supervision from Europeans. This trait of imitation is noticeable even in small children, who may be seen making toy guns, after the pattern of those used by their fathers. These toy guns are often so well made that, when the triggers are pulled, they make a sharp report. Bicycles have been cleverly imitated by boys, with wheels and spokes made of reeds."

Their social rites are numerous and remarkable; they give the impression of being rather a living organic system than a structure of hide-bound superstition. If their social religion can be separated from their theological doctrine and hierological practice, the former appears to have played a more important part than the latter, though this was well developed in the way of temple establishments, divine beings, and priesthoods.

Their economic and industrial system deserves careful study. Every household has its garden, and the garden makes it absolutely self-supporting. Even the bark-cloth garments, as picturesque in certain fashions of wearing them as Roman togas, are grown in the garden, each possessing several bark-cloth trees. But behind the household is the clan. The clan not only regulates kinship and marriage, but acts as a friendly society, insurance company, and general cooperative body. Thanks to the clan system, poverty does not exist. The clans are totemic, each possessing a primary and a secondary totem. Descent and inheritance were in the male line; but in the royal family the system was maternal.

In view of the solidarity of the family, the clan, and the people as a whole, their idea of "impersonation" is significant. An heir "not only takes the office of his predecessor, but so impersonates him that it is common to hear a man telling another that he is the father or the chief of a person who is known to have died years before." A similar continuity is secured by another method in the case of the kingly office. The spirit of the dead king enters a medium, who is consulted at the Temple of the Jaw-Bone. This relic of the dead king, together with his

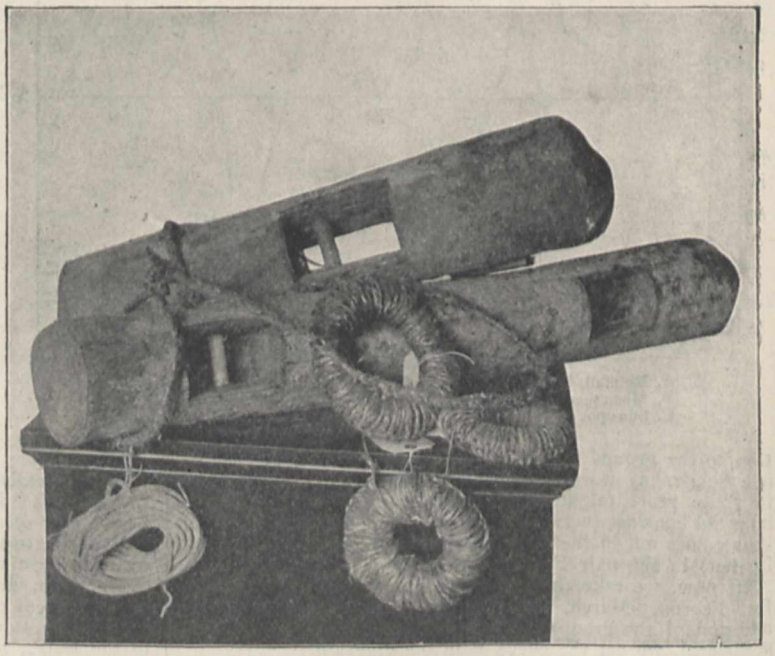


FIG. 2.—Stocks for arms and legs, with plantain-fibre pads worn to protect the arms and legs from the sharp edges of the wood, and coil of rope for binding prisoners. From "The Baganda."

[1] "The Baganda: an Account of their Native Customs and Beliefs. By the Rev. John Roscoe. Pp. xix+547+2 plans. (London: Macmillan and Co., Ltd., 1911.) Price 15s. net.

umbilical cord, serves as an attachment for the spirit, which is *en rapport* with them.

The polity and government of the Baganda was a very perfect form of that kind of feudal monarchy which is frequent in Africa. The description of this system, and particularly of the functions of the King, forms the dominant feature of Mr. Roscoe's book. It is a remarkable chapter in political evolution.

The royal family is distinguished by a straighter nose and less protruding lips. Its descent is traced back, along with the history of the people, for thirty-two generations, about a thousand years, to the first monarch, Kintu, who made the Baganda a nation. Oral history of this type is a very real thing, transcending time and space more efficiently than written records, and probably avoiding many errors inseparable from literature. The other great landmark of Uganda history is the reign of King Mutesa in the middle of last century. Mutesa was a broad-minded and far-seeing ruler. He initiated liberal reforms, and broke away from the previous policy of isolation. It was by him that Speke was welcomed in 1861, and Stanley in 1875. Through the latter's representations Christian missionaries were admitted. But Mutesa also welcomed the Arabs. After his death there was a struggle between the Christian and Muhammadan parties for the succession to the throne, which was ended by the British Protectorate.

The succession, it may be noted, is hereditary, but a committee of chiefs selects and appoints one of the princes. There is much that is equally logical among the rights and duties as between king and chiefs and clans. Take away from the states of mediæval Europe their Greco-Roman culture and inheritance, and you have a civilisation little, if at all, more advanced, both politically, socially, and industrially, than that reached independently by the Baganda. The king is invested at the coronation by "the King's Father." The "Father" says to him: "You are king. Rule over your people well, and always do what is right." The king answers: "I agree to do so." "Always give just judgment." "I will." Side by side with this is the curious custom of killing men so that their lives may invigorate the king. But such atrocities, though differing in intention, have actually been more common in Europe.

Mr. Roscoe has lived with the natives for twenty-five years. He not only knows their character and customs, but has studied them as an anthropologist. His book is full of new and important facts which only scientific insight could have unearthed. Both the ethnologist and the constructive sociologist will find it the most significant and valuable study of a native race that has appeared since "The Northern Tribes of Central Australia." Nor must the author's human quality go without mention. There is an indefinable atmosphere of sympathy permeating his pages, the result of which is that the people as he describes them are a living reality. A. E. CRAWLEY.

## *THE EVOLUTION OF AN AËROPLANE.*[1]

READERS of the first two numbers of the twenty-seventh volume of "Smithsonian Contributions to Knowledge," who have not forgotten the pleasure they derived from the study of Dr. S. P. Langley's work in aërodynamics, will welcome the publication of this third number, on mechanical flight. While experimental aërodynamics and the theoretical study of flight respectively may form the sole subject of an investigation, the successful flight of models and of full-scale machines cannot be attained without both the guide of theory and the possession of accurate numerical data gathered by means of careful experiments. Appeal to nature is even necessary to obtain, through the observations of bird flight, some starting point in a line of research by trial and error that cannot be struck at random. For this reason the pursuit of success in actual flight is the most comprehensive branch of the science of aviation, and it will be enough to say that the work before us deals with the history of Dr. Langley's efforts to realise artificial flight to convey the impression that the account put before us is pregnant with details of the utmost interest to men of science and to non-technical readers alike.

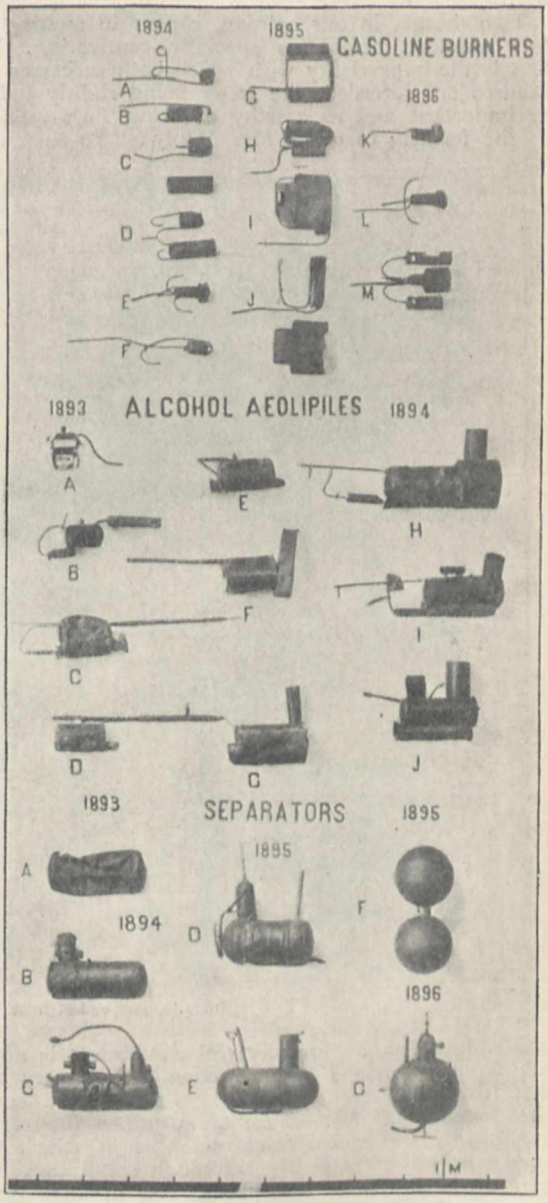



FIG. 1.—Burners, aeolipiles, and separators.

Those indeed who have appreciated Dr. Langley's indomitable perseverance in overcoming the ever-recurring obstacles that stand in the way of any experi-

[1] Smithsonian Contributions to Knowledge, vol. xxvii., No. 3: "Langley Memoir on Mechanical Flight." Part i., 1887 to 1896. By S. P. Langley. Edited by C. M. Manly. Part ii., 1897 to 1903. By C. M. Manly. Pp. xi+320. (Washington: Smithsonian Institution, 1911.)

mental achievement, and have an idea of the endless chain of linked difficulties that runs through the whole problem of mechanical flight, cannot fail to recognise that no better man could have harnessed himself to its solution, and will open the book with a feeling of expectation which, it is needless to say, does not end in disappointment. The gradual evolution of a full-size gasoline-propelled flying machine from a shellaced paper model propelled by twisted india-rubber is presented with a faithfulness and a precision of details that render the story most fascinating.

Two things, in our opinion, concur in making the tale unfolded before us specially captivating. The first is the impartiality with which both successes and failures are recorded, the latter being rightly judged as important and as worthy of being fully reported as the former; to quote Mr. Manly: "To such men as Mr. Langley, an unsuccessful experiment is not a failure, but a means of instruction, a necessary and often invaluable stepping-stone to the desired end." The second and chief cause of sustained interest is undoubtedly the special circumstances in which the work was undertaken, for, although small toys had been made to fly a few yards, yet, at that time, "hardly any scientific men of position had made even preliminary investigations, and almost every experiment to be made was made for the first time." The book is therefore, we believe, perhaps unique in its kind, being a complete record of the production of a highly complex and novel machine from an initial stage where very little help was available, not even an idea of the proportion of sustaining surface area to weight, which had to be gathered from measurements on birds, nature supplying the first—and misleading—data in an almost virgin field of knowledge.

The aim of the research is stated simply to be "putting a trial aërodrome—to use the name adopted by the investigator—successfully in flight, and thus giving an early demonstration . . . that mechanical flight is possible, by actual flying." We shall leave the reader to judge if such a modest statement adequately describes the strenuous endeavour to overcome the manifold difficulties, by gathering highly specialised knowledge in widely different fields of technical attainment until a new science was found to have sprung from the harvest of accumulated data and the acquired experience.

The work is divided in two parts. Part i., written by Dr. Langley himself, deals in chronological order with the flight of models, in ten chapters retracing the successive attempts, beginning with india-rubber models similar to those previously constructed by Pénaud. This portion of the book (chapter ii.) is by no means the least interesting, owing to the fact that practically every difficulty experienced later was met at the outset, the structure being too heavy if able to bear the strain, or too fragile if sufficiently light, while even the difficulty of launching, that was to require so much skill and ingenuity later, was felt at this early stage. A short discussion of the available propelling agents and the history of the special type of steam engine finally found to answer the contradictory requirements as to power and weight is the subject of the next two chapters, and goes far to show that the key to success was the determination with which the word "disheartening" was cancelled from the dictionary of the experimenter and of his able assistant.

Sustaining surfaces and "balancing" are then shortly dealt with. The relative importance of skin friction is not touched upon. The important subject

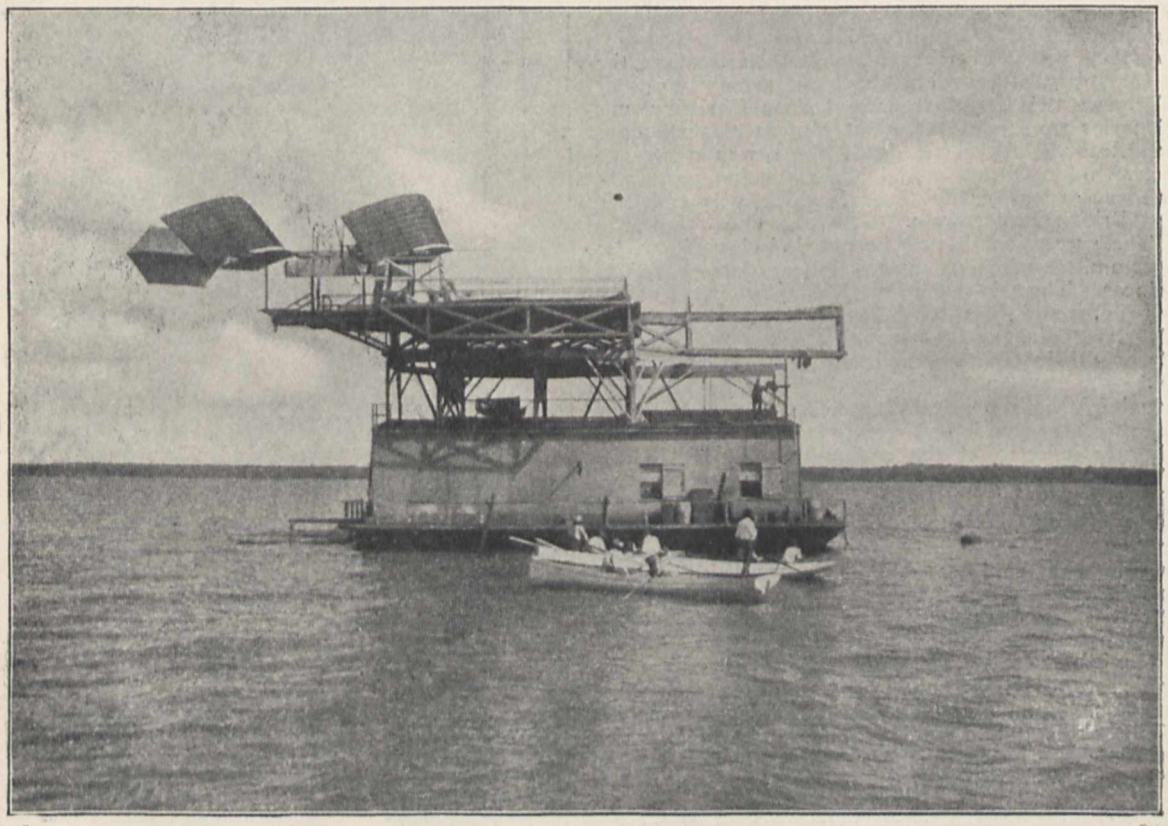


FIG. 2.—Front end of track just preparatory to launching aërodrome.

of stability is dismissed in eight pages, but this chapter is supplemented by experimental information given at various places elsewhere in the book. The rest o part i. is taken up by the description of the several models constructed and of an overhead launching gear by which they were released; Fig. 1 (a reproduction of plate 12) gives an idea of the thoroughness with which the evolution of each part is described. Elaborate and vivid descriptions of the performance of these models are given in each case, including as a rule a map of the path followed during their flights.

Part ii., written by Mr. C. M. Manly, Dr. Langley's chief assistant—to whom no doubt he would have ascribed a large part of the success had he edited himself the present account of his researches—is solely concerned with the construction and the trials of a man-carrying machine, the two first chapters being devoted to general considerations. The alteration of design necessitated by the change of scale required further experiments with two of the models already described; an account of these is found in chapter iii. A new launching gear, shown in Fig. 2 (a reproduction of plate 43), forms the subject of chapter iv., and the next three chapters deal in an elaborate fashion with the construction of the frame and of the supporting surfaces of the large "aërodrome," and the method of ensuring its equilibrium while in flight.

Two chapters deal with the history of the engines of this machine, and of a quarter-size model of it, which it was intended to try first. This is shown in full flight in Fig. 3 (a reproduction of plate 92). The two last chapters contain the account of the shop and field trials and of the failures—solely caused by some defect in the launching gear—which ended the trials.

