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THE COTTON PLANT.

The Wild and Cultivated Cotton Plants of the World. A Revision of the Genus Gossypium. By Sir G. Watt. Pp. xiv+406. (London: Longmans, Green and Co., 1907.) Price 30*s.* net.

SINCE the appearance, in 1877-8, of Todaro's classic monograph on the genus Gossypium, no serious attempt has been made to deal systematically with the botany of the plants that provide the world's supply of cotton. Todaro's work—at once the first and last of any practical utility—owes its value to the fact that he worked for the most part with living plants grown by him from seed received from many parts of the world; the success this method met with justifies the dictum of De Candolle in his "Prodromus" when, speaking of this genus, he says, "Hic species a Botanicis admissas recenseam, monens tamen hoc genus monographiae accuratae et *ex vivo* elaboratae maxime egere." (The italics are not in the original.) Todaro's work requires only to be continued and extended, not to be corrected.

Any attempt at a classification of cotton plants that is based on herbarium specimens is doomed to failure owing to the impossibility of eliminating the effects that differences of soil and rainfall have in inducing differences of appearance in the leaves and other parts of specimens of the same variety that are *not grown under identical conditions*. Many varieties of the genus, even under the most uniform conditions of growth, show a sufficiently wide range of fluctuations to necessitate great care in their determination even when living plants are being examined; when we work on dried specimens, often very fragmentary, grown in widely distant parts of the world under conditions of rainfall that are not recorded, imaginary differentiations occur to such an extent as to make it impossible to deduce a classification of the varieties that more than indicates broadly the groups into which they fall; to attempt anything more than this with herbarium material is to court failure.

The latest attempt at a monograph of the genus Gossypium is the volume now under review. This, unfortunately, belongs to the category for which success is an impossibility, being based entirely—except possibly in the case of a few Indian forms—on herbarium specimens.

The volume contains some most interesting photographic reproductions of a few type-specimens in the Kew, British Museum and Linnean herbaria, and also (often in colours) of early drawings of plants. These reproductions form by far the most valuable portion of the work.

It is impossible in the space at our disposal to give even a general impression of the contents of the volume, much less to point out in detail the very numerous errors into which the herbarium method has led its author. No new information is given us, though several new species and more varieties are created on imaginary differentiations, while nearly every variety that has hitherto been described and named receives a new name.

Thus, of the forty-two varieties mentioned in the volume, Nos. 10 to 25 are cultivated Asiatic or African forms, and out of these sixteen varieties, classified as belonging to four species, all except the species themselves receive new names unnecessarily. When we state that many of the synonyms given fail under investigation, and that the descriptions of plants stated to belong to particular species often differ radically from the descriptions given by the authors of the species, it can well be imagined that the volume is rather a retrogression than an advance on the work of Todaro.

Throughout the book the reader is allowed no opportunity of judging of the correctness of the identification given, since the original definition of the variety is practically never quoted, and must be looked for in the very scattered literature on the genus. It would also have been fairer if, in the case of species here created, a photographic reproduction of the type had been given, and not merely outline drawings, which, throughout the volume, are not good and would not assist in the identification of the plants in the field.

As an example of erroneous synonymy we may take the following case:—

G. obtusifolium, Roxb., var. *Wightiana*, Watt, is stated to be synonymous with *G. Wightianum*, Tod., and to be the plant constituting the Surtee-Broach growth of India. Now, all botanical considerations apart, Todaro states that the seed that gave rise to his *G. Wightianum* was as follows:—"Cotone Hingunghatt di Bombay," "Oomrawatt di Bombay," "Howers Barree (*sic*) di Bombay," "Khandeisk (*sic*) from American seed di Bombay," "Cotone Hinghunghatt Barree (*sic*)," and "Old Dhollera, provenienza di Bombay." Now, in none of the places mentioned—Hinghunghat, Oomrawati, Barsee, Khandeish, Dhollera—will the Surtee-Broach plant grow except in Dhollera; and, curiously enough, Todaro mentions that another sample of Dhollera seed received *directly* from Bombay gave rise to plants belonging not to the species *Wightianum*, but to the species *herbaceum*, and giving "un prodotto di bellisima qualità."

Todaro having already placed the Surtee-Broach plant in the species *herbaceum*, it would appear unnecessary that, as in the volume before us, it should be removed into the species *obtusifolium*, to which it is certainly, to say the least, not more closely related. This removal is further objectionable owing to the great uncertainty as to what plant Roxburgh intended to indicate by the latter name. On this point, again, our author is at once confused and confusing; he states (p. 140) that *G. obtusifolium*, Roxb., is "fairly common in the hedges of Gujarat," while (p. 135) *G. nanking*, var. *roji*, is also said to become sub-scandent in hedgerows in the same district. The present writer has collected and sown in Gujarat many samples of seed from these hedgerow cottons, and the resulting plants have invariably been identical with one another, and also with the crop known as "roji," which our author classifies as *G. nanking*, Meyen,

var. *roji*, Watt. It can safely be said that the last varietal name is superfluous, being synonymous with *G. obtusifolium*, Roxb., as interpreted in this book.

As examples of cases in which a plant is wrongly assigned to an old-established species, the following cases may be cited :—

(1) *G. peruvianum*, Cav., is stated (p. 217) to have fuzz-coated seeds, though Cavanilles states that the seeds are black, *i.e.* devoid of fuzz, and figures them so. This discrepancy would have been immaterial had not the presence or absence of fuzz on the seed been made the basis of classification (see later). This plant is stated to produce the Imbabura cotton of Peru, while the Piura cotton is stated to be produced by a somewhat similar but hairy plant, which is identified as *G. vitifolium*, Lamk. It suffices to say first that Piura cotton is produced by the plant Cavanilles called *peruvianum*, which has, as that author states, naked seeds; and secondly, that Lamarck states that his species *vitifolium* has the under sides of its leaves glabrous.

(2) Of *G. microcarpum*, Tod., its author mentions specially that the two lobes on either side of the central one were unequal, and gives a good figure of this. Our present author not only gives (plate 36) a plant with much broader lobes, but one which does not display the peculiarity of lobes mentioned, is called "red Peruvian cotton," and differs from ordinary Peruvian only in bearing brown cotton instead of white. The reviewer has grown the real *G. microcarpum*, which is an exceedingly characteristic variety, and can be distinguished with certainty at a glance. It is, indeed, the plant for which our author has created a new species, viz., *G. Schottii*, two specimens cited as types in the British Museum being exactly the plant as figured and described by Todaro, and as grown by the present writer. Examples of this kind might be multiplied almost indefinitely.

Turning to the system on which the varieties are classified in the volume under review, we find it is as follows :—

Section i., Species with fuzz but no floss.

Section ii., Fuzzy seeded cottons with united bracteoles.

Section iii., Fuzzy seeded cottons with free bracteoles.

Section iv., Naked seeded cottons with bracteoles free, or nearly so, and glands conspicuous.

Section v., Naked seeded cottons with bracteoles quite free and floral glands absent.

It will be noted that the presence or otherwise of a fuzzy covering to the seed below the cotton is made the primary basis of classification. Now it is hardly too much to say that every cultivated species of cotton comprises varieties some of which bear a fuzzy and others do not. The present writer has found among others completely naked seeded varieties in the species (to adopt the nomenclature of our author) *G. nanking* (Chinese and Japanese cottons), *G. nanking*, var. *roji.*, *G. obtusifolium*, var. *Wightiana*, *G. herbaceum*, *G. punctatum*, *G. hirsutum*. The naked-seeded varieties show not the slightest trace of hybridisation with a member of sections iv. or v., and, indeed, a hybrid between any of the first four varieties named and a member of sections iv. and v. is by no means readily produced even by artificial means. Yet our author seeks to explain the occurrence of naked seeds in the "*jowari hathi*" (=country cotton) of Madras by the supposition of a naturally produced cross between *G. obtusifolium*, var. *Wightiana* (section ii.), and Bourbon cotton (*G. purpurascens*, section iv.). Similarly, those of American upland varieties that have naked seeds are said to be crosses with a naked-seeded variety for this reason alone.

If any further proof of the fallacy of this method is required, it is found in the fact that fuzzy-seeded American has in India been converted into a naked-seeded variety in a few generations by the present writer through the simple process of growing it under irrigation in well-manured soil. That such a change occurs is well known to cultivators in the West Indies and other parts of the world.

If we take the second point on which the classification is based, viz. whether the bracteoles are free or united, we find the same impossibility of applying the characteristic in the field, in some varieties there being found, *on the same plant*, flowers with the bracteoles all free, others with them all united, and still others with two united and one free.

The last chapter (thirty-one pages) is devoted to a discussion of "The Improvement of the Cotton Plant." This consists merely of a general description of the process of selection equally applicable to all crops, an attempt to trace the history of some varieties now grown, and a description of the pollen grains of some species of cotton.

Throughout the book no attempt is made to give the character of the cotton produced under given conditions of soil and climate by the several varieties described, though the author hopes in his preface that the book will be useful to "planters and seed producers throughout the world."

F. FLETCHER.

A CONCISE WORK ON EVOLUTION.

Evolution and Animal Life. An Elementary Discussion of Facts, Processes, Laws and Theories relating to the Life and Evolution of Animals. By David Starr Jordan and Vernon Lyman Kellogg. Pp. xi+489; illustrated. (New York: D. Appleton and Company, 1907.) Price 2.50 dollars net.

THERE is growing up a generation of biological students that does not read its Darwin, its Weismann, or Galton; instead, it cons manuals and text-books on the works of these masters. It is so very much less trouble, if the student's object is to satisfy an examiner, to "get up" a text-book on evolutionary problems than to extract from original sources a clear conception of the authors' theories; and yet what a world of difference is there between the *ipsissima verba* of a master and the cut-and-dried phrases of the manual-maker! The one is the advocate pleading his cause with all the eloquence in his power, the other the reporter compressing the living words and phrases into the limits of a column. The

one is inspiring, stimulating, the other can scarcely avoid exceeding dulness, and certainly no one ever yet was roused to enthusiasm by a text-book.

The book before us is no worse than most of its kind; indeed, it is a great deal better than many. It is compiled from lectures delivered at the Leland Stanford Junior University, and traces of the originality which must have characterised the lectures of two zoologists of the standing of our authors may be found in the book. Refreshing oases of excerpts from original sources frequently add variety to arid plains of didactic statement, and occasionally one may stumble on a good story; such as that of the frozen fish which, bolted whole by a ravenous dog, later emerged alive and flapping from its prison; or the comment of Yves Delage on Schaffhausen's statement that life must have originated from simple inorganic substances, and taken the form of an uncoloured protococcus which later became *Protococcus viridis*. "If the thing is so simple, why does not the author produce one of these protococci in his laboratory? *On lui ferait grace de la chlorophylle.*"

There is a wealth of process-block illustrations of varying degrees of excellence; some are new, some emerge from the obscurity of scientific journals, and some old friends do duty once again. Frequently there is no reference in the text to the figures, and the intelligent student will ask himself for what purpose they are there. As an example may be taken a very poor figure on p. 306, in the chapter on palæontology; it is entitled "Flying Dragon (Draco)." What is this meant to teach our intelligent student? For all that he may find out from the text it may be a mythical monster, the restoration of some giant fossil form, or the little flying lizard of the Oriental tropics.

The ground covered in this work is immense, as the titles of some of the chapters indicate:—Variation and Mutation, Generation, Sex and Ontogeny, Geographical Distribution, Parasitism and Degeneration, Reflexes, Instinct and Reason. The bearing of palæontology on problems of evolution is discussed in eighteen pages; man's place in nature in seventeen. It is impossible to criticise such pemmican at any length; if it is inaccurate it is worthless; if accurate it is of some value. With few exceptions the accuracy of the authors cannot be called in question; we would, however, protest against the view advanced that, whilst variations in the external organs of ametabolic insects may be due to the influence of environment, the variations of corresponding structures in holometabolic insects are congenital. To use the post-embryonic development of a structure as a criterion whereby to judge the nature of its variation is most unsound, for it is not justified by the results of experiments. So that to state (p. 145), "The variations in the colour pattern of Diabrotica, Hippodamia and Vespa are congenital variations" is, to put it mildly, misleading.

The authors, it is evident, are not supporters of the theory of sexual selection, and all the familiar objections to it are paraded. In this connection it is interesting to read the recently published papers by Mr. Edmund Selous on the courtship of birds; the papers are so admirable that they should be consulted by everyone interested in the subject, but it is difficult to refrain from quoting the concluding words of the gifted author.

"I would urge that the facts here brought forward by me, in regard to four different species of birds, are, both singly and cumulatively, strongly in support of Darwin's second great hypothesis of sexual selection, and I believe that, as denial from the chair is replaced or supplemented by evidence from the field, the views of that great naturalist and reasoner will be triumphantly and often most strikingly vindicated."

The insects shown in Fig. 251 are not Membracidæ or leaf-hoppers of the order Hemiptera, but Acridiidæ or grasshoppers of the order Orthoptera. Schaudinn is misspelt Schaudin, and Chillingham Chellenham; there are also one or two obvious misprints. The names of some of the animals quoted are strangely unfamiliar. One might ask the nature of a piddock, a cusk, a silverside, a killifish if the Latin equivalents were not also given, and once again we have occasion to bless the name of Linnæus. R. S.

STUDIES IN EDUCATION.

The Practice of Instruction. Edited by Prof. J. W. Adamson. Pp. xxi+512. (London: The National Society's Depository, n.d.) Price 4*s*. 6*d*. net.

IT has been a favourite plan with English publishers to issue a text-book on teaching made up of separate essays on the teaching of various subjects, with an introduction on general principles of education written by the editor. Mr. P. A. Barnett's "Teaching and Organisation" was the first in the field, and now Prof. Adamson has prepared a similar volume for the National Society.

We confess that we somewhat distrust this method of putting a book together. It is difficult to secure cohesion; some of the essays are pretty certain to disappoint the editor, and such a book can very seldom be adopted for regular use by a body of students. In the volume before us one-third is contributed by the editor, and he provides a really able introduction to the psychology of the schoolroom; there are omissions which betray the author's lack of sympathy with the more practical needs of the young, but within the prescribed limits Prof. Adamson is helpful and clear, and a section devoted to experiments in curriculum and method shows that he is both alive to what is being done at home and abroad, and that he is in sympathy with cautious educational reform.

The rest, two-thirds of the volume, is distributed among ten writers, and some of the essays are of most excellent quality; but Principal Headlam on religious instruction, and Miss Howard on history, are weak performances. Dr. Herbertson's essay on geography contains the views with which the Geographical Association has made us familiar, but it is very evident that much of the work which he prescribes for children has never been taught by himself, and an air of unreality pervades his proposals. In these three sections we feel sure that the editor would have done better to have worked up

the exposition himself, for his introduction shows that he has a good acquaintance both with the capacities of children and with the way in which these studies may be utilised to serve the ends of mental development. Neither Miss Howard nor Dr. Herbertson seem to have got much beyond the primitive idea that children possess empty knowledge boxes into which geographical and historical information can be shot at will.

The other sections are on a higher level. Mr. Baker's account of mathematics is quite good, and will be helpful to teachers in any type of school; but his treatment suffers from compression, for it is impossible to cover in the space allotted the whole field of study from the infant stage to the commencement of trigonometry. Natural science fares well in the hands of Dr. Percy Nunn and Miss von Wyss, and any teacher of science, especially in secondary schools or technical institutions, will profit from studying with care their exposition of method. In their selection of sciences for the "intermediate" and "final" stages we are inclined to think the writers take too narrow a view; botany, chemistry, and physics have their place, but many would prefer, especially in view of the increasing claims of hygiene, to see more recognition given to physiology in the year or two preceding the scholar's departure from school. Languages have been placed in the hands of Dr. Rouse (aided by his colleague, Mr. W. H. S. Jones) for Latin and Greek, and Mr. Mansfield Poole for French and German. Both belong to the ranks of avowed "reformers." Many schoolmasters will rub their eyes with blank amazement on reading the specimen lessons in Greek dialogue as conducted in the Perse Grammar School, but Dr. Rouse's system is merely the application of the same general principles which Mr. Poole expounds for a modern language.

On closing the book one is encouraged to recognise the progress that English teachers are making in the serious study of professional work. Ten years have elapsed since Mr. Barnett edited the pioneer volume of this description, and the comparison is favourable to the craftsman schoolmaster of the present day.

MAINTENANCE OF ROADS.

Road-making and Maintenance. A Practical Treatise for Engineers, Surveyors, and Others. By Thomas Aitken. Second edition. Pp. xviii+527; illustrated. (London: Charles Griffin and Co., Ltd.) Price 21*s.* net.

THE first edition of this book was published in 1901, and the fact that a second edition of a technical book of this character should be called for within so short a period testifies to its value, and also to the greater attention that has been given to the maintenance of roads within the last few years.

After the advent of railways, and the abolition of turnpikes, road-making became a very neglected science; the advent of bicycles and the inconvenience felt by a very large section of the public caused pressure to be brought on highway authorities, and a gradual improvement set in. The subsequent introduction of motor-cars brought road maintenance very much to the front, and, taken generally, the main roads of this country are now kept in very fair condition. This, however, has involved a very large expenditure. It was stated at a recent discussion on motor vehicles at the Institution of Civil Engineers by the surveyor of the county of Middlesex that the cost of main roads in his county had increased from 49,000*l.* in 1889 to 90,391*l.* in 1905. In the two years 1904–6 improvements on the roads had amounted to 86,536*l.* The cost of the main roads of England and Wales has increased from 2,120,332*l.* in 1901 to 2,478,481*l.* in 1905.

