THURSDAY, DECEMBER 5, 1907.

A TEXT-BOOK OF PLANT PHYSIOLOGY.

Lectures on Plant Physiology. By Prof. Ludwig Jost. Authorised English translation by Prof. Harvey Gibson. Pp. xiv+564; illustrated. (Oxford: Clarendon Press, 1907.) Price 21*s.* net.

PROF. JOST'S lectures appeared in German in 1904, and were soon appreciatively reviewed in the columns of NATURE. It was twenty years since a book had appeared so admirably adapted for the use of students of the physiology of plants, and an English translation was eagerly awaited by teachers of the subject. Now that it is to hand we find that it contains several hundred mistranslations; quotation of a short series of these will show how greatly the English rendering lacks accuracy. On p. 44, and elsewhere, "succulent plants" become "oily plants." On p. 114, by mistranslation, all Brown and Morris's work on the carbohydrates of foliage leaves is transferred to another investigator.

On p. 128, the fact that in Engelmann's micro-spectral investigations by the bacterial method the assimilating cells are lighted from *below* is ignored, and the significance of a table of data is destroyed in translation by the illuminated side being styled the *upper* side. On p. 229, Pflüger's hypothesis that respiration always involves direct oxidation of the actual substance of the protoplasm itself is stated in one sentence, and yet the next says that if it could be shown that nitro-bacteria only oxidise ammonia in their respiration, this theory would be *established*. The German says the exact opposite—that the theory would thus be *disproved*. On p. 230 we find the statement that small doses of sugar and organic food *accelerate* the development of nitrifying organisms, whereas the *inhibiting* action of such "nutriments" upon these special organisms is one of the outstanding wonders of protoplasmic mutability. On p. 265 it is stated that certain "cells exhibited growth at their ends" instead of "the cell-growth came to an end."

On p. 278, dealing with the forms of the plant-body, we read:—

"There are quite a number of plants which form only one axis, on which no lateral members save leaves are produced. In a second series may be placed the numerous coniferæ which *develop lateral branches only*. The majority of higher plants, however, form both lateral buds and leaves."

Consultation of the German shows that the three contrasted series really are:—main axes bearing (1) leaves only; (2) leaves and occasional lateral branches; and (3) leaves and as many lateral buds as there are leaves. On p. 334 the process of "budding" is described under the title of "grafting," and that of "grafting" under "budding." On p. 335 "leaf-trace" is translated by "leaf-spur," while on p. 331 it appears as "leaf-base." On p. 339, discussing the range of adaptation to habitat, we read:—

"Although amphibious plants can live in water as well as on land, there is usually in the long run a certain minimum and a certain maximum degree of dampness which may not be exceeded; in other words, amphibious plants cannot on the one hand become aquatics nor on the other xerophytes."

It is hard for the English student to divine that what the author says is that amphibious plants on land generally need a fair amount of moisture; they cannot range from an aquatic habit all the way to a xerophytic habit.

On p. 400 one sentence says that the raising of the temperature of the arum spadix above that of its environment by respiration is scarcely appreciable during *intra-molecular* respiration, while the next says that the organ is hotter in intra-molecular respiration than in normal respiration. On p. 407 we find that Askenasy observed certain capillary phenomena on wetting "deposits on cover-glasses"; this should be on wetting "a pile of cover-glasses": on the same page it is stated that the possibility of gelatine having, in its substance, microscopically fine capillary spaces containing air is disproved by its "impermeability to air"; the German says by its "transparence."

On p. 543 there occurs the following incomprehensibility as a rendering of the Weber-Fechner law as exemplified in human perception of differences of weight:—

"A weight of 1 mg. must be increased one-third, a weight of 10 mg. must be increased ten-thirds before we can appreciate a difference between them."

In some ten or more places the expression "presentation time," in reference to a stimulus, is rendered by "latent period" to the complete confounding of the sense.

Finally, the headings of the chapters are not always correctly rendered. Chapter xxxii. deals with movements due to "Kohäsion des Füllwassers," which means the cohesion of the water-contents filling the cells. Yet in the title and throughout the chapter *Füllwasser* is translated by "imbibition-water," which is quite a different phenomenon.

To these faults of commission are yet to be added those of omission. In the bibliographies at the ends of the chapters all the titles of English works still remain in the German language. Is the student to take no pride in his heritage in the work of Darwin, Hales, Knight, and others? Further, all the many works translated from the German by the Oxford Press are quoted in German without reference to the fact that there are English translations available for students. Even the references to Pfeffer's "Physiology" are all to the pages and volumes of the German edition.

When provided with a list of essential corrections of the text, this text-book will be a very valuable addition to the distinguished series of German handbooks prepared for English students by the Clarendon Press.

In conclusion we may express our high esteem for Prof. Jost's lectures. The exposition is extremely lucid, and just what is needed for students taking up the advanced study of physiology. The author pays well-merited tribute to Pfeffer's classical handbook.

with which the present work does not compete in fulness of treatment, the different parts of the subject being elaborated only so far as will be assimilable by students. In dealing with matters that are still unsettled, the author shows considerable judgment, but he has perhaps a tendency to over-refine the division and classification of phenomena, as, for example, in discussing symbiosis, parasitism, and fermentation.

Short passages, in square brackets, have been interpolated by the author here and there in this issue with the intention of bringing the text up-to-date. Special details may be thus indicated, but broader advances can hardly be dealt with in this way; nevertheless, the work is the most modern exposition of the physiology of plants available in any language.

F. F. B.

LIQUID AND GASEOUS FUELS.

Liquid and Gaseous Fuels, and the Part They Play in Modern Power Production. By Prof. V. B. Lewes. Pp. xiv+334. (London: A. Constable and Co., Ltd., 1907.) Price 6*s.* net.

WITH the multiplication of institutions where the teaching of applied science is made a leading feature, there has sprung into existence quite a number of text-books which specially appeal to students of this kind. Some of these works are both interesting and useful, but it must be confessed that they one and all seem rather to appeal to the type of mind which is disinclined to attack any really difficult problems. Text-books such as were published twenty years ago, by men such as Rankin and Cotterill, which endeavoured to get at the scientific principles underlying the applications of applied science, seem, with very few exceptions, to have gone out of date and to have become replaced with more interesting and better written books, dealing more or less with the descriptive part of the subject which they treat. Prof. Lewes very modestly states that he does not wish to produce a work that shall, to any extent, enter into detail, and his book is professedly a sketch of the subject. This is to be regretted, as we feel sure that a chemist of such eminence could have produced a work which would have been of great value, not only to the students, but to that large class of engineers who wish to get information on some of the difficult points in connection with both liquid and gaseous fuels.

The chapters on combustion deal wholly with burning at ordinary pressures, and are both clear and accurate. It is unfortunate that the scope of the work does not allow Prof. Lewes to allude to some of the phenomena of burning under pressure, a subject of enormous importance, and one of which very little is known.

The description of the various forms of solid fuels, together with the determination of their calorimetric values, is well done, but we should have expected to find something said about the discrepancy which almost always occurs when using the Junker calorimeter with gas and air, which has not been completely saturated, as this affects the quantity of condensed water that has to be measured in order to obtain the lower value.

There is a great deal of useful information on the subject of liquid fuels; the arrangement of the hydrocarbons contained in these fuels is very well brought out, and no student can read through this chapter without acquiring a good idea of the various forms of liquid fuels derived from a common base.

The manufacture of coal-gas is, of course, of very considerable interest. There is nothing very novel, nor, should we say, of much service to the average student, unless, indeed, he is proposing to become a gas engineer.

There is an excellent description of the various methods of making water-gas, which at one time it was anticipated would play a very considerable part in the application of cheap gas for both heating and power purposes, and is very largely used for certain work. The large percentage of carbon monoxide which it contains has caused it to be looked upon with suspicion, except for the purpose of carburetted water-gas for use in coal-gas mains, and it is probable that very little water-gas is used for any other purpose, although, probably, this gas would be very much more used if it were possible to obtain a reduction in the standard now insisted upon as regards the illuminating value of gas.

The description of the producers proper is not so full as the merits of these producers would entitle them to. The suction producer is alluded to, but not described to any great length, and in considering the bituminous producers Prof. Lewes appears to consider that it is essential in bituminous plants to recover the ammonia. This is, of course, a mistake. There are a large number of bituminous plants running which do not recover the ammonia, and which are perfectly satisfactory. Indeed, it is doubtful whether in the method of using excess steam in order to prevent the destruction of ammonia the value of the bituminous plant is not brought down, as a much better gas can be made when the steam is cut down to the lowest amount which can be used to prevent clinkering.

The last chapter, which deals with the fuel of the future, is certainly the most interesting of the whole work, and it points out very clearly that when the existing supplies of fuel become limited, we shall have to fall back upon alcohol, produced from vegetation of some sort or another, which may be made almost inexhaustible. There is no doubt that this is quite correct, and it is very much to be regretted that at present no experiments on alcohol on any scale can be made, owing to the restrictions which our fiscal conditions impose, and we presume that owing to this, the work will be carried out in some other country where the Government is more sympathetic towards scientific research.

There is one point which Prof. Lewes appears to have overlooked. He considers that the alcohol will be either manufactured from potato starch or sawdust. There seems no reason to doubt that when the question becomes urgent some highly-specialised plant will have been brought into existence for the sole

purpose of absorbing the maximum amount of carbon dioxide from the air, and in this manner it may be possible enormously to increase the amount of carbon which a given area of land will pick up. This may sound fanciful, but the wonderful improvements which hybridisation has effected in the past make it quite possible that in the future still greater improvements may be looked for.

A PRACTICAL HANDBOOK ON RUBBER.

Rubber Cultivation in the British Empire. By Herbert Wright. Pp. vi+100. (London: Maclaren and Sons, 1907.) Price 2*s.* 6*d.*

THIS is one of the most interesting and useful little books yet published on rubber cultivation, and should be in the hands of every planter. It is a reprint of a lecture delivered before the Society of Arts. The book is not only of great value to those interested in plantation rubber, but also to those interested in the development of wild rubber. Mr. Herbert Wright, who was at one time controller of the Government experimental station in Ceylon, is now the editor of the *India Rubber Journal.* He is also the author of one of our best standard works on rubber, viz. "Hevea Brasiliensis," which is a scientific treatise on the botany of rubber. The present publication is more in the form of a useful and practical handbook, and deals with the great potentialities of the rubber industry, and its importance from "the producer's standpoint, especially in British possessions."

The gradually increasing demand for raw rubber, and the remunerative prices obtained, have produced enormous developments in the past few years on Eastern plantations. At the present the most important centre for rubber collection is tropical America, which supplies about 60 per cent. of the world's output. Africa comes next with 30 per cent. to 35 per cent., but tropical Asia last year only contributed 3 per cent. Borneo, New Guinea, Fiji, New Caledonia, and the Seychelles are also commencing to develop a strong interest in rubber-producing plants.

"It may be safely stated," writes Mr. Wright, "that to-day there are no less than 14,000,000*l.* of English money represented as paid up capital in companies directly or indirectly concerned with rubber growing. Furthermore, it may be estimated that approximately 30,000,000*l.* worth of rubber may be consumed during the present year."

The natural order which supplies the greater part of the world's rubber is the Euphorbiaceæ, the most valuable species being the Hevea, which produces the well-known Para rubber which has been planted so extensively in Ceylon, Federated Malay States, Straits Settlements, and Sumatra.

Mr. Wright speaks with considerable authority and experience on plantation Para rubber, and he thinks that it will sooner or later obtain a prominent, if not the commanding, position as a source of future rubber; but this will not be for many years, for in speaking of wild rubber he says:—

"Should the supply from wild sources become scarce—an improbable occurrence—it would be impossible for the plantations to supply the balance for many years to come, as the producing capacity of the land now alienated for rubber in the East will only be in 1912 or 1913 some 12,500 to 25,000 tons per year. The rubber manufacturers have hitherto been dependent, almost entirely, on wild rubber; and it seems illogical to suggest that the rubber forests on which so much new capital and enterprise have been recently expended, and in which prominent scientific and business men are concerned, will be unable to satisfy the increased demand expected in the next few years. It may confidently be regarded as the principal source of rubber for the next half score of years, for the simple reason that plantations in the proper sense do not exist to produce what will be required."

At the end of the lecture there is an instructive discussion, in which Lieut.-Col. Prain, Mr. Gray, Mr. Fritz Zorn, and Mr. S. Figgis took part.

L. C. B.

OUR BOOK SHELF.

School Hygiene; a Handbook for Teachers of all Grades, School Managers, &c. By Herbert Jones. Pp. x+151. Dent's Mathematical and Scientific Text-books for Schools. (London: Dent and Co., 1907.) Price 2*s.*

THIS is one of the many books that the great movement towards school hygiene has thrown up. The book, or rather booklet, contains practically nothing that is new, but the selection of topics is done with judgment and care; every main subject of environmental hygiene is touched on with sufficient fulness to meet the needs of immediate practice or to provoke to further reading, and the illustrations are profuse and good. The author has succeeded in treating "the subject as simply as possible." The work of Dr. Kerr at the London County Council is largely drawn upon. As in Dr. Newsholme's "School Hygiene," the book is allocated half to the school and half to the scholar. In criticism, it may be said that rather much space is given to matters, *e.g.* site, building construction, and sanitary appliances, &c., that the teacher cannot alter or affect, and rather little space to what he can affect. But with this qualification the booklet forms a good introduction to the subject. The writing is well adapted to the intended readers.

Regeneration and Transplantation. By Prof. E. Korschelt. Pp. 286; 144 figures. (Jena: G. Fischer, 1907.) Price 7 marks.

OF recent years there has been much experimenting and not a little theorising regarding regeneration and grafting. The results of the experiments have sometimes been very remarkable and full of theoretical suggestiveness, and they are now so numerous that a general survey of their import is very welcome. We have already a volume on regeneration by Prof. T. H. Morgan which has been of great service; we have now an analogous volume by Prof. Korschelt. He traces the phenomena of regeneration through the world of organisms, in unicellulars and multicellulars, in plants and in animals, in young forms and full-grown forms, showing the varied distribution of the regenerative capacity and its varied expressions, and always returning to the central question, How has it come about, and by what precise processes does it come about, that a lost part is re-grown and the intactness of the creature restored? Special sections of the book are devoted to a discussion of such subjects as the following:—autotomy, often-repeated regeneration, restitutions and regulations, heteromorphosis, atavism in regeneration, imperfect and superfluous regeneration, the relation of the nervous system to

regeneration, the relation of regeneration to nutrition, to reproduction, to age, and to environmental conditions. The author's exposition is lucid, and there is an illustration on every second page. In the second part of the book we find an account of grafting or transplantation in plants and in animals, with strange figures of grafted polyps and worms, pupæ and tadpoles, frogs and newts—an altogether quaint assemblage. At the end of the book there is an exhaustive bibliography, certainly amazing in its dimensions, very usefully subdivided into sections relating to different aspects of the subject. As to the general theory of regeneration, Prof. Korschelt seems to incline to a compromise between the views of Weismann and Morgan, admitting that there is a great deal to be said on both sides. He seems—for he is anything but dogmatic—to believe that the regenerative capacity is a primary quality of living matter, which, along certain lines of evolution, has been accentuated and specialised by natural selection. Thus the regenerative capacity is, in general, a primary quality, but in particular cases an adaptive character.

Organische Zweckmässigkeit, Entwicklung und Vererbung von Standpunkte der Physiologie. By Dr. Paul Jensen. Pp. xiii+251. (Jena: Gustav Fischer, 1907.) Price 5 marks.

PROF. JENSEN has produced a book which attempts to deal in a philosophical manner with some of the most difficult problems that confront the biologist. The reader will perhaps be inclined to deprecate an attitude of "cock-sureness" that rather pervades the whole, but he will at the same time recognise that in many places the author is stimulating and suggestive.

A great part of the whole volume is devoted to the examination of the various explanations that have been put forward to account for adaptation in the organic world, as well as of those which have attempted to deal with the meaning and the method of evolution.