An interesting appendix on the flight of the American buzzard ends the book, which should be perused if one wishes to form an adequate idea of the value of the pioneer work done against difficulties of all kinds, conquered by sheer determination to succeed, and only baffled—just as success was at hand—by the lack of financial support due to the antagonism of a hostile Press.

The work is profusely illustrated by more than a hundred plates of a high standard of excellence, including many detail drawings, several maps, and reproductions of photographs; an exhaustive index of twelve pages is not the least commendable feature of this latest and most important addition to the bibliography of aviation.

MAURICE E. J. GHEURY.

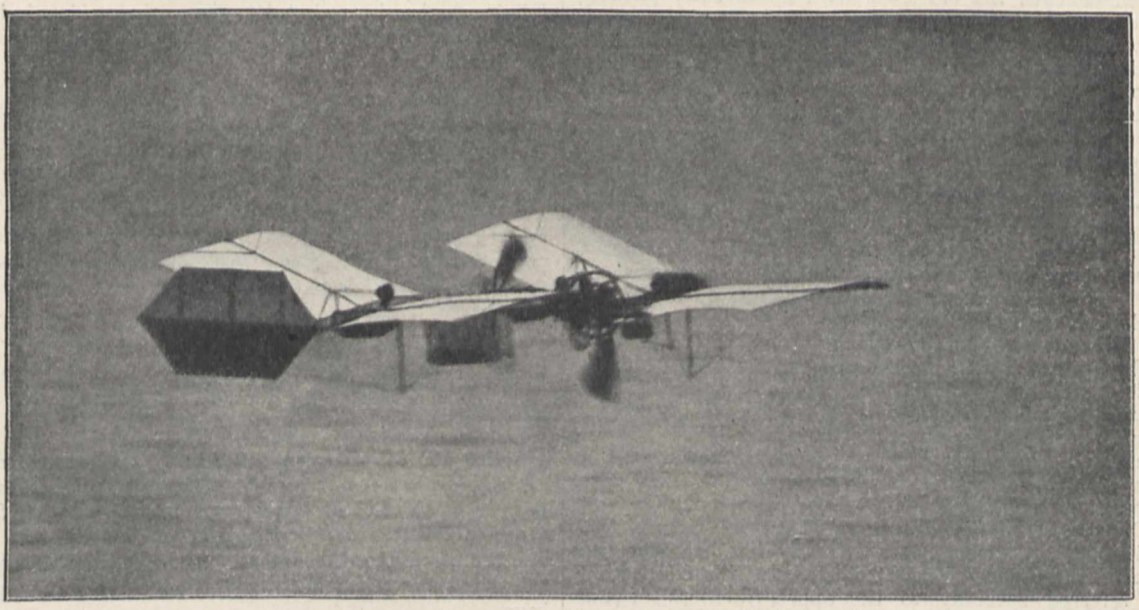


FIG. 3.—Quarter-size Model Aërodrome in Flight, August 8, 1903.

## *THE BESSEMER MEMORIAL GIFT TO THE ROYAL SCHOOL OF MINES.*

ON June 29, 1903, on the very day that Lord Rosebery promulgated the scheme for the establishment of an Imperial College in London, a meeting was held at the Mansion House, under the chairmanship of the then Lord Mayor, Sir Marcus Samuel, for the purpose of devising a scheme "to perpetuate the memory of probably one of the greatest men who ever lived"—Sir Henry Bessemer. It was abundantly evident from the speeches delivered on that occasion by the Duke of Norfolk, Lord Haldane, and Sir John Wolfe Barry, that a very serious attempt was being made to establish in the metropolis of the Empire an institution having for its main object the organisation of scientific education with reference to national and imperial industries. Lord Haldane frankly admitted that "it was clear that in our industrial methods we were, in some respects, behind other nations. We possessed magnificent energy, we had a splendid record; but in the application of science to industry we had not hitherto developed anything comparable to those great institutions for technical training in the higher sense, such as exist elsewhere."

It was fitting that the memorial to Bessemer should be established in connection with an institution having aims so definite as the Imperial College, and it was a happy thought to associate the memorial with the Royal School of Mines, then about to undergo reorganisation. Much has occurred since those days. The Scientific development of the Royal School of Mines as a teaching institution is one of the events of the day. Visitors to South Kensington cannot fail to have noticed how largely the accommodation in that school has been increased, and those who have more intimate acquaintance with the internal affairs

of the Imperial College are well aware how considerably the equipment and buildings of the constituent institutions have been supplemented.

On Tuesday, January 30, the Bessemer Memorial Committee formally handed over to the governors of the Imperial College a costly plant for use in the Royal School of Mines. Visitors to the institution on that occasion will have fully realised the relation which this gift must bear to the efficiency of the School of Mines. The laboratory within which the Bessemer gift has been accommodated is one of the numerous extensions now taking place at South Kensington in connection with both the City and Guilds (Engineering) College and the Royal School of Mines. The ore floor of the laboratory, which runs across its east end, is 121 feet long by 30 broad, and is continued as a 12-foot gallery along the south side, and as a 6-foot gallery along the west end. Accommodation is afforded for nine ore bins of 10 tons capacity each, with discharge-gates above the ground floor to fill cars running on a line of track to the elevator. A large dry crushing-room has been provided beneath the ore floor with an elevator passing through it to a sizing-trommel and shaking-screen, another elevator passing up to a line of trommels feeding four jigs on the concentration floor. There is a Blake crusher at the northern end connected by rails from the elevator, rails being also laid along the south gallery to the furnace department at the extreme west.

We have here the complete equipment of the most recent mining and metallurgical plant which has ever been installed in an educational institution. But if this plant were only designed for academic purposes it would scarcely constitute a sufficient memorial to Sir Henry Bessemer. It is gratifying, therefore, to find that in consequence of representations made to the governors by many practising mining engineers and metallurgists, as well as by the Bessemer Memorial Committee itself, the whole instalment of machinery will be placed at the disposal of professional men for private research and investigation. We cannot imagine anything more appropriate as a memorial to Bessemer than this fact, which was announced on the occasion of the donation.

On behalf of the Bessemer Memorial Committee, Colonel Sir Charles Allen formally handed over the equipment to the governing body. In this connection he referred specially to the appropriateness of the memorial, both as regards the particular form it had taken and its association with the Royal School of Mines, and expressed his great satisfaction in that he had been selected by his colleagues, in the absence in Egypt of Sir William Preece, the chairman of the Bessemer Memorial Committee, formally to make the presentation. Sir Charles further stated that as a near relative and an intimate friend of the late Sir Henry Bessemer he felt sure that the memorial could not have taken a form which would have appealed to him more, since he was very specially interested in the educational training of the engineer.

The Right Hon. Gerald W. Balfour, chairman of the executive committee, accepted the gift of the equipment on behalf of the governing body, associating especially those who are members of the committee, and who, in consequence, have been so intimately concerned with the collection of the memorial, in particular Sir William Preece, and also those others who have contributed to the memorial and so enabled the main ideas to be realised. He heard with the greatest possible satisfaction that the committee was not now to be dissolved, but that it hoped to obtain sufficient funds to enable it to maintain the first equipment and keep it in closest touch with industrial requirements, and also to add to and extend it from time to time as is found to be necessary. He understood that as a laboratory and as an equipment it compared most favourably with anything of the same kind in this or any other country, and went on to state that this implied a corresponding obligation on the governing body of the Imperial College to see that it was put to the fullest and best possible use. He hoped that in this respect the Royal School of Mines would justify its former proud record and its present objects as a part of the Imperial College, and would by research and the most advanced scientific work render imperial service to the industries associated with mining and metallurgy.

## NOTES.

We regret to see the announcement of the death, on January 28, of Admiral the Right Hon. Sir John Charles Dalrymple-Hay, Bart., G.C.B., F.R.S., in his ninety-first year.

Dr. A. P. Laurie, principal of the Heriot-Watt College, Edinburgh, has been elected to the professorship of chemistry in the Royal Academy, vacant by the resignation of Sir Arthur Church, K.C.V.O., F.R.S.

The death is announced, at the age of eighty-nine years, at Schaffhausen, of M. Jacob Amsler, corresponding member of the Paris Academy of Sciences in the section of mechanics since 1892.

According to the daily papers, M. Védrines, the French aviator, is, in conjunction with Dr. Charcot, making arrangements to attempt, probably in two years' time, to reach the South Pole by aëroplane.

The annual meetings of the Institution of Naval Architects will be held on March 27–29 in the hall of the Royal Society of Arts, John Street, Adelphi, London, W.C. The president, the Marquis of Bristol, R.N., will occupy the chair.

The Paris correspondent of *The Times* states that a committee has been formed at Dôle, the native town of Pasteur on the slopes of the Jura, for the purchase of the house in the Rue des Tanneurs in which this great man of science was born, and that Mr. J. D. Rockefeller has subscribed the remaining 2200*l.* required to purchase the house.

The Darboux jubilee celebration passed off successfully on January 21. Congratulatory speeches were made by MM. Lippmann, Poincaré, Appell, and others, including the Minister of Public Instruction, after which a commemorative gold medal (by Vernon) was handed over to M. Gaston Darboux. In his reply M. Darboux referred with satisfaction to the present organisation of higher education in France, as compared with what he could remember. Many delegates from foreign societies were present on the occasion.

Dr. Charles Chilton, professor of biology at Canterbury College, New Zealand, has been granted leave of absence for 1912, and will spend nearly the whole of the year in Europe visiting the chief biological laboratories and stations. He is at present working at the Marine Laboratory at Plymouth, and is preparing a report on the Amphipoda collected by Dr. Bruce during the voyages of the *Scotia* in Antarctic seas.

At its annual conversazione this year, the Selborne Society proposes to arrange a Gilbert White exhibition, consisting of relics and manuscripts of the author of the

famous "Natural History of Selborne," with collections illustrating his work and times. The exhibition will be open on February 16 at the conversazione, and to the public on the following day by kind permission of the First Commissioner of his Majesty's Works. It is hoped that all who have objects of interest which should form part of the exhibition will communicate with the honorary secretary of the Selborne Society, at 42 Bloomsbury Square, W.C.

At the end of the current session Sir William Ramsay, K.C.B., F.R.S., will resign the chair of general chemistry in University College, London, to which he was appointed in 1887. At a meeting of the Senate of London University held on January 24, it was resolved:—"That the Senate accept Sir William Ramsay's resignation with sincere regret, and desire to express to him their high appreciation of the services which he has rendered to the University both by his inspiring work as a teacher and by the great series of researches carried out by him at University College during his tenure of the chair of chemistry." It is unnecessary here to refer to Sir William Ramsay's distinguished career, since so recently as January 11 his work was described in our "Scientific Worthies" series by Prof. Wilhelm Ostwald.

On Monday, January 29, Prof. J. Norman Collie, F.R.S., gave to the Royal Geographical Society an account of his recent explorations in the Rocky Mountains to the north of the Yellow Head Pass. In 1910 he and Mr. A. L. Munn utilised the new branch of the Canadian Pacific Railway by Edmonton to explore the valley of the Smoky River and the mountain region which it traverses. All existing maps of the region are both incomplete and inaccurate, and the information gained in 1910 encouraged the explorers in 1911 to utilise the routes which they had found, and to study more thoroughly the region traversed in the preceding year. Magnificent glaciers, vast snowfields, and range upon range of snow peaks were seen; the main watershed was determined over many miles of the range, and topographical questions of interest were investigated. Series of parallel ranges with transverse valley complicate the drainage, which at some points is indeterminate, flowing at one point to the Atlantic in 1909, and by a new channel in a shingle flat to the Pacific in 1910. Both to the mountaineer and to the student of mountain structure this region, now being rendered accessible by railway, offers problems of the greatest interest.

We regret to record that the distinguished surgeon, Sir Henry Trentham Butlin, Bart., died on January 24, at the age of sixty-six. He was elected president of the Royal College of Surgeons of England in 1910, and again in 1911, but to the regret of all found it necessary to resign that honour only a few weeks ago on account of his health. His investigations and clinical observations helped to improve many branches of practical surgery, but his chief services to medicine were rendered as an ardent supporter and leader of every movement directed towards the improvement of medical education and of medical research. He was himself a keen student of cancer, regarding that disease as parasitic in nature, and took a most active part in the management of the Cancer Research Fund. During the years he was dean of the medical faculty of the University of London he led a strenuous movement which sought to concentrate the teaching of medical subjects in a teaching university worthy of London. He was president of the British Medical Association when that body held its great meeting in London in 1910. His great public services to medicine were recognised last year, when he was created a Baronet. Sir Henry Butlin was a pupil of Sir James Paget, and held the memory of that great surgeon in the highest esteem.

We announced last week with regret the premature death of M. Théophile Durand, director of the Jardin Botanique de l'État at Brussels, who, after a prolonged illness, which assumed a serious aspect about six weeks ago, passed away on Friday, January 12. He was born at Saint-Josse-ten-Noode, a suburb of Brussels, on September 4, 1855. In 1880 he entered the Botanic Garden at Brussels, then under the directorship of F. Crépin, and he remained intimately connected with that establishment to the last. He was appointed "Conservateur au Jardin Botanique" in 1880 and director in 1902, succeeding F. Crépin. He was more a bibliographer and compiler than a man of original research, but within those limits he was very active and successful. In most of his publications he shared the authorship with a collaborator, probably an unavoidable consequence of his very defective eyesight; but he is solely responsible for the "Index Generum Phanerogamarum," which appeared in 1888, and for the "Introduction" and the third volume (Phanerogames) of the "Prodrome de la Flore Belge," by Durand and De Wildemann. With the latter he also published a volume of "Illustrations de la flore du Congo," and another of "Contributions à la flore du Congo"; further, "Plantae Thonnerianae Congolenses," "Reliquiae Dewevrianae," and a "Matériaux pour la flore du Congo"; with Schinz, a "Conspectus Florae Africae," of which, however, only vol. i., part i., and vol. v. appeared, and "Études sur la flore de l'état indépendant du Congo"; with his daughter Hélène, a "Sylloge florae Congolanae" (Phanerogamae); with Pittier, a "Primitiae Florae Costaricensis," since continued by Pittier; and with B. D. Jackson the first supplement to the "Index Kewensis." T. Durand was a corresponding member of the Belgian Academy, a Chevalier de l'Ordre de Léopold, and Officier de l'Ordre de la Couronne. He was for some time president of the Geographical Society of Belgium, and general secretary of the Botanical Society of Belgium, and in 1910 he acted as one of the presidents of the International Botanical Congress, held at Brussels.

An extension of the Horniman Museum, comprising a lecture hall and a new library, the gift of Mr. Emslie J. Horniman, was opened to the public on January 27 by Sir Archibald Geikie, K.C.B., president of the Royal Society. The library is a students' reference library of books on anthropology, zoology and botany, and other works of assistance to biological workers. In declaring the building open, Sir Archibald Geikie said that the old idea that a museum is a miscellaneous collection of oddities has passed away. Museums are now to be found in every town of consequence, and they are as much an essential part of a town's organisation as an art gallery or public library. One great necessity in starting a museum is to begin on scientific lines. The Horniman Museum has been arranged on such lines, which give the ordinary man in the street a clear notion of the relations of different animals and the various functions which they perform. One good feature is the excellent labels affixed to the specimens. A good label is just about as essential as the object to which it is affixed.

A circular letter from the Research Defence Society reminds us that it is just four years since the society was founded, to make generally known the facts as to experiments on animals in this country, and the regulations under which they are conducted, the immense importance of such

experiments to the welfare of mankind, and the great saving of human and animal life and health which is already due to them. During the past year the society gained 1000 new members and associates, and formed ten new branches. It now has 5000 members and associates. The following pamphlets and leaflets have been published during the year:—(1) "A Question of Ethics"; (2) "Experiments during 1910"; (3) "The Facts of the Case"; (4) "The Saving of Human Lives"; (5) "The Rockefeller Institute"; (6) "The Case presented by Antivivisectionists"; (7) "Recent Surgical Progress"; (8) "Antivivisection Shops"; (9) "Tuberculosis"; (10) "Sleeping Sickness"; (11) "Annual Report, Balance Sheet, and List of Members and Associates." A book is in the press giving a full *résumé* of the evidence before the Royal Commission; it will be published within a few weeks after the publication of the final report of the Royal Commission. It is hoped that many readers of NATURE will become members or associates of the society, and will help its useful work. The honorary secretary, Mr. Stephen Paget, 21 Ladbroke Square, London, W., will be glad to answer every inquiry, to send literature to applicants for it, to receive names for membership or associateship, and to make necessary arrangements for addresses and lantern-lectures in London or elsewhere.