The book now under notice has been revised and brought up to date, and much new matter has been added. The question of damage done to the roads by motor-cars, and the nuisance arising from dust caused by the speed at which these vehicles are driven, has been fully treated in a new chapter. A description of the various remedies that have been tried for dealing with the dust problem is given. The conclusion at which the author has arrived is that no real solution for dealing with this nuisance has yet been found, but he has no doubt that the system of "tar macadam" or "building up the road stone coating with a matrix of tar, chips and dust as a binding medium is the best possible method of solving the dust problem in a satisfactory and permanent manner."

The advantages of tar macadam are increased durability over ordinary macadam, imperviousness to moisture, capability of being kept clean, and the surface is not liable to be disintegrated by frost. Owing to its greater durability and to the fact that the surface of the road can be renewed by a thin coating of fine tar macadam, from time to time, without disturbing the subsurface or foundations, the cost over a series of years, when everything is taken into consideration, is not more than that of a steam-rolled ordinary macadam road. The author of this book, however, expresses the opinion that its first cost prohibits its adoption on an extensive scale on rural main roads.

The book is divided into eighteen chapters, dealing in an exhaustive and practical manner with the following subjects:—Historical sketch of road-making; resistance to traction on roads; laying out new roads and the improvement of those already made; retaining walls, culverts, bridges, &c.; materials used for repairs; quarrying road stone; breaking and haulage; rolling and scarifying; prevention of dust; footways; wood pavement; asphalt; brick pavement; tar macadam; testing the surface of roads and use of the viagraph; subways.

OUR BOOK SHELF.

A History of Chemistry. By Hugo Bauer. Translated by R. V. Stanford. Pp. vii+232. (London: Edward Arnold, 1907.) Price 3*s.* 6*d.* net.

THE philosophy of chemistry can only be properly studied by the historical method. Present-day chemical philosophy, like present-day religion, is a product of evolution, and to understand it thoroughly it is necessary to be able to trace the successive stages

by which past beliefs have become merged into present doctrine. Hence the increased attention which is now paid to the history of chemistry, and especially to the history of the development of chemical theory; and hence, too, the large increase in the number of works dealing with the historical aspects of chemistry which have appeared within recent years.

Dr. Bauer's little book cannot be considered as an important addition to the list. To tell the story adequately of the origin and growth of chemistry from the earliest times down to this age of ions and electrons is hardly possible within the limits of 220 small octavo pages. The book, however, may serve to whet the student's appetite for a fuller acquaintance with the subject, although in reading it he will have something to unlearn. To accuse Priestley of "personal intolerance" (p. 69) is wholly to misjudge his character, and the translator—a Priestley research scholar in the University of Birmingham—should have been more careful of what was due to his memory. To say, too, that Cavendish "contended against Lavoisier's theory of combustion until his death" is hardly consistent with accuracy. Cavendish never "contended" against anything; "contention" was absolutely foreign to his disposition, and, as a matter of fact, he ceased to take interest in chemical subjects long before his death. Nizza, as the place of his birth, may stand in the original German, but the English reader is more familiar with it as "Nice." John Dalton is said to have led (probably from his hard up-bringing) "a very modest life," and to have "died at Geneva in 1829." If this is a faithful rendering we must suppose that Dr. Bauer got his notes into confusion, since Dalton died at Manchester in 1844. The date and place evidently refer to Humphry Davy, of whom, however, no biographical account is given. To come down to later times, Kekulé is said to have become professor of chemistry at Geneva in 1858; for Geneva read Ghent. Ultramarine is not usually classed as a dyestuff. Thallium was not discovered by Mosander in the earth from Ytterby, as stated on p. 189; nor was fluorine isolated by Moissan by the aid of the electric furnace (p. 216). The name of Lord Rayleigh is not usually associated with the discovery of helium, xenon, krypton, and neon (p. 217), nor did M. and Mme. Curie isolate radium from "natural pitchblende" as the bromide.

Boyle, we are told, "left many writings, which give us pleasure by their simple style and clearness of expression." Whatever may be the merit of Boyle's writings, their style is hardly that of Addison, and probably no man living has had the courage and tenacity to work through them. Dr. Bauer is evidently not familiar with Swift's "Pious Meditation on a Broomstick in the Style of the Honourable Mr. Boyle."

In spite of minor blemishes the book is not without merit; indeed, it is eminently readable, and interesting. But it needs careful revision, since in its present form a judicious teacher could hardly commend it to his pupils.

Neolithic Dew-ponds and Cattle-ways. By Dr. Arthur John Hubbard and George Hubbard. Second edition. Pp. xxiv+116; illustrated. (London: Longmans, Green and Co., 1907.) Price 4*s.* 6*d.* net.

THIS interesting work has been considerably enlarged since the appearance of the first edition (1905), which was reviewed in NATURE for April 27, 1905 (p. 611, No. 1852). The older work, with its convincing argument of Neolithic man fortifying the heights in order to escape the ravages made by the wolves of the plains on his flocks, has been retained and added to, and we also find the astronomical significance of some ancient works discussed.

In chapter ii. the authors state that they have found the orientation of Maumbury Rings, near Dorchester, to coincide accurately with that of Stonehenge; it would be of great interest to have the exact azimuth of the axis, and also the angular height of the horizon over which the sun is supposed to have risen, in order that the solstitial evidence could be more rigorously tested. Should this prove a true case, the discussion of the data would probably give us an earlier date than the 1680 B.C. ± 200 years (*not* 1800 B.C. ± 200 years, as stated by Messrs. Hubbard) found by Sir Norman Lockyer and Mr. Penrose for the more imposing structure on Salisbury Plain. One of the added chapters (vii.) discusses the possible astronomical origin of some earthworks on the top of Firle Down, in Sussex, and the authors tentatively suggest that they were probably constructed about 1900 B.C. for the purpose of observing the critical seasons of the May and solstitial years. But the evidence needs very careful sifting before one may fix a solstitial date, as was shown in the above-mentioned investigation of the much more permanent stone structure at Stonehenge. Denudation, subaërial, human and animal, will probably have played havoc with earthwork alignments, and the fixing of the original lines, it seems to us, must be more or less an arbitrary proceeding. We would point out that the straight line G.O.B. on the plan given on p. 99 could not possibly indicate the rising and the setting points of the May sun, as stated in the notes; probably the authors mean the *rising* of the *November* sun of the May year, for which the azimuth S. 62° E. would be approximately correct.

The book is beautifully printed and illustrated with reproductions from photographs, and should do a great deal to increase the general interest now being taken in the ancient monuments of these islands.

W. E. ROLSTON.

Übungsbeispiele aus der anorganischen Experimentalchemie. By Heinrich Biltz und Wilhelm Biltz. Pp. xi+232. (Leipzig: Wilhelm Engelmann, 1907.) Price 7 marks.

THERE are many books devoted to the preparation of organic compounds, but one rarely comes across one written especially for the study of inorganic preparatory work. It seems to be imagined that great skill is required to prepare organic compounds, but that anyone can prepare inorganic compounds in a state of purity and with good yields without any previous study. As a matter of fact, the preparation of pure inorganic compounds is by no means simple, and it is a great pity that this branch of chemistry is very rarely taught in a systematic manner. Consequently almost all the research carried out in this country is along organic lines, because owing to the interest aroused by the preparation of organic compounds, the student naturally turns to organic chemistry.

The book before us deals in the main with inorganic preparations, and is arranged, so far as possible, upon systematic lines. Thus chapter i. deals with reductions of oxides, by means of carbon, aluminium, potassium cyanide, and other reducing agents. The sequence mercury from cinnabar and then sodium and ammonium amalgam is rather strange, as some would expect the amalgams to be treated of in connection with alloys. Chapter ii. treats of polymerisation and dissociation, for example, the allotropy of silver sulphide, the modifications of sulphur, the passive state of iron, colloidal solutions, and so on. Then follows the preparation of various

oxides and hydrides, acids, bases and salts, halogen compounds and sulphides.

The preparation of the nitrides of calcium and boron strikes us as strange. The calcium or boron are heated in the air, and so one obtains a mixture of oxide and nitride. As, however, the oxide and nitride cannot be separated, there seems very little point in the experiment, except that the student's attention is directed to ammonia from the air. Certainly, but if the air is first passed over red-hot copper, thus freed from oxygen, and subsequently passed over the heated calcium or boron, surely the experiment is much more striking, and, further, the pure nitride is prepared. This method of preparation would also lead up to a discussion of argon and similar gases.

The book will undoubtedly be of great use to teachers of inorganic chemistry and others who wish to study the subject from a preparatory point of view, but it is rather too full for the average student, who would certainly require very careful direction, or he would be inclined to wander along in a rather aimless fashion. F. M. P.

The Bacteriological Examination of Disinfectants. By William Partridge. With a preface by Major C. E. P. Fowler. Pp. 66. (London: The Sanitary Publishing Co., Ltd., 1907.) Price 2*s.* 6*d.* net.

THE subject of disinfectants has lately attracted considerable attention, and Mr. Partridge's little book forms a very useful summary of the methods employed for testing bacteriologically the germicidal value of disinfectants. The Rideal-Walker or "drop" method is rightly that most favoured, and the major part of the book is devoted to it. We doubt if the explanation given on p. 17, that a forty-eight hours' culture of *B. typhosus* is less readily killed by a disinfectant than a twenty-four hours' one, because it is more vigorous, is correct; we should ascribe the fact rather to the greater number of bacilli and to clumping in the older culture. On p. 18 it is said that while a broth having a reaction of +1·5 is suitable for the culture of the typhoid bacillus, for the diphtheria and cholera organisms a "neutral or alkaline broth must be substituted." The broth named is quite suitable for these organisms, for it is alkaline in the ordinary acceptation of the term; though acid to phenolphthalein, it is still alkaline to litmus. On p. 34 an experiment is quoted to show that an organism from different sources may have a different resisting power from a disinfectant. Doubtless this is so, but the experiment does not prove it. The experiment shows that two strains of the typhoid bacillus, with strengths of carbolic of 1 in 70 and 1 in 100 respectively, are killed in between 5 and 7½ minutes; obviously the one might have been killed in 5¼ minutes, the other in 7¼ minutes, and actually there might have been little difference between them. Everyone has his own method of manipulating tubes for inoculation, but we do not like either method depicted in Figs. 3 and 4. Major Fowler, R.A.M.C., contributes a useful introduction.

R. T. HEWLETT.

Ergebnisse und Fortschritte der Zoologie. Edited by Dr. J. W. Spengel. Vol. i., part i. (Jena: Gustav Fischer.)

UNDER the above title Mr. Gustav Fischer is issuing a new zoological journal, of which a variable number of parts are to appear each year, the whole to form an annual volume at the price of sixty marks. As no prospectus is issued with the part now before us, we are unable to indicate the ground which the publication is specially intended to cover. The present part contains 238 somewhat closely printed 8vo pages, illustrated by fifty text-figures; and from this we presume that plates do not enter into the scheme of the new venture. The name of the editor is a sufficient guarantee that only papers of a high order will be accepted for publication, this being fully borne out by the contents of the initial number. These comprise a discussion on chromosomes by Mr. Valentin Häcker, of Stuttgart; an article by Dr. Richard Heymons on the various types of insect metamorphosis, and their relation to the metamorphoses of other arthropods; and another, by Mr. O. Maas, of Munich, on the scyphomedusæ. The new enterprise has our best wishes for success. R. L.

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.*]

Seismographs and Seismograms.

As I have had occasion to study and compare the records of nearly all the types of seismographs for recording distant earthquakes which are now in use, I may perhaps be permitted to add something to Prof. Milne's letter in NATURE of January 2. The nature of the records, and the relative merits of different types, of seismographs, are not generally apprehended in England, and appear to be misunderstood in Strassburg, from whence much of the recent seismological literature has been inspired.

The two leading problems of seismology, as it stands at present, are the determination, *firstly*, of the exact nature and amount of the movement which takes place, and, *secondly*, of the time requisite for the transmission of the different types of disturbance from the origin, to various distances, and in various directions, through the earth, or along its surface. The first of these is naturally the special object of purely seismological stations and observatories, and for it no single instrument or type of instrument will be sufficient. From the mathematical and experimental investigations of the mechanics of seismographs by Prince Galitzin, Prof. Rudzki and others, it has been conclusively established that no form of instrument, having a pendular period of vibration of its own, however perfectly the oscillations may be damped, can possibly record with exactitude an undulatory movement of the soil such as is caused by earthquakes. As every instrument giving a continuous record must necessarily be of the nature of a pendulum of some sort or other, owing to the necessity for bringing the recording point back to the zero line of the record, it is obvious that no single instrument can suffice for this purpose, and that the only way, by which an understanding of the nature of the movement of the soil can be arrived at, is by installing a number of instruments, of different types and varying response to movements in diverse directions and of unlike period.

For the second purpose a totally different set of conditions comes in. It is no longer necessary to attempt an exact, or even an approximate, representation of the actual movement of the ground, so long as the instruments give records in which the different phases of wave motion can be recognised with reasonable certainty; but, since the solution of this problem involves the collection of numerous records from many stations, it is necessary to obtain the cooperation of astronomical, physical, meteorological, and other observatories, and, consequently, certain conditions, which may be ignored in a specially seismological station, have to be taken into consideration. These are:—

(1) The instrument must not be unduly cumbrous or bulky; it must be easy of transport, occupy only a moderate floor space, and not require special and expensive foundations.

(2) It must run without much attention, and at as moderate a cost as possible.

(3) It must be sufficiently sensitive and consistent in its action to give records capable of interpretation as a general

rule—no instrument has yet been devised which will invariably do this—but should not be too sensitive, or the record of important disturbances may be lost.

(4) The records should be capable of easy and rapid reproduction.

Of the instruments which have been designed or suggested for this purpose, four types are in use to a greater or less extent.

The Wiechert so-called astatic pendulum is an inverted pendulum with a bob weighing more than a ton, kept in position by two springs, and provided with an ingenious system of air-damping of its vibrations. This instrument has been recommended for general use, because its supposed astatic nature is believed to make it record the movement of the soil in an accurate manner; as already pointed out, this condition is immaterial, and, moreover, cannot be completely fulfilled. The instrument is undoubtedly a fine one, and gives valuable records, but its proper place is in an observatory specially devoted to seismology; for general use it is too heavy, requires too much attention, and gives records which are not adapted for ready and rapid reproduction.

The Rebeur-Ehlert instrument is a horizontal pendulum, of the form devised by v. Rebeur-Paschwitz, combined with a recording arrangement devised by Prof. Ehlert. This instrument is an extremely sensitive one, and there seems to be none better for recording small disturbances; in the case of large earthquakes the record is apt to be lost. The record is photographic, and the seismograms are readily reproduced by photography. Its cost of maintenance and too great sensitiveness are the points in which it fails to meet the requirements of an instrument for general adoption.

The so-called Omori pendulum is a horizontal pendulum presenting no special peculiarities, and is a modification, in details only, of a type of instrument in very general use. It fulfils all the first three requirements, being moderate in size, needing little attention, and gives good records, easy of interpretation and measurement. It fails in the fourth requirement only; the record, being taken on smoked paper, is not readily reproduced by photography, and is on too small a scale to obviate the risk of introducing error when copied by tracing.

The fourth type of instrument is the Milne pendulum, a horizontal pendulum with photographic record on a principle quite different from that adopted in any other instrument. This fulfils all the first three requirements, and the fourth too; the seismograms are easily reproduced by contact printing on to the same photographic paper that is used for recording, and the copies are practically as serviceable as the originals. This alone, if the instrument had few other merits, would mean much; but in addition to this I have found its seismograms the most convenient of any for determining the exact time of any point on the record, and had it not been for the general adoption of this type of instrument, and the ease with which its records can be reproduced, a considerable part of what seismological work I have been able to do could not have been attempted. The only improvement I have ever desired to see is an increase in the rate of movement of the recording surface, and this has now been introduced. I have examined and studied hundreds of records of this instrument from different stations; from Victoria, Toronto, Cape Town, Bidston, Paisley, and many other places, its records are consistently good; at a few stations, whether from a defect in the particular instrument, a want of proper adjustment, or, more probably, something in the foundations or the subsoil, its records are less satisfactory, but from none do they seem to be so bad as at Strassburg; having never seen a seismogram of that instrument—it is not easy to get copies from Strassburg—it is impossible to hazard a suggestion of the reason for the failure of the instrument at this station.

No one would wish to see one pattern of instrument adopted to the exclusion of all others, nor has it ever been pretended that the pattern adopted by the organisation which has grown up under the auspices of the British Association is faultless; but for the purpose of securing a large number of records for comparison with each other, and thereby determining the rate of transmission of earthquakes across, through, and around the earth, it is no more faulty than any other pattern, and has one crowning merit which they do not possess. Can it be to this, to the ease of reproduction of its records, which renders unnecessary the centralisation of seismological research, that we must attribute the continuous vilification of a valuable type of instrument? R. D. OLDHAM.