After a somewhat lengthy discussion of these topics, the author puts forward the analogies shown by various cosmic mechanisms to assume positions of relative or absolute stability, and he regards them as useful in throwing light on the problems of evolution. The whole of the constructive part of the book strikes us as very speculative, and though of undoubted interest, it may be doubted whether the point of view as advocated by Jensen will find much sympathy amongst working biologists. The title of the work indicates that it is written from the standpoint of physiology, but we have searched its pages in vain to find any serious physiology, as ordinarily understood, discussed in it at all. There is much philosophy of a sort, and much acute destructive criticism of many ideas and notions that are widely current. But it does not appear that in grappling with the problems he has set himself to face and to solve, the author has expressed himself so clearly as did Herbert Spencer many years ago. There is much in the work before us that recalls the "Principles of Biology," though there is a great difference between the lucid expression of Herbert Spencer and that of our author. The following passage, relating to the causes of extinction of species and genera in the past, will furnish a fair sample of the method of treatment:—"According to our theory of development, a *natural* extinction of species is to be anticipated as the expression of a general law. Organisms that are dying out in this way fall into the same category as those systems which, after enduring through a long period in a stationary condition, pass finally, as the result of slowly advancing changes, into a relatively stable state (death); a destiny that . . . in time will overtake many existing organisms, in spite of the 'rejuvenating' effects of amphimixis" (p. 237). J. B. F.

LETTERS TO THE EDITOR.

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The Windings of Rivers.

AT the meeting of the British Association at Edinburgh in 1892 I read a paper on the subject of the winding of rivers before the geographical section. It was illustrated by a large number of diagrams, but, as these could not be included in the report of the meeting, only the title of the paper appeared. It may not be out of place to give a short account of it, as the subject is now attracting some attention.

In Fig. 1 the courses of three streams are shown. These are distinguished by the letters A, B, C, without indication of their identity or of the scale on which they are drawn. If anyone were to try to select the one which represents the largest or the smallest of these streams he might do so correctly, but he would not be surprised if he were told that he had guessed wrongly, for it could only be a guess. The length of each tracing is the same. In nature it represents in A nine English miles, in B two hundred and sixteen miles, and in C one and a half miles.

Tracing B represents the part of the Mississippi between the mouth of the Arkansas River and that of the Red River. Tracing A represents the Devon Water, a tributary of the Forth, and tracing C represents a quite insignificant brook called the Catter Burn, a tributary of the Endrick, one of the principal affluents of Loch Lomond. These tracings, and indeed the maps of all countries, show clearly the great family likeness exhibited by rivers in all parts of the world. This likeness rests on the fact that in all rivers the relation between the length of an arc or bow and that of its chord is nearly the same. It is an organic rather than a family likeness, and resembles that which exists between dogs of different breeds or builds.

The following table shows, for a selection of well-known rivers, the degree in which the above relation holds good:—

River on the stretch		Length of stretch		Ratio	Number of bows	Average length of bows
From	To	Direct	Along windings			
Mississippi		Miles	Miles			Miles
Columbus	Memphis	124	204	1·65	23	8·87
Memphis	Natchez	270	490	1·83	62	8·10
Natchez	Baton Rouge	88	133	1·51	18	7·39
Baton Rouge	Carrolton	72	124	1·72	20	6·20
Columbus	Carrolton	554	955	1·72	122	7·83
Thames						
Marlow	Walton	18·7	30·0	1·61		
Teddington	Isle of Dogs	16·8	26·5	1·58	11	2·4
Danube	Near mouth	11·4	22·5	1·97	13	1·73
Rhine		kilom.	kilom.			kilom.
Germersheim	Mannheim	34·1	69·2	2·03	11	6·3
Main		114	144	1·27	44	3·27
Neckar						
Heilbronn	Mannheim	80	112	1·40	26	4·30
Lahn						
O. Lahnstein	Limburg	17·2	29·7	1·73		
Mosel	Nr. Coblentz	7·0	10·0	1·43		
Ahr						
Altenahr	Ahrweiler	4·6	9 6	2·09		

From the table it will be seen that over a length of nearly one thousand miles of the Mississippi the average length of stream, following the windings, is 1·72 times greater than the direct distance. In the Lahn we find

almost the same factor. The Lower Danube, the Rhine, and the Ahr show a factor approximating to 2. The Main, Mosel, Neckar, and Thames have lower factors. The mean of all the factors is 1·68. For a certain number of the rivers the number of "bows" is given with their average length. The size of the bows stands in some relation to the volume of the river. What that relation exactly is I am not able to state. To arrive at it will require a careful study of the flood waters of the river in connection with the form of its bed. It is the flood waters which form the bed. When the river falls to low-water level we often see it cutting out a secondary bed on a much smaller scale, which is obliterated by the next following flood.

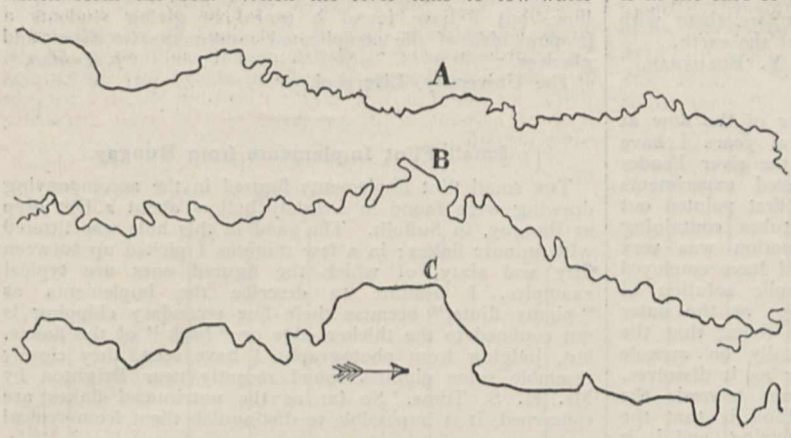


FIG. 1.

It may be taken that the mean track of a stream traces the line of lowest level in the valley. Consequently, the ground must rise on both sides of it. The cross-section of the valley through the river resembles that through the middle of a watch glass, rising at first very slightly on both sides of the stream, then more rapidly as the confines of the valley are approached. It is evident that water displaced to one side of the river will, in returning to it, tend to pass to the other side, and to oscillate about the lowest point.

If the bed of a stream flowing through alluvial ground were rectified so as to direct the water along a straight trough cut in the material, it might preserve a straight course for a time, but a stream following such a course is in a state of unstable equilibrium. The smallest accident or obstruction disturbs the uniform rectilinear motion of the water, and tends to induce oscillations, both longitudinal and transverse. These begin immediately to cut into the banks, if they are yielding, and take larger and larger dimensions until they reach a limit when they have produced a course of the sinuosity which corresponds to the laws of the harmonic motion of its waters.

No attempt was made to arrive at these laws *a priori*. The method of investigation used was purely empirical. Curves were traced according to all kinds of harmonic specification until some were obtained which resembled the courses of actual rivers. Fig. 2 shows one specimen out of many which were exhibited at the meeting of the British Association.

It is assumed that the rhythmic motion set up in a mass of water which is disturbed in its uniform rectilineal motion will be reducible to two reciprocating motions, one in the direction of the fall of the stream and the other at right angles to it. When the gradient of the stream is very steep and the nature of the bed homogeneous, as it is in the case of water flowing down the front of a glacier, the longitudinal oscillation is swamped by the powerful and continuous action of gravity, which does not affect the transverse component. In these circumstances we often meet with small streams which describe an almost perfect simple harmonic curve.

In the ordinary stream of the meandering type the gradient is very small, in the case of the Mississippi from 2 inches to 4 inches per mile, so that the longitudinal pulse can produce its full effect. When the two oscillations are simple pendulum motions and have the same period they produce an ellipse, which, when combined with the steady onward flow due to gravity, produces sinuosities unlike those of actual streams. When the period of the transverse oscillation is twice that of the longitudinal one, their combination produces a figure of eight (8). When a figure of eight is combined with steady forward motion so that both are travelled over in the direction of the arrows in the figure, then it does delineate a curve which may resemble the course of an actual stream. This is illustrated in Fig. 2. In it the sinuous curve falls into three parts, each consisting of a double bow, corresponding to a complete excursion of the tracing point round one of the figures of eight. The horizontal line indicates the path of undisturbed flow of the stream running from left to right in the direction of the arrows. It is divided into seventy-two equal spaces, each of which represents the distance which would be covered by the undisturbed stream in the interval of time in which the circle which generates the transverse reciprocating motion describes one twenty-fourth of a revolution, so that the undisturbed stream passes over twenty-four spaces in the time that the tracing point passes once round the figure of eight. The resultant path of the tracing point is the sinuous curve, which cuts the horizontal line at 12 and 24 when the symmetrical 8 is used, and in 36, 48, or 60, 72 when one of the other two figures is used. It is an essential condition that the tracing point shall go round the 8 in the direction of the arrows, so that it shall be moving in the same sense as the undisturbed water when it traverses the outside parts of the figure which are approximately parallel to the path of undisturbed flow. In describing the sinuous line it is convenient to draw the figure of eight on tracing paper. Then, when the

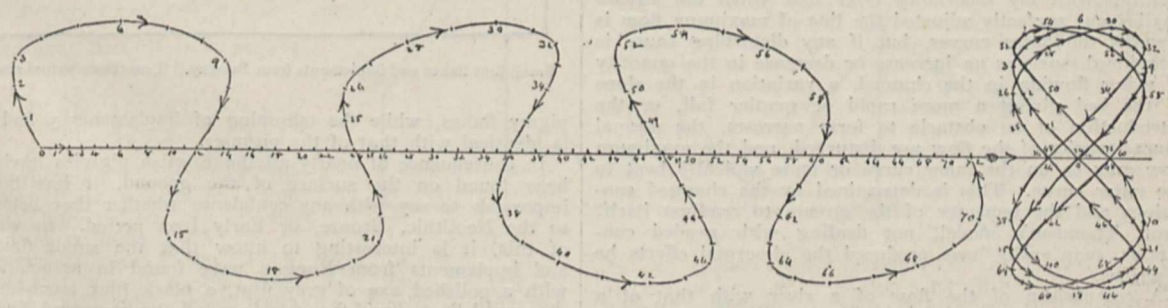


FIG. 2.

centre of the 8 is placed over any mark on the horizontal line numbered, say, 9, the point on the periphery of the 8 numbered 9 must be superposed on the point on the sinuous curve also numbered 9.

The description of the sinuous line is a simple case of mechanical drawing, and presents no difficulty. By varying the harmonic composition of the figure of eight and the rate of undisturbed flow of the water, an infinite number of different individual curves can be produced which are all covered by the same generic specification. It is an interesting occupation, in leisure moments, to compose curves of this kind and to compare them with those traced by actual rivers on the face of the earth.

J. Y. BUCHANAN.

IT is not difficult to show the character of the flow at the bottom of a small river. For several years I have taken my students along the course of the river Fender near Birkenhead, and we have conducted experiments which confirm the laws of bottom flow first pointed out by Thomson. At first we put down tubes containing coloured liquids, and the stream-line motion was very clearly shown by lines of colour. Later, I have employed lump sugar soaked in a strong alcoholic solution of magenta. On placing one of these cubes at the outer bend of a curve—the "turnpool"—it is found that the water there is almost stagnant. Gradually an aureole of coloured water forms round the sugar as it dissolves, and this slowly creeps across the stream towards the inner bend. The advantage of this method is that the coloured sugar is several minutes in dissolving, and it is very easily carried about.

For surface flow I have found mahogany sawdust to be the best, as it approaches water in density, and the fine particles are not influenced by air currents.

Although in measuring the surface flow the line of maximum velocity is usually more eccentric than the middle line of the stream, there are cases where the quickest flow is near the inner bend.

In a small experimental river in my laboratory I can produce both effects at will. A river is always tending towards a definite adjustment of its parts to correspond with the characteristics of its flow. The floor becomes graded by the filling of hollows and the removal of obstacles, and the swings become regular and rhythmic like the swings of a pendulum. This condition is seldom found except in the flood plains, and I presume this is the special case referred to by Sir Oliver Lodge.

In the ungraded part many exceptional and interfering circumstances come into play. I have noticed in experimenting with my laboratory river that when the stream has become perfectly adjusted the line of maximum flow is towards the outer curves, but if any disturbing cause is introduced, such as an increase or decrease in the quantity of water flowing in the channel, a variation in the slope of the bed giving a more rapid or gentler fall, or the introduction of an obstacle to form narrows, the normal characteristics of the flow are disturbed, and the maximum flow may be on the inner curve or more violently bent to the outer curve. This is determined by the changed conditions and the tendency of the stream to readjust itself. Prof. Thomson's model, not dealing with graded conditions, may easily have produced the abnormal effects he describes.

A comparison of the flow of a river with that of a glacier shows more points of similarity than most people suppose. In a curved glacier such as the Findelen, the surface at the outer bend is higher than at the inner bend, and the inner bend is always marked by a "toe-cap" moraine like the shallows on the inner curve of a river. It is only reasonable to suppose that this is the result of a cross current under the glacier, such as can be demonstrated in rivers. Moreover, we have in glaciers the phenomena of whirlpools and eddies where tributaries join the main stream.

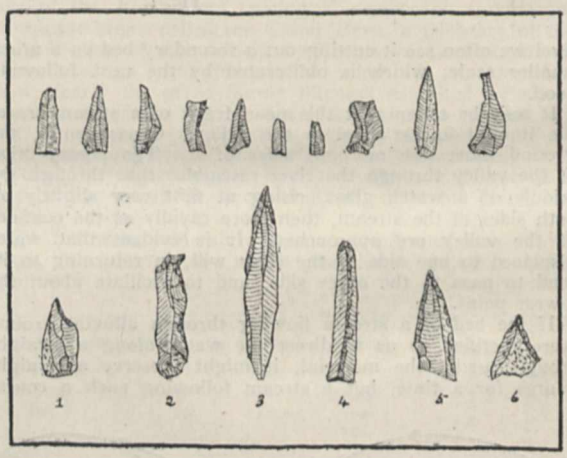
The phenomena of flow are practically the same whether the medium is solid, liquid, or gaseous. The essential feature of flow is *shearing*. In a stream the surface layers shear over the lower, the mid-stream portion shears through the lateral parts, and in a meandering course momentum impels the water towards the outer bends and shears it round the slower moving water in the inner bend. So in glaciers and even in solid rocks flowing under earth stresses the same laws apply. The only difference lies in the unit of shear. In the case of liquids and gases this is extremely small, whereas in glaciers it is usually the "Kugel" which gives rise to the corn structure in glacial ice. In rocks the unit varies from masses of gigantic size to others of very small dimensions. This, perhaps, may be regarded as a very crude conception of the meaning of flow, but I have found it useful in giving students a graphic idea of the complicated movements in rivers and glaciers.

J. LOMAS.

The University, Liverpool.

Small Flint Implements from Bungay.

THE small flint implements figured in the accompanying drawing were found in a sandy hollow about 2 feet deep at Bungay, in Suffolk. The sand in this hole was littered with minute flakes; in a few minutes I picked up between fifty and sixty, of which the figured ones are typical examples. I hesitate to describe the implements as "pigmy flints," because their fine secondary chipping is not confined to the thicker edge or "back" of the flakes, but, judging from photographs I have seen, they closely resemble some pigmies found recently near Brighton by Mr. H. S. Toms. So far as the untrimmed flakes are concerned, it is impossible to distinguish them from typical



Small flint flakes and implements from Bungay. Two-thirds actual size.

pigmy flakes, while the trimming of implements 3 and 5 is identical with that of the pigmies.

In consequence of nearly all the English pigmies having been found on the surface of the ground, it has been impossible to say with any confidence whether they belong to the Neolithic, Bronze, or Early Iron period. In view of this, it is interesting to know that the small flakes and implements from Bungay were found in association with a polished axe of grey flint, a black flint lance-head of very delicate workmanship, one of the rare and finely chipped triangular "knives," and some small convex scrapers showing very delicate secondary chipping. These implements were found in the same sandy hole when the small implements were discovered, and from an examination of the sides of the hollow it was evident that they all came from what might be called a "Neolithic floor" about 18 inches from the surface of the ground. Nowhere on the surface of the surrounding ground could I find a single flake or implement, and if the ground had not been disturbed in order that a small quantity of sand might be carted away, not one of the implements would have been brought to light. As it happened, they were all found within an area of about six square yards. Some

small bones found on the same site have been identified as those of a girl or a small woman.

The makers of the small flint implements evidently had their home or their "workshop" on a sandy knoll only a few feet above the level of the marshes of the Waveney Valley. On this knoll and a neighbouring one there are some saucer-shaped depressions in the ground very suggestive of hut-circles. W. A. DUTT.

Lowestoft.

Graphical Interpolation.