IN the January issue of *The Quarterly Review* Sir E. im Thurn describes the social and economical condition of the Crown Colony of Fiji, with special reference to the question of imported labour. He concludes that the British islands in the western Pacific, with a few negligible exceptions already annexed to the Dominions of Australia and New Zealand, form one growing Crown Colony, widely isolated from all others, and lying adjacent to these great Dominions. There are, he believes, good reasons why these islands should not be immediately annexed to either of these Dominions. But it is time that efforts should be made to advance their growth and development, so that they may be fitted ultimately to join the future United Dominion of Australasia, which is destined to represent the British Empire in the western Pacific.

THE Journal of the Gypsy Lore Society commences in part ii., vol. v., the publication of an important sociological report on the Gypsy problem, being a State paper compiled in 1900 by Mr. A. Tresleff, secretary of the committee appointed in Finland to consider the laws and relations of the Government with these people. Mr. Tresleff, provided with recommendations from the Czar, visited many parts of Europe and made personal inquiries into the condition of these nomads and the legislation affecting them. The question, one of no ordinary difficulty, is discussed by a capable and impartial official, and will be of much value to all who are interested in the problem. The Journal has done good service by bringing it, in a translation prepared under the writer's supervision, before the British public.

IN the January issue of *Man* Mr. C. W. Hobley describes a remarkable collection of protective charms obtained from an old elephant hunter at Ukamba, British East Africa. Various kinds of powder eaten before a hunting expedition make the sportsman's aim straight; another is a whip, which on such occasions is cracked seven times "for good luck"; and two twigs bound together, if bitten after mentioning the animal which the hunter wishes to capture, secure success, and are also useful in winning a suit in the court of the Elders. Another charm is used when a new village is being founded; if the owner walks with it round the proposed site, no beasts of prey will pass the charmed circle. The trade of manufacturing these charms must be profitable, as their price ranges from Rs. 35 and five goats for the magic powder down to smaller numbers of these animals for the cheaper varieties.

WE have on several previous occasions made allusion to the valuable work issued from the medical radiographic department of Guy's Hospital, in which, by the X-ray method after a bismuth meal, kinks and similar disorders in the intestinal tube can be detected. The most recent of these papers, from the pen of Dr. A. C. Jordan (Proc. Roy. Soc. Med., 1911, vol. v., p. 9), deals with the subject more fully, and is illustrated by a number of excellent skiagrams. The intestinal stasis produced by kinks leads to a well-recognised chronic illness, which makes life unendurable. It can be remedied by a radical cure spoken of as "short circuiting." This consists in dividing the lower end of the small intestine and attaching it to the rectum. The cases recorded show most gratifying results.

TO the Transactions of the Buchan Club for 1910–11 Mr. W. Taylor contributes a list of the cetaceans recorded during the last forty years on the east coast of Scotland.

THE exhibition illustrating the animals, plants, and minerals mentioned in the Bible, which was opened last summer at the Natural History Museum, has been so much appreciated by the public that it is to be maintained for some time longer. A new edition of the guide-book to this exhibition contains certain emendations on the original text.

SOME interesting particulars with regard to the distribution of the minute aquatic crustaceans of the genus Apus in eastern Asia are recorded by Messrs. H. J. Walton and S. Kemp in the Records of the Indian Museum of December, 1911 (vol. vi., part 5). Sporadic instances of the occurrence of representatives of the genus have been recorded previously in the Himalaya near the sources of the Sutlej, in Baluchistan, in the salt lakes of the Tibet plateau, and in China. The new records add the Bulandshahr district of the United Provinces of India and the Banihal district of Jamu, lying to the south of the main Himalayan axis, to the range of the genus. The specimens from both these areas, all of which were females, appear referable to the European *A. cancriformis*. In the Jamu district these crustaceans are asserted to be injurious to newly sprouting rice, but, as Mr. Kemp observes, this indictment requires investigation.

CONSIDERABLE economic importance attaches to the announcement by Dr. J. Stafford, in the January number of *The American Naturalist*, that he has discovered the later stages of the free-swimming larva of the Canadian oyster, which had long formed a gap in the developmental history of these molluscs. It is now shown that the larvæ continue to exist as such in the neighbourhood of the oyster-beds for two or three weeks longer than was previously known to be the case before they finally settle down as spat at an age of three or four weeks after fertilisation. The late larvæ were taken in plankton-nets, and for the future can readily be recognised. This will render it practicable to determine the exact date at which "cultch" should be laid down for the reception of the spat. From his own observations Dr. Stafford is led to believe that cultivation of the Canadian Atlantic oyster (*Ostrea virginica*) in the Pacific would prove profitable. The author has discovered that the British Columbia *O. lurida* differs from the Canadian and resembles the European species in being hermaphrodite.

THE chief result recorded in a paper—received as a reprint from *The Journal of Agricultural Science* (vol. iv., part ii.)—on "silver-leaf" disease, by Mr. F. T. Brooks, is the confirmation of the accepted view that this symptom, especially prevalent in the case of plum trees, is caused by the fungus *Stereum purpureum*. Mention is made of the observation of the same pathological appearance on sycamore, horse chestnut, Spiræa, and other trees.

IN his report for the year 1910–11 as director of the Royal Botanic Gardens, Ceylon, Dr. C. J. Willis takes leave of the post which he has occupied for fifteen years, not less to the great benefit of the agricultural interests in the island than to his personal distinction. Owing to the activities of the various assistants associated with him, the gardens have become recognised as an important centre of research, and in recent years a notable stream of distinguished botanists has taken advantage of the research facilities offered. During the year under review there has been a vigorous output of the Annals and Circulars, in which the papers by Mr. T. Petch have been prominent.

IN *The Journal of Genetics* (vol. i., No. 4) there is published a paper on the inheritance of doubleness and other characters in stocks, in which Miss E. R. Saunders follows up her previous conclusions. Having obtained the results that certain single races of stocks produce only single flowers, while others, eversporting, produce doubles and singles, and that the pollen grains apparently all carry doubleness, while the ovules carry in some cases double, in other cases single characters, it is now shown that the sulphur-white, a double-throwing race, is also eversporting in regard to plastid colour. Further, the two phenomena are curiously bound up, as the singles are all white, while the doubles are mostly cream, but a few are also white. These are the premises for which the author elaborates an explanatory hypothesis capable of being tested by further experiment. An appended note gives support to the belief that stock seeds destined to give rise to double flowers are proportionally more vigorous in growth than the single quality.

ONE of the most useful of the publications of the Board of Agriculture is its Journal, containing articles of general agricultural interest, and published monthly at the extremely low price of fourpence. Among recent articles may be mentioned one by Mr. H. C. Long on the identification and eradication of some common weeds, a subject on which the agriculturist still has much to learn. Dr. Raeder describes how small holdings for agricultural labourers are created in Denmark, the method being either to make State contributions to societies established for this purpose, or to advance loans direct to the labourers themselves. Although the small holder enjoys full right of ownership, the common law has been modified in some respects. The holding must always be used for agricultural purposes, and the stock must always be kept up and maintained in good condition. Certain privileges are forfeited if the holding is sold or sublet. The large majority of small holders are labourers, and on an average they work for wages during 155 days of the year.

IN *Petermann's Mitteilungen* for January, E. Banse discusses the central idea of geography, and would mark out geographical regions so that the interaction of all factors within each should aid in completing the picture of the region. He shows in a map how the present artificial divisions of continents might be more logically treated from a geographical point of view.

IN the *Zeitschrift für Vermessungswesen* for 1911 Prof. Hammer discusses the relation of pace-length to stature, and deals exhaustively with the data furnished by 368 students. He obtains 76 cm. as the ordinary pace-length, corresponding to a height of 1·60 metres, and 91 cm. for a height of 1·90 metres, the mean value of the whole series being 83½ cm. for a height of 1·73 metres. He refers also to certain experiments on German soldiers, which seem to indicate a distinct lengthening of the ordinary pace as a result of military training.

MR. J. E. SPAFFORD, of Jerusalem, communicates to *The Geographical Journal* for January a short account of a circumnavigation of the Dead Sea made by motor-boat in June last. Brief descriptions of the shores and various places on them are given, but no special observations of any kind were made. Some excellent photographs of different parts of the shore are given, and especially two illustrating the gorge of the Arnon River. An indication of the present tendency towards a more quantitative and precise treatment of geography is the paper in the same number, by Mr. B. C. Wallis, on the importance of precise description, aided by figures. He deprecates the use of indefinite expressions, and would use percentages and ratios derived from statistics spread over five-year or longer periods. The necessity for this is true not only for economic geography, but for other branches, and in many cases in advanced work the degree of accuracy might often be stated with advantage.

*Himmel und Erde* for January contains an excellent paper on seismographs and their records, by Dr. C. Mainka, of Strassburg. A summary is given of the many different modifications of the horizontal pendulum, with a detailed account of the author's bifilar pendulum. Of the few records which illustrate the paper, the most interesting is that of the Messina earthquake of 1908, furnished by the Mainka pendulum.

THE Austrian Geological Survey has also recently published (*Abhandlungen*, vol. xvi., part iii.) a memoir by Dr. Marian Salopek on the Triassic Cephalopoda of southern Dalmatia and Montenegro. Most of the new species and varieties are unfortunately represented only by a single specimen, but the descriptions and beautiful figures will be useful for comparison with corresponding fossils which are now being studied from Albania, Greece, and Asia Minor.

A SIMPLE form of recording filament electrometer is described by M. P. Villard in the December, 1911, number of *Le Radium*. The U-shaped carbon filament is that of a 110-volt 5 or 10-candle lamp, according to the sensitiveness required. It is supported horizontally midway between two small vertical plates of metal, the distance apart of which can be varied. They are connected to the poles of a dry pile, and the filament is attracted to one or the other, according to the potential to which it is charged. The motion is recorded photographically on a revolving drum by means of the light from an electric lamp reflected into a microscope objective by a small cylindrical mirror attached to the end of the filament. The motion is nearly aperiodic, the zero absolutely stable, and variations of frequency not exceeding 5 per second are correctly recorded.

IN an article in *The Oxford and Cambridge Review* for January, Mr. H. S. Shelton urges on the writers of textbooks on heat the necessity of stating the law of "dissipation" or "degradation" of energy in a less general form than it takes, for example, in Poynting and Thomson's

"Heat." He sees "no ground whatever" for extending it from terrestrial to cosmic processes, and characterises it as a "scientific dogma" current at the present day because "any careful and systematic study of the principles of scientific method is considered unnecessary on the part of those who seek to solve physical problems." We should like to assure Mr. Shelton that the application of the law to molecular processes and to their interaction with the æther has received, and is receiving, the attention of physicists, who can deal with it without offence to the principles of scientific method. Whether their discussions are suitable for students' text-books is very doubtful.

SPECIAL interest attaches to a paper on the phthalylhydrazides, by Messrs. Chattaway and Wünsch, in the Chemical Society's Journal, on account of the fact that the authors have succeeded in preparing measurable crystals of the two varieties of a number of the compounds of this series; their crystalline properties have been examined by Mr. T. V. Barker, who has contributed to the paper complete data and drawings in the case of eight of the modifications. The occurrence of the two varieties is usually determined mainly by temperature, and the authors are therefore inclined to regard them as merely polymorphic. In this they agree with the conclusions arrived at by Piutti and Abati in reference to the substituted phthalimides, which exhibit a similar dimorphism. Later workers on the phthalimides have preferred to regard the two varieties as isomeric. The evidence in favour of this view is here very strong, because one of the varieties of the imides is colourless and the other yellow, and it is almost impossible to believe that the yellow colour could be produced by any process of remarshalling the colourless molecules. In the case of the hydrazides, the difference of colour is less striking, but, as the authors point out, the possibility of isomerism is one that must not be overlooked.

IT has long been known that depth of water on measured miles is a serious factor in determining speed results, and an article in *The Engineer* for January 26 gives prominence to recent investigations on this subject. Following experiments which have been made in this country on the Maplin and on the Skelmorlie measured miles, the first-mentioned having a depth of 45 feet and the second a depth of 240 feet, the United States Navy authorities have run trials with a battleship (the *Michigan*) and with two torpedo-boat destroyers (the *Flusser* and the *Reid*) over their three measured distances. The results show clearly the increase in power due to shallow depth, and it is probable that the two shallower courses will be discarded in future for high-speed trials, new courses being laid down.

THE first presidential address in the twelve years' history of the Society of Model and Experimental Engineers was delivered by Mr. Percival Marshall on January 22, the subject being "Model Engineering: Past, Present, and Future." That models have played a very important part in the development of real engineering practice is well known to those acquainted with the work of Newcomen, Watt, Murdock, Nasmyth, and other early pioneers. Probably the most striking example of service rendered by a model is to be found in Watt's invention of the separate condenser, devised while repairing the Newcomen model belonging to Glasgow University. Since these times the art of model-making has been practised continuously, not only by those professionally engaged, but also by others whose tastes have led them to seek recreation in mechanical pursuits. Exhibitions have been very instrumental in stimulating interest in model-making, and the large and valuable collection at the South Kensington Museum has had great influence, both as an educational factor and in promoting interest in models. Models are now used by hundreds of firms to demonstrate the merits or principles of their manufactures, and are invaluable in the educational work of technical colleges. Models of inventions are also extensively employed, one firm specialising in this class of work turning out some 2500 models every year. Fully twenty thousand metal-turning lathes have been sold during the last seven years by the various firms who cater for amateur workers. The president urged that museums equipped with models representing the chief manufactures should be set up in large towns; these would be very valuable in the education of the rising generation, and would be a source of reference and stimulation for those with inventive minds.

A SECOND edition of Mr. C. T. Millis's "Technical Arithmetic and Geometry" has been published by Messrs. Methuen and Co., Ltd. The new edition has been revised; decimals now receive treatment before vulgar fractions are studied, and notes on factors, multiples, and drawing-office work have been added.

A SEVENTH edition, revised by Prof. F. W. Gamble, F.R.S., of "A Junior Course of Practical Zoology," by the late Prof. A. Milnes Marshall and the late Dr. C. H. Hurst, has been published by Messrs. Smith, Elder and Co. In this edition a new chapter, dealing with the chick, has been added to meet the needs of those who attempt elementary embryology in their junior course. The price of the volume is 10*s*. 6*d*.

MESSRS. CONSTABLE AND CO., LTD., will commence the publication, in April next, of a new quarterly scientific review to be entitled *Bedrock*, "a quarterly review of scientific thought." The editorial committee consists of Sir Bryan Donkin, Prof. E. B. Poulton, F.R.S., Prof. H. H. Turner, F.R.S., and Mr. G. Archdall Reid. The acting editor will be Mr. H. B. Grylls. The first number will contain the following amongst other contributions:—Value of a logic of method, Prof. J. Welton; recent researches on alcoholism, G. Archdall Reid; Darwin and Bergson as interpreters of evolution, Prof. E. W. Poulton; social and sexual evolution, the hermit of Prague; notes on current research; the interaction of passing ships, Prof. A. H. Gibson.

## *OUR ASTRONOMICAL COLUMN.*

ASTRONOMICAL OCCURRENCES FOR FEBRUARY:—

Feb. 1. 1h. 36m. Neptune in conjunction with the Moon (Neptune 5° 39′ S.).
3. 8h. 0m. Saturn at quadrature to the Sun.
6. 17h. 54m. Mercury in conjunction with Uranus (Mercury 0° 55′ S.).
11. 9h. 21m. Jupiter in conjunction with the Moon (Jupiter 4° 37′ N.).
14. 10h. 30m. Venus in conjunction with the Moon (Venus 5° 44′ N.).
15. 9h. 21m. Uranus in conjunction with the Moon (Uranus 4° 36′ N.).
23. 20h. 28m. Saturn in conjunction with the Moon (Saturn 4° 23′ S.).
24. 9h. 29m. Venus in conjunction with Uranus (Venus 0° 39′ N.).
25. 15h. 32m. Mars in conjunction with the Moon (Mars 1° 43′ S.).
26. 7h. 0m. Venus in the descending node.
28. 10h. 5m. Neptune in conjunction with the Moon (Neptune 5° 46′ S.).

MARS AND SATURN.—M. Jarry-Desloges reports (*Astronomische Nachrichten*, No. 4549) that the southern white polar cap on Mars appears to be reforming, particularly on Thyle I., and that the insular area which he reported to the west of Novissima Thyle is still apparent, and forms a background to the dark, sharply defined M. Australe.