An Early Acoustical Analogue of Michelson's Echelon Grating.

IN the "Œuvres complètes" of Christiaan Huygens (tome x., p. 571) occurs the note given below. It was destined for Ph. de la Hire, and of date November, 1693. Huygens's remarkable observation and his ingenious explanation of the musical note produced by reflection from a large flight of steps of the noise of a fountain in the park of Chantilly will be read with interest also by those who, though having no ready access to the "Œuvres complètes," are still concerned with the (reflecting) echelon grating:—

"Je veux adjouter icy au sujet de la réflexion du son une observation assez singulière, que j'ay fait autrefois estant à la belle maison de Chantilly de la Cour où est la statue Equestre on descend avec un degré large de . . . marches dans le parterre ou il y a une fontaine de celles qu'on appelle gerbe d'eau, qui fait un bruit continuel. Quand on est descendu en bas et qu'on se tient entre le degré et la fontaine on entend du costé du degré une résonance qui a un certain ton de musique qui dure continuellement, tant que la gerbe jette de l'eau. On ne sçavoit pas d'où venoit ce son ou en disoit des causes peu vraisemblables ce qui me donna envie d'en chercher une meilleure. Je trouvay bientost qu'il procédoit de la réflexion du bruit de la fontaine contre les pierres du degré. Car comme tout son, ou plustost bruit, réïtéré par des intervalles égaux et très petits fait un son de musique, et que la longueur d'un tuyau d'orgue détermine le ton qu'il a par sa longueur par ce que les battements de l'air arrivent également dans les petits intervalles de temps que ses ondoiements emploient à faire deux fois la longueur du tuyau sçavoir quand il est fermé par le bout, ainsi je concevois que chaque bruit tant soit peu distingué qui venoit de la fontaine, estant réflechi contre les marches du degré, devoit arriver à l'oreille de chacune d'autant plus tard qu'elle estoit plus éloignée, et cela par des différences de temps justement égales à celuy que les ondoiements de l'air employent à aller et venir autant qu'estoit la largeur d'une marche. Ayant mesuré cette largeur qui estoit de 17 pouces, je fis un rouleau de papier qui avoit cette longueur, et je trouvai qu'il avoit le mesme ton qu'on entendoit au bas du degré.

"Je trouvay comme j'ay dit que la gerbe n'allant point l'on cessoit d'entendre ce ton. Et aiant eu occasion d'aller à Chantilly pendant l'hyver, qu'il estoit tombé beaucoup de niège qui ostoit la forme aux marches, je remarquay que on n'entendoit rien quoyque la gerbe allast et fit du bruit à l'ordinaire."

A slight confusion is caused by Huygens's first referring in his note (apparently only drafted) to a closed organ-pipe and later to an open one. Taking a pouce=2·7 cm., the depth of the steps becomes $17 \times 2{\cdot}7 = 45{\cdot}9$ cm. At 10° C., the corresponding sound of about 368 vibrations per second would be given by an open pipe of 46 cm.

The effect of gratings on impulsive motion of light is now well understood, thanks to the labours of Lord Rayleigh, Gouy, Schuster, and others. It remains interesting, however, to contrast the opinion concerning the supposed regularity of white light, held by some high authorities before these discussions, with Huygens's statement that the regularity in the nature of the sound which he observed has been impressed upon it by outside influence. P. ZEEMAN.

Amsterdam, January 6.

The Inheritance of "Acquired" Characters.

MAY I ask for information upon the interpretation of two sets of facts?

(1) Prof. Henslow states that the garden parsnip "known in the trade as 'The Student' was raised from seed of the wild plant by Prof. J. Buckman in 1847 at the Agricultural College, Cirencester," and also that M.

Carrière "raised several garden forms" of radish "of various colours from the seed of the wild species (*R. raphanistrum*), and found that they produced the long form in a light soil, and the turnip-rooted form in a stiff soil. A similar result has occurred with carrots. By selecting seed from plants having the best formed roots, these" (characters) "have become fixed and hereditary" ("How to Study Wild Flowers," 1902).

(2) I was delighted in the early summer by the marvellous skill and intelligence exhibited by some collies in the annual sheep-dog trials, which reveal apparently much more than the results of individual training. I have lately seen a pack of hounds streaming over the same country after a fox. The hound (*triste lupus in stabulis*) would make an indifferent sheep-dog, and the master who brought a pack of collies to a meet would provide some novel sport for the field. The collie is trained individually, but he has an inherent, if not inherited, aptitude, just as the foolishly good-natured hound puppy who is "put out to nurse" in his earlier days readily learns his work when he joins the pack. Further than this, an ordinary dog-show displays group peculiarities in different types of dog. The fox-terriers snarl savagely at each other, the greyhounds and their allies bark and yelp continuously, and appear as though on the verge of neurotic insanity, while the foxhounds lie and appear to drowse silently with a well-bred air of tolerant boredom that forms a curious contrast to the howling multitudes around them. Yet they are all dogs, and have reached their typical specialisation by characters acquired in some way.

If we are forbidden to believe that acquired characters are hereditary, what is the explanation of the seed of the "student" parsnip and the "turnip" radish coming true to type, and why does a collie drive sheep and a hound give tongue at the scent of a fox? Is it suggested that in the "germ plasm" of the wild dog all these special qualities are already involved, just as the digestive peptones gathered functionally and localised in the leaves of Dionæa and Drosera are found wandering aimlessly and to no purpose in some fruit trees? If so, what is the nature of the directive impulse that localises these characteristics in hound, collie, Drosera, and radish immediately fertilisation takes place? And again, how does the "peppered moth" contrive to appear in the black country hatched with sooty wings that harmonise with the now smoke-stained bark whereon he must rest? The whole subject of mimicry seems to be involved, and if your reviewer is right (NATURE, January 2, p. 193) in noting with "a sense of weariness mingled with surprise the appearance of a book on the transmission of acquired characters," it is quite certain that the "isolated biologists, and whole hosts of medical men who still hold the belief that acquired characters are transmitted" would regard it as a great boon if he would tell those who "make him tired" what are the conclusions apparently already established by "the modern, and still infant, science of heredity" that will satisfactorily account for such facts as I have ventured to state.

It will hardly do to say that in one sense the problem is "as unreal as the question of the apple dumpling which puzzled one of the Georges, because the characters of an organism do not get into its germ-cells any more than the apple gets into its crust, for both the germ-cells and the apple were there all the time." "One of the Georges" would doubtless have been grateful for a little culinary instruction, just as "whole hosts" of somewhat puzzled people with open minds would be honestly sincerely grateful for a definite explanation from "the infant science of heredity" as to how the sheep-driving impulse really got into the sheep-dog. For "nature" is more luminous than a text-book. E. C. SPICER.

Waterstock, Oxford, January 3.

The Diamantiferous Rock of Kimberley.

MY friend, Dr. Hatch, is not quite correct in stating (January 9, p. 225) that I was led to dissent from the late Prof. Carvill Lewis's view that the diamantiferous rock of Kimberley was a volcanic peridotite "by a microscopic examination made in 1899 of specimens from the Newlands Mines" (Proc. Roy. Soc., lxv., 1899, p. 223). Four years earlier I expressed the opinion that this rock was a breccia, and that the diamonds, with other conspicuous minerals, were not formed *in situ* (*Geol. Mag.*, 1895, p. 500). This belief was strengthened rather than shaken by editing Prof. Carvill Lewis's notes and examining his specimens ("The Genesis of the Diamond"), and was expressed yet more decidedly later in 1897 after examining another series of specimens from Kimberley (see *Geol. Mag.*, 1897, p. 501). To discuss the "magma" and "concretion" hypothesis would be out of place here, but elsewhere I may have something to say on those subjects.

T. G. BONNEY.

Musical Sands.

MR. CARUS-WILSON'S failure (January 9, p. 222) to obtain sounds from "millet seed" sand of highly spherical grains puts a difficulty in the way of the suggestion made in "Sound" by Poynting and Thomson, though I do not think that it finally disposes of it.

I have not been able to follow the friction explanation as given by Mr. Carus-Wilson (NATURE, August 6, 1891), and I write in the hope that he may give more detail as to the moving system which produces the musical note. It appears probable that the musical sounds excited in a body by friction are due to the natural vibrations of that body. Obviously the grains of sand are far too small to give the notes heard. I suppose that the fundamental period is of the order of the time taken by an elastic wave to travel half round the grain. With elastic moduli of the order 10^{11} and density $2\frac{1}{2}$, the fundamental frequency would be not less than 10^6. What system does the friction set in vibration? J. H. POYNTING.

The University, Birmingham, January 11.

IN NATURE of January 9 (p. 222) Mr. Carus-Wilson's letter asks for further details of the "singing sands" that I exhibited to the Physical Society. I am able to give the mineralogical description, by Mr. A. J. Maslen, of the Maine sand from Mareen's beach, near Small Point, at the entrance of the Kennebec River.

A subangular sand very free from *very* small grains. Clean.

Quartz. Principal constituent. As perfectly colourless grains showing conchoidal fracture (rock-crystal) and as more or less coloured grains of quartzite.

Muscovite Mica. Small quantity. Flakes.

Glauconite. Dark green grains, many of fairly large size. Almost black.

Topaz (?) Square pieces due to cleavage. Yellow.

Opaque white substance. (Felspar?)

Magnetite. Small grains. Rare.

The other specimens of sands were very similar to that from Maine. SIDNEY SKINNER.

South-Western Polytechnic, Chelsea, S.W.,
January 13.

Intensity of Spectrum Lines.

VERY little attention has been paid in the past to the accurate measurement of the optical intensity of spectral lines in vacuum tubes under different conditions, probably on account of the considerable experimental difficulties. Hence I may, perhaps, be allowed to indicate a relation I have obtained between the optical intensity, current strength, and pressure of the glowing gas. Throughout the whole experimental range, using the so-called "electrodeless" tube—with wholly external mercury electrodes, when the current is of a slowly oscillating character—the optical intensity, with an end-on tube, is accurately proportional to the readings of a thermo-galvanometer in series, and over a more limited range of measurement, at constant current, is inversely proportional to the pressure of the gas.

In other words, the intensity is proportional to $\lambda \int c^2 \delta t$, where λ is the *mean free path*.

Measurements on the monatomic gases are now in progress, and it is intended later to investigate the influence of temperature. A. D. COWPER.

University College, London, W.C.

NOTES ON ANCIENT BRITISH MONUMENTS.[1]

IV.—*Avenues.*

I HAVE measured several avenues since "Stonehenge" was published, and I have studied others of which the orientation could be determined by the Ordnance maps. Many of them have been found to have had the same astronomical use which had been suggested in those measured on Dartmoor. The longest avenue I have seen is at Avebury—the Kennet Avenue—which, in Stukeley's time, was more than a mile long. Associated with it is the Beckhampton Avenue. These avenues must have been very imposing parts of the complete temple when it was in full use. Avebury is such a mass of ruins that it is difficult to reconstruct it in the mind's eye in its entirety, but some parts of it, considered by themselves, present no difficulty. Mr. R. H. Caird, of Devizes, has twice enabled my wife and myself to visit the region by driving us from Devizes in his motor-car, and these visits gave us time enough to see that the Beckhampton Avenue and the remains of the Cove were both oriented to the May sunrise, were, in fact, probably closely associated in the May ceremonials, the avenue abutting on the north circle, in the centre of which the remaining gigantic stones of the cove still stand.

The theoretical conditions for the azimuth of the May sunrise at Avebury (lat. 51° 30′, variation 16° 48′ W. in 1906), are, with 2′ of limb showing:

N. 62° E. with sea horizon
63° 40′ ,, hills 1° high
65° 12′ ,, ,, 2° ,,

A rough measurement on the spot gave me N. 65° E. for the outlook of the cove, the horizon being about 2° high, and on the 1-inch Ordnance the line joining the two large monoliths at the west end of the Beckhampton Avenue and the cove gives N. 64° E. Further, this line studied on the 25-inch map passes close to the stones indicated by Stukeley, who expressly says that he saw the remains of the avenue. I give his description.[2]

"The Beckhampton Avenue goes out of Abury town at the west point, and proceeds by the south side of the churchyard. Two stones lie by the parsonage gate on the right hand. Those opposite to them, on the left hand, in a pasture, were taken away in 1702, as marked in the ground-plan of Abury. Reuben Horsal remembers three standing in the pasture. One now lies in the floor of the house in the churchyard. A little farther one lies at the corner of the next house on the right hand, by the lane turning off to the right to the bridge. Another was broke in pieces, to build that house with in 1714. Two more lie on the left hand opposite. It (*i.e.* the Avenue) then passes the beck south of the bridge. Most of the stones hereabouts have been made use of about the bridge, and the causeway leading to it."

Smith's account goes on:—

"Moreover, we have some evidence of the existence of the avenue in this direction, in the fragments of sarsen stones which may still be seen there, as the Rev. Bryan King has pointed out in his note on this subject, to which I have already called attention;[1] therein he says: 'Beginning with the walls of the churchyard and of the church, and of the manor-house, with its enclosures, in an entire length of full half-a-mile from the earthwork on the west side of Avebury to the corner of the large field in which the two large stones near Beckhampton now stand, there are very few lineal yards which are not occupied by causeway, walls or cottages, all formed of sarsen stone, sufficient and more than sufficient, to absorb all the stones of the Beckhampton Avenue': and then he goes on to enumerate the several stones, or portions of stones, which still exist, and which are apparently the remnants of those described by Stukeley."

On the accompanying plan of Avebury, photographed from the 25-inch Ordnance map, I have indicated the two circles as roughly determined from the

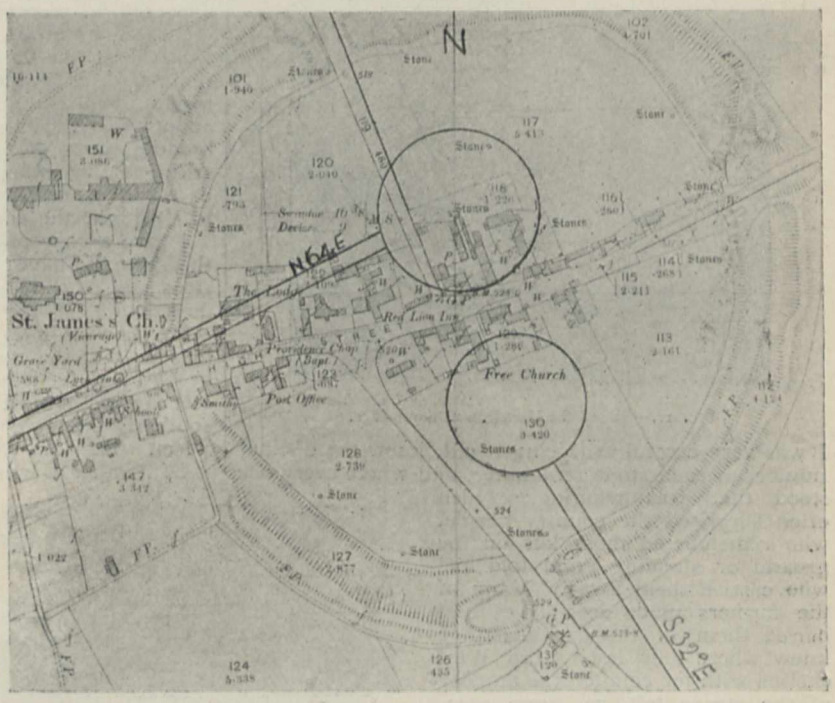


FIG. 11.—Avebury, showing the circles and avenues.

remaining stones. It will be seen that the May-year avenue line is directed nearly, but not quite, to the centre of the northern circle, the cove occupying the centre itself, and so blocking the view from the avenue or processional road to the S.W.

I next come to the south-eastern or 'Kennet Avenue.' Stukeley[2] says of it: "The Kennet Avenue consisted originally of one hundred stones on each side, reaching from the vallum of Abury town to the circular work on Overton Hill. Mr. Smith, living here, informed me that when he was a schoolboy the Kennet Avenue was entire from end to end. The stones composing it were of all shapes, sizes, and heights that happened, altogether rude. Some we measured six feet thick, sixteen in circumference. If the stones were of a flattish make, the broadest dimension was set in the line of the avenue, and the most sightly side of the stone inward. The founders were

[1] Continued from p. 152.
[2] Avebury described, p. 34, quoted in Smith's "British and Roman Antiquities of North Wiltshire," p. 146.

[1] *Wiltshire Magazine*, vol. xviii., pp. 377–383.
[2] Avebury described by Stukeley, quoted in "British and Roman Antiquities of North Wiltshire," p. 145.

sensible that all the effect desired in the case was their bulk and regular station. When I abode here for some time on purpose, for several summers together,

Photo. by Lady Lockyer.

FIG. 12.—One of the Monoliths at Borobridge.