SIR GEORGE DARWIN has directed attention (*Mess. of Math.*, 1877; Phil. Trans., A, 1891; "Collected Works," vol. i., p. 319) to the problem of interpolating values of

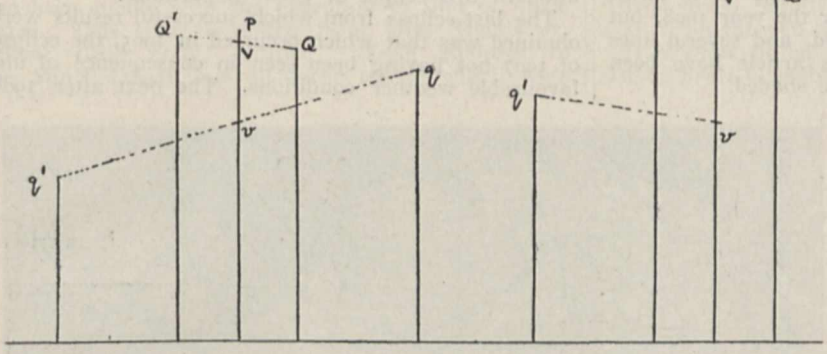


FIG. 1.

FIG. 2.

a function at points each half-way between two consecutive points of an equidistant set, *e.g.* for determining probable half-hourly values when the hourly ones are found from observations. Let q', Q', Q, q be four points (Fig. 1) with equidistant ordinates u', U', U, u. It is required to find P where the graph through these four points cuts the ordinate half-way between Q and Q'. By taking the origin on the half-way ordinate and writing the function as

$$y=a+bx+cx^2+dx^3+\ldots,$$

we find that if we neglect terms beyond x^3, then

$$a=\frac{U'+U}{2}+\frac{1}{8}\left(\frac{U'+U}{2}-\frac{u'+u}{2}\right).$$

A rule for determining the point P is accordingly:—join QQ', qq' and let them cut the central ordinate in V, v respectively, then P lies in vV produced, and $PV=\frac{1}{8}Vv$. This rule, although theoretically identical, is simpler in form than that discovered by Sir George Darwin, and seems to be safer, especially near a point of inflexion. It may be worth noticing that in the special case where QQ' and qq' are parallel, the cubic reduces to a parabola, and the rule for finding P is involved in the relation $PV : Pv = QV^2 : qv^2 = 1 : 9$. At the beginning and end of the series the rule breaks down, but it can be adapted by assuming the parabolic form for the first and last arcs. In the latter case q is indeterminate, and $q'v$ must be drawn parallel to $Q'Q$ (Fig. 2).

In the diagram (Fig. 3) the rule is applied to an example in which the assumption that the function can be expressed as a power series is scarcely justifiable, but it will be seen that it makes it easy to draw a smooth curve through the points Q. F. J. W. WHIPPLE.

Merchant Taylors' School, E.C.

Reflection of Polarised Light.

SOME recent correspondence (vol. lxxvi., p. 637) having directed attention to an error in Preston's "Theory of Light," I venture to send notice of another error in the same work (see article 158). The same error will be found in Prof. Tait's article on light (see p. 611, vol. xiv., of the "Encyclopædia Britannica"), and is repeated in his text-book on light (article 271).

I sent word of the error to the late Sir George Stokes, who expressed himself astonished at it, and said he would look into the matter; but I did not hear from him again, as his letter to me (dated September 19, 1902) was written only five months before his death.

Let the planes of two thin plates of ordinary glass, A and B, be parallel, so that light, which has been completely plane-polarised by reflection from A, falls at the polarising angle upon B. Preston states that this light will be wholly reflected from B, whilst Tait states that this light will be reflected, almost without loss, from B.

As a matter of fact, if we represent by unity the intensity of the polarised beam incident upon B, then the intensity of the light reflected from B will be represented by about $\frac{8}{9}$, and this takes into account both surfaces of B. The remainder of the beam, about $\frac{1}{9}$, is transmitted. To reflect the whole of the incident beam an infinite number of plates would be

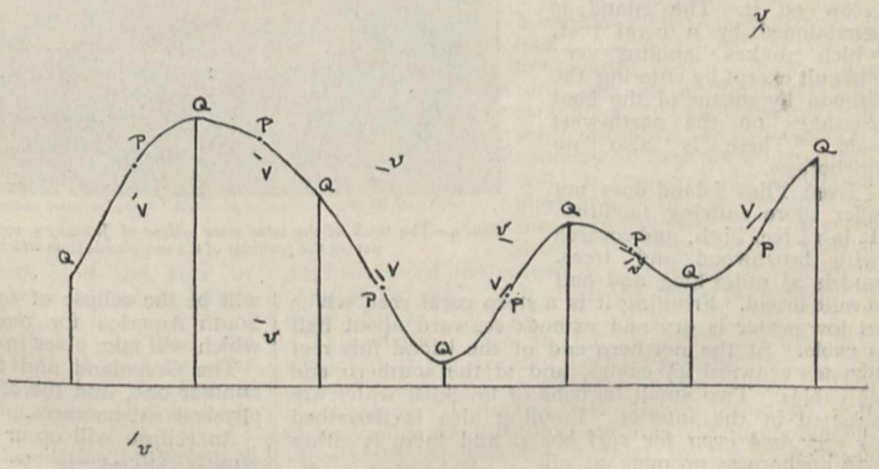


FIG. 3.

required, and the glass would have to be perfectly transparent.

Both authors state correctly that, when the plane of reflection of B is perpendicular to that of A, and the polarised light from A falls at the polarising angle on B, then practically none of this light will be reflected from B.

I therefore think that the mistake arose from accidentally supposing that the total want of reflection in the second case should be balanced, as it were, by a complete reflection in the first case. C. T. WHITMELL.

Invermay, Hyde Park, Leeds.

THE TOTAL SOLAR ECLIPSE OF JANUARY 3, 1908.

ON the third day of the approaching new year, according to Greenwich mean time, a total eclipse of the sun will take place, the line of totality passing from a point in the Pacific, about east longitude 155° and north latitude 12°, in a curved path through Polynesia and terminating in Mexico.

Unfortunately for astronomers and others who go far afield to make observations on these occasions, the eclipse is mostly restricted to the ocean, and the only two portions of land from which totality can be seen are two Pacific islands, namely, Hull Island, in the Phœnix group, and Flint Island, to the north of Tahiti.

The accompanying map, Fig. 1, gives a general idea of the path of the line of totality. It is taken from the "Nautical Almanac" for the year 1908, but has here been considerably reduced, and several lines which were not required for this article have been omitted, and the land areas more shaded.

The positions of the two islands to which reference above has been made are denoted by two small circles on the central line. Even these observing stations do not offer those facilities with regard to anchorage, landing, shelter, &c., which make eclipsing easy, as the following particulars, gathered from Dr. Downing's paper in the Monthly Notices of the Royal Astronomical Society, will show.

Hull Island has a lagoon and a little fresh water, and cocoa-nut trees 50 feet high grow on it. The island is surrounded by a coral reef, which makes landing very difficult except by entering the lagoon by means of the boat passages on the north-west side. There is also no anchorage.

Even Flint Island does not offer more enticing facilities. It is 13 feet high, and covered with brushwood and trees, and is 2½ miles long and half a mile broad. Fringing it is a steep coral reef, which at low water is dry and extends seaward about half a cable. At the northern end of the island this reef extends seaward 4½ cables, and at the southern end 2½ cables. Two small lagoons of brackish water are situated in the interior. Landing also is described as very bad even for surf boats, and there is either bad anchorage or none at all.

So far as is known at present, no one intends going to Hull Island, but as Flint Island will be occupied the following data regarding the particulars of totality, gathered from the above-mentioned source, may be of interest. As the island is situated in longitude 151° 48′ W. and latitude 11° 26′ S., the duration of totality is 4 minutes. Such a long eclipse will be specially suitable for the study of some problems, and more especially for those connected with the corona. This station is also very favourable in another respect, because the sun at eclipse time has an altitude of 74 degrees, or only 16 degrees from the zenith.

The following table shows the times of the four contacts of the moon with the sun in both Greenwich and local mean time.

Mean Solar Time.

	Greenwich					Local			
		d.	h.	m.	s.		d.	h.	m.	s.
(1)	January	3	7	52	51	January	2	21	45	39
(2)	,,	3	9	22	44	,,	2	23	15	32
(3)	,,	3	9	26	44	,,	2	23	19	32
(4)	,,	3	11	2	59	,,	3	0	55	47

While the accessibility of the station and the weather conditions are not all that could be wished for, the length of totality, the great altitude of the sun, and the importance of continuity of observation of eclipses are sufficiently tantalising to tempt astronomers to journey to this far-off land.

There is another reason which makes the observation of this eclipse of great importance.

The last eclipse from which successful results were obtained was that which occurred in 1905, the eclipse of 1907 not having been seen in consequence of unfavourable weather conditions. The next after 1908

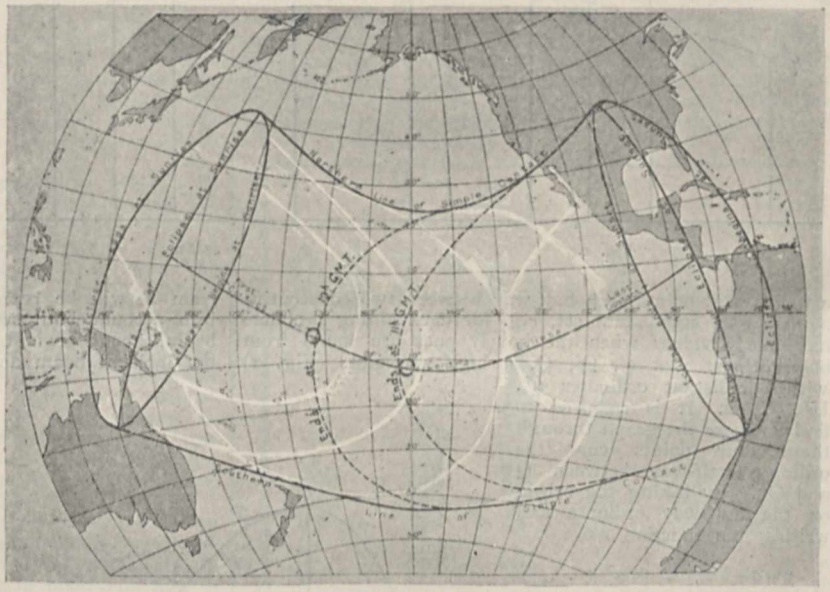


FIG. 1.—The track of the total solar eclipse of January 3, 1908. The small circles on the central line denote the positions of the two islands from which totality can be observed.

will be the eclipse of 1912, which will be visible from South America for one minute. The other eclipses which will take place in this interval are as follows:—

The Greenland and Siberian eclipse of 1909 is an annular one, and therefore not of any importance for physical astronomers.

An eclipse will occur in Tasmania in 1910, but as totality will commence at 4h. 3·5m. and end at 4h. 6·4m., and as the sun will set at 4h. 53m. Hobart mean time, the sun will probably be too low for any extensive series of observations.

In 1911 an eclipse track will begin in the south-eastern portion of Australia, pass across the Pacific Ocean, and finish by skirting the coast of Florida.

It may be that some islands lie in the track, in which case this eclipse can be utilised, but at the Australian end of the line the sun will probably have too small an altitude to warrant the sending of expeditions from great distances.

In April of 1912 there will be an eclipse visible in Spain, but until the calculations are published it

is not certain whether it will be "total" or "annular." This uncertainty is due to the fact that the apparent diameters of the sun and moon on that occasion will be so very nearly equal that it will depend on the value of the moon's diameter employed in the computations whether the sun will be totally eclipsed or not. Should it prove, however, to be total, the time of duration will probably be very short. Such an eclipse would most probably be a very valuable one from the point of view of the spectroscopic study of the chromosphere.

It will thus be seen that we shall most probably have to wait until October, 1912, for a favourable eclipse following that of 1908, so it is hoped that the approaching event in the Pacific will be satisfactorily observed.

The accompanying map of the world (Fig. 2) shows the tracks of all the eclipses to which reference above has been made, with the exception of that of April, 1912. This chart is taken from Mrs. Todd's excellent little book, entitled "Total Eclipses of the Sun" (1894), but all those tracks which were not required have been deleted, and the year of occurrence of each eclipse has been printed in larger type.

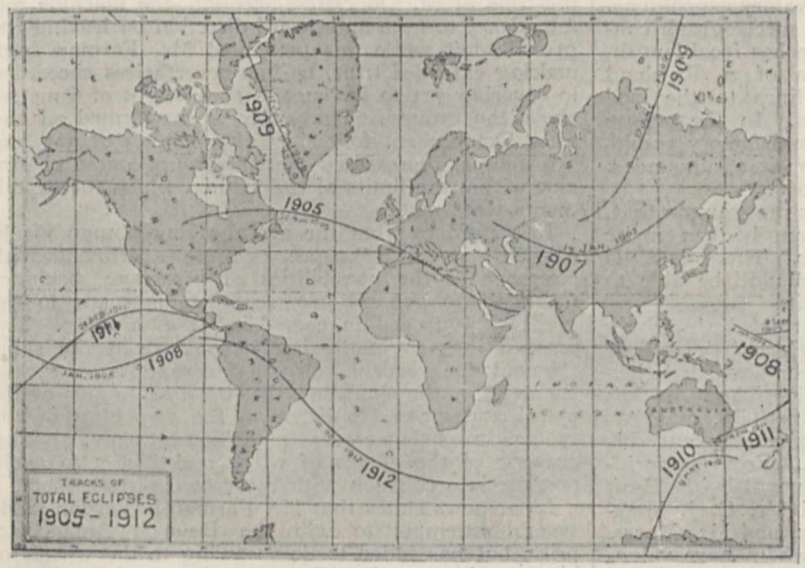


FIG. 2.—Chart showing the tracks of all the total solar eclipses from 1895 to 1912. The 1909 annular eclipse is included also, but the uncertain total eclipse of April, 1912, which might be seen from Spain, is excluded.

It is interesting further to point out that the eclipse of 1905 occurred at the time of greatest solar activity as indicated by the sun-spots, while that of 1912 will take place about the epoch of minimum sun-spots.

The eclipse of 1908, occurring in an intermediate year, will therefore be a useful connecting link between the two, and renders it important even from this point of view alone.

The only official expedition which, so far as is known, has made preparations to view this eclipse is the one from the Lick Observatory in America, under the direction of Prof. W. W. Campbell. Flint Island will be the observing station, and Mr. William H. Crocker, of San Francisco, who has defrayed the expenses of five previous expeditions, has again offered to finance this one. The Navy Department of the United States has come forward and provided a war vessel to transport the expedition from Tahiti to Flint Island and back. The ship put on this special duty is the *Annapolis*, and she will be under the personal command of His Excellency Governor Moore, U.S.N., of the Island of Tuituila, Samoa.

No doubt the officers and men of the *Annapolis* will prove most valuable assistants to Prof. Campbell, as they were found useful in the eclipse of 1905. On that occasion, it may be remembered, the United States Navy Department sent a "special eclipse squadron" of three vessels to Europe, under the command of Rear-Admiral C. M. Chester, U.S.N., the result of which was a complete series of observations only the preliminary results of which have as yet been published.

To describe briefly the scientific staff and instruments which will be conveyed by the *Annapolis*, reference has been made to the contents of an article which recently appeared in the Journal of the Royal Astronomical Society of Canada (vol. i., No. 4, p. 254) from the pen of Mr. C. A. Chant.

It is there stated that the party will probably consist of Prof. Campbell, with Messrs. Aitken, Perrine, and Albrecht, of the Lick Observatory; Prof. Lewis, of the University of California; Prof. Abbot and his assistant, and possibly one or two other assistants. They will all sail from San Francisco on November 22, arriving at Tahiti on December 4. The party will then join the *Annapolis* and sail for Flint Island.

With regard to the instrumental equipment, corona pictures on a large and small scale will be secured by a 40-feet focal length coronagraph pointed straight at the sun, and by a 5-inch objective of 70 inches focal length respectively. For the purpose of searching for intra-Mercurial planets, two groups of four cameras each will be pointed towards the east and west equatorial regions of the sun's surroundings. Objective-prism spectrographs, or prismatic cameras as they are often called, will be employed for obtaining photographs of the spectrum of the chromosphere. In one of these "running" plates will be used to record the sequences of changes in the spectrum of the sun's limb about the times of second and third contact.