On Saturn he has remarked many changes in the southern regions. The dark polar cap has not been seen again, but the pole is occupied by a bright area surrounded by a very thin dark band; three other bands were also seen on the disc.

SEARCH-EPHEMERIDES FOR WESTPHAL'S COMET, 1852 IV.—The period for Westphal's 1852 comet is rather uncertain, but, according to a new calculation by Dr. Adolf Hnatek, which is published in No. 4549 of the *Astronomische Nachrichten*, it is not unlikely that perihelion will be reached in October of this year.

This is on the basis that the period is sixty years, but Dr. Hnatek gives search-ephemerides, for the first half of this year, taking 60·0, 60·1, 60·2, 60·3, 60·4, 60·5, 61·0, 61·5, and 62·0 years as the period; for the first six values the computed brightness, on June 19, would lie between magnitudes 7·5 and 10·0, but until later in the year the comet is considerably south of the equator.

OBSERVATIONS OF JUPITER'S GALILEAN SATELLITES.—In Circular No. 12 of the Transvaal Observatory, Mr. Innes records a large number of eclipses, transits, &c., of the four Galilean satellites of Jupiter, and gives some interesting notes concerning the more uncommon phenomena observed. On April 4, 1911, a partial transit of J. III. was observed, and Mr. Innes remarks that the possibility of a partial transit does not appear to have been recognised hitherto. A table is given showing the differences between the observed times and those computed by Dr. de Sitter, those given in the "Nautical Almanac," and those computed from Prof. Sampson's tables; the differences range between −0·6 and −12·5 minutes. Peculiar shapes of the satellites and their shadows, *e.g.* the shape of a figure 8, were noted during several transits, and on May 24, 1911, before the commencement of the ingress of a transit by J. III., a bright spot, with a dark band skirting it on the south side, was seen in the N.*f.* quadrant of the satellite.

STAR CALENDARS, CHARTS, AND GUIDES.—From the publishers we have received copies of the H.P.H. series of annuals. The "Star Calendar" for 1912 is an improvement on that of former years, and has the aperture, which enables the star chart on the under card to be seen, oval instead of circular; the price is 1*s.* net. The "Star Almanac," 6*d.* net, is, as in previous years, intended to display on the observatory or study wall, and it contains a large amount of useful information. A number of notes discuss the æther, the corona, &c., and in addition to four circular star charts there are reproductions of Father Cortie's 1905 corona and Max Wolf's photograph of the North America nebula. The above are published by Messrs. Simpkin, Marshall and Co., Ltd.

In "Stars and Constellations: a Little Guide to the Sky," Miss Agnes Fry describes the constellations and their relative positions, &c., in rhyme. For the instruction of young people the work will probably prove useful, and may be obtained from the publishers, Messrs. Baker and Son, Clifton, price 6*d.* net.

## *RECENT EARTHQUAKES.*

SEVERAL shocks, supposed to be due to earthquakes, were felt in this country towards the end of last week. On January 26, at 4 a.m., a shock was felt at Dunblane strong enough to awaken sleepers, but not strong enough to affect the Milne seismograph at the Royal Observatory, Edinburgh. On January 28, at about 3.35 a.m., a tremor was felt in Glenfruin, a valley lying between the Gareloch and Loch Lomond. Early in the morning of January 26 there were three distinct shocks in the colliery district of Llanhilleth, in Monmouthshire, strong enough to make the miners leave their work. On January 20, shortly before 2 a.m., a sharp tremor was felt at Lennoxtown and Campsie, in Stirlingshire, again without affecting the Edinburgh seismograph. Of the four disturbances, the first two were apparently of seismic origin. Dunblane lies close to the district on the south side of the Ochil Hills, where so many earthquakes have resulted during the last twelve years from slips of the great fault which forms the southern boundary of the hills. The Glenfruin shock seems to be a successor of two other earthquakes in the same part of Scotland—the Dunoon earthquakes of September 18, 1904, and July 3, 1908. The Llanhilleth and Lennoxtown shocks bear a close resemblance to those which are often felt in colliery districts, and which are probably caused by small fault-slips precipitated by the working in the mines.

A severe earthquake occurred at 6 p.m. on January 24 in the island of Cephalonia, which, with the neighbouring islands of Zante and Santa Maura, forms one of the most important seismic zones in Europe. Buildings in Argostoli, the capital, were injured; considerable damage was caused in the villages at the southern end of the island, as well as in the island of Zante. The villages in the north-east of Çephalonia seem to have suffered most. Altogether, five villages are reported as destroyed and eight persons as killed. Though hundreds of shocks have been felt in the district during the last twenty years, the earthquake of January 24 is apparently the most severe since the disastrous Zante earthquakes of January 31 and April 17, 1893.

The director of the Meteorological Office reports that on January 25 he received a telegram from the superintendent of the Eskdale Observatory, in Dumfriesshire, as follows:—"Fine earthquake 24th at 16½ hours 3000 km. S.E." More exact measurements of the records have given the epicentre as 2570 kilometres distant, 56° 34′ E. of S., that is, at lat. 39° 16′ N., long. 21° 53′ E. The position of the earthquake is thus placed in S.W. Thessaly, near the border between Turkey and Greece, so that the Eskdale record would appear to have been derived from the earthquake in Cephalonia referred to above.

## *A NEW SYSTEM OF GUN SIGHTING.*

THE new Remington negative angle system of sighting, which formed the subject of a lecture by Sir George Greenhill, F.R.S., to the Junior Institution of Engineers on Friday, January 19, is the invention of Mr. H. Ommundsen, worked out and applied to military and sporting rifles in collaboration with Mr. E. Newitt. The invention has for its object the elimination of the necessity for judging distance in sport and war by making use of the visual angle which proceeds from the shooter's eye and embraces the object aimed at. By inverting the back-sight, making it so that the object can be seen under it instead of over, as at present, the object can be callipered visually between the fore- and back-sight. The magnitude of the visual angle varies inversely with distance, and the further off the object is the smaller will be the visual angle, and consequently the higher the foresight has to be raised in order to calliper the object, the result being a suitable automatic increase of elevation. This automatic variation of elevation may be obtained simply by selecting a point of aim at a predetermined depth below the objective. This predetermined depth creates a visual angle, which varies in precisely the same way as above described, and being below the objective the angle automatically subtracts from the fixed angle of elevation on the rifle, and is thus called the "negative angle." The fixed angle of elevation on the rifle is calculated beforehand to give appropriate results within limits which depend upon the power of the cartridge. Applied to sporting rifles, the negative angle sight gives astonishing results. With the comparatively old 0·303 deer-stalking rifle, or with, say, the 0·400 big-game rifle, animals can be shot through the heart at any distance between, say, 30 and 230 yards, without in any way altering the aim or adjusting the sight. Some tests have been carried out by the Remington Arms-U.M.C. Company, of New York and London, who have acquired the whole patent rights. In the military tests the skirmishing results bounded up from less than 20 per cent. under the old style of sights to 95 under the negative angle method. On "stag" targets with the ordinary 0·303 sporting rifle, 7-inch "heart" groups were made with unfailing regularity at varying distances between 50 and 250 yards.

## GLACIERS IN SOUTHERN NORWAY.

IN the second part of *Bergens Museums Aarbok* for 1911, J. Rekstad publishes in German a description of the glacier region of southern Norway, accompanied by thirty-four illustrations. The paper is intended to serve as a guide to visitors, and does not discuss questions of glacial erosion or the origin of landscape-forms. The Jostedalsbræ (Fig. 1) north of the Sognefjord has a surface of 855 square kilometres, and furnishes an excellent type of the plateau-snowfield, from which glaciers fall, rather than creep, into the valleys round about. As one views a high field of this kind from a distance, the contrast with the limited snow-basins of the Alps is immediately apparent. Round about it, isolated glaciers lie in cirques, which have been no doubt carved out since the time when the main ice spread farther over hill and dale.

Regenerated glaciers occur at the feet of steep places on the plateau ridge, and one of these, the Suphellebræ, extends down to a level of 50 metres above the sea. The author directs attention to its banded structure, which here must be attributed to flow under pressure, since any such structure due to successive deposition of snow on the névé-field would be obliterated as the ice falls over the rock-face (Fig. 2). The terminal block-moraines of the Böium Glacier are referred to, and are so well marked as to have deserved a photograph.

As a glacier retreats, its valley may become filled up by detritus washed out by the water from the melting ice. An alluvial flat arises, over which the streams meander, frequently changing their courses, and these streams have no relation to the magnitude of the original valley. When the ice finally passes away, under warmer climatic conditions, the streams may almost disappear. Where ice-erosion has been powerful, dry valleys filled by alluvium may remain, in the formation of which water has played very little part. This consideration is suggested by the view of the Tunsberg valley (Fig. 3), stretching from the foot of the longest glacier in Norway, one of the tongues from the east side of the massive Jostedalsbræ. The author records (p. 26) that the rate of infilling in these valleys is so rapid that vegetation does not gather on the stones, and that dwellings have to be shifted, owing to the rise of glacial waters on the growing alluvial floor. The cattle-paths must similarly be moved upwards on the valley-sides. The retreat of the glaciers during the last 150 years has left smooth steep rocks exposed in many cases, the scenes of former ice-cascades, and the

FIG. 1.—The Jostedalsbræ, showing the snow-plateau.


FIG. 2.—The Suphel ebræ, a regenerated glacier on the margin of the Jostedalsbræ.

valley-glaciers will probably shrink back to the edge of the high field whence they came.

In the lower part of the Lodal Glacier (p. 30), the moraine material comes to light in consequence of melting of the surface, and the stones, as happens in ordinary glacier-tables, protect the ice beneath them. The linear moraines thus run on walls of ice, which increase in height towards the glacier-foot.

FIG. 3.—The Tunsberg Valley, from the termination of the Tunsberg Glacier.

Leaving the Jostedalsbræ, the author proceeds to consider a number of small glaciers, mostly of the Alpine type, and then deals with the Hardangerjökel, a plateau-glacier of almost circular form, south of Finse, on the new Christiania and Bergen line. The term *jökel* is applied to firn and glacier-masses, equally with the more familiar *brae*. The Rembesdalsbræ, a tongue from this plateau, has dammed a stream so as to form the Dæmmevatn, a lake which at one time endangered the Simadal below. An artificial tunnel in the rock now carries off its water when the level rises unduly high.

The Folgefonn, or Folgefond—in "fonn" we have yet another word for a firn-mass giving rise to glaciers—lies to the east of the Hardangerfjord, and gives rise to the Buarbræ, often visited by travellers from Odde. This glacier has begun to advance during the last six years (p. 49).

The precipitation that feeds these plateau-snowfields of Norway is greater near the coast than in the interior. The snow-line in the southern part of the country lies at 1200 metres above the sea on the west, and rises eastward to 1900 metres.

In connection with J. Rekstad's descriptive work, a paper by Fritz Machaček may well be referred to, entitled "Geomorphologische Studien aus dem norwegischen Hochgebirge" (*Abhandl. der k.k. geographischen Gesellschaft in Wien*, Bd. vii., 1908, Nummer 2). Dr. Machaček shows how the general form of southern Norway is that of a dissected plateau, on which snowfields rest here and there.

FIG. 4.—The Mjölkevoldsbræ descending from the plateau of the Jostedalsbræ.

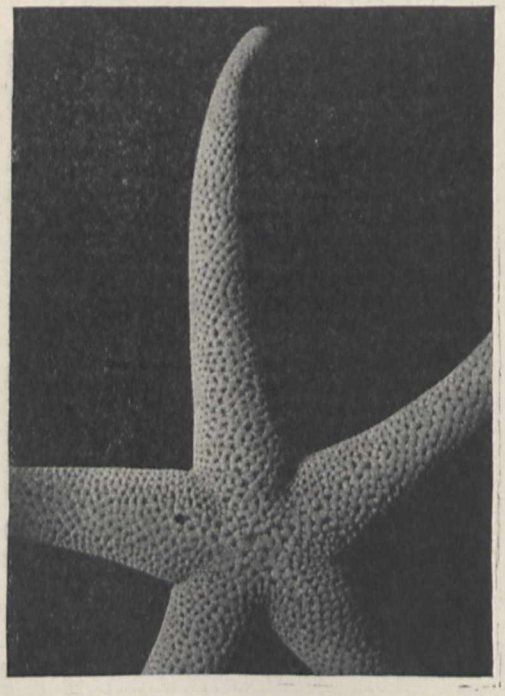
The mountain-crests are not grouped along parallel chains. The glacier-fields on the plateaus are from 300 to 400 metres thick, a fact that must be taken into account when the height of the plateau itself is estimated (p. 13).

Machaček very naturally sets aside Richter's suggestion that the plateaus have been formed by the working back of cirques and the union of their floors, and he sees in them the remains of a pre-Glacial peneplane, which was already formed by the close of Mesozoic times, and which was invaded in the Christiania district by the Upper Cretaceous sea. Traces of a second peneplane are found on the valley-sides, so that the uplift to the present level occurred in at least two stages. The author discusses the forms produced by glacial erosion, and attributes the steepness of the valley-heads (p. 52) to the concentration of the ice descending from the plateaus, and a consequent almost vertical erosion at these points.

This paper is illustrated by ten exceptionally fine photographs, which are, however, not discussed in detail as geographical examples in the text. G. A. J. C.

## THE STARFISHES OF THE NORTH PACIFIC.[1]

THE prolific nature of the Pacific fauna is well shown by this intensive study of the starfish. The region covered by this report includes all the waters north of a line drawn from the southern end of Sakhalin to the southern boundary of the United States; and when this vast area is examined, the north-east Pacific portion of it turns out to be not only the most fertile section, but, as regards starfishes, the most prolific in species and individuals of any portion of the world. Even though the deep-water forms are little known, ninety-six species (of



*Henricia leviuscula.* Specimen from Puget Sound.

the twenty-three families under consideration) are described and figured, and another bulletin is promised in which the remaining large super-family Forcipulata (including the genus Asterias) is to be described. The descriptions are based upon a large, often a very large, amount of material, and include minute descriptions of the external features, together with other anatomical characters. The compilation of such a work has involved a vast amount of labour extending over several years, and the result is a monograph of value to every museum. A full estimate of the work can only be made when the complementary volume is published.

Perhaps the most interesting points in what appears at first sight to be a forbidding list of systematic descriptions lie in the distribution and variation of certain genera. Of the ninety-six species here described, seventy-three are confined to the North Pacific, twelve occur in the North Atlantic also, whilst the remainder form part of another and southern fauna ranging down the west coast of South America. The dozen species common to the two great oceans include such well-known forms as *Solaster endeca*, *S. papposa*, and *Henricia sanguinolenta*. These are, speaking generally, circumpolar forms, and they include species which exhibit a baffling, and as yet little analysed, form of variation. Upon this subject we cannot do better than quote the judicial remarks of the author:—"The study of this collection of Henricia has strongly suggested the possibility that all the species of a genus are connected by intergrades, not serially, but by numerous often anastomosing lines" (p. 270). "So great and so numerous are the variations in most of the species that each is to be regarded more as a centre of variation, deviations from the type proceeding in many directions till they meet and often merge with aberrant members of nearly related forms" (p. 269). "A system of nomenclature perfected for a rather limited set of animals (the higher vertebrates) may not so well meet the requirements of a different class of creatures . . . . which have been subjected to more modifying factors" (p. 270).

The whole work is, from this point of view, simply an unconscious comment upon the need for rigorous experimental analysis of the genetics of this group. We only wish that Dr. Fisher, who knows these animals so well, had imparted a more life-like aspect to the delineation of their characters. The very curious parasite figured on Plate iii. (said to be an Ascothoracid [Cirripede] parasite) is the only mention of an intrusive body we have discovered. There must be a great mass of interesting bionomical information about Pacific Asteroidea, and it is to be hoped that Dr. Fisher will publish it in his next volume. Perhaps the most generally useful part of the present one lies in the "keys" for determining both genera and species and in the valuable plates with which the volume is so generously provided.

[1] Smithsonian Institution, United States National Museum, Bulletin 76 Asteroidea of the North Pacific and Adjacent Waters, by Prof. W. K. Fisher. Part 1., Phanerozonia and Spinulosa, pp. vi+419+122 plates (Washington: Government Printing Office, 1911.)