I was very careful in tracing it out, knew the distinct number of each stone remaining, and where every one stood that was wanting; which often surprised the country people, who remembered them left on the ground or standing, and told me who carried them away. Many of the farmers made deep holes and buried them in the ground; they knew where they lay. Lord Winchelsea with me counted the number of the stones left, 72, anno 1722. I laid it all down in the nature of a survey, on large imperial sheets of paper, and wrote a detail of every stone present or absent; but it would be very irksome to load the press with it." Mr. Long, after describing the war of extermination which had been waged against them, and how such stubborn blocks as refused to succumb to fire and hammer were buried in the pits dug for them, continues: "Two of them lie six feet underground in the premises of Mr. Butler of Kennet, and over another the Bath road passes. The work of destruction has been so successfully carried out that only nineteen stones or their stumps are now visible between West Kennet and Abury; four in the bank on the left-hand side of the road from Marlborough as it enters Kennet, and which can only be seen by going into the adjoining field: these stones lie about thirty paces apart, and that these were the original, or nearly the original, distances, seems confirmed by Stukeley's twentieth plate."[1]

As will be seen from the map, this avenue apparently was connected with the southern circle as the Beckhampton one was with the northern one. If this were so, certainly the enormous bank, erected apparently for spectacular purposes, which is such a striking feature of Avebury, was not made until after the Kennet Avenue had fallen out of any astronomical use.

The alignment of this avenue, as measured on the 25-inch map, is S. 32° E., the elevation of the horizon from the 1-inch map being 49′. This gives a declination of 31° 34′ S. I shall return to this point later on.

This avenue seems to have struck another aligned from the circle on Overton Hill, which formerly was oriented to the May sunset or the November sunrise, to judge from the positions of the stones given in Smith's map.

At Borobridge, near Harrogate, is another avenue I have visited; only three stones remain, two have disappeared in recent times, the extreme stones being separated by about 700 feet. They are not in a line. Lukis was the first to suggest that they were the remains of an avenue, and I agree with him. According to my measurements the breadth of the avenue was about 25 feet. With a clino-compass the mean of three readings gave N. 355° E. as the magnetic azimuth; taking the variation as 17° (October 4, 1907), this gives us S. 22° E. or N. 22° W.; the true northern horizon is 1½° high, the southern one 1°.

I give a copy of a photograph of the central stone; this seems to have been squared, and the east and west sides are slightly slewed from the general line of direction.

Mr. Lewis,[2] in an interesting account of these stones, tells us that the most northerly stone is 18 feet high by 7½ by 3½ feet, the second (the one illustrated), 197½ feet away, 22 feet high by 4½ by 4½ feet; and the southerly one, 362 feet away, 23 feet high by 4½ by 4 feet. They are called locally the Devil's Arrows.

Of another Dartmoor avenue, that at Assacombe, in

FIG. 13.—Assacombe Avenue looking west.

the Chagford district, I am enabled, by the kindness of Mr. Falcon, the author of "Dartmoor Illustrated"

[1] *Wiltshire Magazine*, vols. iv., pp. 327-9; xvii., pp. 329-31.
[2] *Journal Anthropological Institute*, November, 1878.

(a book which everybody interested in the monuments should possess), to give two photographic views from the east and west ends. It is a May-year avenue (Az. N. 63° 30′ E., from 25-inch Ordnance map) like the Beckhampton Avenue at Avebury.

FIG. 14.—Assacombe Avenue looking east.

It will be noticed that, like the avenues at Merrivale, the row of stones is furnished at the west end with monoliths larger than ordinary, and that the other end has a well-marked blocking or sighting stone ending the avenue.

I may here refer to yet another May-year avenue which I measured in South Wales. It is near "Arthur's Stone," a famous cromlech in Gower to which I refer elsewhere. The true azimuth is S. 61° E., height of horizon 1° 30′.

There is no doubt, I think, that the "Nine Maidens" near St. Colomb, Cornwall, of which a plan is given by Lukis (plate xxxii.), is the remains of a double or multiple avenue. With Lukis's value of the magnetic variation, I found from his plan an azimuth of N. 28° E. I visited them in April, 1907, and assuming a variation of 18° W. (with hill 2°), I got the same value, giving Dec. N. 33° 47′: that of Capella in 1480 B.C.

This is a locality worthy of minute study, especially with reference to the actual commencement of the avenue, for the true azimuths of the many stones on the E. side of course depend upon this.

This avenue and the fine one at Callernish can be treated together. For the latter the conditions are as follows:—

Azimuth of Avenue.—N. 9° E.; hill, 1° 26′; dec. 32° 26′ N.; Capella, 1720 B.C.

This avenue is associated with a circle 42 feet in diameter, within which is a remarkable chambered cairn referred to elsewhere. The avenue consists of two parallel lines going off to the northward 270 feet in length, and about 27 feet in width. The total number of stones is forty-eight, and the total length of the monument, from the extremity of the double line, through the centre of the circle to the extremity of the single line beyond, is 408 feet.

It will be seen, then, that the more recent measurements give us avenues directed, on the orientation theory, both to sun and stars. The sun is the May sun, and the solar avenues are at Avebury, Assacombe, and Gower.

Of new stellar avenues parallel to others previously shown by the investigations to be aligned on northern clock-stars, we have those at Callernish and St. Colomb.

But these are not all.

NORMAN LOCKYER.

Photo. by Lady Lockyer.

FIG. 15.—The Nine Maidens.

THE CALIFORNIAN EARTHQUAKE OF 1906. ALTHOUGH only twenty months have passed since Central California was devastated and San Francisco destroyed, partly by earthquake but largely by fire, some fifty papers have appeared from technical and other journals describing this great catastrophe. The last appears as a Bulletin (No. 324, Series R, Structural Materials, 1) of the U.S. Geological Survey. It is a volume of 158 pp., illustrated by fifty-seven excellent process plates, in addition to which there are two maps. The introduction is by Dr. G. K. Gilbert, and it treats of the earthquake as a natural phenomenon.

The earthquake, Dr. Gilbert tells us, had its origin chiefly along the line of an old fault. This can be traced from San Juan, about ninety miles south-east of San Francisco, to Point Arena, about 120 miles north-west of that city, the total length being approximately 200 miles. There are, however, good reasons for believing that the fracture extends very much farther to the north. The total length of the line of yielding would therefore have been 300 or even 400 miles. Its general appearance is that of a huge furrow, the displacement of one side of which relatively to that of the other side has varied from 2 to 20 feet. In Fig. 1 the furrow-like appearance is not visible, but the fence, which is broken across and shifted 8½ feet, indicates the existence of a sheer, the trace of which is hidden.

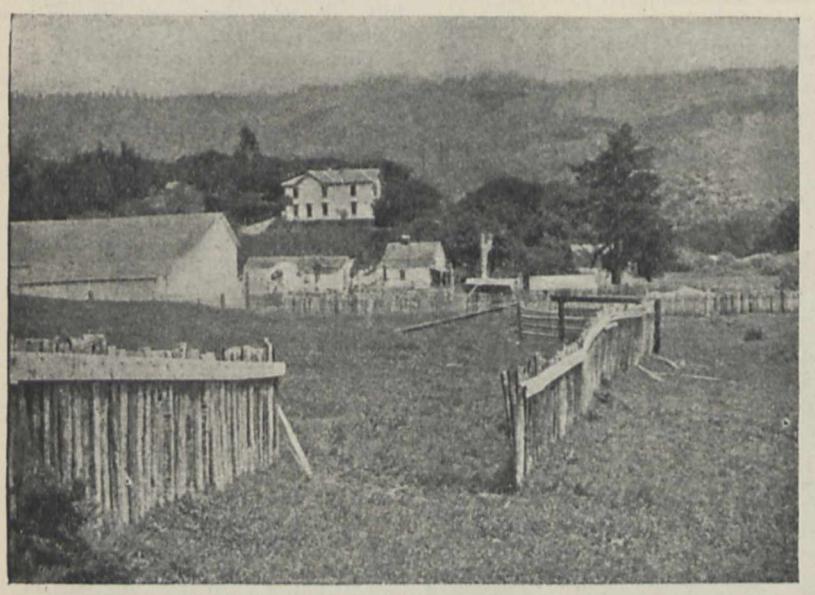


FIG. 1.—Fence parted by Earthquake Fault. The fault trace or fracture accompanying the earthquake is inconspicuous although the horizontal displacement is considerable. (Photograph by G. K. Gilbert.)

The vertical displacements were comparatively small. Passing out from the main fault are branching cracks. These are particularly noticeable in soft ground. The depth to which this shattering has extended cannot be directly measured, but that it has descended to a considerable depth is indicated by alteration in the general circulation of underground waters. New springs have been created, whilst old springs have been closed or altered in their flow. The great length of the main fault suggests that it had a great depth. Further, as the initial impulse was sufficient to send earth waves round the world it is reasonable to suppose that this was occasioned by the sudden displacement of a very large earth block. We know something about its length. Its breadth may be estimated from its distance from more or less parallel faults which yielded or from the width of the area of the molar displacement. Its thickness may be that of the earth's crust. A suboceanic mass movement of this size might disturb the Pacific Ocean for twenty-four hours, or shake the world from pole to pole. Were it very much less it is difficult to imagine that such far-reaching commotions could be originated. This may be mere speculation, but to shake the world a heavy blow needs to be applied over a considerable area. A curious observation relating to the length of earthquake waves was made in Tomales Bay, where, before the earthquake, there was the usual smooth mud plain commonly seen on tidal flats. After the earthquake this plain was ridged, the crests of the ridges being ten to twenty metres apart. Whether these represent the solidification of gravity waves we are told is not quite clear, but whatever their history may have been, they illustrate the response of a mud flat to earthquake motion.

The major and most important part of the publication is written by three engineers, Messrs. R. L. Humphrey, J. S. Sewell, and Prof. Soule. All have had experience of fires, whilst Prof. Soule has for many years watched the growth of San Francisco and was present at its fall. We are told that the whole secret of earthquake-resisting power depends upon "proper design, first-class materials, and honest workmanship." The first condition, inasmuch as it involves radical changes in methods of ordinary construction, might have been underlined. The greatest destruction came from fire, and the modern structures which best resisted both fire and earthquake seem to have been those made of reinforced concrete. Tunnels, flumes, wrought and cast-iron pipes, particularly where

FIG. 2.—Memorial Arch, Leland Stanford Junior University. Earthquake Effect:—The beams designed to stiffen the walls were not tied to them, and helped to batter them down when the shock came. (Photograph by Richard L. Humphrey.)

they crossed the fault line, were interrupted, but the chief reason that fire gained the upper hand was the failure of the water systems in the city. Steel skeleton buildings withstood the earthquake, but although these and their supporting columns had been encased in fire-resisting material, under the effects of heat the protecting surfaces flaked off. Internal metal-work expanded, buckled, and then collapsed. Fire-proofing had been inefficient. Although there is much of scientific interest in the bulletin, its chief value will be to the practical engineer, who has to contend against, not simply the effects of earthquakes, but chiefly against the effects of fire.

PUBLIC CLOCKS AND TIME DISTRIBUTION.

THE interesting correspondence on "Lying Clocks" inaugurated by Sir John Cockburn in the *Times* has tended to degenerate into a display of advertisements by different firms interested in various systems of clock synchronisation. But in its original form, the point raised is one of great importance, and if it is not appreciated by the public as fully as it should be, the explanation is probably to be found in the general contempt for accuracy exhibited in this country, and the non-scientific habits which have been so long cultivated or permitted. It seems impossible to get the man in the street to understand the significance of seconds. He is ready with his old adage, *De minimis non curat lex*, and thinks he has settled the question. But this is not so, and the interest taken in the *Times* discussion indicates the possible introduction of a healthier state of things. We may look forward to a time when every progressive town or city will be provided with clocks, publicly exhibited, which will declare the correct time. If such mechanism were provided, it would not only tend to economy in various directions, owing to the more complete appreciation of small intervals of time, but such clocks would furnish a wholesome lesson in accuracy, and by the introduction of scientific processes into everyday life inculcate the importance of paying greater attention to scientific methods.

The term synchronisation seems to be used very vaguely. For its successful operation, two distinct processes have to be considered—the distribution of correct time signals and the control of local clock dials. Some seem to think that the problem would be sufficiently solved if clocks were all made to show the same time. This result could be ensured by simple methods of control, and it is true that so long as we remained in one town the annoyance of a "lying timekeeper" would not have to be tolerated, but the uncertainty would reappear as soon as we entered another town, and the only way to secure uniformity is to arrange for the exhibition of correct standard time. This essential preliminary of the distribution of correct time signals is provided for by the Post Office authorities, working in cooperation with the Royal Observatory, Greenwich. The telegraphic service throughout the country is suspended for a few seconds, while the signal is sent through the trunk lines at 10 a.m. But, unfortunately, it is to be feared that the duty of forwarding this signal to the smaller towns is very carelessly and inefficiently performed, simply because the officials who are responsible for its wider distribution have not sufficiently apprehended the necessity for accuracy. From personal experience we are afraid that this signal is not sent on automatically. Here is the first necessity for reform. If it were thoroughly well known that there did exist in every town and village an office where correct time could be had, even at some personal inconvenience careful people would take the trouble to keep their clocks fairly accurate, and by so doing gradually educate the more indifferent to a higher standard.

The control of the clock dial is a much simpler matter, and has passed into the commercial stage. The convenience of having a number of clocks in one establishment indicating the same minute is so evident that a variety of patents has been secured with the view of effecting this purpose. But most of the patentees do not concern themselves with extreme accuracy, and are content if no greater difference than half a minute can be perceived between any dial and the master clock, from which the signal is sent generally at intervals of half a minute. There are several processes which can be easily utilised, some of which are admirably adapted for outside dials, and could be supplied at small cost. Probably it would not be wise to insist on extreme accuracy, but to endeavour to establish a system that could be improved. The trouble is that London, and other large towns generally, have no system of clocks under municipal control which could be synchronised. It is necessary to make a new departure, and the discussion in the *Times* is so far valuable that it tends to create a public opinion, which may induce the authorities to take the initiative.

LORD KELVIN AND THE ROYAL SOCIETY OF EDINBURGH.

ON January 6, at the first meeting of the Royal Society of Edinburgh since the death of the president, Lord Kelvin, Prof. Crum Brown, F.R.S., vice-president, read the following appreciation, a copy of which has been communicated to us by the society:—

We meet here to-night for the first time since the death of Lord Kelvin.

This is not the time to enter into an enumeration or a criticism of what he did. Our thoughts now are of the loss which we have sustained. But it is impossible in our mind to separate the man from his work. For the transparent truthfulness, the simplicity and straightforwardness, the absence of the least trace of affectation or trick, which contributed so much to the charm of his manner, felt by everyone who came, even in the slightest and most transient way, into relation with him, are to be seen in all that he did. It was his love of truth and his sympathy with nature that led him in all his investigations directly to the root of the matter, and made him so zealous and successful in his searches for the essential principles underlying the phenomena of nature. And when a truly essential new view was obtained, by himself or by another, of the way in which nature works, he rejoiced greatly, and called on his friends to rejoice with him. Nature was to him very real, and no demonstration seemed to him quite satisfactory until it had been "realised." This and his sympathy with men and with their work gave everything to him a practical aspect. And so in almost every direction in which he worked he devised working models and instruments of precision. Some of these are known only to specialists, and by them used and valued, but everybody has heard of his compass and of his sounding apparatus, and knows something of the enormous benefits he has conferred on navigation.

It was not only in pure and applied science that he was interested; everything that affects the life of the people, education, politics, religion, occupied his thoughts, and on all subjects which he had seriously considered he had definite opinions. While he would, on occasion, defend with zeal and energy what he believed to be the truth, he was always perfectly fair to his opponents, as he was always courteous to everybody.

We have already had emphatic evidence that the world knows that a great and good man has left us; we who knew him more intimately also mourn a dear, trustworthy, and trusted friend.

NOTES.

M. BAILLAUD, director of the Toulouse Observatory, has been appointed director of the Paris Observatory.

SIR GEORGE DARWIN, K.C.B., F.R.S., has been elected a corresponding member of the Imperial Academy of Sciences of St. Petersburg.

LIEUT.-COLONEL R. E. CROMPTON, C.B., has been elected to the presidency of the Institution of Electrical Engineers vacant by the death of Lord Kelvin.

PROF. BOUCHARD has been elected a vice-president of the Paris Academy in succession to M. Henri Becquerel, who has passed to the presidential chair.

THE Hayden memorial geological medal of the Academy of Natural Sciences of Philadelphia has been awarded to Mr. C. D. Walcott, secretary of the Smithsonian Institution.

WE regret to see the announcement of the death of Lieut.-Colonel R. L. J. Ellery, C.M.G., F.R.S., late Government astronomer and director of the Melbourne Observatory, at eighty years of age.

WE learn from the Paris correspondent of the *Chemist and Druggist* that the appointment of Prof. E. Jungfleisch, of the Paris Superior School of Pharmacy, as successor to Berthelot's chair of organic chemistry at the Collège de France was formally signed by M. Briand on January 6.

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal to Prof. Paul Groth, of Munich; Murchison medal to Prof. A. C. Seward, F.R.S.; Lyell medal to Mr. R. D. Oldham; Wollaston fund to Mr. H. H. Thomas; Murchison fund to Miss Ethel G. Skeat; and Lyell fund to Mr. H. J. Osborne White and Mr. T. F. Sibly.