This method was, so far as I am aware, first employed at Sir Norman Lockyer's suggestion in the prismatic camera in my charge at the eclipse of 1896 in Lapland. Unfortunately, clouds prevented any photographs at all being secured. Prof. Campbell successfully applied the method to the eclipses of 1898, 1900, and 1905, and therefore proposes to continue the series.

Other spectrographs included in the programme are one of low dispersion for recording the general structure of the corona, another for the determination of the wave-length of the green coronal line, and a third for studying the form of the gaseous envelope responsible for the green line. For the ultra-violet spectrum of the corona, Prof. Lewis is taking out a large quartz spectrograph. Polariscopic photographs will be undertaken, and a study of the brightness of the corona as a whole will be attempted.

From the above brief sketch it will be gathered

that Prof. Campbell's party is equipped with a fine set of instruments, and that it is prepared to cover a wide field of research.

Although the above will be the only official expedition to the island, an enthusiastic amateur in the person of Mr. F. K. McClean is already wending his way there. Mr. McClean is the son of the late Mr. Frank McClean, F.R.S., who, it will be remembered, besides completing a valuable spectroscopic survey of the brighter stars in both hemispheres, made valuable endowments both to the Cape Observatory and the Cambridge University.

At the eclipse of 1905 Mr. F. K. McClean accompanied the Solar Physics Observatory's expedition to Majorca as volunteer assistant. On that occasion he was in charge of a large coronagraph of 16 feet focal length, which he manipulated successfully, so he is not a novice at eclipse work.

For the coming eclipse he is taking out a fine 22-inch siderostat, one coronagraph, and a small grating spectrograph. The coronagraph consists of a 4⅛-inch De la Rue objective of 8 feet focal length, which has been used on numerous occasions during eclipses by the Solar Physics Observatory expeditions.

The optical parts of the grating spectrograph consist of a 4-inch Voigtländer of 42 inches focal length, and a Thorp's transparent replica of a Rowland diffraction grating having 14,500 lines to the inch and a ruled surface of 3 × 2 inches. In the eclipse of 1905 this instrument gave such satisfactory results that Mr. McClean wished to employ it again under, it is hoped, better weather conditions.

Mr. McClean has so arranged his programme that, failing any assistance at the station, he can make exposures in both the instruments. There is little doubt, however, that Prof. Campbell will be able to render him help should he require it.

It may be mentioned that if the *Annapolis* had been able to accommodate more than twelve of the eclipse party Mr. McClean would have been invited to join the Lick expedition. To reach Flint Island he has therefore gone to Auckland *viâ* Australia, and has chartered a special steamer to take him and his equipment to the island and back. From later information I find that, by arrangement with Prof. Campbell, he will pick up at Tahiti Mr. C. J. Mersfield, of the Royal Society of Sydney, and Mr. Moors, of the Sydney University, both of whom have volunteered to act as Prof. Campbell's assistants, and will convey them to Flint Island and back to Tahiti.

Let us hope that eclipse day will be fine, and that all will return with results which will add to our knowledge of the sun.

A cablegram, dated November 25, from Mr. McClean, at Auckland, states that Mr. Mersfield has joined him and will be attached to the Lick party. He further informs me that Mr. Raymond, of the Sydney Observatory, and Mr. Short, photographer to that observatory, together with the Rev. Mr. Walker, an amateur astronomer at Auckland, are going out with him and will form his party.

WILLIAM J. S. LOCKYER.

NEW AËROPLANES.

AN account of the successful aëroplane flights by which Mr. Henry Farman has succeeded in breaking the record hitherto held by M. Santos Dumont (in the absence of trustworthy information concerning the experiments of the Wright brothers) has probably been seen by most readers of NATURE in the daily papers. We are indebted to an article by M. René Doncière in *La Nature* for the further details regarding the machine and its performances which form the subject of the present notice.

Mr. Farman's machine has been constructed in the works of Messrs. Voisin Brothers, and is of the well-known cellular form, as shown in the accompanying illustration. The front pair of planes measure 12 × 2 metres, the height between them being 2 metres. This pair is connected by a framework 4½ metres long with the rear pair of planes, which only measures 6 metres transversely. The vertical rudder is situated between the latter planes, while a horizontal rudder is fixed right in front of the machine. The motors and tanks of petrol are contained in a spindle-shaped case in front, into which is let the seat for the operator.

The motive power is furnished by an eight-cylinder "Antoinette" motor of 40–50 (metric) horse-power, and operates on a propeller the two vanes of which are 2·10 metres across and 1·10 metres in pitch. The whole apparatus rests on four wheels when on the ground. The total wing surface is 52 square metres and the weight 500 kilograms; the length of the machine is 10 metres. At present—or at any rate at the time of M. Doncière's account—the machine has a tendency to take an upward direction on leaving the ground, but while this prevented Mr. Farman from making extended trips, he has nevertheless succeeded in covering 771 to 800 metres at a height of 6 metres above the ground. These records, performed on and after October 26, following after flights of 303 and 350 metres, represented the maximum course obtainable within the limits of the field on which the experiments were made.

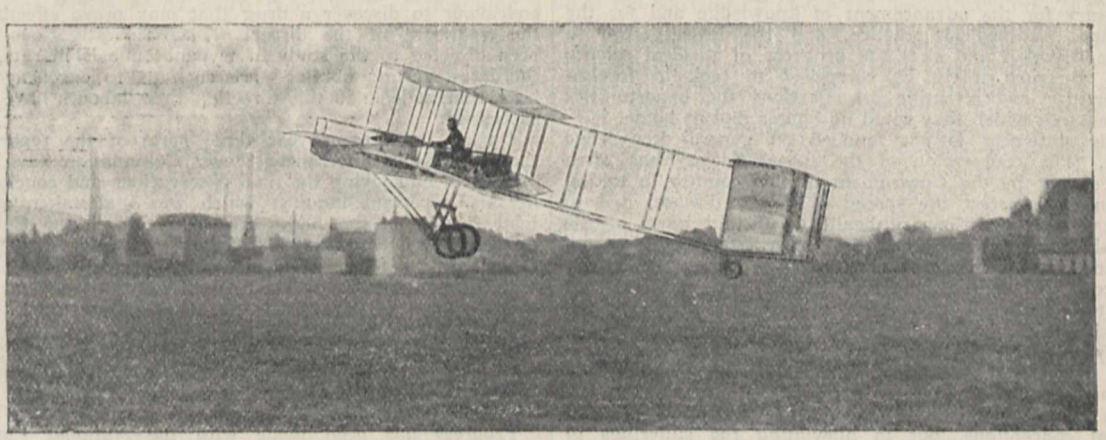
In regard to what the average Englishman would call the "practical" aspect of these experiments with reference to the possibilities of aëroplane machines coming into general use, reference is made to the great skill needed in controlling the machine. The operator has to manipulate or observe at the same moment the vertical and the horizontal rudder, the carburettor, the sparking, the pressure gauges of the petrol and water, to listen to the throbbing of the motor, to balance the machine laterally, taking account of the effects of wind, and finally to avoid coming into collision with the crowd of spectators.

Later news states that Mr. Farman has again made several attempts to win the Deutsch Archdeacon prize, but has failed to do so owing to the wheels of his machine grazing the ground, especially in the neighbourhood of the turning points.

Another aëroplane which is also attracting considerable attention at Paris is the "monoplane" of M. Robert Esnault Pelterie. This, unlike most recent types, has only a single transverse supporting surface, which in one machine measured 9·6 metres from tip to tip with a superficial area of 18 square metres; in a more recent machine these dimensions have been reduced to 8·6 metres and 16 square metres respectively. The surface is somewhat concave in form. In addition there is a single horizontal rudder placed at the rear, while the motor and propeller are in the front of the machine. The motor consists of seven cylinders arranged round a circle, and it gives 25 to 30 horse-power with a weight of 44 kilograms. The total weight of the machine and its rider amount to 240 kilograms. For running along the ground the monoplane has two wheels, arranged bicycle-fashion, attached to the body, and two other wheels are attached to the tips of the wings. The recorded performances, which commenced on October 22, include straight flights of about 100 metres and 147 metres, and a path stated to be a semicircle of radius about 1640 feet, which, if correct, represents a flight of, roughly, 1600 metres. But at the end of the flight of 147

metres the machine fell vertically on the ground, and was damaged.

An aëroplane constructed on the other side of the Atlantic is described in the *Scientific American* for November 16 as "a heavier than air flying machine which lacks the faults of former similar devices according to its inventor, J. W. Roshon, of Harrisburg, Pa. . . ." This machine, which has not yet been tried, is characterised by its complexity to much the same extent that the monoplane is characterised by its simplicity. It has three principal supporting planes, the bottom and middle plane measuring 24 feet transversely by 8 feet longitudinally, while the top plane has only a transverse measurement of 12 feet. Between these three planes, which are placed one above the other, giving a total height of 17 feet, there are 26 narrow flat planes placed transversely at the front and rear of the larger planes. The total wing surface is 900 square feet, say 80 square metres, and the weight with an operator is estimated at 600lb., say 270 kilograms. To launch this large machine into the air an inclined plane has been specially constructed curving up at the bottom in order to start the machine with its rider skyward, but for the first test a bag of sand is to take the place of the latter.



Mr. Farman's aëroplane in full flight. From *La Nature*.

A further departure from the present fashion of machine is the gyroplane of Messrs. Breguet, which revives interest in the attempt to overcome gravity by vertical screw propellers. As at present designed, it is supported by four propellers placed at the corners of a square, each propeller having four revolving vanes, and each vane carrying a pair of superposed planes. The machine, which with its operator would weigh 540 kilograms, was found to hover successfully in the air at a height of a few feet for a minute, this representing the limit of the experiment, and the machine being held down to prevent any accident. It is thus claimed that aërial navigation by vertical screws is possible.

It is interesting to record the fact that the *Scientific American* estimates Mr. Farman's longest flight on October 26 as 2529·52 feet, and his longest measured flight on November 7 as 2624·66 feet. The French records are 771 and 800 metres respectively. Thus, by the use of English units, the American correspondent would appear to claim, if the results are correct, to have estimated these long-distance flights to within an eighth of an inch. But unless the figures represent the results of actual exact measurements (and of this no evidence is given), their accuracy cannot be admitted.

ANNIVERSARY MEETING OF THE ROYAL SOCIETY.

THE anniversary meeting of the Royal Society was held on Saturday, November 30, St. Andrew's Day. Lord Rayleigh, the president, was in the chair. Among the subjects referred to in the report of the council are the publication of the National Antarctic Expedition results, the International Catalogue of Scientific Literature, Royal Society's Catalogue of Scientific Papers, International Association of Academies, sleeping sickness, and Malta fever. The following statement, drawn up by the council, was presented to the Royal Commission on Vivisection in March last:—

The Royal Society, from its age and the position accorded to it among scientific institutions, feels its responsibility as a guardian of the general interests of science in this country. Founded as it was for the promotion of natural knowledge, whenever from time to time legislative changes have been proposed which might seem likely to affect the advancement of that knowledge, the society has desired to make its voice heard on behalf of scientific progress. The recent appointment of a Royal Commission on the subject of experiments on animals has been deemed by the president and council of the Royal Society to be an occasion when they may ask to be allowed to lay before that Commission a statement of their views on the broad scientific bearings of the question.

There can be no doubt that the main cause of the remarkable development of science in modern times has been the adoption of the experimental method of investigating nature. In every department of research this method has led to the most important advances, both in questions of theory and in practical applications to the useful purposes of life. From the beginning of its history the Royal Society has fostered the prosecution of experiment, not only in physical and chemical, but in biological inquiry, and its publications are full of records of the discoveries which have consequently been made.

In no branches of investigation have the theoretical and practical successes of experimental work been more conspicuous in recent years than in physiology and its practical applications in medicine and surgery. In medicine, the careful and patient testing of the effects of drugs on the lower animals has not only led to an accurate knowledge, not otherwise attainable, of these effects as produced on the human body, but has greatly increased the number of substances now available to the physician in the treatment of disease. Without this method of investigation the progress of pharmacology, in recent years so astonishing and beneficent, would be arrested, and diseases, which may in time be successfully combated, would continue their ravages unchecked. In modern surgery the application of similar experimental work has been attended

with brilliant success. Most delicate and fundamental operations on the human body have been made possible by the knowledge obtained from the treatment of animals.

The president and council of the Royal Society claim that since the continued advancement of science in every department depends so largely upon the use of the experimental method, the utmost caution should be observed in any proposals for legislation whereby the prosecution of the method might be unduly limited. So much has already been gained from the application of experiments on animals, both for the progress of physiology and for the alleviation of human suffering, and so much more may be confidently expected in the future, that the president and council trust that nothing will be done that would hamper the legitimate employment of the method.

While precautions should undoubtedly be taken against improper use of experiment on living animals, it is not the province of the society to suggest what safeguards should be adopted. It is, however, the bounden duty of the president and council to urge that those safeguards should be so framed as not unnecessarily to interfere with that advancement of knowledge to promote which the society exists.

Such restriction would not only cripple or arrest the growth in this country of an important branch of biological science, but in so doing would reduce the efficiency of both physician and surgeon to mitigate or cure disease. It might then become no longer possible to maintain the high position which this country has gained in researches necessary for the advancement of knowledge and for the guidance of medical practice, and the investigators to whose devotion and skill the progress of medical science owes so much might be compelled to seek in foreign universities and scientific organisations the opportunities for research which they could no longer find at home.

This statement is not founded on general knowledge alone. The cooperation of the Royal Society has often been sought by the Government of this country in taking measures to arrest the spread of deadly disease, and to improve the conditions of health in distant parts of the British Empire. Without the ungrudging services of physiologists and pathologists, many of whom the society is proud to count among its fellows, the services thus solicited could not have been given. The president and council gladly avail themselves of this opportunity of testifying to the laborious and unselfish devotion, often in most dangerous conditions, with which the necessary experimental researches have been carried on, and to the value of these researches, not only in enlarging our biological conceptions, but in alleviating the sufferings of mankind.

A further sum of 350*l.* has been voted by the council from the Government grant towards a fund of 2000*l.* which Sir David Gill is endeavouring to raise for the purpose of extending the work of measuring the great African geodetic arc. The grant was voted conditionally upon the 2000*l.* referred to being obtained.

The main part of Lord Rayleigh's presidential address is reprinted below.

An important feature in the work of the Royal Society consists of various inquiries, undertaken for different departments of Government, in regard to diseases which affect the tropical portions of our foreign possessions and dependencies. Among these diseases the attention of the civilised world has been for some years directed to the malady known as sleeping sickness. The first concerted action for the study and combating of this appalling scourge arose out of a representation made by the Royal Society to the Foreign Office in the spring of 1902, in consequence of which, at the request of the Treasury, the society's Malaria Committee organised and dispatched a small scientific commission to Uganda. In the course of a short time the source of the disease was traced by this Commission to the presence of a trypanosome in the blood and cerebro-spinal fluid of the victims, and the further discovery was also made by the same Commission that the trypanosomes are carried by a species of biting tsetse-fly. These important revelations were followed up by detailed studies of the character and distribution both of the disease and of the fly. Besides sending out a succession of observers to prosecute the investigations of its Commission at Entebbe, the Royal Society urged upon the Colonial Office the necessity of organising, and under an increased medical staff, a more comprehensive inquiry into the local conditions under which the disease is propagated. This recommendation was carried out, and some valuable information on the subject has been obtained. Meanwhile, though various drugs had been tried with at best only temporary success, no lasting remedy had been found for the malady, which has continued to be fatal and to spread steadily over Central and East Africa.

The various European Governments which have possessions in those regions have at last determined to make a united effort to cope with sleeping sickness through the instrumentality of an International Conference having a separate bureau in each country concerned and a central bureau in London. The object of this cooperation will be to collect information bearing on the disease, to devise and carry out such scientific researches as may seem to be necessary, and to concert measures for dealing with the disease and the populations affected or likely to be affected by it. The Royal Society, having led the way in this subject, has been invited to give the proposed combined international action its support. The society welcomes the proposal, and will be prepared to render every assistance in its power. In the meantime, our Tropical Diseases Committee is continuously and actively engaged in the endeavour to discover a drug that may prove effective in the treatment of the disease. Their investigations have been directed to the study of trypanosomiasis in rats, and the latest results obtained are such as to encourage the hope that at least in this direction their labours have been successful.