## SOME RECENT FISH LITERATURE.

TO No. 5 of the Leland Stanford Junior University Publications Mr. E. A. Starks contributes three articles on the osteology of certain scomberoid fishes, the first dealing with the genus Leiognathus, the second with the families Gempylidæ, Lepidopidæ, and Trichiuridæ, and the third with the horse-mackerels (Carangidæ). In regard to Leiognathus, it may be mentioned that the genus was transferred by Mr. Boulenger from the scomberoid group to a position in the neighbourhood of the percoids in the family Gerridæ; but this view is disputed by the author, who regards the genus as the type of a scomberoid family.

At the conclusion of an article on the breeding of the eel, published in the September number of *Himmel und Erde*, Mr. Carl Müller states that we are still in ignorance with regard to the age of the youngest Leptocephalus larva at present known, namely, specimens of about 7 cm. in length, it being uncertain whether these are six or eighteen months old. Of younger larvæ and the eggs nothing is yet known, and we are equally ignorant as to the interval which elapses between the arrival of eels in the sea and their spawning. Neither is it known what becomes of eels subsequent to spawning; possibly they die soon after this event, although it is equally possible that they may live for a considerable period. All that is definitely known on this point is that after having once entered the sea they never return to fresh water.

To *The Field* of September 23 (vol. cxviii.) Mr. Boulenger contributed an article on the eels of Africa, in which it was pointed out that, although our knowledge is still imperfect, there appear to be four species, of which the one inhabiting North Africa (and likewise Madeira and the Canaries) is identical with the European *Anguilla vulgaris*.

In East and South Africa are found *A. mossambica*, *A. bengalensis*, and *A. bicolor*, the range of all of which extends to the South Pacific. Of these, *A. mossambica*, ranging from the Cape to Zanzibar and the Seychelles, comes nearest to the European species, from which it differs by the broader bands of teeth. Strange to say, however, there are no eels in tropical West Africa, this being accounted for by "Dr. J. Schmidt, of the Danish Fishery Commission, who, with the aid of Danish hydrographers, has ascertained that the water of the great depths of the inter-tropical Atlantic is for the greater part between 4° and 5° C., nowhere reaching the temperature ascertained to be the minimum (7° at a depth of 1000 metres) required for the breeding of the eel in the North Atlantic. Therefore the reason why eels are absent from some of the warmest regions of the world, such as West Africa and tropical South America, is that the deep sea to which they would have to resort for breeding is too cold, an extraordinary fact when we bear in mind that, outside the period of reproduction and of larval life, the European eel can accommodate itself to such varied climatic conditions as obtain between the Arctic circle and Nubia. The suitable conditions for breeding are only to be found in the North Atlantic, the Mediterranean, and the Indian Ocean; in consequence eels are only found in those parts of Africa (North, East, South) which are within the migratory powers of the fish."

In this connection may be quoted a paragraph recently published in the daily Press, that, in order, apparently, to preserve the supply for home waters, "Denmark intends to stop the migration of eels from the Baltic to the outer ocean by placing a barrier of submerged electric lights between the island of Faröe and the Fyen coast. Eels, which migrate in the dark, will not, it is believed, cross this barrier."

An article on the migration of fishes, including eels, by Mr. V. Franz, appears in the aforesaid issue of *Himmel und Erde*.

A summary of reports relative to eel-fry, drawn up by Mr. A. B. E. Hillas, is published in No. ii. of Irish Fisheries Investigations for 1909 (1911); while No. vi. of the same for 1910 is devoted to an account, by Messrs. Holt and Byrne, of the fishes of the genus Scopelus from the Irish Atlantic slope.

## PAPERS ON PLANT PHYSIOLOGY.

THE action of radium compounds on plants is discussed by Prof. H. Molisch in a short article published in the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxx., part v.). Experiments showed that sufficient light is emitted by strong preparations to produce heliotropic curvature in the case of very susceptible plants such as the oat and the common vetch. With regard to the action of the $\alpha$, $\beta$, and $\gamma$ rays, it was found that longitudinal growth is diminished and that the periods of spontaneous nutation are shortened, but they induce no form of tropism.

Prof. J. v. Wiesner contributes to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften*, Vienna (vol. cxx., part iii.), a paper, supplementary to his book, discussing further investigations as to the light-regulated position of leaves and the amount of light utilised by plants (Lichtgenuss). In the same publication experiments are described by Dr. F. Weber which were intended to throw light on the dormant condition of trees and shrubs. Following up the warm-bath method of forcing proposed by Molisch, which showed that individual branches can be separately resuscitated, the effect of injecting water into branches was tried, and also of the mere insertion of the injection syringe. In the case of lilac and the broad-leaved lime, water injection caused the buds to open three weeks earlier than normal buds, while mere pricking produced a similar result, though not quite so pronounced.

With reference to experiments designed to investigate the effect of growing plants in air enriched with carbon dioxide, Dr. F. F. Blackman communicates a note to *The Gardener's Chronicle* (December 2, 1911) in which he presents an apt illustration of the operations of "limiting factors." When plants are placed in air which contains more than the normal amount of carbon dioxide, if either the light or the temperature is low, the plant may not respond to the increased supply of carbon dioxide, because assimilation is as great as the amount of light or degree of heat will allow; the light or temperature may act as a limiting factor. If the light is increased, then plant assimilation may also increase until another limiting factor comes into operation. Therefore in experiments dealing with assimilation, growth-rate, or other physiological processes it is necessary to consider whether the results expected from improvements of any one condition may not be prevented by the limitation imposed by another factor.

An account of cotton investigations in Egypt, by Mr. W. L. Balls, published in *The Cairo Scientific Journal* (vol. v., No. 60), deals with several interesting problems in general plant physiology. The conclusions, based on the study of the root system of the cotton plant, deserve close attention. While examining the effect of temperature upon growth, it was observed that growth of the tap root amounted to half a metre in twenty-four days at a mean temperature of 25° C. Considerable importance is attached to checks imposed upon root growth, whether by interference of other roots or rise of the water-table. It is argued, and experiments are cited in proof, that a premature rise of the water-table, as in 1909, must cause untimely shedding of bolls, flowers, and buds. Reference is also made to the previously noted "sunshine effect," *i.e.* the complete arrest of main-stem growth during the hottest months whenever the sun shines directly on the plant.

A contribution to the subject of saltmarsh and estuarine vegetation, which deals with the distribution of halophytic plants as controlled by the salinity of the subsoil water, is presented by Dr. J. W. Harshberger in the Proceedings of the American Philosophical Society, Philadelphia (vol. i., No. 201). A combined hydrometer and thermometer was used for determining the water density at various stations, where the assemblage of plants was also noted. From the readings taken, maximum and minimum densities were obtained for each plant. Thus *Spartina stricta*, var. *maritima*, which showed the widest range of accommodation, was found growing in water containing as little as 2 and as much as 4 per cent. of salt. For *Spartina patens* and *Salicornia herbacea* a similar maximum, but a higher minimum, are recorded. *Distichlis spicata*, *Limonium carolinianum*, and *Juncus Gerardi*, which follow next in order, have a much narrower range. A remarkably low maximum is recorded for *Suaeda maritima*.

In connection with the condition of apples appropriately known as "bitter pit," which has supplied fungologists and others with a puzzling problem, an explanation ascribing the cause to poisonous effects produced by arsenical sprays has been put forward in the Proceedings of the Royal Society of Victoria (vol. xxiv., part i.) by Dr. Jean White; the arguments are rational, and if substantiated will lead to a more careful consideration of spray effects. The author had had the opportunity of making a few trials with sprayed and unsprayed trees which bear out the explanation, but the opinion is expressed reservedly and published in order to induce fruit-growers to put the theory to test.

## A PHOTOGRAPHIC STUDY OF VORTEX RINGS IN LIQUIDS.

THOUGH the laws of vortex motion have been extensively examined by the ablest mathematicians, comparatively few experiments appear to have been made to study the nature of these motions in air and liquids beyond some experiments made about 1867 by Prof. P. G. Tait, who examined the properties of smoke rings in air. In an extended experimental investigation of this subject the present writer found that very beautiful vortex motions may be easily produced in such high-density fluids as water and oils which have free surfaces and small viscosity. The study consisted in examining the various properties of single and double rings, both visually and with the aid of the camera.

A tank was constructed which would permit the rings to be observed from the two sides, the top, and one end. This tank was made with sides of plate glass. It was 151 cm. long, 59·5 cm. high, and 12 cm. wide. For the production of the rings a cylindrical metal can was pro-

vided. The diameter of the can was 7·7 cm., and its axial length 6·6 cm. One end of this was provided with a flexible diaphragm of phosphor bronze, which could be struck suddenly by the plunger of an electromagnet. The other end of the can could be closed with metal discs, which were provided with one or more holes of various shapes and dimensions. For the production of a single ring one hole in the centre of a disc was used 1 cm. in diameter, and for the production of double rings two holes, one above the other, each 0·85 cm., were employed. We shall hereafter call this can the "gun."

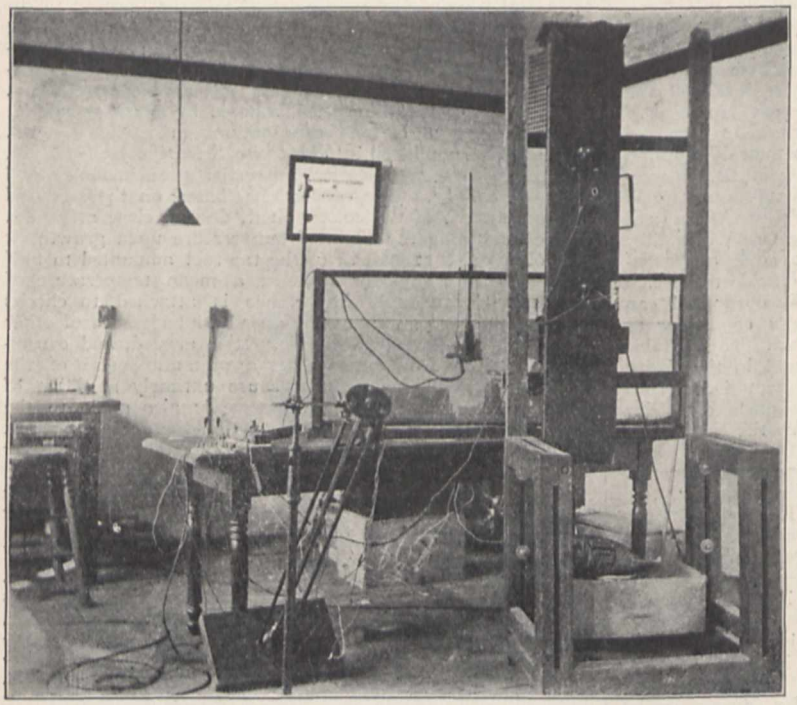


FIG. 1.—Apparatus for the production and photography of vortex rings.

To make the rings visible, and at the same time provide for keeping the water clear so that the tank would not have to be repeatedly refilled, it was necessary to fill the can with highly coloured water, the colouring of which would entirely disappear when the ring broke up and dissipated. Among other colouring materials tried in the experiments, that which was most used was phenol phthaline. The water in the can was made strongly alkaline, and the water in the tank was made slightly acid. Thus the projected rings were of a deep red colour, and entirely disappeared upon breaking up. An illustration is here reproduced (Fig. 1) of the entire outfit above described, together with the plate drop and other devices employed in the photographing of the rings.

Experiments preliminary to the photographic work revealed the following properties of these rings. The motion through the water is rapid, being about 2 metres per second. The rings move in a straight path with a gradually diminishing speed, and always maintain their plane perpendicular to their line of motion. When the water of the tank contains suspended particles of slightly greater density than water, a ring will pass through and among them without incorporating and carrying any of the particles along with it. When a piece of chiffon cloth is stretched over a frame and is held in the path of a ring, the ring will be found to pass easily through it without being broken up or much disturbed in its motion. When a piece of tissue paper similarly stretched on a frame is held in the path of the ring, the ring will break through it, though it is in turn broken up by the impact. If a light watch-chain hangs in the water and is fairly struck by a ring it is bent into a decided curve by the force of the blow. The kinetic energy of these rings is thus seen to be considerable. When two rings are made to approach from opposite ends of the tank, they will on impacting be broken up and dissipated if they meet fairly, but if their line of approach

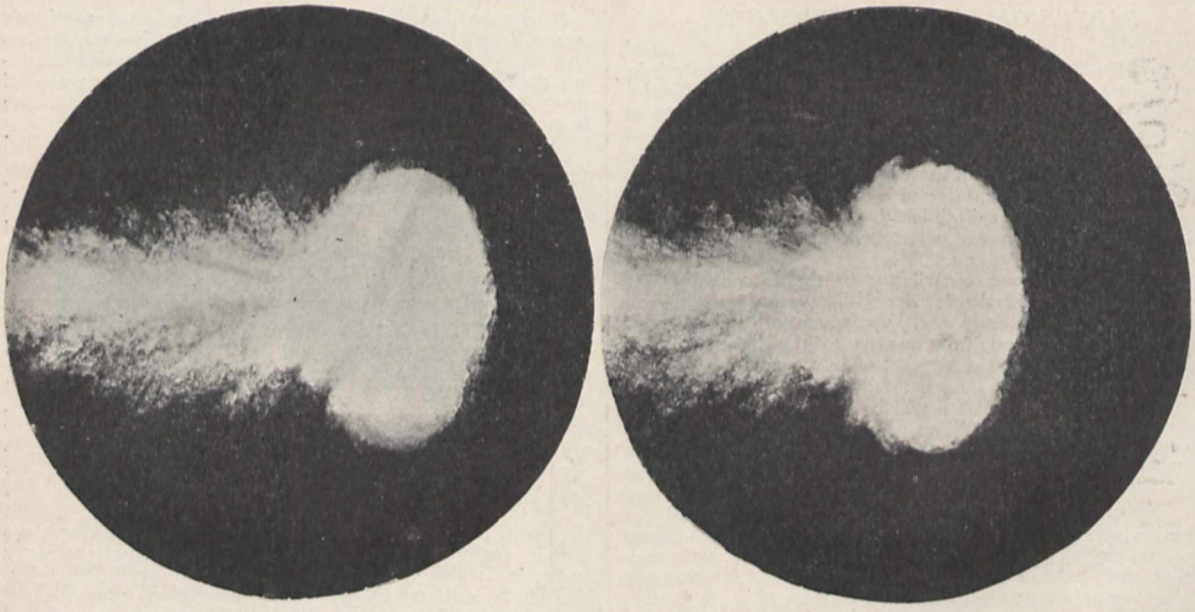


FIG. 2.—Stereoscopic photographs of a vortex ring just issuing from the gun.

is such that they might be expected to touch on their edges, upon a close approach they bend out of a straight course and pass one another without an encounter.

When a ring is aimed to approach the surface of the water, it is upon reaching the surface reflected in a very beautiful manner. As the surface of the water is approached the upper edge of the ring gains velocity over the lower edge, the plane of the ring tilting in such a manner as to maintain itself always at right angles to the line of motion of the ring. If the angle between the surface of the water and the line of approach of the ring to the surface be as much as 22°, the ring is still reflected. If this angle is much exceeded the ring bursts through the surface with a spurt of water.

Refraction was also observed. The lower half of the tank was filled with a dense salt solution, and the upper half with pure water. The ring in passing from the upper to the lower layer, with a slight angle from the horizontal, was deviated from its straight path. The laws of both reflection and refraction were proved to be, approximately at least, those of light.

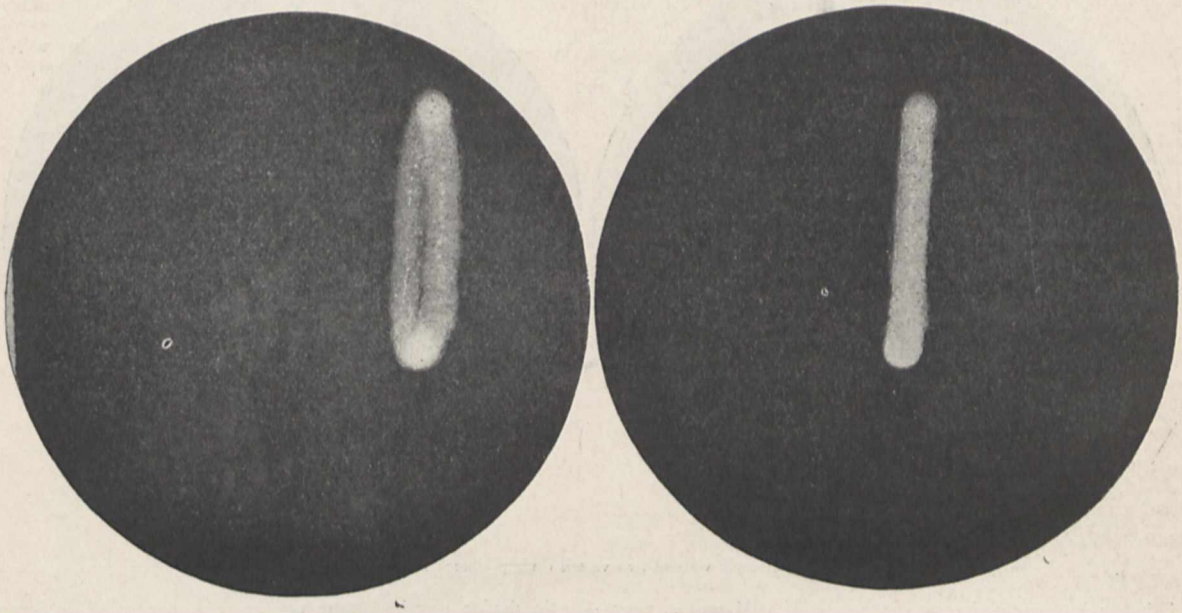


FIG. 3.—Stereoscopic view of a fully-formed vortex ring.