REPORTS have appeared in the daily Press of a new treatment for consumption in which the diseased portion of the lung is removed by operation. The only novelty seems to be the use of hot water or steam to control the hæmorrhage, for excision of a portion of the lung has occasionally been performed during the last seventy years. Such a procedure could only be of service in a very few selected cases.

WE deeply regret to announce the death of Prof. C. D. West on January 10 in Tokyo. He had then been twenty-five years in the service of the Japanese Government, and was one of those men the Japanese did not wish to lose. He never cared to write scientific papers, but his thought can be traced in those written by others. "West's formula" relating to the destructive power of earthquakes is certainly the basis of all other formulæ on this subject, and these have had a wide application. He was a pioneer in the education of engineers in Japan, and is looked up to as the father of engineering in that country. A modest man has been called across the bar.

As the result of a vigorous sanitary campaign, involving an expenditure of more than 40,000*l*., bubonic plague has now been almost eradicated from San Francisco. One of the most notable features has been the destruction of 130,000 rats during the last four months. Of this number, 11,391 were examined by bacteriologists in the laboratory of the Health Department, and 108 were found to be infected. Up to the end of December, 1907, the total number of persons reported as plague-stricken was 136, of whom seventy-three died. The sanitary measures adopted have been under the control of an officer of the U.S. Marine Hospital Service, with the cooperation of the local health authorities.

NEW awards will shortly be made from the "Elizabeth Thompson Science Fund," which was established "for the advancement and prosecution of scientific research in its broadest sense," and now amounts to 5200*l*. Applications for assistance from this fund should be sent promptly, with full information, to the secretary of the board of trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. The trustees are disinclined, for the present, to make any grant to meet ordinary expenses of living or to purchase instruments, such as are found commonly in laboratories. Decided preference will be given to applications for small amounts, and grants exceeding 60*l*. will be made only in very exceptional circumstances.

IN honour of the memory of the great Russian chemist Mendeléeff, a Congress of Chemistry and Physics was held at the University of St. Petersburg on January 2–12. The congress was organised by the Russian Physico-Chemical Society, and the following telegram, signed by Prof. Borgmann, Rector of the Imperial University, who presided, was sent to Sir James Dewar:—"The Russian Physico-Chemical Society, with members of the first Mendeléeff Congress, express to you—a friend of the late Prof. Mendeléeff—great esteem for your scientific labours opening new ways for investigations of Nature." Many British men of science will be glad that their Russian colleagues have thus shown their appreciation of the greatness of Mendeléeff's work and of the high regard in which his memory is held in this country. This sympathetic feeling and unanimity of aim among scientific men is of international importance, and makes the congress at St. Petersburg an event in which the whole scientific world is interested.

MR. HENRY FARMAN on Monday won the Deutsch-Archdeacon prize by flying toward a goal previously fixed and returning to the starting point, the total distance being more than one kilometre, with a machine heavier than air. The course was marked out by delegates of the Aëro Club of France upon the military ground of Issy. Five hundred metres from the starting point, two posts were placed fifty metres apart, and the conditions of the contest were such that the aëroplane had to pass between these posts in the journeys both out and back. At the starting signal the machine ran along the ground for a few yards and then rose easily in the air and headed toward the turning post. This point was reached by a steady flight, and after sweeping round it, Mr. Farman returned to the starting point with perfect ease. The entire flight occupied 1m. 28s. A description, with an illustration, of Mr. Farman's aëroplane was given in NATURE of December 5, 1907 (p. 106).

AN electrical engineer, M. Lemoine, is under arrest in Paris charged with having obtained more than 60,000*l*. from Sir Julius Wernher in connection with an alleged invention for the manufacture of diamonds. The "secret" of the process was deposited in a London bank at the time the negotiations were entered upon, and the magistrate appears to be in a legal difficulty, since the defendant refuses to allow the document to be examined. The defendant has, it is reported, given several demonstrations of his process, and some of these were in the presence of witnesses. During the progress of the case, a *Times* correspondent states:—"An Englishman, Mr. Jackson, said that he had been present at two experiments in M.

Lemoine's laboratory. Mr. Jackson himself compounded the substances, put them into a crucible, and sealed it up. M. Lemoine then ran the crucible into an electric furnace, and after about twenty-five minutes he drew the crucible out. Mr. Jackson opened it, and found in it twenty-five little diamonds. At another time they obtained thirty. He offered the diamonds to a London jeweller, who found them very fine, and an expert to whom he showed them thought they came from Jagersfontein." A representative of the *Daily Chronicle* has had an interview with Lord Armstrong, who was present at one of the demonstrations, and affirms that diamonds were really produced. Lord Armstrong is reported to have said:—"M. Lemoine handed me a powder, which, in order to convince myself, I worked up with my fingers. It was nothing but a powder. I myself put this powder into an empty crucible, which I closed again, and I personally put the crucible into the furnace. When, under the instruction of M. Lemoine, who stood some distance from me, and could in no way interfere in the operation, I withdrew the crucible I found in it an agglomerated mass, which I allowed to cool before my eyes. I myself broke this shapeless mass, which presented the appearance of carbonised matter, and there I found these pure diamonds and these other diamonds less perfect." As the case has not yet been decided, it is undesirable to comment upon it at this stage. So far as we have seen the evidence, nothing is added to what has been known by chemists since Prof. Moissan found that diamonds could be produced by allowing carbon to crystallise from solution in molten iron or silver. Prof. Moissan used pure sugar charcoal to obtain his artificial diamonds. This carbon was compressed in a plugged cylinder of soft iron which was placed in a crucible containing iron rendered molten by an electric furnace. The best crystals were obtained when the crucible was afterwards cooled rapidly by immersion in molten lead. As these particulars have been matters of scientific knowledge for the past fourteen years, the Reuter telegram from Paris that the substance of the formula contained in the sealed envelope is as follows, is amusing reading:—"Take carbon of sugar, place it in a crucible, and heat to the requisite temperature. The result will be diamonds."

We have to acknowledge the receipt of a copy of No. 18 of the Bulletin of the Imperial Academy of Sciences of St. Petersburg for 1907, which contains, among other articles, an account by Dr. W. Salensky of the interesting acœlous turbellarian worm *Haplodiscus ussowii*, a species named in 1896.

The fifth number of vol. ii. of the *Philippine Journal of Science* is almost exclusively devoted to ornithology, no fewer than fourteen out of fifteen articles dealing with this subject. A number of new species (one referable to a new genus) are described, but perhaps the most generally interesting article is one on the rare monkey-eating eagle (*Pithecophaga jefferyi*) from Mindanao and Luzon. None of the specimens was perfect, and no additional information appears to have been ascertained with regard to the habits of this remarkable species.

In *British Birds* for January, Messrs. Bentham and Mouritz record the breeding of the hen-harrier and the hobby in Surrey in 1907. A nest of the former was discovered in May, originally containing four eggs, out of which two were hatched, and in due course the young took wing. Sad to relate, both parents were shot by a gamekeeper, and there is some doubt whether the young birds survived. In the same issue Mr. J. B. Nichols records a specimen of the grey-backed warbler (*Aëdon familiaris*) shot at Hythe, Kent, in July, 1907, this being the first occurrence of the species in Britain. It breeds in Asia Minor, Turkey, Greece, and further eastwards. The allied rufous warbler (*A. galactodes*) has occurred thrice in England and once in Ireland.

Whether or no they agree with all the opinions expressed, readers of the January number of the *Fortnightly Review* will unite in welcoming an article on "Evolution and Character" by the veteran evolutionist Dr. Alfred Russel Wallace. Despite the absence of any advance in human character during the whole period of which we have any definite ken, such an advance will, in the author's opinion, make itself apparent in the not distant future. It is added, however, that "our imperfect human nature . . . can only make a systematic advance through the thoroughly sympathetic and ethical training of every child from infancy upwards, combined with that perfect freedom of choice in marriage which will only be possible when all are economically equal, and no question of social rank or material advantage can have the slightest influence in determining that choice."

According to the latest report of the Liverpool Marine Biology Committee, the Marine Biological Station at Port Erin, Isle of Man, has had a most successful year's work, this being especially the case at sea, where greater activity in submarine exploration than in any previous season was rendered possible by means of a steam-yacht. This yacht, although small, has been fitted with apparatus for dredging, tow-netting, and various other purposes in the comparatively deep water outside the bay, and it is hoped that she may be available for much further exploration in the Irish Sea. The aquarium, to which nearly sixteen thousand visitors were admitted during the summer, continues to be a great success. As regards the economic side of the work, the number of plaice larvæ hatched was considerably below the average, a large percentage of the eggs being infertile. Lobster-culture, on the other hand, made steady progress, although it was found that the experiment of placing the "berried" lobsters in one of the ponds did not prove a success.

A few weeks ago we referred to a paper by Mr. Graham Renshaw on the Californian condor (*Gymnogyps californianus*). In the *Century Illustrated Magazine* for January appears an article by Mr. W. L. Finley based on several visits to the actual haunts of the bird, and illustrated with photographs of the egg, young, and adults taken at close quarters. The interviews took place high up in the San Bernadino Range of southern California, and one of the most remarkable events was the near approach the writer and his companion were able to make to the old birds without any manifestations of alarm or fierceness on the part of the latter. These birds, it appears, lay only a single egg in a season, and the young is of remarkably slow development, the black quill-feathers not showing until the nestling is more than two months old. It has been ascertained that there are only forty-one eggs of the species in collections (against about seventy of the great auk), and the number of adult birds in captivity is half a dozen. The photographs obtained during these trips—which include several of the young at different stages of development—are claimed to be absolutely unique.

An example of a plant which sheds its leaves in summer is afforded by *Euphorbia dendroides*. The large yellow bushes which in winter time adorn the Jurassic limestone rocks on the northern shores of the Mediterranean are represented in August by a network of bare brown ramify-

ing stems. In September the new leaves begin to sprout for the winter growth.

PROF. M. C. POTTER records in a leaflet his observations on a barley disease prevalent in the north-eastern counties last year, producing undeveloped grains known locally as "deaf ears." Examination of diseased flowers showed that development had followed a normal course until pollination had taken place, but at this stage arrest of development in the ovary was caused by the attack of the fungus *Helminthosporium gramineum*.

IN the *Verhandlungen des Vereins zur Beförderung des Gewerbfleisses*, Berlin, is published the substance of a lecture delivered by Dr. F. Frank before the society on caoutchouc, dealing mainly with its exploitation from natural sources and on plantations, also with the methods of its preparation and the regeneration of old rubber. Reference is made to the development in Mexico of a trade in *guayule*, the substance obtained from the shrub *Parthenium argentatum*, that is worked up in local factories. Special information is furnished with regard to plantations and methods of treating the crude latex of different rubber trees in German colonies in Africa and New Guinea.

IN connection with the problem of natural regeneration of forests in tropical and subtropical climates, an article contributed by Mr. A. W. Lushington to the *Indian Forester* (October, 1907) on sucker reproduction in certain forest reserves and jungle scrub in the Kistna district of Madras points to the importance of this mode of regeneration. The grouping of shrubs of *Bauhinia tomentosa* and Ormocarpum suggested that they were not produced from seedlings, and subsequent examination showed that sucker reproduction was the potent factor, not only in the spread of the shrubs, but also of the trees. A note by Mr. Daya Ram in the same number refers to the sporadic flowering of *Strobilanthus Wallichii* and *Strobilanthus alatus* in 1906 in the United Provinces. Previous flowerings were recorded in 1894 and 1882, giving twelve years as the normal life-cycle of these species.

FROM the Royal Botanic Gardens, Kew, we have received the final part (No. 10) of the *Kew Bulletin* for 1907, and appendix v. to the same volume, containing a list of literary contributions by members of the staff during the years 1896 to 1906. In the case of systematic papers, it has been thought useful to add to the title the names of new species. In the Bulletin, Dr. O. Stapf furnishes an account of the gums ammoniac of Morocco and the Cyrenaica. The latter, which is the gum ammoniac described by Dioscorides, is referred to *Ferula marmarica*. The Morocco product has been identified as a variety of *Ferula communis*. The gum ammoniacum of European markets to-day is yielded by the Persian plant *Dorema ammoniacum*, which has ousted the African drug. Mr. W. Dallimore contributes an article on gardens of interest near Newport, Mon., making special reference to tree cultivation. In another article attention is directed to Zapupe fibre, the product of an undetermined species of Agave that is proposed as an alternative to the sisal Agave in tropical countries such as the West Indies.

THE report of the early proceedings at the West Indian Agricultural Congress, held in Jamaica in January, 1907, together with the papers that would have been read but for the earthquake, has been published in the *West Indian Bulletin* (vol. viii., parts i. and ii.). A review of the year's work in connection with the more important agricultural industries was presented by Sir Daniel Morris in his presidential address. On the subject of sugar canes, Mr. J. R. Bovell and Mr. F. A. Stockdale discuss new seedling varieties and the methods of obtaining hybrids. Artificial cross-fertilisation offers so many difficulties that other methods, such as planting alternate rows of two selected varieties throughout a plot, have been adopted. Cacao, pine-apples, limes, and cotton provided the subjects for several papers. With regard to varieties of rubber, it is noticeable that Castilloa has received more attention than Hevea. Mr. B. H. Jones, writing about the collection of rubber in the forests of British Guiana, makes special reference to three indigenous species of Sapium.

A RETURN of the frost occurred during the past week over the whole of England, and in many places the thermometer fell as low as in the severe frost in the early part of the month. At Greenwich the thermometer in the screen registered 19°·1 on the morning of Saturday, January 11, while on the grass the temperature was 11°·1, and on Sunday the shade reading was 17°·9, which is in agreement with the lowest temperature in the earlier frost, whilst the exposed thermometer fell to 8°·8, which is more than a degree lower than during the previous frost. Among the lowest temperatures reported to the Meteorological Office on Sunday, January 12, were:—18° in the screen at Bath and Oxford, 19° at Nottingham, 20° at Dover, and 22° at Dungeness.

IN the Bulletin of the Italian Geographical Society (1907, pp. 738–745) Prof. L. Palazzo, director of the Italian Meteorological Service, under the title "I brontidi del Bacino Bolsenese," gives an interesting account of the mysterious phenomenon generally known as "*mistpoeffers*," or in English as barisal guns, from its occurrence in the delta of the Brahmaputra. The paper is compiled from reports supplied by persons living on the shores of the lake of Bolsena (Latium) and adjacent parts, and deals with the sonorous character of the phenomenon, its frequency, and the accompanying meteorological conditions. The sounds generally appear to come from the shores of the Tyrrhenian Sea, about twenty-four miles distant from the lake; the description of them agrees entirely with reports from other parts, and with the accounts published by Van den Broeck, Günther, and others. The paper contributes much information on the subject, but throws no additional light upon the physical cause of the phenomenon, whether the origin be aërial or subterranean (see NATURE, vol. lii., p. 650, and vol. liii., p. 4).

IN the Proceedings of the American Antiquarian Society, vol. xviii., Prof. A. L. Rotch makes a timely publication of Franklin's descriptions of the first balloon ascents. These interesting documents consist of five copy-press letters written to Sir J. Banks, P.R.S., in 1783, when Franklin was Minister to the French Court. One of them probably has never before been published; the others are little known, although printed, with some alterations, in the editions of Franklin's works by Bigelow in 1888 and Smyth in 1906. The first ascent was made from the Champ de Mars on August 27, 1883; the balloon was filled with hydrogen, and was capable of lifting a weight of 39 lb.; about 50,000 people assembled to see the experiment. The second ascent was a hot-air balloon from Versailles, apparently in September; it carried a sheep and some poultry. The first and second manned balloons ascended on November 20 and December 1, 1783, filled with hot air kept up by burning straw and by "inflammable air" respectively; both experiments were successful. Referring to the first manned ascent, Franklin

wrote :—"I am sorry this Experiment is totally neglected in England where mechanic Genius is so strong. . . . Your Philosophy seems to be too bashful. . . . This Experience is by no means a trifling one. It may be attended with important Consequences that no one can foresee."

THE most noteworthy article in the Journal of the Franklin Institute for December, 1907, is that by Prof. J. W. Richards reviewing the progress made in the electrothermic production of iron and steel. There is also a paper by Mr. E. S. Cole describing the pitometer, an ingenious instrument for measuring the leakage of water in mains.

THE current issue of the *Central*, the organ of the Central Technical College Old Students' Association, contains as a frontispiece an excellent portrait of Prof. W. E. Dalby. There is also an article by Prof. H. E. Armstrong on the nature of chemical change, in which he reviews the excellent research work accomplished by the chemical department of the college since 1885.

AT a meeting of the Association of Engineers in Charge held in London on December 11, 1907, Mr. L. Gaster read a paper on the province of the illuminating engineer, in which he directed attention to the waste which is going on in the conversion of energy into light, and to the utilisation of the illuminants so as to produce the best illumination. He suggested a method for reducing the existing waste, and indicated some of the important problems with which the illuminating engineer has to deal.