During the present year three parts of the reports of the society's Mediterranean Fever Commission have been published, embodying the final observations and conclusions in this important inquiry, which was undertaken at the joint request of the Admiralty, War Office, and Colonial Office. The members of the Commission have shown how the scourge of fever, which has been so long rife in Malta, and has so seriously reduced the strength of our garrison there, may be eventually banished from the island. Already their recommendations, so far as they have been followed, have reduced the amount of fever to trifling proportions. It now remains for the authorities to adopt the further precautions pointed out to them, which will probably banish the disease altogether.

Progress has been made with the National Physical Laboratory's buildings at Eskdale Muir, some of which are now ready for occupation. It was hoped that the work might have begun this summer, and the Treasury has provided a sum of 750*l.* for the expenses during three-quarters of the current financial year. Owing to the bad weather in the early summer this anticipation has not been realised, but a start will be made very shortly. The buildings are admirably adapted for their purpose, and will render possible the study of terrestrial magnetism under the undisturbed conditions which used to exist at Kew.

The completion of the work on the electrical units will be satisfactory to those who have been interested in this question. At the time of my own researches, about twenty-five years ago, the ohm and the ampere were uncertain to 2 per cent. or 3 per cent., and I then scarcely hoped to get nearer than one part in a thousand. The recent work carried on at Bushey would seem to indicate that an accuracy of one part in ten thousand may have been attained. The possibility of such a refinement depends largely upon the use in the instruments of coils composed of a single layer of wire, the position of every turn of which is open to exact determination. The importance of this feature was insisted upon by the late Prof. Jones.

Accuracy of measurement appeals less to the lay and scientific public than discoveries promising to open up new fields; but though its importance at any particular stage may be overrated, it promotes a much needed consolidation and security in the scientific edifice. A remarkable example of enhanced accuracy is afforded by modern measurements of luminous wave-lengths, for which we are

mainly indebted to our Copley medallist. Not only did he introduce the vacuum tube charged with mercury or cadmium as the best source of homogeneous light, but by a most able use of an ingenious method he determined, with the highest precision, the values of the cadmium red, green, and blue wave-lengths in terms of one another, and of the metre. His work has been skilfully followed up by Fabry and Perot, and numerous wave-lengths are now known with a relative accuracy of one millionth part. When we reflect upon the almost ultra-microscopic magnitude of a wave-length of light, the possibility of such an achievement may well excite our astonishment.

For the advancement of science the main requirement is, of course, original work of a high standard, adequately explained and published; but this is not enough. The advances so made must be secured, and this can hardly be unless they are appreciated by the scientific public.

In all the principal countries of the world we have now a body of men professionally connected with science in its various departments. No doubt the attention of many of these is so engrossed by teaching that it would be hard to expect much more from them, though we must remember that teaching itself takes on a new life when touched with the spirit of original inquiry; but in the older universities, at any rate, the advancement of science is one of the first duties of professors. Actual additions to knowledge occupy here the first place; but there must be many who, from advancing years or for other reasons, find themselves unable to do much more work of this kind. It is these I would exhort that they may fulfil their function in another way. If each man would mark out for himself a field—it need not be more than a small one—and make it his business to be thoroughly conversant with all things, new and old, that fall within it, the danger of which I have spoken would be largely obviated. A short paper, a letter to a scientific newspaper, or even conversation with friends and pupils, would rescue from oblivion writings that had been temporarily overlooked, thereby advancing knowledge generally, and sometimes saving from discouragement an unknown worker capable of further achievements. Another service such experts might render would be to furnish advice to younger men desirous of pursuing their special subject.

A movement is on foot, and has already received valuable support, to promote the publication of standard scientific works in embossed type suitable for the use of the blind. Mr. H. M. Taylor tells me that in the course of the last twelve months he has written out the whole of Mr. C. Smith's "Elementary Algebra" in Braille type, has afterwards read the copy with his fingers, and again, later, read the whole in proof. There can be no doubt that books in embossed type on such subjects as mechanics, physics, astronomy, geology, not to mention the various biological sciences, would be an immense boon to many blind readers. I commend the proposal heartily to your notice.

Another remedy for the confusion into which scientific literature is liable to fall may lie in the direction of restricting the amount of unessential detail that is sometimes prevalent in the publication of scientific results. In comparing the outputs of the present time and of, say, thirty years ago, the most striking feature that appears is doubtless the increase of bulk, in recent years coming especially from young workers stimulated by the healthy encouragement of direct research as a part of scientific education. But I think it may also be observed, and not alone in the case of such early dissertations, that there is, on the whole, less care taken for the concise presentation of results, and that the main principles are often submerged under a flood of experimental detail. When the author himself has not taken the trouble to digest his material or to prepare it properly for the press, the reader may be tempted to judge of the care taken in the work from the pains taken in its presentation. The tendency in some subjects to submit for immediate publication the undigested contents of note-books is one that we hear much of at the present time. It is a matter that is difficult for publishing bodies to deal with, except by simple refusal of imperfectly prepared material, with its danger of giving offence to authors of recognised standing, but it seems not unlikely that at present public scientific opinion would endorse such a course of action. A related difficulty, and one that contributes to this trouble, is the tendency, noticeable in some public scientific organisations, to imagine that their activity is estimated by the number of pages of printed matter they can produce in the year. Probably no consideration is further removed than this from the minds of the educated public, whose judgment is alone worth considering.

COPLEY MEDAL.

The Copley medal is awarded to Prof. Albert Abraham Michelson, For.Mem.R.S., on the ground of his experimental investigations in optics.

In 1879 Michelson brought out a determination of the velocity of light by an improved method, based on Foucault's, which gave 299,980 kilometres per second. Three years later, by means of a modification of the method, capable of even greater precision, he found for this constant, of fundamental importance for electric as well as optical science, the value of 299,853 kilometres.

Michelson has been a pioneer in the construction of interferometers, which are now indispensable in optics and metrology. With his new instrument, at Paris, he determined the absolute wave-lengths of the red, green, and blue lines of cadmium by counting the number of fringes (twice the number of wave-lengths) corresponding to the length of the standard metre of the Bureau International des Poids et Mesures. He found the metre to be 1,553,164 times the wave-length of the red line of cadmium, a result which is almost in exact agreement with the re-determination last year by Perot and Fabry. Michelson thus proved the feasibility of an absolute standard of length, in wave-lengths, of such accuracy, that if the standard metre were lost or destroyed it could be replaced by duplicates which could not be distinguished from the original.

He had the greatest share in the elaboration of precise experiments on the relative motion of ether and matter. He repeated in an improved form Fresnel's experiment of the speed of light in moving media, using water and sulphide of carbon. He found that the fraction of the velocity of the water by which the velocity of light is increased is 0·434, with a possible error of ±0·02. The fact that the speed is less in water than in air shows experimentally that the corpuscular theory is erroneous; but his results, moreover, established the correctness of Fresnel's formula for the effect, the theory of which has since become well understood.

In conjunction with E. W. Morley, he devised and carried out a very remarkable method by which, on the assumption of ether at rest, an effect depending on quantities of the order $(v/V)^2$ would appear to be appreciable. No displacement of the fringes was found. Of this result the simplest explanation would be that the ether near the earth partakes fully in its orbital motion; but modern electric and optical science appears to demand a quiescent ether, and the existence of this and similar null results is fundamental for its theory.

He has shown the possible application of the interferometer method to astronomy, by himself measuring the diameters of the four satellites of Jupiter, which are only about one second of arc. He suggests the further application of the instrument to such of the fixed stars as may not subtend less than one-hundredth of a second of arc.

In 1898 Michelson constructed a spectroscope which enables us to make use of the great resolving powers of the very high orders of spectra which are absent in the use of the ordinary grating, and with the added advantage of having most of the light in one spectrum. The echelon consists of a pile of glass plates of precisely equal thickness, which overlap by an equal amount; with it spectral lines which appear single with the most powerful gratings can be resolved into components. This instrument has been especially useful for the direct observation of the important, because definite, influence of magnetism on light, discovered by Zeeman. With thirty plates, and using the 25,000th spectrum, the echelon has a resolving power of 750,000, while the most powerful gratings do not exceed 100,000.

In connection with the analysis of radiations, he has constructed and used various machines for the analysis of periodic motions. For example, in conjunction with

Stratton, he perfected a remarkable machine which is based on the equilibrium of a rigid body under the action of springs.

Prof. Michelson has also investigated by his interferometer the important subject, both theoretically and practically, of the breadth and the structure of spectral lines, including the effect of a magnetic field, and in various other ways his genius has opened up new ground in experimental optics.

Royal Medals.

One of the Royal medals has been awarded, with the approval of His Majesty, to Dr. Ernest William Hobson, F.R.S.

During the last twenty years Dr. E. W. Hobson has been distinguished for the fundamental character of his contributions to mathematics and mathematical physics. His earlier published work, from 1888 onwards, deals largely with the so-called harmonic analysis, which embraces many topics having for their common aim the solution of the potential equation in forms suitable for application to the problems of physics. The exhaustive examination of the general types of harmonic functions contained in his paper in the Phil. Trans., 1896, has been found to be of high utility for this application. He was led by these researches, and particularly by the difficulty of describing in general terms the characteristics of a function capable of being represented by Fourier's series, to take part in the revision of the logical basis of differential and integral calculus which is now in progress; his presidential address to the London Mathematical Society in 1902 on the questions here arising aroused general interest among mathematicians, and he has recently (1907) published an extensive volume dealing with the whole matter and its applications to the theory of Fourier's series, which is of great importance for the history and development of mathematics.

His Majesty has also approved the award of a Royal medal to Dr. Ramsay H. Traquair, F.R.S. Dr. Traquair is honoured on the ground of his long-continued researches on the fossil fishes of Palæozoic strata, which have culminated, within the past ten years, in his discovery of new groups of Silurian and Devonian fishes, and in his complete exposition of the structure of Drepanaspis, Phlyctenaspis, and other remarkable forms.

For nearly forty years Dr. Traquair has been busy with the description of fossil fishes, mostly from the Palæozoic rocks of Scotland, and he is deservedly held to be one of the most eminent palæontologists of the day. He has been highly successful in the interpretation of the often very obscure and fragmentary remains which he has had to elucidate, and his restorations of fishes have won such credit as to appear in all modern text-books of palæontology. It may be said that his work, notwithstanding the great difficulties of the subject, has well stood the test of time.

Dr. Traquair has done much to advance our knowledge of the osteology of fishes generally. His earliest memoirs on the asymmetrical skull of flat-fishes and on the skull of Polypterus remain models of exactness. His acquaintance with osteology enabled him to show how former superficial examination of the Palæozoic fishes had led to wrong interpretations. He demonstrated that Chirolepis was not an Acanthodian, as previously supposed, but a true Palæoniscid. In 1877 he satisfactorily defined the Palæoniscidæ and their genera for the first time, and conclusively proved them to be more nearly related to the sturgeons than to any of the other modern ganoids with which they had been associated. He thus made an entirely new departure in the interpretation of extinct fishes, replacing an artificial classification by one based on phylogenetic relationship. His later memoir on the Platysomidæ was equally fundamental and of the same nature.

All subsequent discoveries, many made by Traquair himself, have confirmed these conclusions, which are now universally accepted.

In 1878 Dr. Traquair demonstrated the dipneustan nature of the Devonian Dipterus, and somewhat later he began the detailed study of the Devonian fishes. His latest researches on the Upper Silurian fishes of Scotland are equally important, and provide a mass of new knowledge for which we are indebted to his exceptional skill and judgment in unravelling the mysteries of early vertebrate life.

Davy Medal.

The Davy medal is awarded to Prof. Edward Williams Morley. Prof. Edward W. Morley is well known both to chemists and to physicists for his work in the application of optical interferences and other physical phenomena to increase the accuracy of measurement. Numerous valuable papers have appeared, either in collaboration with Prof. Michelson and others, or in his own name, on such subjects. Special reference may be made to his experiments, in conjunction with Prof. Michelson, on the fundamental question of the absence of effect of translatory motion of material bodies on luminous phenomena.

His claim to the Davy medal rests on grounds closely related to these researches, for he has combined thorough mastery of accurate measurement with an intimate knowledge of modern chemistry, and has utilised them in his attempt to solve one of the most difficult and fundamental problems of chemical science. The special problem to which he has consecrated many years of his life is the determination of the relative atomic weights of hydrogen and oxygen; it has been attacked by him with rare insight and skill, and with indomitable perseverance, and he seems to have settled it for many years to come, if not permanently. All the recent work devoted to this problem, and there has been much, has tended to establish more firmly the ratio arrived at by Prof. Morley.

His determinations of the absolute weights of a litre of hydrogen and of oxygen, and his investigations of the amounts of moisture retained by gases dried by various desiccating agents, are of the very greatest importance for scientific progress.

Sylvester Medal.

Prof. Wilhelm Wirtinger, of Vienna, is the recipient of the Sylvester medal. He is distinguished for the importance and wide scope of his contributions to the general theory of functions. Our knowledge of the general properties and characteristics of functions of any number of independent variables, and our ideas for the further investigation of such functions, are, for the most part, at present bound up with the theory of multiply-periodic functions, and this theory is of as great importance for general solid geometry as the ideas of Abel have proved to be for the theory of plane curves. Prof. Wirtinger has applied himself for many years to the study of the general problems here involved. A general summary of his researches is given by him in the Abel centenary volume (xxvi., 1902) of the "Acta Mathematica." Two of his papers may be particularly referred to, both of 1895. One of these deals with the reduction of the theory and general multiply-periodic functions to the theory of algebraic functions, with a view to their expression by Theta functions; this was one of the life problems of Weierstrass, who did not, however, during his lifetime, publish anything more than several brief indications of a method of solution. Prof. Wirtinger's memoir obtains a solution, and is, moreover, characterised throughout by most stimulating depth and grasp of general principles. This paper was followed by two others, one continuing the matter in detail, the other making an application of its principles to the general theory of automorphic functions. Another extensive paper, which obtained the Beneke prize of the Royal Society of Göttingen, deals with the general theory of Theta functions. In it he obtained results of far-reaching importance, for geometry as well as for the theory of functions, the full development of which will require many years of work.

Hughes Medal.

The Hughes medal is awarded to Principal Ernest Howard Griffiths. Principal Griffiths has conferred great benefit on physical science by his series of measurements of fundamental constants, mainly in the domain of thermal and electric energy. At a time when the equivalent of the thermal unit in mechanical energy stood urgently in need of revision, he devoted himself to the problem with all the refinements and patient manipulation that could be devised, the result being a value for Joule's equivalent which at once acquired authority in the light of the

evidence produced, and largely confirmed the corrections already advanced by Rowland and others. A main cause of discrepancy had been found to be the variation of the thermal capacity of water with the temperature; and by an investigation in which this variation was determined, Griffiths elucidated and correlated fundamentally the work of previous observers, from Joule onward. Of special importance also, in the domain of chemical physics, was an investigation of the depression of the freezing point of water by very dilute admixture of dissolved substances, wherein he verified, with all the refinement of absolute physical determinations, that the change of freezing point ran exactly parallel to the electric conductivity when the dilution of the electrolysable salt was comparable to that of gases, being twice as much per molecule as the standard value of the depression for non-electrolytes.

BUCHANAN MEDAL.

The Buchanan medal is awarded to Mr. William Henry Power, C.B., F.R.S. Mr. Power's services to hygienic science and practice have extended over a period of more than thirty years, and have been of the most distinguished kind. He has himself personally conducted successful inquiries into the causes of the spread of various diseases, and has obtained results which have proved of the greatest benefit to mankind. Moreover, in his long connection with the medical department of the Local Government Board he has planned and directed numerous general and local investigations whereby our knowledge of disease, and of the methods of coping with it, have been greatly increased. The medical reports issued by the Local Government Board, which are universally regarded as among the most important contributions of our time to this subject, have for many years past been either written by him or owe much to his editorial criticism and supervision. It is not too much to say that no living man in this country has advanced the cause of scientific hygiene more than Mr. Power, or is more worthy of the distinction of the Buchanan medal.

In the evening of the anniversary meeting, the fellows of the society and their guests dined together at the Whitehall Rooms of the Hôtel Métropole. Lord Rayleigh was in the chair, and responded to the toast of the Royal Society proposed by Lord Dunedin. Speeches were also made by several of the medallists, and by Lord Fitzmaurice and the Dean of Westminster.

NOTES.