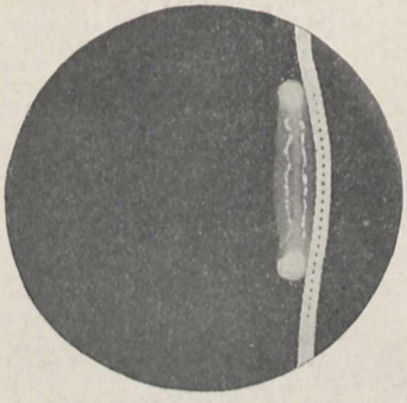


FIG. 4.—Vortex ring about to strike a watch-chain after progressing about half a metre from the gun.

Rings ejected from a very exactly circular hole are themselves circular, and advance through the water with no other motion visible than that of progression. If, on the other hand, the hole is elliptical, they have a vibratory motion in their own plane. The vibrations are such that the vortex changes from an ellipse with its major axis vertical to an ellipse with this axis horizontal. The vibrations are almost too rapid to be followed distinctly with the eye, but make an interesting sight when the ring is observed from the end of the tank as it approaches the eye.

The most scientifically interesting property of water rings may be observed when the end of the gun is provided with two holes, one above the other. In the experiments tried, the two holes, each 0·85 cm. in diameter, were placed with their centres separated 2·55 cm. The two rings, which issue simultaneously from the two holes, begin to attract each other the moment they leave the gun, and at a distance from the gun of about 6 to 8 cm. they come together with great suddenness, uniting to form a single ring of approximately twice the circumference of one of them. The rings so formed proceed with the same velocity as a single ring until broken up by impact with the end or side of the tank. This ring possesses vibratory motions that are remarkable. Unlike the single ring, which issues from an elliptical hole with vibrations in one plane only, a ring which is formed by the union of two rings has a very complicated vibratory motion in planes both normal and parallel to the direction of forward motion of the rings. These motions will be better understood by a study of the photographic views.

If the surface of the water in the tank be covered with a layer of kerosene oil from 5 to 10 cm. deep, an interesting phenomenon may be observed, which is rendered more apparent when the oil is coloured a deep red with a dye known to the trade as Soudan III. When the gun is filled with uncoloured water, and is located a few centimetres below the surface of the oil, and an invisible ring is projected at a suitable angle with the surface of the oil, it enters the oil, and is instantly converted into an oil ring which proceeds to the upper surface of the oil; it is there reflected and re-enters the water as a visible oil ring, which proceeds with only slightly diminished velocity for a metre or more through the water. After the ring breaks up the oil rises to the surface of the water, and after the surface has been quitted another ring may be produced, and the process may be continued indefinitely. As the water is uncoloured, the illusion is produced of red oil rings issuing from the oil without any apparent agency for their production.

Experiments were conducted which demonstrated that in the case of two liquids of different densities—at least if these two liquids are not miscible—it is possible to project

a ring of the less dense liquid through the liquid of greater density, but it is not possible to project a vortex ring of the liquid of greater density through the liquid of less density. Thus a ring of kerosene oil can be projected through water, but a ring of carbon tetrachloride cannot. By projecting rings of liquid paraffin through hot water, and thence into an underneath stratum of cold water, very pretty solid rings of paraffin were obtained and preserved.

The problem of photographing these rings was one of peculiar difficulty. The rapidity of their motions made it necessary to make exposures which would be of the order of only one twenty-five-thousandth of a second. Of course, no mechanical shutter could be constructed to give so brief an exposure. An electric spark method, an optical arrangement, and a timing device were finally devised which gave excellent results and fully exposed plates. The majority of the pictures were obtained with a stereoscopic camera, and the double views which were obtained, when examined, as they should be, with a stereoscope, reveal the mechanism of the rings in a much finer manner than can be obtained from single views. The electrical spark device employed was very similar to the primary spark used in the sending station for wireless telegraphy. The stereoscopic device required that two sparks, separated in space by a distance equivalent to that between the lenses of the stereoscopic camera, should be simultaneously produced. A very special form of double spark-gap was constructed so that the sparks took place between amalgamated zinc terminals and the clean, bright surface of mercury.

FIG. 5.—Stereoscopic view of two vortex rings produced simultaneously.

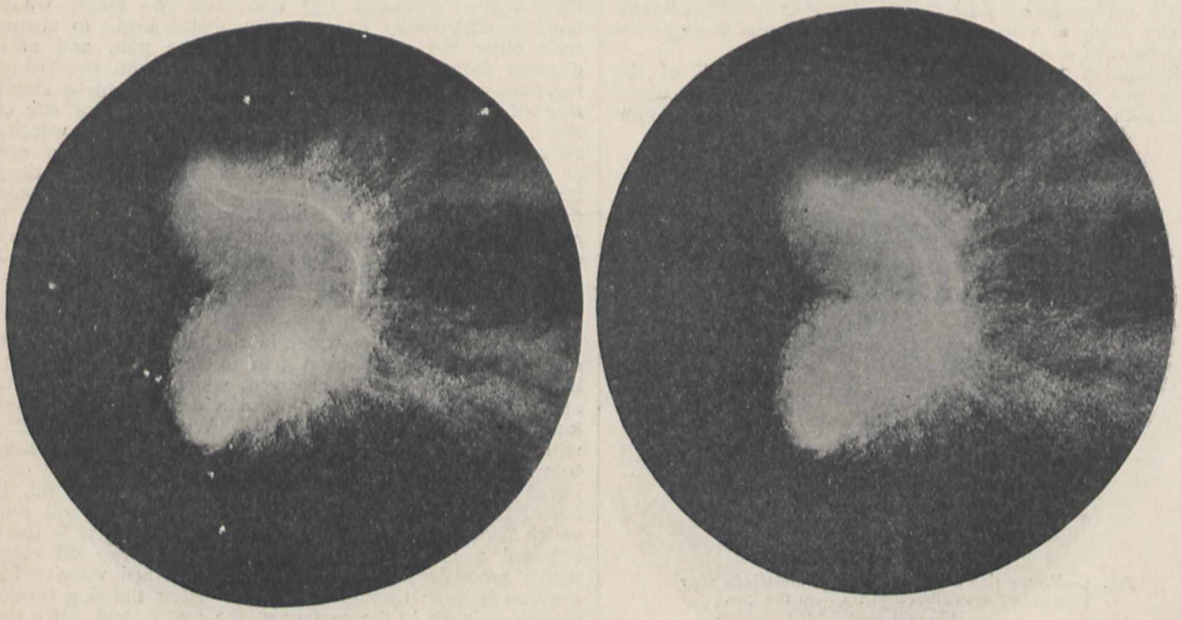


FIG. 6.—Stereoscopic view of two vortex rings uniting.

At the moment when the ring was photographed it appeared before the brilliantly illuminated surface of a plano-convex lens 12½ cm. in diameter. The ring as seen in the camera thus appeared as a dark object against a brilliantly illuminated background. The alternating

current used produced a succession of sparks, each lasting a less time, perhaps, than the fifty-thousandth of a second,

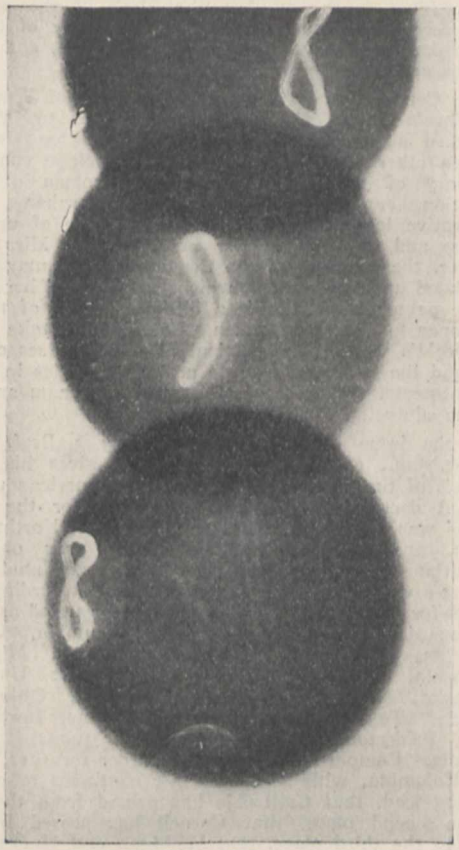


FIG. 7.—Three photographs, separated by about one-fiftieth of a second, of a vibrating vortex ring formed by the union of two rings.

one, and only one, spark occurring at each alternation of the primary current, or about eighty per second.

Three events were made, by the timing device, to occur simultaneously; they were the arrival of the falling plate at the back of the camera, the arrival of the ring in the field of view, and the occurrence of a spark, or, more precisely, of a brilliant flash of light. The timing was all done by a falling weight, which made suitably timed electrical contacts, one of which operated an electromagnet to release the plate, and another the electromagnet of the vortex ring gun.

When a single ring first issues from the gun it is not recognisable as a ring, but is surrounded by an ellipsoid of coloured water, and is followed by a trail of colour. This is shown in the stereoscopic view in Fig. 2. As the ring progresses, the colouring of this ellipsoid, in which the ring is embedded, and the colouring of the trail, grows paler and paler until the ring in the interior of the ellipsoid alone is visible, and has the appearance shown in the steroscopic view in Fig. 3. Fig. 4, which is of special interest on account of the fortunate timing, shows a ring which has already progressed half a metre or more, and is just about to strike a silver watch-chain which hangs suspended in the water. It should be noted that the chain has begun to bend before an actual impact has occurred. This, together with the other views, demonstrates that the ring is at all times surrounded with an ellipsoid of water which moves with the ring, and in its early stages is visible as shown in Fig. 2. Water being a viscous fluid, the material of this ellipsoid is gradually being drained off and left behind as the trail, but also being as continuously replenished with clear water, until it is invisible except by its effects, which are made manifest in Fig. 4.

The stereoscopic view in Fig. 5 shows two rings which have just issued simultaneously from two holes in the gun. They are perhaps 5 or 6 cm. from the gun, and are already seen to be approaching each other under the influence of their mutual attraction. In the stereoscopic view in Fig. 6 two single rings have just united. A careful study of this picture in a stereoscope will show just what has taken place. Already the conditions are fully established for the subsequent complicated vibratory motions of this type of ring. The single view in Fig. 7 shows another ring at a later stage, also made up of two separate rings, as it appears in three successive stages separated by intervals of about one-fiftieth of a second. Here is plainly seen the four types of motion possessed by liquid vortices formed by the union of two single rings. First, there is a rotation about the vortex filament; secondly, the forward motion of the vortex as a whole; thirdly, the motion of oscillation of the extremities of the vertical diameter of the vortex in a vertical plane lying parallel to the direction of forward motion; and, fourthly, a motion of oscillation of the extremities of the horizontal diameter of the vortex in a horizontal plane. These four motions, except the second, are too rapid to be observed satisfactorily with the eye.

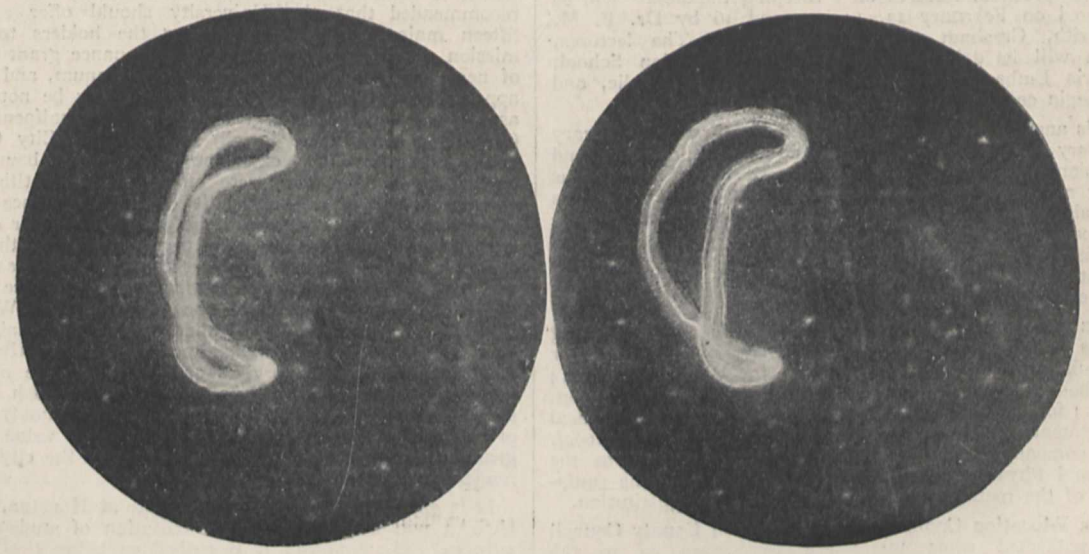


FIG. 8.—Stereoscopic view of a vibratory ring in one phase of its motion.

A slightly enlarged stereoscopic view of one of these vibratory rings in one phase of its motions is shown in Fig. 8. In this view, as also in Figs. 3 and 4, note the line of particles lying in the filimentary axis of the ring. These particles probably consist of materials less dense than water which have been gathered up by the ring in its progress through the water, not entirely free from suspended matter, and swept into the axis and carried along with the ring.

The results of the research above outlined were first described in the September and October numbers (1911) of the Journal of the Franklin Institute. In the original paper are given other photographs than those reproduced here, and the apparatus is described in sufficient detail to enable one to reproduce it. The electric circuits and other devices employed in taking the pictures are fully described, and physical explanations of the vortex motions observed are given. It is there shown that most, if not all, of the observed motions of liquid vortices may be approximately explained by employing the principle first laid down by Bernoulli, that since the sum of the potential and kinetic energies in a liquid is constant, it results that where the velocity of the fluid is high the hydrostatic pressure is diminished. The attraction and final union of two rings is supposed to be explained by this principle.

It is hoped that this experimental study of actual vortex motions in fluids having viscosity will throw light upon and constitute a proper basis for mathematical investigations regarding ideal fluids.

EDWIN F. NORTHRUP.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

CAMBRIDGE.—The governing body of Gonville and Caius College has resolved to place in the hands of the University Association for transference to the university the sum of 500*l.*, to be invested for the maintenance of buildings. It hopes that the sum will be added to the fund now being collected for the maintenance of the new buildings for physiology and experimental psychology.

Dr. Macalister, professor of anatomy, and Dr. Haddon have been nominated to represent the university at the International Congress of Americanists to be held in London in May next, and Prof. Burkitt has been chosen to represent the university at an International Congress on the History of Religion to be held at Leyden in September next.

FOUR Gresham lectures on "Sleeping Sickness" will be delivered on February 13, 14, 15, and 16 by Dr. F. M. Sandwith, Gresham professor of physic. The lectures, which will be delivered at the City of London School, Victoria Embankment, E.C., are free to the public, and will begin each evening at six o'clock.

IT is announced in *The Times* that Dr. Francis, honorary secretary of the Education Fund for Europeans and Eurasians in India, has been promised by an anonymous donor a lakh of rupees (about 6600*l.*) if four lakhs more are raised in India. Between 80,000*l.* and 90,000*l.* of the 250,000*l.* needed has already been raised in this country, and it is hoped that the recent impetus given to native education in India will also direct attention to the urgent need of those whom the fund will benefit.