A BATCH of publications received from the Department of Mines of Queensland affords striking evidence of the excellent work that is being done by the Geological Survey in investigating the mineral resources of the colony. Mr. B. Dunstan (Publication No. 207) describes some copper, gold, and bismuth mines in the Burnett district, west of Maryborough. Mr. L. C. Ball (No. 208) gives a careful report on the Norton goldfield, where gold was discovered in 1871, the total yield since then having amounted to 16,630 ounces. The reefs have hitherto been worked for their gold and silver contents, and the returns would, but for the complex sulphides in the ore, have given a profit. If a suitable method of treating these sulphides were adopted, many reefs hitherto neglected would probably be opened up. Mr. W. E. Cameron (No. 209) describes some goldfields of the Cape York Peninsula. The same author (No. 210) gives an exhaustive account, illustrated by a map and fourteen admirable plates, of the Annan River tinfield, Cooktown district. He shows that rich alluvial tin occurs at numerous points over an area twelve miles long by eight miles broad. Recently, hydraulicing the face with water under pressure has been adopted, and an attempt has been made to deal with the deposits by machinery by dredging the alluvial flats. Mr. B. Dunstan (No. 211) describes the Stanhills tinfields near Croydon, where recent operations have revealed ore of exceptionally rich quality, and the field has become very active. The tin is found in lodes and in alluvial deposits, and the area of the field amounts to about 100 square miles. Mr. B. Dunstan also publishes a further report (No. 212) on some Croydon goldmines, with special reference to Bennion's reef and to the Highland Mary reef. Publication No. 213 is a map, on a scale of six miles to the inch, of the copper-mining district of Cloncurry, compiled by Mr. L. C. Ball.

To the Bulletin of the American Mathematical Society, xiii., 10, Prof. Cleveland Abbe contributes a short note on the possibility of studying the movements of the atmosphere by laboratory experiments with projections of a globe. It being necessary to use flat models, the conditions are necessarily different from those on our earth, and the author discusses the projections of the sphere best suited for taking account of different effects.

THE Transactions of the American Mathematical Society (viii., 4) contain a paper by Prof. A. G. Greenhill, F.R.S., on the elliptic integral in electromagnetic theory. The investigation was undertaken during the lifetime of the late Principal Viriamu Jones, F.R.S., in connection with the calculation of the mutual attraction of two coaxal helices employed in the ampere balance designed by Principal Viriamu Jones and Prof. Ayrton. The object is to exhibit the third complete elliptic integral in the form most suitable for computation.

IN the *Revue générale des Sciences* (November 30, 1907) M. Th. Reinach publishes, with an introduction by Prof. Painlevé, a translation of the manuscript of Archimedes discovered in 1899 by Papadopoulos Kerameus on a palimpsest parchment. This manuscript soon attracted the attention of Profs. H. Schoene and Heiberg, and the latter visited Constantinople in 1906 to study the precious document. It consists of four parts, some containing works already known, and the present article deals with the fourth, namely, the treatise on method (Éphodos), which is dedicated to Eratosthenes. It deals with the quadrature of a parabola, and with the volumes and centres of gravity of spheres, ellipsoids, paraboloids and hyperboloids of revolution, and the "method of exhaustion" adopted by Archimedes distinctly anticipates its modern equivalent of integration. A further interesting feature of the problem is Archimedes' use of the principle of the lever in comparing different solids of revolution by a kind of method of balancing the elements of one against the corresponding elements of the other.

IN the *Verhandlungen der deutschen physikalischen Gesellschaft* for November 30, 1907, Drs. U. Behn and H. Geiger give 1·63 as the result of their determination of the ratio of the specific heats of helium at constant pressure and at constant volume respectively. Their method is a modification of Kundt's. The tube containing the gas is sealed at both ends, and is clamped in the middle. Its frequency for longitudinal oscillations is adjusted by attaching metal discs to the ends with sealing wax, until the lycopodium within is set in motion by the resonance of the gas. One end of the helium tube projects in the usual way into a second tube containing air, and produces dust figures in the air from which the frequency of the oscillation is calculated.

PART vii. of vol. xxi. of the Journal of the College of Science of the University of Tokyo consists of an account of the work done by Messrs. K. Honda and T. Terada on the reciprocal relations of stress and magnetisation in a number of irons and steels. The specimens, in the form of wires, were magnetised under tension in a vertical magnetising coil, and the induction was measured ballistically both with change of stress at constant field and with change of field at constant stress. The result is a verification of the theories of Prof. J. J. Thomson and others so far as the principal effects are concerned, but hysteresis effects appear to make it impossible to test experimentally the correctness of the terms of the second order, in which the theories differ from each other.

A MEMOIR by Miss E. M. Elderton, Galton research scholar in national eugenics of the University of London, assisted by Prof. Karl Pearson, on the resemblance between first cousins, has been issued by Messrs. Dulau and Co. The memoir gives the results of two series of investiga

tions, the first dealing mainly with qualitative characters—such as health, ability, temper, temperament, and success in life—the second, not yet completed, with certain measurements on the hand, eye-colour and hair-colour, as well as health.

IN the current number of *Science Progress*, published by Mr. John Murray at five shillings net, there are several articles of interest on applied science. In the first place we notice a paper by Dr. J. S. Haldane, F.R.S., on work under pressure and in great heat, giving a very good *précis* of the author's researches in this department, which have altered the Admiralty practice as regards diving, and should alter the factory-mining regulations, when these well-meant rules are inspired by knowledge as well as good intention. The article by Dr. F. H. A. Marshall, on nutrition and fertility, touches on matters of great importance to breeders of stock, and furnishes a curious (and unintentional) commentary on the work of Prof. Chittenden on the minimum of food-stuffs. Articles that also call for mention are those of Prof. Halliburton on the repair of a nerve, and Mr. A. D. Darbishire on Mendelism. A fine portrait of the late Lord Kelvin appears as frontispiece.

AMONG the subjects of lantern-slides from photographic negatives, in the supplementary list just issued by Messrs. Newton and Co., are:—steel-making, showing operations at a great steel-works; coal-mining; wild life; pathological tissues; animal life in earlier times; eruption of Vesuvius in 1906; bacteriology of tropical diseases; and colour photography. The slides should be of real service in illustrating popular lectures upon scientific subjects.

THE old students of the Finsbury Technical College are to be congratulated on the first number of the magazine produced and published by their association. The cover of the magazine carries a medallion portrait of the principal of the college, Prof. Silvanus P. Thompson, F.R.S., and a portrait of the first president, Dr. M. O. Forster, F.R.S., forms a supplement. The reading matter includes a greeting from Prof. J. Perry, F.R.S., in which he refers to reformed methods of teaching mathematics and physical science.

THE tenth issue, that for 1908, of "Wellcome's Photographic Exposure Record and Diary," will prove of assistance to photographers. Much useful guidance is provided, and the mechanical calculator attached to the cover will be found serviceable. In addition to a complete diary for 1908, the book also contains tables for interior work, telephotography, copying, enlarging and reducing, moving objects, night photography, and for printing by artificial light. Three editions, adapted respectively to the conditions of various latitudes, are published, and the price of the volume is one shilling.

WE have received a copy of the first number of a new monthly technical magazine entitled the *Illuminating Engineer*, which is to be devoted to the subject of scientific illumination. The periodical is edited by Mr. Leon Gaster, and the price of each issue will be 1*s*. The first number, which runs to eighty-eight pages, contains a variety of articles and notes, some of which are well illustrated. Prof. J. A. Fleming, F.R.S., describes vacuum tube electric lighting; Dr. C. V. Drysdale deals with the production and utilisation of light; Mr. A. P. Trotter discusses the distribution and measurement of illumination; and Dr. Hugo Krüss gives an account of some researches on reflected transmitted light. The new periodical should appeal to all engineers concerned with illumination.

OUR ASTRONOMICAL COLUMN.

COMETS DUE TO RETURN THIS YEAR.—In No. 392 of the *Observatory* (January), Mr. W. T. Lynn publishes a number of particulars concerning the periodical comets due to return during the present year. The first named is that discovered by M. Giacobini in December, 1900, and found to have a seven-year period.

The comet discovered by Mr. Denning on October 4, 1881, has, according to the calculated elements, a period of 8·8 years. In 1890 and in 1898–9 its position was not favourable for observation, so there is a likelihood of its being re-discovered in the early part of this year.

Encke's comet has been observed at every return since it was recognised as a periodic comet in 1819, and has already been found by Prof. Max Wolf. The comet discovered by Tempel in 1869 November 27, and recognised as periodical by Swift in 1880, should reappear during the coming summer; its period was found to be a little greater than 5½ years. It was not seen in 1903, when it was last due, or in the preceding return of 1897, but was well observed in 1891.

DETERMINATION OF THE MOON'S LIGHT WITH A SELENIUM PHOTOMETER.—Some interesting results, accruing from preliminary experiments on the determination of the amount of light received from the moon at different phases, by means of selenium cells, are published in the December (1907) number of the *Astrophysical Journal* (vol. xxvi., No. 5, p. 326) by Messrs. J. Stebbins and F. C. Brown.

The moonlight was compared with the light of a standard candle burning under known conditions, the values obtained being subsequently reduced by correcting for atmospheric absorption, &c. For the light given out by the full moon the observers derived a value of 0·209 candle-power, but other cells employed gave different values, the mean value being very near to the 0·23 candle-power adopted by Müller as the mean obtained from visual observations.

The results show that at full moon we receive about nine times as much light as at half moon, and they also indicate that the moon is brighter between first quarter and full than in the corresponding phase after full moon. Observations made during the partial lunar eclipse of July 24, 1907, gave the instant of least light as 16h. 23m., whilst according to the *American Ephemeris* it was 16h. 24m.

The differences obtained by using different cells are probably due to the fact that the cells are not equally colour-sensitive, and to this point the authors propose to pay considerable attention; presumably the question of colour would not enter into the determination of the values at various phases when the same cell was employed throughout.

THE APPEARANCE OF NEPTUNE IN SMALL TELESCOPES.—A paper recently communicated by Mr. Holmes to the British Astronomical Association gave rise to an interesting discussion at the November (1907) meeting. The question discussed was the planetary appearance of Neptune in small telescopes, and whilst some of the members averred that it was difficult to recognise the disc with a 6-inch telescope, others, including Mr. Maw, stated that they had found such an instrument sufficiently large for this observation. The general result of the discussion appears to have been the conclusion that some of the earlier descriptions of the size and brightness of the disc of Neptune are misleading, although the form should be clearly recognised with an instrument of equivalent power to a 6-inch achromatic telescope (the *Observatory*, No. 392, p. 47).

THE "ANNUAIRE ASTRONOMIQUE" FOR 1908.—The excellent year-book of astronomy and meteorology issued by M. Flammarion is one of the most useful of its type and price to the amateur astronomer who reads French. It contains practically all the data he is likely to require in his work, besides a valuable annual review of the progress of astronomy. Many of the notes and directions are illustrated, and, in addition to the diary giving the astronomical phenomena for each day of the current year, there is a map of the sky for different times and dates in each month. The price of the volume is 1.50 francs.

SIMULTANEOUS OBSERVATIONS OF JUPITER.[1]

IN the December *Bulletin de la Société astronomique de France* for 1905 (p. 556), readers who possessed telescopes were invited to collaborate in a scheme for the simultaneous observation of Jupiter on prearranged dates, and to make drawings and notes of what they saw, which were to be forwarded to a central authority for correlation and discussion.

The valuable results likely to accrue from such a combined attack are too obvious to need recapitulation, and when M. Nicolas Poutiata suggested the idea to M. Camille Flammarion, that indefatigable organiser transmitted it immediately to the French Astronomical Society, and asked for its cooperation. A scheme was drawn up, thirty-six observers in various parts of Europe responded to the invitation in the December Bulletin, and Dr. Jean Mascart undertook to discuss all the drawings and notes sent in. The present brochure collects his discussions, which have been appearing month by month in the Bulletin, and gives some valuable hints for any similar undertaking in the future.

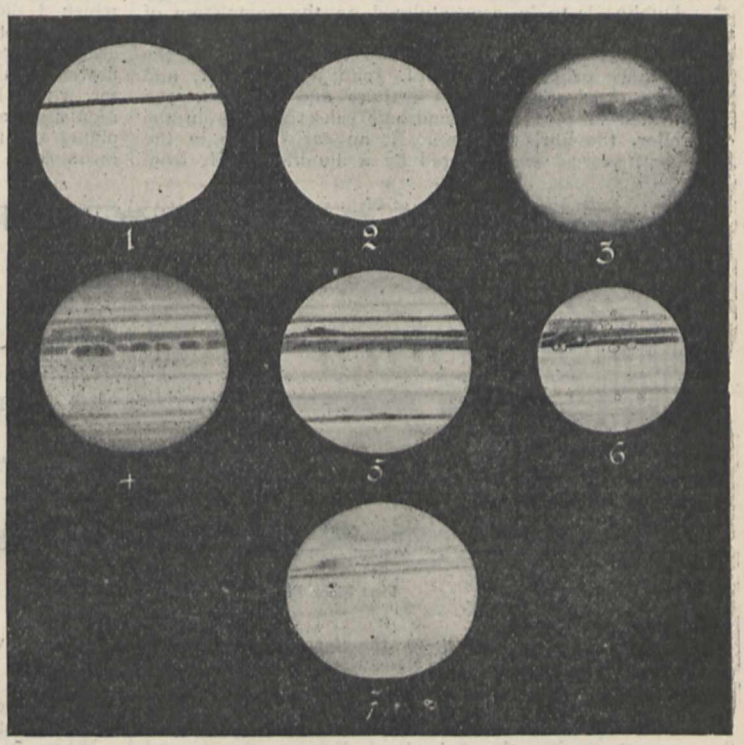
Briefly, the programme arranged was as follows:—(1) Observers were to draw on prepared discs all the markings they were able to see on the planet's surface, at 20h. 0m. (8 p.m.) *precisely* (G.M.T. Paris), on every clear night from January 2–20, inclusive, 1906. (2) Arrangements were made so that observers residing in other longitudes than Paris should know the exact *local time* at which the observations were to be made, thus preventing any ambiguity as to the precise hour of observation. (3) Drawings were to be made on previously prepared white discs identical in size and shape, the scale being such that 1 mm. on the disc corresponds to about 2000 km. on the planet. (4) Detailed instructions were also given as to the preparation of fair copies of the drawings, their orientation, &c., and also as to the noting of any written details which would assist the general discussion.

The instruments employed varied in aperture from 75 mm. to 380 mm., and eye-pieces of various powers were used. The number of observations varied from five, on January 15, to seventeen, on January 14, and, altogether, 172 individual observations were made.

To illustrate the general character and variety of the drawings, we reproduce the set made on January 2, 1906. It is interesting to note that the personality of many of the individual observers appears throughout the entire series. Thus, for example, No. 4 here reproduced was made by Herr Phil. Fauth, who for twenty years has been training his eye to see finer and finer details on the moon's surface, and it is decidedly characteristic of all the drawings made by him in this series. The similarity of the drawings of this observer and those of Dom Amann, of Aosta, Italy, is a feature of each of the series where both occur, and the apertures and powers employed were practically the same in each case. No. 5 was drawn by the latter observer.

Dr. Mascart gives the notes made each day by each observer, and reproduces the drawings with numbers so that each may be identified, the latter being arranged, so far as possible, in the order of the instrumental aperture employed. Thus No. 1 in the above series was made by an observer using a telescope of 75 mm. aperture, No. 5 with a refractor of 170 mm., and No. 7 with a reflector of 195 mm. aperture made by the observer himself, M. Paul Vincart, of Antwerp, who thus demonstrates to his co-workers that, lacking the necessary wherewithal to purchase an instrument of serious size, a very good substitute may be made "*par un peu de volonté et beaucoup d'huile de . . . biceps!*" Following the *seriatim* display of each day's notes, the author points out briefly the similarities and differences of the various drawings, directing particular attention to any striking peculiarity of any one of them.

These notes are too numerous to give in detail here, but it is safe to predict that they will amply repay the close study of every Jovian observer. The various undulations of the great southern equatorial band, the various tints of the polar regions, the fine rifts in the several bands, and many other features of interest, and of possible variation, are all recorded and commented upon. One item of more practical interest perhaps, illustrated, for example, in the drawings of January 5, is that the smaller apertures appear to give a greater relative intensity to the tints of the polar regions. Several curious globular structures, attached to the northern edge of the south equatorial band, and some *striae* in the north polar regions were recorded by Senor J. Comas Sola, using the 380 mm. Mailhat equatorial, on January 12. The seventeen drawings of January 14 form the most extensive and most valuable series, of which the various features provide plenty of material for a detailed study; one unique feature is the delineation of the south tropical band by M. Crouzel, who used the 380 mm. equatorial of the Toulouse Observatory, and shows this band as a chain-like series of loops.



The Planet Jupiter: simultaneous drawing made by different observers, January 2, 1906.

When the January campaign was ended, several observers expressed the desire to continue, but it was found that the notice was too brief to organise the matter effectively. Nevertheless, some of the observers did continue, and valuable results, which Dr. Mascart discusses, were obtained.

An attempt was made by M. Blum, at Dr. Mascart's request, to obtain photographs showing the combined results of each day's work. The methods employed are fully described in the paper, and some reproductions of the combined photograph for January 8, obtained by different methods of exposure, &c., are shown, and seem to give excellent promise.

[1] "Observations simultanées de la Surface de Jupiter réunies." By M. Jean Mascart. Extrait du Bulletin de la Société astronomique de France (1907).