IN proposing the toast of "The Royal Society" at the anniversary dinner on Saturday last, Lord Dunedin referred to the popularisation of science as one of the functions of a society which exists for the promotion of natural knowledge. This remark provides the subject of a letter by an anonymous correspondent in Tuesday's *Times*. The writer urges that the neglect of science in this country is largely due to the indifference shown by scientific men to the intellectual interests of the average reader. Few men of science make any attempt to describe their investigations in language which can be understood by men of culture without special scientific knowledge, and it is scarcely too much to say that most investigators are so closely absorbed in their particular researches that whether the world in general knows anything of the results or not is regarded as no concern of theirs. This spirit, and the obscure and diffuse manner in which scientific investigations are often described are to be deplored. Lord Rayleigh, in the presidential address which appears elsewhere in this issue, directs attention to the undigested material often presented as papers to scientific societies; and it seems as if the zeal for research is rarely accompanied by the aspiration for simplicity of expression. Prof. M. E. Sadler suggests in Wednesday's *Times* that the neglect of the teaching of the mother tongue in our schools provides a reason "why so many Englishmen of learning and high scientific attainment are unable to express themselves in a lucid and stimulating way." It may be pointed out, however, that though rhetoric receives more attention in the United States than it does in this country, the style of scientific papers and other works from America is not superior to that of our own scientific literature. But whatever the explanation may be, there can be only one opinion as to the advantage of increasing interest in scientific work by making the results as widely known as possible.

THE formation of the Royal Society of Medicine has already been the subject of a congratulatory note in these columns. The inaugural dinner of the society, held on Tuesday last, December 3, was a remarkable testimony to the successful establishment of what Sir Ray Lankester described on that occasion as the National Academy of Medicine. The society consists of thirteen federated sections, representing fifteen pre-existing societies, and it is hoped that other sections will be included before long, so that no branch of medical knowledge will be unrepresented in the society. The number of fellows is upwards of 1800, and of members above 600, and there is every reason to anticipate that these numbers will be considerably increased now that the society is in full working order. The library, which has been strengthened by the inclusion of those of the Odontological and Obstetrical Societies with that of the Royal Medical and Chirurgical, now consists of upwards of 70,000 volumes, and in the reading-room of the society no fewer than eighty-nine British and 180 foreign periodicals can be consulted. Sir W. Church, president of the society, who presided at the dinner on Tuesday, bore testimony to the manner in which the various bodies now forming the Royal Society of Medicine have been willing to sacrifice somewhat of their independence and individual prestige for the common good. Never in the history of medicine has there been a time in which so wide a field has engaged the attention of medical men as the present. In every department of medicine, science has placed at the disposal of medical men new methods and fresh means, not only for the investigation, but also for the treatment of disease, and the ground to be covered in each branch of medicine must as time goes on necessarily increase. To provide every facility for diffusing the increased knowledge which is being gained and enable the profession to keep in touch with what is going on is perhaps at the present time the main object of the society; but the time will come, and that soon, when the Royal Society of Medicine will be in a position, not only to discuss the value of the researches brought to its notice, but also, through the appointment of scientific committees, to add to knowledge.

THE Lalande medal has been awarded by the Paris Academy of Sciences to Mr. Thomas Lewis, of the Greenwich Observatory, and secretary of the Royal Astronomical Society.

SIR W. H. BENNETT, K.C.V.O., has been elected president of the Incorporated Institute of Hygiene in succession to the late Sir W. H. Broadbent, F.R.S.

AN experiment in the breeding of Maine lobsters in the Pacific Ocean is about to be tried by the U.S. Commission of Sea and Shore Fisheries. A car-load of seed lobsters has already been dispatched by a fast express from the Government hatchery at Boothbay to the western coast.

BY the death of Mr. M. Walton Brown, which occurred on November 22, the Institution of Mining Engineers loses an indefatigable secretary and the profession of coal mining one of its most useful representatives. Mr. Walton Brown was the author of numerous papers on mining

engineering, and was the recognised authority in this country on the scientific principles of colliery ventilation.

A DISCUSSION on the subject of "Rivers Pollution from the Naturalist's Point of View" will be introduced by Prof. R. Meldola, F.R.S., at a conference meeting to be held, under the auspices of the Essex Field Club, on Saturday, December 14, at 6 p.m., in the physical lecture theatre of the Municipal Technical Institition, Romford Road, Stratford, Essex.

AT the meeting of the Cardiff City Observatory Committee on November 30 it was announced that arrangements are busily proceeding for the installation of a seismograph at the observatory on Penylan Hill. The seismograph is being provided by the Cardiff Naturalists' Society, its upkeep being undertaken by the city council. It is hoped that the instrument may be installed early in the new year, and that Prof. Milne will be able to attend the opening. Prof. Milne has urged the establishment of a seismograph at Cardiff, which will form a triangle with the existing stations at Birmingham and Shide.

WE are pleased to learn that Mr. Haffkine has accepted an appointment to a post at Calcutta offered to him by the Secretary of State for India. It will be remembered that Mr. Haffkine was held responsible for an unfortunate accident that occurred in the Punjab in connection with plague inoculation, an accident for which a large body of scientific opinion has pronounced him to be in no way to blame. So far the Secretary of State has recognised the strength of that opinion, but we could have wished that the recognition had taken a form more complete and more in accordance with the true circumstances of the case.

THE Paris correspondent of the *Times* reports that Dr. Jean Charcot, who conducted a successful expedition to the South Polar regions two years ago, is now engaged in the preparation of another expedition to the Antarctic circle. The State has made a credit grant of 24,000*l.* toward the cost, but at least 6000*l.* more will be required. Dr. Charcot intends to start next July. He will proceed by way of Buenos Ayres and Cape Horn to the Antarctic region which he discovered and named "Terre Loubet." The Marquis de Dion has offered Dr. Charcot some motor sledges, so that dogs will not be needed.

THE annual conversazione and exhibition of new apparatus, heretofore held under the auspices of the late British Electro-Therapeutic Society, but now under the electro-therapeutical section of the Royal Society of Medicine, will be held in the Queen's (small) Hall on Friday, December 13. The leading makers of electro-medical and X-ray apparatus are taking part, and many new designs will be shown, so far as possible under working conditions. Communications regarding cards of admission or other matters must be addressed to Dr. Reginald Morton, hon. secretary, 22 Queen Anne Street, Cavendish Square, London, W.

THE American Association for the Advancement of Science will meet at Chicago on December 28. The business meetings commence on December 30, in the morning of which the first general session will be held, and the new president, Prof. E. L. Nichols, will be introduced by Dr. W. H. Welch, the retiring president. In the afternoon addresses will be given by some of the presidents of sections. Prof. Edward Kasner will speak on "Geometry and Mechanics" to the section of mathematics and astronomy; Mr. Richardson will address the section of chemistry on "A Plea for the Broader Education of the Engineer," and Prof. Conklin will deliver his address to the section of zoology. In the evening of the same day the retiring president will deliver his address. On December 31 Prof. W. C. Sabine will address the section of physics on the "Origin of the Musical Scale"; Mr. Conant the section of social and economic science on the "Influence of Friction in Economics"; and Dr. Flexner the section of physiology and experimental medicine on "Recent Advances and Present Tendencies in Pathology." Messrs. MacDougal, Warner, and Brown will respectively address the sections of botany, mechanical engineering, and education on subjects to be announced later. Mr. Charles L. Hutchinson is the chairman of the local committee, and Mr. J. Paul Goode is the local secretary.

THE following are among the lecture arrangements at the Royal Institution before Easter:—Sir David Gill, a Christmas course of six illustrated lectures on "Astronomy, Old and New," adapted to a juvenile auditory; Dr. A. A. Gray, two lectures on the internal ear of different animals; Prof. W. Stirling, six lectures on membranes, their structure, uses, and products; Dr. E. A. Wallis Budge, three lectures on the Egyptian Sudan, its history, monuments and peoples, past and present; Prof. W. W. Watts, two lectures on (1) the building of Britain, (2) recent light on ancient physiographies; Prof. W. Somerville, two lectures on wood, its botanical and technical aspects; Sir John Rhys, two lectures on Celtic; Dr. R. T. Glazebrook, two lectures on physics; Mr. R. Lydekker, two lectures on (1) the animals of Africa, (2) the animals of South America; Prof. Gisbert Kapp, the electrification of railways; and Prof. J. J. Thomson, six lectures on electric discharges through gases. The Friday evening meetings will commence on January 17, when Prof. T. E. Thorpe will deliver a discourse on the centenary of Davy's discovery of the metals of the alkalis. Succeeding discourses will probably be given by Colonel David Bruce, Prof. E. Rutherford, Dr. C. W. Saleeby, Sir Oliver Lodge, Prof. W. A. Bone, Prof. J. Milne, Prof. A. E. H. Love, the Hon. R. J. Strutt, and Prof. J. J. Thomson.

BY the death (which was announced in the *Times* of November 28) of Dr. Carl Bovallius, late professor of zoology at the University of Upsala, Sweden has lost one of her most eminent ethnologists, naturalists, and scientific explorers. A graduate of Upsala, Bovallius took the degree of Ph.D. in 1875, and from some time after that date held the chair of zoology until 1897. In zoology his main subjects were Mollusca and Crustacea, especially the amphipod group of the latter, and the Swedish representatives of both groups. "Contributions to a Monograph of the Amphipoda Hyperidea" is the title of one of his works, the first part (in two numbers) of which was published at Stockholm, 1887–9. It is only by this single part, which appears to be all that was issued, that his name is represented in the catalogue of the Zoological Society's library. Forestry was another of his specialities, and from reports furnished by him as the results of investigations undertaken between 1889 and 1895 the present forest laws of Sweden were based. As an explorer and surveyor he travelled much in Central America from 1881 to 1883, returning again to Nicaragua in 1900, while in 1898–9 he visited southern Venezuela and the Amazons. From these countries he brought extensive zoological and ethnographical collections. In the obituary notice in the *Times* of November 29 he is reported to have made important contributions to the natural history departments of the British Museum, but his name does not appear as a donor in the recently published volumes on the "History of the

Collections" in those departments; and his donations appear to be limited to a few river crustaceans. Dr. Bovallius was the recipient of several decorations from his own and foreign sovereigns, among these being the Grand Cross of the Order of Isabella Catholica and the knighthood of the Danish Order of the Dannebrog, and of the Portuguese Order of St. Iago.

THE ascidians collected on the coast of California by the U.S. Fisheries steamer *Albatross* during the summer of 1904 include a number of new species, which are described by Mr. W. E. Ritter in the Zoological Publications of California University, vol. iv., No. 1.

THE greater portion of the October issue of the *American Naturalist* is occupied by a paper by Mr. A. W. Grabau on orthogenetic variation (*i.e.* variation along definite lines) in the shells of gastropod molluscs. Among the points discussed are the mode of arrangement and development of ribs and spines on the shell.

TO Messrs. Witherby and Co. we are indebted for a copy of an illustrated pamphlet entitled "Gilbert White of Selborne." The text formed the subject of a lecture delivered before the Hastings and St. Leonards Natural History Society in June last by Mr. W. H. Mullens. The illustrations include several views of Selborne village, and one of the interior of the church. A good summary of the chief features of White's career will be found in this well-got-up pamphlet, of which the price is half-a-crown.

IN No. 1567 (vol. xxxiii., pp. 197–228) of the Proceedings of the U.S. National Museum, Lord Walsingham describes a number of new North American moths of the tineid group, with the addition of a list of genera of the family Blastobasidæ. The specimens on which the determinations are based were in part supplied by the U.S. Museum and U.S. Department of Agriculture, and in part contained in the author's own collection. Types of most of the new species are now in the U.S. Museum. Soft river-tortoises (Trionychidæ) from various Tertiary horizons in the United States form the subject of a paper by Mr. O. P. Hay published in the Bulletin of the American Museum of Natural History, vol. xxxii., pp. 847–863.

TO the November issue of the *Zoologist* Mr. W. L. Distant, the editor, contributes the second and concluding part of his article on the extermination of animals, dealing in this instance with the destruction dealt by man. After referring to the destruction of African antelopes and quaggas for the sake of their hides, the author quotes a statement to the effect that in the twenty years from 1856 to 1876 Africa supplied Europe with an annual average of 1,500,000 lb. of ivory, in addition to 250,000 lb. exported to India and about 150,000 lb. to America, this representing the destruction of about 51,000 elephants. Another item which bulks very large is the toll of alligators killed in Florida for their hides, this being estimated at no less than two and a half millions. In Australia, again, we find a flock-owner boasting that in the course of eighteen months he had killed, on his own estate, 64,000 of the smaller marsupials, such as wallabies and kangaroo-rats, in addition to several thousand kangaroos. As the author well remarks, no species can stand such wastage long, and kangaroos and their kin must apparently be exterminated as wild animals at no very distant date.

TO vol. xvi. of the *Anales* of the National Museum of Buenos Aires Dr. F. Ameghino contributes no less than 135 pages of "preliminary notes" on an atlas vertebra and imperfect femur (which, so far as we see, may or may not be associated) from the later Tertiary deposits of Monte Hermosa. On these two specimens, coupled with certain alleged evidence of the existence of an intelligent being at the time the Monte Hermoso strata were deposited, he considers himself justified in naming a new genus and species—*Tetraprothomo argentinus*—of the family Hominidæ. Nor is this all, for in the latter part of the paper he publishes a series of phylogenies in which the Ungulata and Primates, together with the Patagonian extinct Carnivora, are derived from a single South American ancestral type, the Microbiotheriidæ, a group which most palæontologists now regard as inseparable from the opossums. On a later page we are furnished with the names of a number of non-existent connecting links between "Tetraprothomo" and man and gibbons on the one hand, and earlier forms on the other. It may be added that in one of the hypothetical genera is included the Neanderthal man under the name of *Prothomo neanderthalensis*.

THE fifth annual report of the Horniman Museum and Library, Forest Hill, S.E., dealing with the work of the year 1906, has been issued. The museum is intended to be a teaching institution where the general public, students, and school children may be able to inspect properly labelled specimens exhibited in related series. Saturday morning lectures for teachers and afternoon lectures for the general public have been held with much success. The report contains illustrations of some of the models made by the museum naturalist to illustrate natural phenomena. Among these are diagrammatic models of coral reefs designed to illustrate the manner in which they are built up and the effects of currents on the growth of the reefs. Useful though these models are, their scientific value would have been increased had they been modelled to a true scale, and some indication of the scale given.

THE Bulletin of the Johns Hopkins Hospital for November (xviii., No. 200) contains an interesting paper by Dr. Arthur Meyer on the physician and surgeon in Shakespeare.

THE pages of the *Journal of Hygiene* for October (vii., No. 5) are mainly occupied with two papers on ship beriberi and scurvy by Prof. Holst and Dr. Frölich. It is stated that ship beri-beri is closely connected with food, and shows a marked congruence with scurvy. By keeping animals on certain diets, conditions were produced simulating human scurvy very closely. The etiology of tropical beri-beri is considered to be outside the field of these investigations.

THE reports of the Board of Health, New South Wales, on the outbreaks of plague at Sydney are important contributions to the epidemiology of this disease, and show conclusively the interdependence of the rat and plague. The latest report, by Dr. Ashburton Thompson, deals with the sixth outbreak, which occurred in 1906. A continuous outlook is kept for infection in rats, large numbers of which are caught and examined. In the fifth outbreak, in 1905, the last case of plague in man occurred on July 12, and the last plague-infected rat was identified on December 5. In 1906, the first plague-rat was identified on January 23, the first case in man occurred on March 12, the last on December 22, and the last plague-rat was identified on December 29. From December 6, 1905, to January 22, 1906, 3225 rats and mice were examined and found to be plague-free. During the epizootic period, January 23 to December 29, 1906, 27,731 rats and mice were examined, among which plague was identified in

174 rats and mice. It is again shown, therefore, that the plague epidemic is preceded by an epizootic among the rats and mice. Notes are given on the species of rodents affected, and on the clinical details of the cases.

THE Bulletin of the Department of Agriculture, Jamaica (August and September), contains articles on the subject of curing vanilla pods for market and on the vanilla industry, also on bastard logwood and cacao cultivation.

WE have received from Messrs. A. E. Staley, of Thavies Inn, London, a list of Bausch and Lomb's new microscope models fitted with an improved form of fine adjustment, also a brochure on the use and care of the microscope.

THE development of the pollen grain in the gymnospermous genus Dacrydium is interesting because, according to the account contributed by Miss M. S. Young to the *Botanical Gazette* (September), a number of cells are formed in what is technically known as the microgametophyte. The spore passes out of the single-cell stage when a small prothallial cell is cut off; by another division of the vegetative nucleus a second prothallial cell is formed, and in a similar way a third, the generative cell, is produced. The generative cell gives rise to a sterile and a so-called body cell, the progenitor of the sperm cells. As the second prothallial cell not infrequently divides, the mature pollen grain may show as many as seven nuclei.