THE Goldsmiths' Company has made the following grants to the Senate of the University of London:—for the building fund of King's College for Women, 10,000*l.*; for the endowment fund of Bedford College for Women, 5000*l.*; for the building and equipment fund of the chemical department of University College, Gower Street, 1000*l.* The company has also made a grant of 1000*l.* to the National Physical Laboratory at Teddington for the equipment of the metallurgical department at that institution.

THE Education Committee of the London County Council has published some interesting particulars as to the number and ages of pupils in London secondary schools receiving financial aid from the Council. During the year ended on March 31 last there were in such schools 14,036 pupils—9369 boys and 4667 girls. Of this total there were 112 boys and 31 girls above eighteen years of age; 618 boys and 402 girls between sixteen and eighteen years; and 2820 boys and 1435 girls between fourteen and sixteen years. That is to say, less than half of the pupils in these secondary schools, which include many of the best in London, are above fourteen years of age, and 941, it may be added, are below ten years of age.

THE Central Bureau for the Employment of Women, of 5 Prince's Street, Cavendish Square, London, W., has published a pamphlet entitled "Openings for University Women other than Teaching." The booklet contains a summary of professions suitable for women of higher education, suggestions on more recent spheres of remunerative labour, and a comparative table of university degrees and diplomas in the British Isles. Miss M. G. Spencer, the secretary of the Central Bureau, may be congratulated upon the success which has followed her attempt in the pamphlet to provide a bird's-eye view of the field now open to educated women who desire to take part in the world's work. The particulars as to courses of training, and the information as to probable salaries in various appointments, should be of assistance to parents arranging for the education of their girls.

IN the issue of *Science* for January 5 Prof. Rudolf Tombo, jun., of Columbia University, gives his annual analysis of the registration statistics of American universities. A decrease in the total enrolment for the current session was noticeable at Chicago, Missouri, Northwestern, Texas, and Yale Universities. This year only four institutions exhibit an increase of above 200 students, as against seven in 1910 and eleven in 1909. According to the figures for 1910, twenty-seven universities ranked as follows as regards number of students:—Columbia, Chicago, Michigan, Harvard, Pennsylvania, Cornell, Minnesota, California, Wisconsin, Illinois, New York University, Nebraska, Northwestern, Yale, Syracuse, Ohio State, Missouri, Texas, Kansas, Indiana, Tulane, Iowa, Stanford, Princeton, Western Reserve, Johns Hopkins, Virginia. Comparing this with the order for 1911, we find that Columbia, with 8642 students, continues to maintain its long lead, that California has passed from the eighth to the second place, that Cornell has passed from the sixth to the third place, that Michigan and Harvard have each dropped down one place, Pennsylvania two places, and Chicago four, and that Wisconsin and Illinois have advanced a place.

THE Birmingham Education Committee has decided to recommend the City Council to make a grant annually to the University equal to the net produce of a penny rate, which is estimated to realise about 16,000*l.* It has also recommended that the University should offer annually fifteen major scholarships entitling the holders to a remission of fees, together with a maintenance grant in case of necessity of not more than 30*l.* per annum, and should appoint certain additional lecturers. It may be noted that as a consequence of the grant of an extra halfpenny rate (making a penny rate in all) made by the City Council last year, before the extension of the city boundaries, twelve city scholarships were offered for competition, the successful candidates being entitled to maintenance grants of an annual value not exceeding 30*l.* each if their circumstances were such as to render pecuniary aid of this kind desirable. Nine of these scholarships have been awarded, and six of the holders are receiving maintenance grants (five at 30*l.* per annum and one at 25*l.*). The Workers' Educational Association has hitherto received valuable support from the University, and members of the University staff have given their services gratuitously. The Birmingham Education Committee now suggests that such services should receive formal recognition, and presumably appropriate remuneration, which the increase in value of the grant in consequence of the enlargement of the city should render possible.

IT is expected that the Rice Institute at Houston, Texas, U.S.A., will be opened for the reception of students next autumn. The institute is described as being "of liberal and technical learning founded by William Marsh Rice, and dedicated by him to the advancement of Letters, Science, and Art." An artistically illustrated prospectus of this latest American institute has reached us, which shows

that the late Mr. W. M. Rice, who was for many years a resident in Houston, left a large sum of money, which after reduction by litigation still reached 2,000,000*l.*, to endow and equip the institute. President Lovett, who is in charge of the new institution, came from Princeton University, and spent a year visiting seats of learning throughout the world, so as to enable him to advise the trustees as to the character the buildings and work of the new institute might with advantage take. The result is that the first of the palatial buildings are now almost complete, and will form the nucleus of what will eventually be a much more extensive suite of halls and residences. For the present no upper limit will be assigned to the work of the institute, and the lower limit will be that of the more conservative of American universities. The initial teaching staff is to be organised for university work in science and letters, and it is intended to build up a school of pure and applied science of the highest grade. Men and women will be admitted, and there will be no charge for tuition. Rooms in the residential hall and board will be provided at actual cost price. It is interesting to record that the corner-stone of the administration building was laid last year on the seventy-fifth anniversary of the date when Texas declared its independence of Mexico. For the first few years this building will be used to meet some of the needs of instruction. The first building in the students' residential group for men has been begun, and the mechanical laboratory, machine shop, and power house are being erected north of the administration building.

## SOCIETIES AND ACADEMIES.

### LONDON.

Royal Society, January 25.—Sir Archibald Geikie, K.C.B. president, in the chair.—Prof. J. S. **Townsend**: Determination of the coefficient of interdiffusion of gases and the velocity of ions under an electric force, in terms of the mean free paths. A method is described by which an expression for the rate of interdiffusion of gases may be easily found, either on the ordinary supposition that the effect of a collision makes all subsequent directions of motion of the molecules equally probable, or without specifying in any way the effect of a collision. Similar expressions are found for the velocity of ions under electric forces. In all cases the rate of diffusion of the ions is of the form $K=\frac{1}{3}LV$, and the velocity under the electric force $u=\frac{Xe}{m}\cdot\frac{L}{V}$. L does not, in general, represent the mean free path, but it has the same meaning in both expressions, so that when an ion is moving under the action of a force and also by the process of diffusion its velocity is given by the equation

$$u=\frac{-K}{n}\frac{dn}{dx}+\frac{Xe}{m}\cdot\frac{L}{V},$$

or

$$\tfrac{1}{3}mnV^2u=-\frac{mV^2}{3}\frac{dn}{dx}+Xen,$$

or

$$\frac{1}{K}(pu)=-\frac{dp}{dx}+nXe,$$

which is the well-known form to which Maxwell's equation reduces when external electric forces are acting. The general equations for the motion of ions may thus be easily found from the rate of diffusion and the velocity under an electric force when these quantities are correctly determined.—Dr. H. **Geiger**: Note on the scattering of α particles. In a previous paper experiments were described on the scattering of the α particles by foils of various materials and thicknesses. The present note deals with a theoretical examination of the question. The scattering is considered as the result of a multitude of small deflections of the α particle by the individual atoms of the matter traversed. The experimental curve of distribution with angle for a scattered pencil of α particles is found to be in good agreement with that derived from simple probability theory. The deductions also explain the experimental result that for thin foils, which do not appreciably alter the velocity of the α particles, the most probable angle of scattering varies as the square root of the thickness. To find the variation of the most probable scattering angle for large thicknesses of matter traversed, the change in velocity of the α particles has to be taken into account. Assuming, as found by experiment, that the most probable angle of scattering is inversely proportional to the third power of the speed, the theoretical curve is found to give a satisfactory explanation of the experimental results obtained with thick foils.—A. S. **Russell**: The effect of temperature upon radio-active disintegration. The effect of temperature upon the rate of decay, and the amount of β and γ-ray activity, of radium emanation, of active deposit, and of radium C has been investigated. The results are entirely negative. All abnormalities of activity of β rays obtained by previous authors, and by the author in this research, may be completely explained on two simple grounds. The first of these is a change of distribution of radium C caused by its partial volatilisation inside the quartz tube at temperatures greater than 320°. The second is a change in the partition of radium C between the walls of the quartz envelope and the space enclosed. At room temperature the greater part of the radium C is usually on the walls. At room temperature, after the tube has been cooled suddenly from high temperatures, it is entirely on the walls. Above 650° the radium C is distributed homogeneously throughout the volume of the tube. Each of these partitions gives a different β-ray ionisation in an electroscope, because the average path of the rays through the walls of the quartz envelope depends upon the partition. Under the conditions of experiment, radium B and radium C, and very probably radium A, may be completely volatilised inside sealed quartz tubes at a temperature of 650°. Radium B commences to volatilise at room temperature.—F. W. **Aston** and H. E. **Watson**: The relation between current, voltage, pressure, and the length of the dark space in different gases. In a previous paper one of the authors has shown that in the discharge between large plane aluminium electrodes in gases at various pressures the following empirical equations are approximately true:—

$$D=\frac{A}{P}+\frac{B}{\sqrt{c}},\quad V=E+\frac{F\sqrt{c}}{P}$$

where D is the length of the dark space, V the voltage between the negative glow and the kathode, *c* the current density, P the pressure, and A, B, E, F constants depending on the nature of the gas. The first part of the present communication gives the results of the continuation of this work, with the values of the constants for hydrogen, nitrogen, air oxygen, carbon monoxide, helium, and argon. The second part deals with a systematic investigation into the behaviour of the inactive gases when in a pure state. It was found that these gases behaved in an anomalous manner, and by no means satisfied the above equations in general, but gave values in better agreement with a third equation obtained by eliminating P from the two above. The results are described for helium, neon, argon, krypton, and xenon. Peculiar interest attaches to these gases in that all of them exhibit to a more or less striking degree the primary dark space recently discovered by one of the authors in hydrogen and helium. The behaviour of helium was exceedingly erratic, and seemed to indicate that this gas could support the discharge in two entirely different ways.—Dr. A. O. **Rankine**: The viscosities of gaseous chlorine and bromine. By means of a method resembling in some respects that described by the author in earlier communications, the viscosities of chlorine and bromine have been compared with that of air. From these ratios the absolute values are deduced. The viscosities of chlorine having been obtained at two temperatures, it has been possible to calculate Sutherland's constant. The various values are as follows:—

| Gas. | Temperature. | Viscosity in C.G.S. |
|---|---|---|
| Chlorine | 12·7° C. | $1·297\times10^{-4}$ |
| Chlorine | 99·1° C. | $1·688\times10^{-4}$ |
| Bromine | 98·7° C. | $1·869\times10^{-4}$ |

The value of Sutherland's constant for chlorine is

$$C=325.$$

The ratio of the critical temperature of chlorine (416° abs.) to this constant is 1·28, which is somewhat higher than the constant value (1·14) of the corresponding ratio for

most gases; but this might be accounted for by the uncertainty of the exact value of C, arising from the smallness of the temperature range. If the values of the viscosity of chlorine and bromine at *corresponding* temperatures are calculated, it is found that the squares of the viscosities are proportional to the respective atomic weights. (Corresponding temperatures signify those which bear equal ratios to the respective critical temperatures.) In this respect chlorine and bromine appear to conform with the same rule as has been shown to hold for the inert gases.—Dr. P. E. **Shaw**: The testing of plane surfaces. Scraped and lapped plane surfaces are found not only in surface plates supplied by the engineering trade, but also in several apparatus of precision, *e.g.* interferometers and measuring machines. It is quite possible that the errors of these surfaces may be the determining factor in the accuracy of the measurement made in using these apparatus. Yet up to the present there seems to have been no simple device for measuring these errors. To supply this want, two forms of surface-tester have been made by the writer:—(*a*) A stout wooden bar, 16 inches long, has twin feet half-inch apart at one end, whilst there is a third foot at the far end. Midway between the twin feet at one end and the third foot at the other is a micrometer screw. The instrument acts on the spherometer principle, but contact is made electrically with a telephone in circuit. (*b*) A steel bar, 12 inches long, has one foot quarter-inch diameter at one end and a similar foot at the other end, whilst midway between the feet is the end of a micrometer screw. Contact is generally made mechanically. This instrument must be made very carefully, the flat surfaces of the two feet and of the micrometer end being in one position truly in one plane. (*b*) is made in duplicate, so that by using first one tester and then the other on one place of a surface, and then "fitting" them together, the actual departure of the surface from planeness can be found. These testers read to 1/10,000 inch, and have an error on one reading of about that amount. Investigations have been made on a considerable number of "surface plates" and "straight edges" as supplied by the engineering trade. A bad plate shows errors of about 1/2000 inch from true plane, an average one only 1/5000 inch, and some special ones of small size, recently made, had a figure of only 1/10,000 as indicated by tester (*b*). Tests were also made by these instruments on many samples of plate-glass, for which the errors varied from 1/3000 inch to 1/300 inch on a length of 12 inches. Thus we have a means of revealing a surface out of truth, whether due to faulty making or to warping with lapse of time.—Captain A. D. **Fraser** and Dr. H. L. **Duke**: Antelope infected with *Trypanosoma gambiense*. (1) Antelope may remain in apparently perfect health for a year after having been infected with a human strain of *T. gambiense*. (2) One antelope was still capable of infecting clean laboratory-bred *Glossina palpalis* 315 days after it had been infected. (3) A small quantity of blood taken from one antelope 327 days after its infection was proved by inoculation into a white rat to be infective. (4) As the interval after the infection of the antelope increases, their infectivity, as tested by "cycle" transmission experiments, dissection of flies which have fed upon them, and by the injection of the buck's blood into susceptible animals, appears to diminish. (5) A duiker was infected with a human strain of *Trypanosoma gambiense* by feeding infected *Glossina palpalis* upon it.

**Geological Society**, January 10.—Prof. W. W. Watts, F.R.S., president, in the chair.—S. H. **Warren**: A late glacial stage in the valley of the river Lea, subsequent to the epoch of River-drift man. With reports on the flowering plants, by F. J. **Lewis**; on the mosses, by H. N. **Dixon**; on the Mollusca, by A. S. **Kennard** and B. B. **Woodward**; on the Coleoptera, by C. O. **Waterhouse**; on the Entomostraca, by D. J. **Scourfield**; and on the microscopic examination of the sandy residue, by G. M. **Davies**. A carbonaceous deposit embedded in the low-level river-drift gravel of the Lea Valley, in the neighbourhood of Ponder's End, is described. It belongs to the close of the Pleistocene period, and is much later than the Moustierian deposits. It may be of Magdalenian age. It is more probably post-Magdalenian, formed during the time of the supposed archæological hiatus between the Palæolithic and the Neolithic epochs. The deposit yields a varied fauna and flora. The conclusions arrived at indicate climatic conditions similar to those now found in Lapland. The evidence of this comparatively late Arctic climate in the south of England is important. It throws light on many questions with regard to the relationship of Palæolithic man to the Glacial period. It may have been the Arctic conditions represented by the Ponder's End stage (as it might appropriately be named) which caused the migration of Palæolithic man to less inclement regions. The evidence is interesting as showing another important fluctuation of climate during the Pleistocene period.

**Royal Meteorological Society**, January 17.—Dr. H. N. Dickson, president, in the chair.—Dr. H. N. **Dickson**: Some meteorological observations. Meteorology has at the present time reached an important and critical phase in its history. This is due, in the main, to the operation of three principal factors:—(1) by the effluxion of time a mass of observational material has been accumulated which urgently requires examination and discussion with the object of ascertaining the precise meaning and value of the records and of improving routine methods for the future; (2) the rapid increase of knowledge of the conditions obtaining in the upper atmosphere has modified and is modifying current views as to atmospheric phenomena generally, and new interpretations must be placed upon the distributions observed at the surface of the earth; (3) the importance of applied meteorology in relation to agriculture and other activities of everyday life is becoming more generally recognised. It follows that there is in many directions urgent need for the extended prosecution of research work. Increase of popular interest and public support is necessary, and the active assistance of research workers must be enlisted. It is to be noted that the investigations required are of many different qualifications; they include the criticism and improvement of methods of routine observation, participation in organised exploration of the upper air, investigation of statistical and analytical methods of dealing with data already collected, investigation of mathematical or physical problems stated as the result of observation, and the examination or restatement of geographical or other questions affecting the relation of meteorology to the problems of botany and other applied sciences.