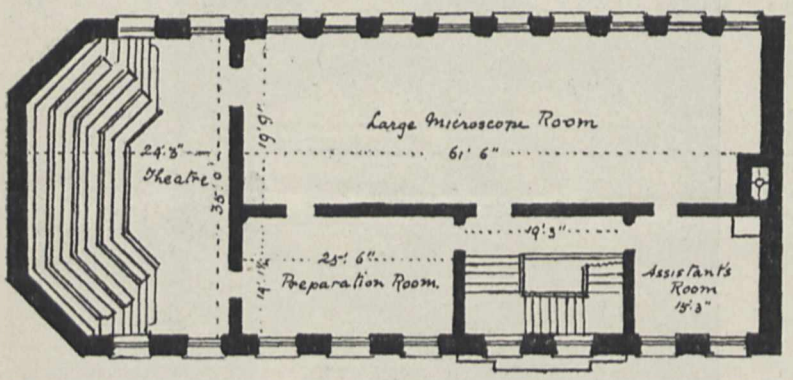
In conclusion, Dr. Mascart points out that perhaps the most valuable result of the recent attack is the experience gained, and he emphasises the details in the programme which need greater attention, such as the closer observance of the precise prearranged hour, the correct orientation of the final drawing, the care which should be exercised in confirming the presence of a faint marking before showing it on the drawing, and so on. Finally, he gives, with full detail, descriptions of various objectives and eye-pieces, showing in each case, by means of diagrams, their action on rays of light.

Taken as a whole, this preliminary campaign appears to have provided very valuable results, and it is to be hoped that future similar organisations will be guided by the experience now gained.

W. E. R.

THE NEW SCHOOL OF BOTANY, TRINITY COLLEGE, DUBLIN.

THE science schools committee of Trinity College, Dublin, is to be congratulated on the completion of the second item in its scheme for the scientific development of Trinity College. This project, which was in the first instance originated by Prof. John Joly, F.R.S., and has since owed much to his activity and devotion, was inaugurated in 1901 by a handsome subscription from the chancellor, the Earl of Rosse. At an early stage in the movement success was assured by a munificent gift from



First Floor Plan.

Viscount Iveagh. According to the terms of this gift, Lord Iveagh undertook to build those departments for which the friends of Trinity College subscribed a capital sum requisite to yield the annual upkeep. Last year the School of Physics was completed, and at the beginning of the present session the School of Botany, the second department which has been benefited by this movement, was opened for work.

The School of Botany is a two-storied building of cut granite, situated in the east end of the college park, and lies east and west. This orientation gives a large number of windows facing north, with the best light for microscopic work. The western end, being octagonal, is occupied by a lecture theatre in the upper storey, on the ground floor by a very fine laboratory for general physiology. The northern side of the upper storey is occupied by a large microscope room, which can accommodate about sixty students working simultaneously. Through a large double door in the west end of this room access is obtained to the theatre. The auditorium in the latter is octagonal, so that every seat is close to the lecture table.

On the ground floor on the north side is a room for microscopic research, a library, professor's laboratory, and the laboratory for general physiology, which also forms the west end of the building. A solidly built greenhouse running out on the north side of the building is immediately connected with the physiological laboratory; on the south side of the latter opens a chemical laboratory. In addition to the usual fittings in the physiological laboratory, there is a large dark chamber, constructed like a fume cupboard, in which plants may be grown in complete darkness, or illuminated by light transmitted through special filters. The greenhouse has a separate heating system from the rest of the building, and a centrally placed case in it may be heated by a special radiator to a higher temperature than the rest of the greenhouse. Much thought has been given to the working out of the plan and fittings of this new school, and as it stands the School of Botany in Trinity College must rank with the best in the British Isles. The architect was Mr. Wm. C. Marshall, of London, who also designed the Botanical Laboratory in Cambridge.

ON THE COLOURING MATTERS OF FLOWERS.

THIRTY or forty years ago I devoted much attention to the colouring matters in plants, studying them with my newly invented spectrum microscope. I published a few papers on particular branches of the subject, but there are other very wide questions the importance of which I did not perceive until altered circumstances led me to devote my attention to work out at sea. Amongst other things studied was the variation in the colour of flowers, which is manifestly a very extensive subject, and for which I had only limited opportunity to obtain the requisite material, having to rely to a great extent on wild plants and flowers in my garden. Though the results are incomplete, they are probably characteristic; and it may be well to publish them, since it is now impossible for me to complete them, and what I did will at all events serve to show what might be done. The whole subject is very complex in more ways than one.

The colouring matters of plants may be divided into two divisions, viz. those soluble in water but insoluble in carbon bisulphide or benzol, and those soluble in the latter reagents but not in water. Both are soluble in hydrous alcohol of the usual strength. Nearly all the blues and purples belong to the former, and most of the yellow and orange to the latter.

I found the best way of dealing with the flowers was to boil the petals or other portions in the usual hydrous alcohol, which dissolves both groups of pigments, and, after evaporating to dryness, to re-dissolve the constituents soluble in water, filter, and finally evaporate to dryness in a small saucer, in which, if kept fairly dry, the pigment will remain unchanged for a considerable time. Some pigments may be kept unchanged for a long time in a concentrated solution of lump sugar.

When re-dissolved in water many of the colouring matters soon become pale or nearly colourless, but recover their colour when evaporated to dryness. I never saw proof of this in living flowers, but it may occur when they die and fade. If there be any colour insoluble in water, it may be dissolved in carbon bisulphide, but this is seldom the case in blue, red, or purple flowers.

In those cases where the predominant colour is insoluble in water, it may be separated by agitating the alcoholic solution with carbon bisulphide, adding a little water. The bisulphide carries down the pigment in solution, which may then be evaporated to dryness in a small saucer and kept. When dissolved in alcohol or carbon bisulphide the colour fades more or less quickly, especially in the light, but if sealed up almost absolutely free from air, it will remain unchanged for many years, at all events in the dark.

Having, then, obtained the pigment in a fit state, the next thing is to examine it when in appropriate solution, either in its natural state or after the addition of a suitable reagent. To enter into full detail would make this paper far too long, but it seems desirable to give some particulars in order to show how the various pigments can be distinguished. Speaking generally, this is by their

optical properties, occasionally by the fluorescence, but usually by the absorption, as studied by a spectrum microscope, and whenever possible by the position of absorption bands under identical known conditions. This latter is very important, since their position may vary considerably with the character of the solution. I never attempted to obtain the pigments pure, in a state fit for chemical analysis, so as to determine their chemical composition.

The number of distinctly different colouring matters in flowers must be very great, and to study them completely would occupy a long time. The distribution of the different kinds is sometimes very definite, but often the reverse. In the genus Hypericum are sometimes small dark spots in the petals, and sometimes small dark rounded bodies are attached to the sepals. These are coloured by a pigment which gives a spectrum with narrow, well-marked absorption bands, which could not be mistaken for any other. This occurs in all the species I examined, but in no other flowers. On the contrary, there is a blue pigment, giving a sufficiently well-marked spectrum with several absorption bands, met with in many flowers separated about as much as possible botanically.

Much may be learned by the use of reagents. Vegetable pigments may be divided into three groups by the action of sodium sulphide, which I called Groups A, B, and C. Group A is at once made nearly or quite colourless by the addition of a small quantity of this salt. Group B is not at all altered when alkaline or neutral, but is at once made nearly colourless when acid. Group C is not changed even when acid. When made colourless the pigments are not permanently decomposed, but recover their colour when evaporated to dryness. I do not fully understand the cause of these effects.

Then, again, much may be learned from the action of citric acid and a weak alkali. The colour and spectra of many reds, purples, and blues are very different in acid, neutral, or alkaline solution. Some yellow pigments are made thirty times more intense by an alkali, whilst others are unchanged. As a rule, none of the above changes is due to a permanent alteration, but in some cases it is useful to employ stronger reagents, which decompose the natural pigments, such as nitrite of soda with the addition of a little citric acid. As an example I may cite the pigment of the common yellow garden crocus. This gives a strongly fluorescent yellow substance, unlike that produced in the case of any other flower I have examined. The only objection to such powerful reagents is that they may produce highly coloured substances from colourless bodies in the plant, and not merely alter the coloured constituent. As an interesting example I may name a deep red substance produced in the case of the different species of geranium examined, but not in the case of any other plant.

My remarks so far apply only to colouring matters soluble in water. Orange, orange-yellow, and lemon-yellow flowers are in most cases coloured by one or other of the four yellow pigments met with in green leaves, or by various mixtures of them, which are distinguished by the absence or presence of two absorption bands. These vary considerably in position according to the nature of the solvent, lying much nearer the red end of the spectrum when the pigment is dissolved in carbon bisulphide than when in benzol or alcohol. These absorption bands can also be seen in the spectra of the flowers themselves, and for some time I was unable to understand why in the case of *Chelidonium majus* they lay materially nearer the red end than in nearly all other yellow flowers which gave the same spectrum when the pigment was in solution, until I came to the conclusion that in Chelidonium it occurs in a free state, and not dissolved in oil or wax. There are other cases in plants where the spectra show that the pigments exist in a solid state, which would explain slight differences in tint.

We may now consider facts very common in cultivated plants, viz. a great variety of colours. In many cases this is easily explained, because we can see that two pigments exist, either alone or mixed in various proportions, one frequently being a yellow insoluble in water, and the other a blue or red soluble in it. As an example, I refer to the common wallflower of our gardens (*Calendula vulgaris*), which is sometimes a clear yellow, sometimes a sort of crimson, but more commonly a crimson brown. The yellow is a xanthophyl soluble in carbon bisulphide; the crimson is a pigment soluble in water; the common colour is a mixture of these two, and gives the same spectrum as a yellow and a purple petal combined. We have a similar case in chrysanthemums and various other flowers. The common garden marigold is sometimes a pure yellow and sometimes a true orange or an intermediate tint, which is due to two different pigments alone or variously mixed. One or other of these may occur separate in different parts of the same flower in some plants.

In some flowers we find a considerable variety of tints, probably due to another cause. The common bedding geraniums of our gardens are a good example of this. At one time I thought that such varying tints might be due to varying acidity, but did not obtain satisfactory proofs, though it may be true in some cases. I, however, studied several closely allied pigments from other plants, and found that they seemed to agree in nearly every particular, except that the absorption bands in the spectra were not exactly in the same place. An excellent example of this kind is the red pigment of blood, giving two very well-defined absorption bands, which differ in position if the oxygen is replaced by carbonic oxide or nitrous oxide. Also the red pigment found in many birds' eggs, which I named oorhodeine, gives precisely the same remarkable and well-marked spectrum as the product of the action of strong sulphuric acid on the red pigment of blood, except that the position of the absorption bands differs distinctly. My suggested explanation of the difference in the colour and spectra of a number of the pigments in flowers is that some fundamental constituent is the same, but modified by some varying substance in combination.

A few flowers contain pigments which give spectra with unusually well-marked absorption bands. As remarkable examples I may mention the crimson Cineraria and the deep blue Lobelia of our gardens. The spectra are of almost exactly the same character, having two dark absorption bands, only they occur at a different part of the spectrum. I am unable to say whether this shows any relationship between the pigments, but the difference in the position of the bands is perhaps too great.

It will thus be seen that a very great number of distinct pigments are found in flowers, sometimes having a very restricted distribution, and sometimes the reverse. Then, again, the plant may be able to form two or more quite distinct colouring matters, either alone or mixed in varying proportions. In some cases the pigments seem to be easily subject to change, as though some constituent could be substituted for another. In one way or another there is thus great scope for variation, perhaps not brought into play, or only to a limited extent, in wild plants, but sometimes to a remarkable extent by cultivation.

H. C. SORBY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has received a letter from Baron von Hugel, curator of the Museum of General and Local Archæology and of Ethnology, recording a gift from the Rev. John Roscoe, of the Church Missionary Society, of exceptional value and interest. It consists of a second instalment of selected native manufactures from Uganda. The chief value of the gift lies in a unique set of relics of deceased Baganda kings, which, enclosed in ornate cases, were preserved by the people under the name of Lubare (*i.e.* the Deity) in special shrines placed under the guardianship of hereditary custodians. Of these king-gods, the most sacred objects of Baganda cult, three generations are represented in the present collection.

With the first Roscoe collection, which was supplemented by a valuable gift of objects from the Katikiro of Uganda, the University acquired Kibuka, the war god of the Baganda, who with all his appurtenances was safely unearthed from his ruined shrine in the Mawokota district. In this deity, as in the Lubare, personal relics form the essentials, and in Kibuka are enshrined the jaw-bone, &c.,

of the deified chief of that name, a renowned fighter who lived in the reign of Nakibinge, the eleventh king of the Baganda.

Objects such as these are not readily to be obtained; indeed, it required years of careful investigation and all the knowledge and experience gained in the field by this veteran missionary to negotiate their safe removal from the ancient shrines of Uganda to the show-cases of the University museum.

MANCHESTER.—Daily observations at the meteorological Observatory of the University at Glossop Moor are now being taken with kites or captive balloons, and preliminary records of the results are being published every day in the *Daily Telegraph* and other papers. The work, which has been instituted by Prof. A. Schuster, F.R.S., is under the immediate direction of Mr. J. E. Petavel, F.R.S., assisted by the following staff:—Mr. Travis Rimmer, resident observer at Glossop Moor; Messrs. T. V. Pring and W. A. Harwood, and Miss Margaret White, voluntary assistants. The generous cooperation of the meteorological observatories at Buxton, Huddersfield, Stonyhurst, Sheffield, and Manchester will facilitate the working out of comparative results, in the subsequent utilisation of the observations, and should add greatly to the value of this investigation of the meteorology of the upper atmosphere.

AT a dinner of the Bristol University College Colston Society on Tuesday, the president, Mr. G. A. Wills, stated that contributions towards a university for Bristol have in the past two years amounted to 40,000*l*. He also announced that his father, Mr. H. O. Wills, has promised 100,000*l*. towards the endowment of the university for Bristol and the west of England provided a charter be granted within two years.

THE national importance of brain-power produced by universities, as well as sea-power obtained by a strong navy, was insisted upon by Sir Norman Lockyer in his presidential address to the British Association in 1903; and a comparison was made of the expenditure on higher education with that on battleships. Prof. Turner, of the University of Birmingham, speaking at Stourbridge on January 6 in connection with the Stourbridge and District Higher Education Committee, used similar illustrations in referring to the cost of technical education. He pointed out that the Birmingham University and other local colleges and universities obtain a total grant per annum of about 100,000*l*. Let this be compared with our naval expenditure, and it is found that to build one battleship of the *Dreadnought* type absorbs the whole of the funds allocated to the local universities for seventeen years. Battleships are a necessity, but the Army and Navy cannot exist apart from the nation's third line of defence—its internal manufactures—and these depend largely upon the rearing of an educated and skilled people.

THE annual meeting of the Geographical Association was held on January 8. Mr. Douglas Freshfield, who presided, said that last year he had found it necessary to comment on the extraordinary decision of the Civil Service Commissioners to exclude geography from the examinations for the higher branches of the Civil Service, including the Foreign Office, but now he was able to congratulate the association upon a reversal of that decision. The report read supplied evidence that the association continues energetically its work of improving geographical instruction. Major Close delivered a lecture on map projection. It may be noticed that various lectures on the teaching of geography have been arranged by the association. The first will be delivered by Mr. G. G. Chisholm on January 24, at 8 p.m., at University College, and the second, on scientific method in the teaching of geography, by Prof. R. A. Gregory, on February 14 at the same place and time. The remaining lectures will be delivered on alternate Fridays upon the following subjects:—Physical geography as an essential part of school geography, Mr. T. Alford Smith; how to teach the geography of a country, Prof. L. W. Lyde; orographical maps as the basis of the geography lesson, Dr. A. J. Herbertson; and geographical laboratories, Mr. A. T. Simmons. Particulars may be obtained from Mr. J. F. Unstead, 5 Wiverton Road, Sydenham.

THE issue of *Science* for December 20, 1907, contains the annual opening address delivered last October by Prof. F. F. Wesbrook, of the University of Minnesota, before the faculty of science of the University of Manitoba at Winnipeg. Discussing the needs of the Canadian university, Prof. Wesbrook instituted an interesting comparison between what is required in the direction of higher education in Manitoba and the similar needs of the University of Minnesota, which was founded nine years earlier than the Canadian institution. Although Manitoba has had a university since 1877, it cannot be said as yet to have made provision for it which is at all adequate. Manitoba has now a population of about 380,000, and with all the demand on her for increased university facilities has only been able to expend approximately 16,000*l*. for building and permanent improvement, and for maintenance 3000*l*. per annum (which until last year was only 1200*l*.), with an addition of 5000*l*. from land grant and other sources, making a total current expenditure of 8000*l*. per annum. In the case of Minnesota University, there were in 1887 only 412 students registered out of a State population of 1,180,000, and there was available 7000*l*. from State funds and a total of practically 14,000*l*. from all sources, with a total student attendance per ten thousand population of 3·49. In 1906 the population of the State had nearly doubled, the University attendance had increased to 3956, the total funds derived from the State to 50,300*l*. per annum, the total annual current expense of the University, exclusive of buildings and permanent improvements, was 108,400*l*. per annum, and the attendance at the University for each ten thousand of State population was twenty students. The total expenditure for maintenance, exclusive of State grants for hospital maintenance, special investigations, library expenses, repairs, and so on, will this year be above 132,600*l*. Well may Prof. Wesbrook urge the people of Manitoba to emulate the American example he cites. It is to be hoped that the approaching visit of the British Association to Winnipeg will assist the Canadian authorities in developing the University.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 14, 1907.—"On the Cranial and Facial Characters of the Neandertal Race." By Prof. W. J. **Sollas.**

As a result of a comparison of the calvarium of the Neandertal race with that of the aborigines of South Australia, it is shown that a much closer resemblance exists than some authorities have supposed, especially as regards the calottal height, Schwalbe's ("bregma") angle, and the bregma index. The chief differences are to be found in the cephalic index, the continuity of the frontal torus, and the deeply impressed character of the frontal fossa.