IN the *Engineering Magazine* (vol. xxxiv., No. 2) a new mineral industry, the manufacture of radium, is described by Mr. Jacques Boyer. He gives illustrations of the works lately installed at Nogent-sur-Marne, where waggon-loads of various minerals (pitchblende, autunite, chalcolite, carnotite, and thorianite) are treated for an ultimate production consisting of a few minute particles of radium salts.

THE Institution of Engineers and Shipbuilders in Scotland has reached its jubilee year, and in his presidential address Mr. John Ward gave an able retrospect of the events connected with the work of the institution, a subject especially suitable in view of the fact that it is also the centenary of marine engineering as applied successfully to ocean navigation. To the address, which is printed in the Transactions (vol. li., No. 1), is appended a useful chronology of events in the evolution of the marine steam engine.

THE problem of peat utilisation, so often pronounced hopeless, may now be considered as practically solved. The Mond Power-Gas Corporation is building a large peat-generator gas-plant near Herne, in Westphalia; Messrs. Crossley Brothers are projecting plants on the basis of their long-continued experiments at Openshaw; and Martin Ziegler has made peat-coke and obtained the chemical by-products, at Oldenburg and at other places, ever since 1897. The Ziegler plant at Beuerberg, in Upper Bavaria, which was opened in 1906, is described in detail in *Engineering* of November 15. The results obtained have been eminently satisfactory, and suggest the possibility of manufacturing at a profit peat-coke and chemicals in Ireland, where from 16 feet to 40 feet of peat can be worked over large areas.

MR. GUSTAVE CANET, past-president of the French Society of Civil Engineers, has honoured the Junior Institution of Engineers by accepting the presidency, and in his inaugural address, which was delivered on November 18, he frankly and critically compared English and French practice in connection with the design and manufacture of artillery. The conditions under which gun-makers work in the two countries are, he pointed out, essentially different. The whole tendency of French policy has been adverse to the interests of private manufacturers. In Great Britain, on the other hand, there has never been any restriction placed upon manufacturers with regard to the supply, during peace time, of war material to foreign Powers. Hence works of private manufacturers have developed and have acquired vast experience that is a valuable national asset, for they can place all their resources at the disposal of the Government in case of need.

STRIKING evidence of the reduction in working costs and in the number of unskilled coloured labourers effected by the installation of labour-saving appliances in the Transvaal mines is afforded in the paper on the equipment of the New Kleinfontein mine read by Mr. E. J. Way before the Institution of Mechanical Engineers on November 15. A branch line was constructed from the nearest railway station up to the mine, and the surface plant was equipped with a complete system of conveyors and elevators for handling all coal, ash, ore, waste rock, and residue sands, whilst the stopes underground have been provided with swinging conveyors specially designed to permit the rapid and easy dismantling and re-erection necessitated by blasting requirements and by the constant shifting of the working faces of the stopes. The actual annual reduction in the working costs due to the installation of labour-saving appliances is equivalent to a saving of nearly 3*s*. per ton milled.

THE Institution of Mining and Metallurgy has drawn up a series of standard weights and measures with the object of securing uniformity in scientific papers. The word "ton" shall, it is decided, represent a weight of 2000 lb. avoirdupois; the word "gallon" shall represent the Imperial gallon measure of 10 lb. of water. Temperatures shall be expressed in degrees centigrade. Returns of gold and silver shall be expressed in terms of fine gold and fine silver respectively, not as "bullion." Gold contents of ores, determined by assay, shall be expressed in money values as well as in weights; and in this connection the value shall be taken (as a convenient constant) at 85*s*. per troy ounce of fine gold. The adoption of these definitions in assay returns will doubtless obviate much of the existing confusion, but it is to be feared that the use of the new ton of 2000 lb. would, in the case of statistics of mineral production, not be so convenient as the statute ton of 2240 lb. or the metric ton of 2204 lb., both of which may legally be employed.

IN the Transactions of the Institution of Engineers and Shipbuilders in Scotland, Dr. Victor Cremieu describes his proposed apparatus for extinguishing the rolling of ships, some references to which have appeared in the daily Press. One method involves the use of a heavy sphere rolling in viscous liquid in a curved tube at the bottom of the ship; in the second form the moving weight takes the form of a pendulum swinging in a chamber in the form of a sector of a circle, again filled with viscous liquid. The paper contains no reference to what would happen in the event of the weight striking the boundaries of the chamber in a heavy sea or in a disaster.

IN the *Rendiconto* of the Naples Academy (Mathematical and Physical Section), xiii., 3 and 4, Profs. F. Bassani and C. Chistoni direct attention to a recently formed orifice in the Solfatara of Pozzuoli. This opening was first seen on February 2, and the authors consider that it affords an excellent opportunity for the study of geophysical problems connected with the changes of level of the well-known temple of Serapis. They propose that a series of observ-

ations should be undertaken at once under the control of the department of geophysics of the University of Naples pending the formation of the geophysical institution which is to be established at Pozzuoli, and that Government assistance should be asked for the necessary means of carrying on the temporary researches rendered urgent by the present eruption. Prof. Bassani, in conjunction with Dr. A. Galdieri, describes further observations on the windows broken at Ottajano during the eruption of Vesuvius of 1906, and maintains their view, which has been doubted by other writers, that the damage was done by lapilli driven against the windows by the action of wind.

"THE Climate of Abbassia, near Cairo," is the title of No. 3 of the useful Survey Department papers now being issued by the Egyptian Ministry of Finance. The observatory at Abbassia was founded by the Khedive Ismail Pasha in 1868, and was removed to Helwan in 1903. Summaries of the observations have been issued from time to time, except for the five years before the removal; the present report contains a careful discussion, by Mr. B. F. E. Keeling, of the results of those five years and summaries of the mean values for the whole thirty-five years. The mean annual temperature was 70°·2; January, 54°·1; July, 83°·5; the absolute extremes, 117°·1 (August, 1881) and 28°·4 (February, 1880). Rainfall is very small; the mean for seventeen years was only 1·18 inches; from June to September, inclusive, no rain falls. There are about 3100 hours of bright sunshine annually, not far from double the average amount in the south of England. Series of charts show the mean annual and daily curves for each of the principal elements.

WE have recently had an opportunity of inspecting and testing the binocular diffraction spectroscope patented and sold by Dr. Marshall Watts, and have found it to be a remarkably efficient instrument for the spectroscopic investigation of light-sources of definite form, such as vacuum tubes. It consists of an ordinary good field-glass having attached in front of each object-glass a transparent diffraction grating mounted on optically worked plane glass. In examining a luminous vacuum tube we found that the bright lines apparently stood out in relief, whilst the illumination, even in the second and third orders, was very satisfactory. The first-order spectrum of Capella, on by no means a perfect night, was seen as quite a bright colour band. For the examination of broader light-sources, such as flames or arcs, a metal or ebonite plate with a slit in it may be usefully employed in order to obtain a purer spectrum. The price of the binocular spectroscope is 3*l*. 3*s*., and further details of the instrument may be obtained from Dr. Watts, "Shirley," Venner Road, Sydenham.

THE fortieth anniversary of the existence of the German Chemical Society was celebrated recently in Berlin. We learn from the *Times* that the meeting was devoted to retrospective addresses on important achievements of chemistry during the last forty years. Prof. Nernst delivered an address on physical chemistry; Prof. Landolt spoke on the development of inorganic chemistry; Prof. Graebe described the successes of the chemistry of the carbon compounds by the process of synthetical combinations; and Prof. Otto N. Witt, who discussed the development of technical chemistry, remarked that technical chemistry has brought about a revolution in productive industry mainly by the aid of electrotechnical science. Prof. Witt directed attention to the manufacture of cellulose from wood leading to the changed methods in the production of paper, to the employment of nitro-cellulose for the preparation of silk-like substances for weaving, to the synthetic production of indigo and alizarin, and to the fixation of atmospheric nitrogen.

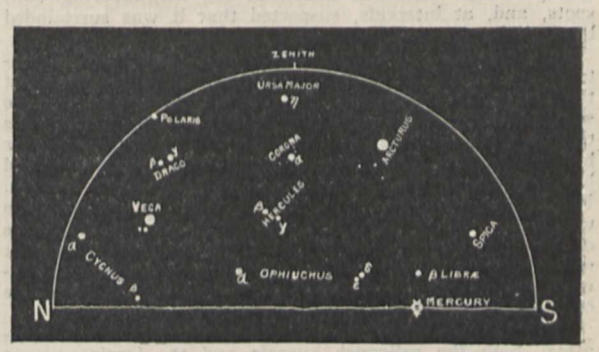
THE current number of the *Oxford and Cambridge Review*, the second issue, contains two articles dealing with scientific subjects. Mr. J. Butler Burke contributes an article on "Haeckel and Haeckelism," and the headmaster of Eton College, under the title "More about Biometry," tells of the introduction of the system of anthropometric measurement of the boys at Eton, and refers to this movement as "a united act of faith in the desirability of knowledge for its own sake."

A SECOND edition, which has been revised and enlarged, of "The Practice of Soft Cheesemaking: a Guide to the Manufacture of Soft Cheese and Preparation of Cream for Market," by Messrs. C. W. Walker-Tisdale and Theodore R. Robinson, has been published by Mr. John North at the office of the *Dairy World and British Dairy Farmer*. The characteristics of the book were described in a review of the first edition which appeared in NATURE for June 9, 1904 (vol. lxx., p. 137). The practice of making soft cheese is increasing in this country, and this new edition of a useful book should assist small holders endeavouring to gain a livelihood from the land.

OUR ASTRONOMICAL COLUMN.

MERCURY AS A MORNING STAR.—Although the present elongation of Mercury—the planet was at greatest western elongation (20° 20′) at 2h. on Sunday last—is not so favourable for the naked-eye observation of the planet as those which took place in February and August respectively, there is a possibility that during the next day or two observers may be able to pick up this elusive object near the eastern horizon just before dawn. On December 6 the planet will rise at 5h. 57m. a.m., the sun at 7h. 51m., whilst on December 8 the respective times will be 6h. 4m. and 7h. 54m.

At this season of the year an object near the horizon is not easy to find, and the would-be observer would do well to learn beforehand the exact rising point, and then



Relative positions of Mercury and bright stars at 6 a.m. December 6; observer facing due east.

to get into such a position that the horizon thereabouts is quite free. The planet rises a little less than 30° S. of E., and this direction may be noted, and in some way marked, on the previous evening, by observing the rise of Sirius, which takes place in the same azimuth at about 9 p.m. β Libræ rises about an hour before Mercury at a point some 15° nearer the east point.

The accompanying rough sketch-map may assist the observer to locate the planet. It is intended to show the approximate position of the stars, with the observer facing due east, at the time that Mercury rises, the stars being shown here as projected on to a plane parallel to the plane of the meridian.

A BRIGHT METEOR.—An exceptionally bright meteor was observed by Mr. T. F. Connolly, at South Kensington, at

11h. 30m. p.m. on November 27. The commencement of the flight was estimated to lie half-way between α Cygni and ζ Ursæ Majoris, and after pursuing a vertical path the meteor died away before reaching the horizon. The colour of the object was yellow, its shape that of a pear, a round head followed by a tapering tail. The meteor travelled slowly, and no persistent trail was observed.

SATURN'S RINGS.—A communication from Prof. Pickering to the *Astronomische Nachrichten* (No. 4216, p. 267, November 26) contains the following messages received from Prof. Lowell:—"Condensations in Saturn's rings confirmed here and measured repeatedly. They are visible symmetric and permanent. Outer situated near the outer edge, ansa *b*, inner at middle of ansa *c*. A conspicuous relative gap also detected and measured at 1·56 radius from the centre of the planet. Ring easily seen. Placed further south from shadow at west than east." This message was dated November 7, and the following was dated November 22:—"Ring shadow on Saturn bisected, black medial line, phenomenon explicable by extra-plane particles only."

THE RECENT TRANSIT OF MERCURY.—No. 21 of the Paris *Comptes rendus* (November 18) contains a number of communications regarding the observations of the transit of Mercury which took place on November 13.

At the Nice Observatory the times of the contacts were observed with several different instruments, and micrometer measurements of the polar and equatorial diameters were made. For several seconds "before" the second contact black ligaments were seen by MM. Javelle and Simonin, and before third contact; the black disc of the planet was seen to be surrounded by a whitish or yellowish appearance. The measurements of the diameters are not consistent for different observers, but they all agree in making the polar diameter the shorter. M. Charlois saw very distinctly the black ligament after the second and before the third contacts, its thickness being less than the diameter of the planet. The unsteadiness of the image rendered the proposed astrophysical observations almost impossible.

At the Lyons Observatory observations of the times of contact and measurements of the diameters were also made, and none of the three observers was able to see any peculiar feature on the planet's disc.

M. Bourget, at Toulouse, found the planetary disc distinctly blacker than the nuclei of the neighbouring sunspots, and, at intervals, suspected that it was surrounded by a slight, pale yellow border.

At Marseilles, where a number of observations of contacts and of diameters were made, M. Borrelly noted that the disc was of a dark violet colour, and appeared to be surrounded by a nebulous greyish ring of light nearly as thick as the diameter of the planet. The same observer believes he saw Mercury as a small dark disc surrounded by a violet annulus about an hour before first contact. Paying special attention to the matter, M. Esmiol was unable to discern the slightest deformation of the horns of the planet as it crossed the sun's limb at entry, but saw a sharply defined ring, of about three seconds in thickness, around the dark disc of the planet during the whole of the transit.

With the smaller magnifications at the Bourges Observatory, both the yellowish aureole and the luminous spot were seen, but Abbé Th. Moreux believes both of them to be subjective phenomena. At the beginning of the observations the bright spot was to the east of the centre, but at the end it appeared to be to the west. With a magnification of 325 it always appeared central.

Comte de la Baume Pluvinel, who had set up special spectroscopic apparatus at the Nice Observatory, was unable to find any modification of the solar spectrum near the planet's limb, although he especially examined the absorption bands of oxygen and water vapour, both visually and photographically.

Arrangements were made for observing the possible spectroscopic phenomena, visually and photographically, at the Solar Physics Observatory, South Kensington, but clouds prevented the observations being made. The planet was only seen for a few seconds some little time after the commencement of the transit, and appeared as a well-defined black disc.

SOME RECENT WORK IN PALÆONTOLOGY.

AMONG palæontological papers sent to us, the following have a faunistic bearing:—

Mr. F. R. Cowper Reed ("Memoirs of the Geological Survey of India," "Palæontologia Indica," new series, vol. ii., mem. 3, 1906) describes the lower Palæozoic fossils of the northern Shan States, Burma, and points out that we know very few fossils from pre-Devonian rocks in southern Asia. The rich finds in Burma, which have mainly become revealed through the survey by Mr. T. D. La Touche, are consequently very welcome. Dr. Bather has furnished thirty-four pages on the cystideans, and Miss Elles has assisted in the description of the graptolites, which are represented by three species of Monograptus (p. 90). The critical remarks on genera by Dr. Bather and Mr. Reed render the memoir of general importance. The Naungkangyi beds, which doubtless include more than one stage (p. 83), are shown to have affinities with the Lower Ordovician of northern Europe. La Touche believes the Nyaungbaw beds to be Upper Ordovician; but the fossil evidence is scanty. The Namhsim Sandstones (p. 152) are correlated with the European Wenlock. The Zebingyi beds, which contain abundant *Tentaculites elegans*, side by side with Monograptus, are of later age, and the fauna verges on that of the Lower Devonian of Europe; but the presence of Monograptus leads Mr. Reed to regard these Burmese strata as uppermost Silurian, the fauna heralding that which afterwards spread into the Mediterranean or south European province. The fine plates in the memoir are from drawings by Mr. T. A. Brock.

Dr. Carl Diener deals with the fauna of the Tropites-limestone of Byans, on the south-west flank of the Himalayas, adjoining Tibet and Nepal (*ibid.*, ser. xv., vol. v., mem. 1, 1906). The author visited the sections in 1892, and extensive collections have since been made by the Indian Geological Survey in 1899 and 1900. The cephalopod-fauna includes Atractites, Orthoceras, and a fine series of ammonites, these last furnishing 155 species out of 168 forms of all kinds known from this horizon (p. 188). This fauna is now well illustrated. We have already referred (NATURE, vol. lxxiv., p. 530) to the conclusion that in Byans, in one limestone band 3 feet in thickness, the dissimilar Carnic and Noric faunas of the Alps are both represented. Transitional types of ammonites are not, however, discoverable, and the apparent mingling of the faunas is held to be due to lack of sedimentation, whereby a thin stratum represents a prolonged epoch of Triassic time.