**Institution of Mining and Metallurgy**, January 18.—Mr. H. Livingstone Sulman, president, in the chair.—Frank **Reed**: A submerged flexible-joint main. A brief description of the construction and laying of a 30-inch water-main across the valley of the mountain river Taramakau, New Zealand. For reasons of economy, the author decided to adopt the use of a submerged flexible-joint main in preference to a pipe bridge, despite the somewhat hazardous nature of the operation, due to the rapid flow and treacherous nature of the river to be crossed. The pipes used were 30 inches in diameter, with a length of 12 feet, with flanges at each end reinforced by brackets, and between each set of three of these sections a flexible joint was bolted, consisting of a ball and socket connection, sealed with a lead filling, which was found to be quite watertight. The pipe was laid in the river bed from a special pontoon moored between a line of piles. The main was laid on the river bed and then moored, and it was found that the bed silted over it and prevented it from shifting with variations in the current.—Cyril **Brackenbury**: Unwatering Tresavean Mine. A description of the method adopted during the past five years to unwater the Tresavean Mine in Cornwall, which was not only flooded, but in many parts of the shaft either partially or completely choked by débris. The depth of the main shaft was 1422 feet. Electrical high-lift turbine pumps were used for the unwatering process, but the operation involved a number of problems due to the existence of a former timbering and the extensive choking encountered, together with varying quantities of incoming water, according to the rainfall at different seasons of the year. Consequently, the average rate of sinking was subject to many fluctuations, and was sometimes for a brief period a minus quantity. Much valuable experience was gained during the process of unwatering the mine, which is given in detail by the author.—Humphrey M.

**Morgans**: Notes on the operation of two winding engines. The operations of the winding engines while engaged on various classes of work were recorded by means of a tachograph, the readings of which in diagram form were reproduced by the author, and afforded an interesting evidence of the characteristics of the different operations and their influence on the winding power.—E. P. Corbett **Sullivan**: Stoping at the Calamon Mine. A note on the method of stoping and filling adopted recently at the Calamon Mine. A conspicuous feature of the work is the preparation of inclined cuts, which are worked from the level upwards, and filled in practically in an automatic manner as the work proceeds.

PARIS.

**Academy of Sciences**, January 22.—M. Lippmann in the chair.—B. **Baillaud**: The accuracy of the knowledge of the time at the Observatory of Paris during the last months of 1911 and the commencement of January, 1912. A description of a new astronomical clock, Riefler D No. 228, recently presented to the observatory. The correction formula deduced from two months' observations is $C = -1{\cdot}54s. - 0{\cdot}20s.\ t - 0{\cdot}0015s.\ t^2$, and a comparison of the deviations of the observed values and those calculated from this formula gives a mean deviation of 0·03s.—L. E. **Bertin**: Presentation of some documents relating to the protection of warships and to dynamic stability.—Charles **Moureu** and Amand **Valeur**: The degradation of sparteine. The formation of a new hydrocarbon, sparteilene. In a previous paper it has been shown that by the successive application of Hofmann's method to the alkaloid sparteine an unsaturated base, methylhemisparteine, was the final product. Further application of the same method gives a dimethylhemisparteilene and a hydrocarbon, sparteilene, $C_{15}H_{20}$, the physical and chemical properties of which are given. Lack of material has prevented the determination of the constitution of this hydrocarbon.—A. **Müntz** and H. **Gaudechon**: The awakening of the soil. Experiments are given tending to show that the nitrifying organisms in soil commence to become active at a definite date, and this activity is not due to changes of temperature. The samples of soil, taken at different dates, were preserved at a constant temperature of 2° C., and all the other conditions of the experiments, including that of temperature, were kept rigorously constant. The maximum action was found to be between March 28 and April 25.—Léon **Labbé**: A potato disease, *la teigne*. An account of the measures taken to combat this disease.—A. **Lacroix**: The volcano of Reunion. A detailed description of the present condition of the volcano.—Paul **Sabatier** and A. **Mailhe**: The catalytic formation of the esters of the formenic series, starting with the formic esters. A mixture of isobutyric acid and methyl formate was passed in the state of vapour over titanium oxide at a temperature of about 250° C. Carbon monoxide was evolved, and the condensed liquid contained, besides methyl alcohol and unchanged isobutyric acid, methyl isobutyrate and an appreciable quantity of isobutyric aldehyde. No isobutyrone was found. Similar results were obtained by substituting isoamyl formate for the methyl formate. The substitution of thoria for titanium oxide as the catalytic material somewhat modifies the reaction.—M. **Bourgeois**: The results of the observations made by wireless telegraphy of the difference of longitude between Paris and Bizerta obtained by MM. Noirel and Bellot. Details are given of the method of observation, the mean error of the mean of a series being 0·04 to 0·05 sec.—Serge **Bernstein**: The asymptotic value of the best approximation of $|x|$.—H. **Parenty**: The progressive regulation of pressures at the entrance of a main distributing water, gas, or vapour. A detailed description of the instrument, with diagrams.—F. **Ollive**: The elastic pressure of saturated vapours. A new exponential formula is developed, and the figures calculated according to this formula for water vapour are compared with the experimental results.—L. **Decombe**: The theory of dielectrics. An investigation into the causes of the residual effects in dielectrics.—A. **Rothé**: The reception of meteorological radio-telegrams with reduced antennæ.—G. **Austerweil**: The passage of hydrogen through the rubber tissue of aërostats. Rubber, which is commonly employed as a waterproofing agent in balloon fabrics, is not a very suitable material for this purpose, as it absorbs hydrogen and allows the passage of the gas. Figures are given of the actual losses of hydrogen over a period of twenty days.—E. **Baud**: A general law of solution.—Daniel **Berthelot** and Henry **Gaudechon**: The photolytic decomposition of smokeless powders by the ultra-violet rays. The effects of the light from a quartz mercury vapour lamp on pure nitroglycerol and nitrocellulose were first studied, and then smokeless powders containing amyl alcohol and diphenylamine were examined. Tables are given showing the amount and composition of the gases evolved.—Camille **Matignon**: The synthetic formation of nitrous oxide. The application of the Nernst formula to the known thermochemical data of nitrous oxide shows that the amount of this gas formed from a mixture of nitrogen and oxygen at atmospheric pressure at a temperature of 2700° C. would be of the order of 2 in 100,000; at high pressures the amount might be higher.—D. **Tschernobaeff** and L. **Wolgodine**: The heats of formation of some silicates.—Louis **Hackspill** and Robert **Bossuet**: Some new alkaline phosphides. By working in a high vacuum with highly purified materials it has been found that the four alkali metals may be combined with phosphorus without explosion. The phosphides of cæsium, rubidium, potassium, and sodium thus obtained had the composition expressed by the formula $M_3P_5$.—G. D. **Hinrichs**: The true atomic weight of silver deduced from the experimental results of more than a century. The graphical method used in previous communications by the author has been applied to the data of Berzelius, Mather, Marignac, Stas, Maumené, Dumas, Baxter, Penny, Smith, and Richards. Taking the atomic weight of carbon as 12, the author concludes that the true atomic weight of silver is 108 exactly.—MM. **Portevin** and **Nusbaumer**: The influence of tempering upon bearing bronzes.—V. **Hasenfratz**: The bromine compounds of the alkaloids of *Peganum harmala*, and their basic derivatives.—P. **Carré**: The constitution of the glycerophosphoric acid obtained by the esterification of glycerol by means of phosphoric acid or the monosodium phosphate.—Marcel **Guerbet**: The action of caustic potash upon the secondary alcohols. The diagnosis of primary and secondary alcohols of high molecular weight. If an alcohol of high molecular weight is heated in a sealed tube to 230° C. with its own weight of potash, a primary alcohol gives a product entirely soluble in water; secondary alcohols undergo condensation, and the product on treating with water separates into two layers.—Étienne **Foëx**: The presence of two sorts of conidiophores in *Oidiopsos taurica*.—W. **Lubimenko** and A. **Froloff-Bagreief**: The influence of light on the fermentation of grape must.—Raoul **Dupuy**: Backwardness in infants and endocrinian polyopotherapy.—M. **Stapfer**: The utero-ovarian rhythm in woman.—R. **Pigache** and I. **Worms**: The thymus considered as an internal secretion gland.—H. **Colin** and A. **Sénéchal**: Is iron the catalysing agent in the oxidation of phenols by Raifort's peroxydiastase?—O. **Boudouard**: The smells of Paris. Unpleasant smells were particularly marked during the summer of 1911. A study of the conditions under which unpleasant smell may arise from manure works in Paris.—Georges **Bohn**: The sensibility of animals to variations in pressure.—Louis **Calvet**: *Watersia paessleri*, a parasite of *Polyzoa gordiana*.—A. **Legendre**: The *massif* of Ya-Long, western China, between 28° and 30°.

## BOOKS RECEIVED.

A Monograph of the Mycetozoa. A Descriptive Catalogue of the Species in the Herbarium of the British Museum. By A. Lister, F.R.S. Second edition, revised by G. Lister. Pp. v+302+201 plates. (London: British Museum (Natural History); Longmans and Co., and others.) 30*s*.

The Evolution of Animal Intelligence. By Prof. S. J. Holmes. Pp. v+296. (New York: H. Holt and Co.)

Heaton's Annual, 1912. Pp. 562. (Toronto: Heaton's Agency; London: Simpkin and Co., Ltd.) 5*s*.

Wonders of Plant Life. By S. L. Bastin. Pp. x+136. (London: Cassell and Co., Ltd.) 3*s*. 6*d*. net.

Heredity in Relation to Eugenics. By C. B. Davenport.

Pp. xi+298. (New York: H. Holt and Co.) 2 dollars net.

Who's Who in Science (International), 1912. Edited by H. H. Stephenson. Pp. xvi+323. (London: J. and A. Churchill.) 6s. net.

Church's Laboratory Guide. Ninth edition. Revised and largely rewritten by Prof. E. Kinch. Pp. xvi+368. (London: Gurney and Jackson.) 6s. 6d. net.

Handwörterbuch der Naturwissenschaften. Edited by E. Korschelt and others. Erste Lieferung. Pp. 1–160. (Jena: G. Fischer.) 2.50 marks.

Journal of the Institute of Metals, No. 2, Vol. vi., 1911. Pp. viii+369. (London: Caxton House, S.W.) 21s. net.

Meddelanden från Statens Skogsförsöksanstalt. Häftet 8, 1911. Pp. 279+xxiii. (Stockholm.) 2.25 kronor.

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

Spices. By H. N. Ridley, C.M.G., F.R.S. Pp. ix+449. (London: Macmillan and Co., Ltd.) 8s. 6d. net.

Manual Training Woodwork Exercises treated Mathematically. By F. E. Drury. Pp. xi+215. (London: G. Bell and Sons, Ltd.) 2s. 6d.

## DIARY OF SOCIETIES.

*THURSDAY*, FEBRUARY 1.

ROYAL SOCIETY, at 4.30.—The Bacterial Production of Acetylmethylcarbinol and Butylene Glycol from Various Substances: Dr. A. Harden, F.R.S., and Miss D. Norris.—The Chemical Action of Bacillus Cloacæ (Jordan) on Glucose and Mannitol: J. Thompson.—On the Distribution of the Nerves of the Dental Pulp: J. H. Mummery.—A Method for Isolating and Cultivating the Mycobacterium Pseudo Tuberculosis enteritidis bovis (Jöhne), and some Experiments on the Preparation of a Diagnostic Vaccine for Pseudo Tuberculosis enteritis of bovines: F. W. Twort and G. L. Y. Ingram.—On the Fossil Flora of the Forest of Dean Coalfield (Gloucestershire), and the Relationship of the Coalfields of the West of England and South Wales: E. A. N. Arber.—Simultaneous Colour Contrast: Dr. F. W. Edridge-Green.—Studies on Enzyme Action. XIV.—Urease, a Selective Enzyme: Prof. H. E. Armstrong, F.R.S., and E. Horton.

LINNEAN SOCIETY, at 8.—Fourmis des Seychelles reçues de M. Hugh Scott: Prof. A. Forel.—Tipulidæ from the Indian Ocean: F. W. Edwards.—Sciaridæ, mit einem Anhang von Dr. J. J. Kieffer (Beschreibung neuer Sciariden von den Seychellen Inseln): Dr. Günther Enderlein.—Ichneumonidæ from the Indian Ocean: C. Morley.—New Fishes from Aldabra and Assumption, collected by Mr. J. C. F. Fryer: C. Tate Regan.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

*FRIDAY*, FEBRUARY 2.

ROYAL INSTITUTION, at 9.—Vital Effects of Radium and other Rays: Sir J. M. Davidson.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Presidential Address; Rocks containing Radiolaria: William Hill.

*MONDAY*, FEBRUARY 5.

VICTORIA INSTITUTE, at 4.30.—The Historicity of the Mosaic Tabernacle: Rev. Prof. J. Orr.

SOCIETY OF ENGINEERS, at 7.30.—Presidential Address: John Kennedy.

ARISTOTELIAN SOCIETY, at 8.—The Relation of Willing to Cognition: Prof. G. Dawes Hicks.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—*Discussion:* The Industrial Bursaries Scheme of the Commissioners of the 1851 Exhibition.—*Papers:* Constant Temperature Heating Apparatus for Explosives; Experiments on the Decomposition of Nitro-Cellulose: J. S. S. Brame.—Some Physical Constants of Structureless Cellulose Filaments (Artificial Silk): W. P. Dreaper and J. G. Davis.

ROYAL SOCIETY OF ARTS, at 8.—The Meat Industry: L. M. Douglas.

*TUESDAY*, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—Report on the Deaths which occurred in the Zoological Gardens during 1911: H. G. Plimmer, F.R.S.—On Experimental Pheasant Breeding: Mrs. R. Haig Thomas.—Mendelian Experiments on Fowls: J. T. Cunningham.—A Further Collection of Mammals from Egypt and Sinai: J. Lewis Bonhote.—On the Pairing of Pseudoscorpiones: H. Wallis Kew.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—The Kayak in North-Western Europe: D. MacRitchie.

RÖNTGEN SOCIETY, at 8.15.—After-glow in Vacuum Discharge Tubes: Hon. R. J. Strutt, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Water-supply of the Witwatersrand: D. C. Leitch.—Investigations Relating to the Yield of a Catchment-area in Cape Colony: E. C. Bartlett.

*WEDNESDAY*, FEBRUARY 7.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual General Meeting.—Notes on the Determination of Butter Fat and Cocoanut Oil in Margarine: F. W. F. Arnaud and H. Hawley.—The Souring of Milk: H. Droop Richmond and H. C. Huish.—A Flour Improver: E. Hinks.

ENTOMOLOGICAL SOCIETY, at 8.—On the Comparative Anatomy of the Genital Tube in ♂ Coleoptera: D. Sharp and F. Muir.—On Some Hitherto Imperfectly-known South African Lepidoptera: Roland Trimen.—Notes on Australian and Tasmanian *Scydmænidæ*, with descriptions of New Species: A. M. Lea.

ROYAL SOCIETY OF ARTS, at 8.—The Influence of Ozone in Ventilation; Leonard Hill, F.R.S., and Martin Flack.

GEOLOGICAL SOCIETY, at 8.—On an Inlier of Longmyndian and Cambrian Rocks at Pedwardwine (Herefordshire). Dr. A. H. Cox.

*THURSDAY*, FEBRUARY 8.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* The Spectrum of Comet Brooks (1911c): Sir N. Lockyer, K.C.B., F.R.S.—A Chemically-active Modification of Nitrogen produced by the Electric Discharge. III.: Hon. R. J. Strutt, F.R.S.—The Atomic Weight of Radium: R. Whytlaw-Gray and Sir W. Ramsay, K.C.B., F.R.S.—An Optical Determination of the Variation of Stress in a Thin Rectangular Plate subjected to Shear: Prof. E. G. Coker.—Spectroscopic Observations. Lithium and Cæsium: Dr. P. V. Bevan.—The Observation by means of a String Electrometer of Fluctuations in the Ionisation produced by γ rays: Prof. T. H. Laby and P. W. Burbidge.

ROYAL INSTITUTION, at 3.—The Phenomena of Splashes: Prof. A. M. Worthington, C.B., F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High Voltage Tests and Energy Losses in Insulating Materials: E. H. Rayner.

ROYAL SOCIETY OF ARTS, at 4.30.—The North-East Frontier of India: Sir Thomas H. Holdich, K.C.M.G., F.R.S.

*FRIDAY*, FEBRUARY 9.

ROYAL INSTITUTION, at 9.—Very High Temperatures: Dr. J. A. Harker, F.R.S.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL GEOGRAPHICAL SOCIETY, at 5.30.—Desert of North Africa: Captain H. G. Lyons, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Steam-turbines: Some Practical Applications of Theory: Captain H. Riall Sankey, R.E.

PHYSICAL SOCIETY, at 8.—Annual General Meeting.—Presidential Address: Prof. A. Schuster, F.R.S.

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