Comparisons based on the glabella-inion line are misleading, owing to the inconstancy in position of the inion.

The exterior foramino-basal angle owes its perplexing anomalies to the fact that its magnitude is determined by five variables, one of which is connected with the cranial height, so that in depressed forms of skull it acquires a higher value than might otherwise be expected.

The Gibraltar skull is the only example of the Neandertal race which presents the bones of the face and the basi-cranial axis in undisturbed connection with the calvarium. Its characters, apart from the cranial vault, are unique; no other known skull possesses so long a face or such a large and broad nasal aperture. In profile, the nasal curve flows into that of the glabella, without any sudden change of flexure, that is, there is no nasal notch, such as occurs in the Australians.

The orbit, as in all skulls of the Neandertal race, is distinguished by its excessive height above a line drawn from the nasion to the middle of the fronto-zygomatic suture.

The sphenethmoidal angle has been measured from the limbus sphenoidalis by a line drawn to the crista galli on the one hand and the basion on the other; it exceeds the corresponding angle of the lowest known South Australian skull, similarly measured, by 16° 30′.

The palate is very dolicho-uranic. The thickness of the frontal bone, measured on one side of the crista galli, is 24 mm. The prognathism of the upper jaw, in whatever way measured, is extremely small, so that the skull must be classed as orthognathous.

The cranial capacity is estimated at 1250 c.c., a close approach to that of the Neandertal calotte. The average capacity of South Australian skulls is very similar, but ranges from 1460 c.c. to 1100 c.c. If the calotte of Pithecanthropus represents the mean of a similarly variable race, then the extreme forms of such a race would almost completely bridge over the hiatus between man and the higher apes.

Society of Chemical Industry, January 6.—Dr. J. Lewkowitsch in the chair.—Some observations on the keeping power of Fehling's solution, together with notes on the volumetric process of determining reducing sugars with it: Dr. Francis **Watts** and H. A. **Tempany.** The authors point out that, contrary to the commonly expressed idea, Fehling's solution, or at least Violette's modification of it, is not liable to deteriorate rapidly if kept in the dark, and if access of air is prevented. The solution can thus be kept mixed ready for use for many months, and it is not necessary to keep the stock in the form of two solutions to be mixed as required.—The determinations of small quantities of bismuth: H. W. **Rowell.** Methods of separation suitable for ores, copper, and base bullion are given which eventually precipitate the bismuth, together with various impurities which do not affect the subsequent colorimetric estimation, but aid in the collection of the bismuth. The colour test depends upon the solubility of bismuth iodide in excess of potassium iodide producing a yellow colour. The test is very delicate, and the amount of bismuth in copper or base bullion may be determined within five hours.

Mathematical Society, January 9.—Prof. W. Burnside, president, in the chair.—The distinctive character of Lord Kelvin's mathematical investigations: Prof. A. E. H. **Love.**—A formula of interpolation: C. S. **Jackson.**—Hilbert's invariant integral in the calculus of variations: T. J. I'A. **Bromwich.**—An operator related to q-series: Rev. F. H. **Jackson.**

PARIS.

Academy of Sciences, January 6.—M. Henri Becquerel in the chair.—Report presented in the name of the section of geography and navigation concerning a subject put forward by the Geographical Society of Paris relating to meteorological telegrams from Iceland: Bouquet **de la Grye.**—The transformations of the comet 1907*d*: Ernest **Esclangon.** The variations in the form of the comet on approaching perihelion were studied under very favourable conditions of weather and atmosphere, and are illustrated by six diagrams.—The use of flames as valves for alternating high-tension currents: André **Cathiard.** When two electrodes, one of which has a very small section compared to the other, are placed in a flame and in a high-tension (2000 volts to 10,000 volts) circuit, a small continuous current passes, a sort of faintly luminous arc being produced in the flame. In the experiments described, the frequency was forty per second, and a current was obtained, not exceeding 0·03 ampere, capable of producing galvanic deposits. The nature of the current has not yet been studied with the oscillograph.—Contribution to the study of the formation of certain precious stones of crystallised alumina: F. **Bordas.** Exposure to a temperature of 300° C. for a long time causes the yellow colour of both natural (Oriental topaz) and artificial yellow corundums to disappear. The Oriental emerald, a very rare stone, can be produced by starting with a sapphire-blue stone and subjecting it to the above temperature for a certain time. Further experiments with the kathode rays, analogous to the β-radium rays, do not cause colourless corundums to pass to yellow, and the yellow stones are not affected.—The harmonics of a vibrating body: G. **Sizes** and G. **Massol.**—Some new homologues of diglycollic acid: E. **Jungfleisch** and M. **Godchot.**—The mechanism of the transpositions of the phenyl group in the iodohydrins and aromatic glycols: Marc **Tiffeneau.** Although the mechanism of the transpositions of iodohydrins of the type Ar(R)C(OH).CHI.R is definitely established, the interpretation of the mechanism of the transpositions of the aromatic glycols by the formation of diethylene oxides can only be considered as provisional.—The structure of the fundamental substance of hyaline cartilage: Ed. **Retterer.** From the morphological and structural point of view, the fundamental substance of hyaline cartilage is identical with bone substance. It represents, in fact, only the second stage of evolution of the cytoplasma of the cartilaginous cell.—The development and structure of the spores of *Thelohania Giardi*: L. **Mercier.**—The existence of six branchial arches and six aortic arches in the embryo of the mole: A. **Soulié** and C. **Bonne.**—The fertilisation and development of the eggs in *Rhopalura ophiocomae*: Maurice **Caullery** and Alphonse **Lavallée.** The egg evolves into an embryo with perfectly individualised cells, and having none of the plasmodial structure of the ulterior parasitic stages. Ten figures of the egg in different stages of development accompany the paper.—Prolonged anæsthesia by mixtures of oxygen and ethyl chloride: Pierre **Rosenthal** and Albert **Berthelot.** The authors have been able to prolong the anæthesia due to ethyl chloride by administering it mixed with oxygen. In experiments with animals, a true anæsthesia lasting an hour was obtained, the subject going under very rapidly, the narcosis quiet, and recovery prompt. They hope to be able to apply the method to human subjects, more especially as this anæsthetic has the great advantage of not causing the after effects of ether and chloroform.—The slow action of chlorinated products derived from bacilli: MM. **Moussu** and **Goupil.**—The value of the magnetic elements at the Observatory of Val-Joyeux on January 1, 1908: Th. **Moureaux.**—The study of a series of specimens of sea-water collected in the English Channel: A. **Chevallier.** Determinations were made of the density, temperature at the time of collection, chlorine, and sulphuric acid. A curve is given showing the difference of density as ordinates, and the distance from Dieppe as abscissæ.

NEW SOUTH WALES.

Royal Society, October 2, 1907.—Mr. H. Deane, president, in the chair.—Law of meteorological phenomena: A. G. **Williams.**—A simple form of Sprengel vacuum pump: Prof. J. A. **Pollock.** A modified short-fall Sprengel vacuum pump of moderate dimensions is described, in which the raising of the mercury, necessary for continuous working, is effected by evaporating the mercury at a lower and condensing it at a higher level.—Note on the internal structure of some gold crystals: Prof. A. **Liversidge.** The author exhibited sections of isolated crystals and groups of gold crystals, mainly octahedra and rhombic dodecahedra, and photographs of the same before and after cutting. The simple faces on polishing and etching showed that the internal structure did not correspond with the external; *e.g.* in one case the rhombic planes of an externally simple dodecahedron were found to be made up of two triangular faces; on these triangles there were also faces of smaller crystals. Some showed a still more complex structure.

November 6, 1907.—Mr. H. A. Lenehan, vice-president, in the chair.—Notes on the Arranda tribe: R. H. **Mathews.**—A short, accurate method for the estimation of iron, alumina, and phosphoric acid when occurring together: Dr. T. **Cooksey.** When iron, alumina, and phosphoric acid occur together the iron is estimated by a volumetric process (as, for instance, by means of potassic iodide and thiosulphate of soda); the phosphates of the two metals are weighed, and the phosphoric acid in filtrate estimated, as previously described. These data are sufficient for the determination of all three quantities. The method is short and very accurate.—Note on the formation of formaldehyde in solutions of cane sugar, and its bearing on Hehner's test for formaldehyde in saccharine mixtures: A. A. **Ramsay.** The author directs attention to the production of formaldehyde when cane sugar and water are heated at a temperature below that at which caramelisation might take place. This fact explains how a reaction for formaldehyde by the Hehner test (which is one generally used, and particularly delicate) may be obtained from manufactured products

such as jams, sweetened condensed milk, or saccharine liquids, &c., and to which the manufacturer has added no formaldehyde, by the usual analytical operations of distilling a slightly acidified aqueous solution of the substance and testing the distillate, since the act of distilling a saccharine liquid results in the formation of formaldehyde.

Linnean Society, November 27, 1907.—Mr. J. H. Maiden, vice-president, in the chair.—The geology of the Nandewar Mountains, New South Wales: H. I. **Jensen.** The physiography and geology of the Nandewars offer points of similarity to those of the Warrumbungle Mountains. For example, the Nandewars present the features of arid erosion, and the level country to the west of them forms an arid-erosion peneplain. In late Palæozoic times the present line of trachyte necks was practically a shore-line, with land to the west and sea to the east. By the end of the permo-Carboniferous period, the sea had given place to a fresh-water lake. In Triassic and Cretaceous times sedimentation took place west of this line, and erosion east of it. During late Mesozoic times the area of the Nandewar Mountains was reduced to a peneplain; basic laccolites were injected, and basic lavas flowed over parts. During early Tertiary times much faulting took place. Lavas escaped from the main fissure and from numerous cross-fractures. Tuffs, ashes, and breccias were ejected, and alkaline lavas solidified in their vents. Gradually more basic types of lava were emitted. In one respect the Nandewar Mountains differ from the Warrumbungles in that, in the Nandewars, sill-structure is represented on a grand scale.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—Alternate Current Measurement: Dr. W. E. Sumpner.—Prominence and Coronal Structure: Dr. W. J. S. Lockyer.—The Conversion of Diamond into Coke in High Vacuum by Kathode Rays: Hon. C. A. Parsons, C.B., F.R.S., and A. A. Campbell Swinton. On the Perception of the Direction of Sound: Prof. C. S. Myers and Prof. H. A. Wilson, F.R.S.—Preliminary Note on Certain Phenomena of the Electric Discharge through Rarefied Nitrogen: Dr. G. J. Burch, F.R.S., J. E. Marsh, F.R.S., and R. de J. F. Struthers.

ROYAL INSTITUTION, at 3.—The Building of Britain: Prof. W. W. Watts, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.—The Vaal River Diamond Diggings: M. Park.—The Eruptive Diamond-bearing Breccias of the Boshof District, South Africa: J. P. Johnson.—The Auriferous Banded Ironstones and Associated Schists of South Africa: O. Letcher.

SOCIETY OF ARTS, at 4.30.—Indian Agriculture: Henry S. Lawrence.

LINNEAN SOCIETY, at 8.—(1) Brassica Crosses, illustrated by lantern slides: (2) Notes on Wild Types of Tuber-bearing Solanums, illustrated by lantern slides: A. W. Sutton.—Revision of the genus Illigera, Blume: S. T. Dunn.—New Coniferæ of Formosa: Bunzō Hayata.

CHEMICAL SOCIETY, at 8.30.—Colour and Constitution of Azo-compounds. Part II. The Salts of *p*-Hydroxyazo-compounds with Mineral Acids: J. J. Fox and J. T. Hewitt.—The Oxidation of Aromatic Hydrazines by Metallic Oxides, Permanganates, and Chromates: F. D. Chattaway.—Studies in Fermentation. II. The Mechanism of Alcoholic Fermentation: A. Slator.—Organic Derivatives of Silicon. Part IV. The Sulphonation of Benzylethylpropylsilicyl Oxide and of Benzylethyldipropylsilicane: H. Marsden and F. S. Kipping.—The Formation and Reactions of Imino-compounds. Part VI. The Formation of Derivatives of Hydrindene from *o*-Xylylenedinitrile: C. W. Moore and J. F. Thorpe.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 9.—The Centenary of Davy's Discovery of the Metals of the Alkalis: Prof. T. E. Thorpe, C.B., F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Third Report to the Gas-Engine Research Committee: Prof. F. W. Burstall.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Principles of Engineering Geology: Dr. Herbert Lapworth.

SATURDAY, JANUARY 18.

ROYAL INSTITUTION, at 3.—The Electrification of Railways: Prof. Gisbert Kapp.

MONDAY, JANUARY 20.

SOCIETY OF ARTS, at 8.—The Theory and Practice of Clock Making: H. H. Cunynghame, C.B.

VICTORIA INSTITUTE, at 4.30.—Resemblances between Jewish Ideas and Customs and Those of India: Col. T. H. Hendley.

TUESDAY, JANUARY 21.

ROYAL INSTITUTION, at 3.—The Internal Ear of Different Animals: Dr. Albert A. Gray.

ROYAL STATISTICAL SOCIETY, at 5.

MINERALOGICAL SOCIETY, at 8.—On Zeolites from the Neighbourhood of Belfast: F. N. A. Fleischmann.—On Strüverite and its Relation to Ilmenorutile: Dr. G. T. Prior and Dr. F. Zambonini.—Twin-structure: Dr. J. W. Evans.—On a Simple Method of Drawing Crystals of Calcite and other Rhombohedral Crystals, and of Deducing the Relations of their Symbols: Prof. W. J. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Experimental Investigations of the Stresses in Masonry Dams Subjected to Water Pressure: Sir J. W. Ottley, K.C.I.E., and Dr. A. W. Brightmore.—Stresses in Dams: an Experimental Investigation by Means of India-Rubber Models: J. S. Wilson and W. Gore.—Stresses in Masonry Dams: E. P. Hill.

WEDNESDAY, JANUARY 22.

GEOLOGICAL SOCIETY, at 8.—The Origin of the Pillow-Lava near Port Isaac in Cornwall: Clement Reid, F.R.S., and Henry Dewey.—On Subdivision of the Chalk of Trimmingham (Norfolk): R. M. Brydone.

SOCIETY OF ARTS, at 8.—Siam and its People: H. Hillman.

THURSDAY, JANUARY 23.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* Report on the Eruption of the Soufrière in St. Vincent in 1902, and on a Visit to Montagne Pelée in Martinique. Part II.: Dr. Tempest Anderson.—On the Intimate Structure of Crystals. Part VI., Titanic Oxide, its Polymorphs and Isomorphs: Prof. W. J. Sollas, F.R.S.—Dietetics in Tuberculosis. Principles and Economics: Dr. N. D. Bardswell and Dr. J. E. Chapman.—The Origin and Destiny of Cholesterol in the Animal Organism. Part I., On the so-called Hippocoprosterol: C. Dorée and Dr. J. A. Gardner.

ROYAL INSTITUTION, at 3.—Recent Light on Ancient Physiographies: Prof. W. W. Watts, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Standard Performances of Electrical Machinery: R. Goldschmidt.

FRIDAY, JANUARY 24.

ROYAL INSTITUTION, at 9.—The Extinction of Malta Fever: Col. David Bruce, C.B., F.R.S.

PHYSICAL SOCIETY, at 5.—Recalescence Curves: W. Rosenhain.—An Experimental Examination of Gibbs' Theory of Surface Concentration Regarded as the Basis of Adsorption, and an Application to the Theory of Dyeing: W. C. M. Lewis.

INSTITUTION OF CIVIL ENGINEERS, at 8.—A Cost Theory of Reinforced-Concrete Beams: J. R. Wade.—The Neutral Axis in Reinforced-Concrete Beams: E. I. Spiers.

SATURDAY, JANUARY 25.

ROYAL INSTITUTION, at 3.—The Electrification of Railways: Prof. Gisbert Kapp.

MATHEMATICAL ASSOCIATION, at 2.30.—Address by the President, Prof. G. H. Bryan, F.R.S.—On the Teaching of Elementary Mechanics, with Special Reference to the Preparation and Use of Simple and Inexpensive Apparatus: W. J. Dobbs.—On the Teaching of the Elements of Analysis: C. O. Tuckey.—On the Geometrical Treatment of Series in Trigonometry, with Lantern Illustrations: F. J. W. Whipple.—On a New Treatment of Similarity in Elementary Geometry: W. E. Bryan.—Machine for Drawing Rectangular Hyperbolas: H. L. Trachtenberg.

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