In the succeeding memoir (*ibid.*, mem. 2) Dr. Diener describes "the fauna of the Himalayan Muschelkalk." The beds are mainly of Upper Muschelkalk age, yielding numerous cephalopods. India is no longer inferior to Europe in the number of species known from this stage. Ten species of cephalopods, and three common species of brachiopods (p. 135), are identical with those of Europe.

Mr. H. Woods, working, like Mr. Cowper Reed, in Cambridge, describes the Cretaceous fauna of Pondoland for the Geological Survey of Cape Colony ("Annals of the South African Museum," vol. iv., part vii., 1906). He has also had the advantage of examining Mr. Griesbach's collection in the Hamburg Museum. The whole deposit in Pondoland is regarded by Mr. Woods as Upper Senonian. Mr. Brock must again be congratulated on the beautiful plates accompanying the memoir.

Mr. S. Tokunaga (Journ. Coll. of Science, Univ. of Tokyo, vol. xxi., article 2, 1906), in a paper on fossils from the environs of Tokyo, has made good use of material close to the city itself, in beds hitherto regarded as Pliocene. The fauna is almost entirely molluscan, but the author has secured from it a few remains of *Elephas antiquus*. Carefully comparing his results with those of his predecessor Brauns, who wrote in 1881, he is persuaded that the affinities with the European Crag beds have been overstated; and he brings the deposits round Tokyo forward into post-Pliocene or "Diluvial" times. The new species, and many already recorded, are figured on five large plates.

We may perhaps refer here to Mr. Schuchert's discussion of the Carboniferous and Permian beds of Russia,

India, and America (*American Journal of Science*, vol. xxii., 1906, pp. 29 and 143), since the treatment is mainly palæontological. The conclusion arrived at is that as yet we cannot determine whether the Permian is an independent system; but hopes are expressed that the unbroken section of 9000 feet in south-western Texas, opening in Carboniferous strata, may throw important light on the true Permian sequence. The Permian faunas usually known to us are detached members of an obviously larger system, which may prove after all to be the Carboniferous.

We have received also a number of papers dealing with special divisions of fossil organic remains:—

In the Transactions of the Geological Society of South Africa, vol. ix., 1906, p. 125, Messrs. Mellor and Leslie describe the fossil forest exposed, during an unusually dry season, in the bed of the Vaal near Vereeniging. The river had etched out, as it were, the roots of trees, bedded below in coal, and a picture of a land-surface lay revealed, probably of Permian age. The authors believe that the roots and associated stems belong to Nœggerathiopsis. Photographs are given of this interesting exposure, which may not again become visible for many years.

Fusulina, like Nummulites, has an interest for all geologists, apart from the fact that it is a handsome representative of the Foraminifera. Mr. H. Yabe (Journ. Coll. Science, Univ. of Tokyo, vol. xxi., article 5, 1906), in describing a Fusulina-limestone from Korea, discusses the genus in general, and adds a new subgenus, Neoschwagerina, to the three proposed by Schellwien, viz. Fusulina s.s., Schwagerina, and Doliolina. He corrects (p. 17) a reference to Fusulina-limestone in Borneo, originating in the *Geological Magazine* in 1875, and points out that Sumatra was the locality referred to. A useful summary of the distribution of such limestones is provided, and Brazil, Persia, Turkestan, and the Salt Range are grouped together as regions on the coast of the Carboniferous "Mediterranean Ocean" (p. 24). Our knowledge of Fusulina-limestone in Asia is still extending (see the recent discoveries in Burma, "Records Geol. Surv. of India," vol. xxxv., 1907, p. 52), and stratigraphers may well read Yabe's paper in connection with Schuchert's faunistic review, to which attention has been directed above. A Japanese author who writes in such good English may perhaps be excused for using "foraminifera" throughout as a singular noun.

An important criticism on the views of Prof. J. E. Duerden as to the primary hexameral character of rugose corals appears from Mr. T. C. Brown in the *American Journal of Science* for April. Brown selects *Streptelasma rectum*, one of the Devonian corals examined by Duerden, as a type, and discovers in its earliest stage a primary set of four septa, two forming a bar across the calicle, the other two (alar septa) being set obliquely on the cardinal one. In the next stage a secondary septum appears in each of the comparatively large cardinal spaces, and joins the alar septum obliquely. Here, then, a pseudo-hexameral effect is temporarily produced. The author comments on Mr. R. C. Carruthers's recent paper in the *Annals and Magazine of Natural History*, which describes a similar succession of septa, but which puts forward a different view as to the mode of development of the first pair of secondary septa. We may feel sure that Prof. Duerden's work will be further stimulated by the parallel and critical investigations to which it has given rise.

Mr. Frank Springer uses the discovery of the disc of Onychocrinus as a basis for a complete review and a new analysis of the genera of *Crinoidea flexibilia* (*Journ. of Geology*, vol. xiv., 1906, p. 467). Drawings were made from Angelin's specimens by Mr. G. Liljevall, of Stockholm, who discovered, in the course of his work, that Ichthyocrinus has an extra (primitive radianal) plate in the right posterior ray. Springer thereupon examined numerous specimens of this genus from other localities, and states (p. 478) that the Silurian ones agree with those drawn by Liljevall, while the Carboniferous ones have no radianal. For the latter, which are regarded as showing an evolutionary elimination of a primitive character, the genus Metichthyocrinus is now proposed. A comparison is instituted (p. 504) between the progressive variation in position and the final removal of the radianal in time, and the similar events that affect the anal plate during the life-history of Antedon. The six figures illustrating the disc of Onychocrinus are unfortunately not numbered, and some ingenuity is required before they can be fitted in with their descriptions.

The characters of certain labyrinthodont footprints have led the Rev. Longinos Navás, S.J. (*Boletín de la Sociedad Aragonesa de Ciencias naturales*, tomo v., 1906, p. 208), to form a new species, *Chirosaurus ibéricus* or *Cheirotherium ibericum*; but surely the reference of the beds at El Moncayo, in which the specimen occurs, to the Silurian (p. 212) rests on far too little evidence. Footprints of Chirosaurus from Lower Triassic strata are, moreover, already known in Aragon, and are cited by our author. The fact that he is not startled by his own conclusion shows that, in his zoological studies, the succession of vertebrate forms has not as yet attracted him.

Mr. G. R. Wieland (*Science*, vol. xxiii., 1906, p. 819, and vol. xxv., 1907, p. 66) brings together good evidence on "Dinosaurian gastroliths." The surface of such stones, even when they are flints, shows "a higher polish than wind or water ever produces." The deinosaurs are, moreover, credited with a selective taste for brightly coloured pebbles.

In a paper on the origin of the Wasatch deposits of the Big Basin (*American Journal of Science*, vol. xxiii., 1907, p. 356), Mr. F. B. Loomis describes (p. 363) a new species of Lambdotherium, and one of Glyptosaurus, a terrestrial lizard. The fauna, which includes Eohippus, Phenacodus, Coryphodon, Crocodilus, aquatic turtles, and a few fishes, is explained as having accumulated in flood-plains, and not in a lake-basin, as has been generally asserted.

The Rev. T. Gardner, S.J., describes and illustrates several types of small stone implements formed by primitive man in Rhodesia ("Zambesi Mission Record," vol. iii., 1906, p. 149). The author points out that many of the specimens now found upon the surface may have been once deeply buried, and were washed out during the sudden bursts of rain. We are already familiar with the argument as to the antiquity of such implements in Africa, based on their occurrence in the river-gravels cut through by the Zambesi gorge. In Father Gardner's paper we are brought into touch with some of the first discoverers of these interesting forms, including the observant author and the scholars of St. George's School in Bulawayo.

Finally, fossil man receives a whole-hearted greeting from the Positivists, represented by Dr. Cancalon, in an essay on "Le Progrès aux Temps paléolithiques" (*Revue positiviste internationale*, 1907). The proofs of this paper have not been very carefully corrected; but its acceptance of long ages of mental progress in man, as not incompatible with Comte's conception of human nature, will no doubt be of service in certain quarters, where science has hitherto seemed fraught with pessimism rather than with a guiding inspiration. G. A. J. C.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Dr. Barclay-Smith has been appointed university lecturer in advanced human anatomy as from Michaelmas, 1907, until Michaelmas, 1912.

Prof. H. S. Carslaw has been approved for the degree of doctor in science.

The degree committee of the special board for mathematics is of opinion that the work submitted by J. B. Hubrecht, of Christ's College, entitled "An Attempt at a Spectroscopic Investigation of the Solar Rotation," is of distinction as a record of original research.

WE learn from the *Revue scientifique* that the University of Lyons has accepted a gift from M. Théodore Vautier of 4000*l.*, the income from which is to be devoted to research work in experimental physics.

SIR EDWARD H. CARSON, P.C., M.P., will distribute the prizes and certificates at the Borough Polytechnic Institute on Thursday, December 12. Mr. J. Leonard Spicer,

chairman of the governing body, will take the chair at 8 p.m.

COPIES of the general and departmental reports on the work of Bradford Technical College for the session 1906–7 presented to the Higher Education Subcommittee of the city have been received. The principal of the college appeals to employers of labour in the city to recognise the efforts made by those in their employ who desire to obtain instruction in evening classes, and urges masters to make arrangements to liberate students during the time the classes meet. The work of the department of textile industries is exerting a beneficial influence on the trade of Bradford. The demand for students trained in the department, and the increasing tendency of combers, spinners, and manufacturers to appeal to the college in cases of difficulty, have been very marked during the session. The reports contain other indications that the college is assisting the various industries in its neighbourhood.

AT the recent annual convocation of the University of Allahabad for conferring degrees, the Vice-Chancellor, Rai Sunder Lal Bahadur, delivered an address on the need for higher technical education in the United Provinces. Referring to the conference which sat in August last at Naini Tal to consider important questions in connection with technical education, the Vice-Chancellor said, we learn from the *Pioneer Mail*, that "among the matters which engaged the attention of the conference was the suggestion for the establishment of a high-class technological institute for research and instruction, where students could receive instruction in chemical technology, mechanical engineering, and other kindred subjects. The cost of maintaining an institution like this will be large. According to Sir Norman Lockyer," continued the Vice-Chancellor, "for the up-keep of seven out of twenty-two universities, the annual sum found in Germany chiefly by the State comes up to 271,000*l*. When these figures are borne in mind, the cost of the proposed institute ought not to stand in the way of its establishment. Its advantages will abundantly repay the outlay. It will provide an opening for graduates in science, and will divert many of them to the useful paths of industry and research. In such an institution graduates, who have studied the general principles of science in colleges, will be able to master the various methods of the practical application of science to the needs of the present day. They will there learn with what extraordinary skill, in other and more advanced countries, men are 'harnessing science in the service of business and the other tasks of modern life.'"

THE Earl of Crewe, chairman of the governing body of the Imperial College of Science and Technology, has authorised the publication of the following communication:—The governing body of the Imperial College of Science and Technology has appointed three standing committees, a finance committee (chairman, Sir Francis Mowatt), an education committee (chairman, Mr. Arthur Acland), and a general purposes committee (chairman, Lord Halsbury). In addition, two temporary committees have been appointed, namely, a transfer committee (chairman, Mr. Arthur Acland), and an organisation committee (chairman, Mr. Gerald Balfour; vice-chairman, Sir William White). Matters relating to the transfer to the Imperial College of the constituent institutions, which it has been arranged shall take effect as from January 1 next, and to the transfer of land from the Exhibition Commissioners, have been referred to the transfer committee. The organisation committee, to which have been referred matters relating to the future organisation of the Imperial College, has appointed four subcommittees to consider questions arising under this head in relation to the following sciences or groups of sciences, viz.:—(1) mining and metallurgy (chairman of the subcommittee, Sir Julius Wernher); (2) other branches of engineering (chairman, Sir John Wolfe-Barry); (3) biological sciences (chairman, Sir Archibald Geikie); and (4) other pure and applied sciences (chairman, Sir Arthur Rücker). The governing body has authorised the appointment of persons not members of the governing body who are specially conversant with the sciences in question or with their industrial applications as additional members of these subcommittees, which are now engaged in considering the questions referred to them. The governing body has also approved in principle the appointment of a principal officer of the Imperial College, and has referred the question of his title and functions to the organisation committee.

SOCIETIES AND ACADEMIES.

LONDON.

Society of Chemical Industry, November 4.—Mr. R. J. Friswell in the chair.—The determination of indigotin in indigo-yielding plants: Cyril **Bergtheil** and R. V. **Briggs.** The accurate determination of indigotin in the indigo plant is of considerable importance, since a correct estimate of the efficiency of the process of indigo manufacture depends thereon. A method of precipitating indigotin from an extract of the plant in boiling water by means of ammonium persulphate, proposed by Rawson in 1904 and modified by the present authors, has been shown to give correct results by comparison with those obtained by fermentation of the extract by means of the indigo enzyme (Journ. Soc. Chem. Industry, 1906, xxv., 729). This method has been criticised by Orchardson, Wood and Bloxam, and two alternative methods proposed, one of which, depending on the same principle, is said to give results identical with those obtained by the authors' method, whilst the other, depending on the precipitation of indirubin by the action of isatin in acid solution, indicates a considerably higher potential yield of indigotin in the plant extract used (Journ. Soc. Chem. Industry, xxvi., 4). The authors' original method is now verified, and some minor modifications are recommended. The conclusion that the isatin method may in certain circumstances indicate a higher indican content in a given extract than the persulphate method is not borne out by the authors' experiments.—Analysis of indigo (part iii.) and of the dried leaves of *Indigofera arrecta* and *I. Sumatrana*: R. **Gaunt,** F. **Thomas,** and W. P. **Bloxam.** A summary is first given of the results of the work on indigo carried out for the Government of India at the University of Leeds during the years 1905–7. In the present paper the exact conditions were prescribed for the preparation of pure indigotin to serve as the standard on which the tetrasulphonate process for the estimation of indigotin is based. A reply was made to certain criticisms on the tetrasulphonate process; the defects complained of were shown to be due to want of proper precaution on the part of the operators. The methods in use for the estimation of indigotin in the leaf were described. The persulphate method was found altogether faulty, as the results obtained by it were too low. The new "isatin" method was found to give much higher results, and, moreover, the method is quantitative, as proved by its action on the glucoside indican, which has recently been isolated in quantity by Messrs. A. G. Perkin and W. P. Bloxam. As a result of employing the isatin process, the indigo leaf is demonstrated to be capable of yielding more indigotin than had previously been supposed. Again, the percentage of leaf present in the green plant has been underestimated in India. It is insisted that these facts are in favour of the survival of the Indian indigo industry. Finally, it was submitted that the work on the indigo ferment or enzyme had not been properly followed out, and that the present reports on the Indian manufacture are eminently unsatisfactory, for (1) the colour-giving value of the raw materials was seriously underestimated, whilst (2) the indigotin value of the manufactured cake was overestimated, and this owing to the persistent use of unsatisfactory methods of analysis in lieu of adopting the tetrasulphonate process.

Physical Society, November 8.—Dr. C. Chree, F.R.S., vice-president, in the chair.—A freehand graphic way of determining stream surfaces and equipotentials: L. F. **Richardson.** Where an accuracy of 1 per cent. to 3 per cent. of the range is sufficient, solutions of the equation

$$\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}+\frac{\partial^2 V}{\partial z^2}=0$$

may be obtained by drawing equipotentials and sections of stream surfaces, and amending them freehand until the

chequers which they form take the appropriate shape at each point of the field. The method can only be applied in certain types of symmetry, as where V is constant along each line of one or other of the following families of lines:—(1) parallel straight lines; (2) circles with their centres on a common axis and their planes normal to this axis; (3) radii from a point; (4) the normals common to the two surfaces of a thin shell of any shape; and (5) a certain family of screw-threads. It is doubtful whether there are any other possible types. Within these five types of symmetry the freehand method far surpasses analytical methods in its adaptability to boundaries and boundary conditions of almost any shape which can be drawn on paper. It can no doubt be extended to deal with conductivity which depends on position, on the potential, or on the force.—The lateral vibration of bars supported at two points with one end overhanging: Dr. J. **Morrow.** When a bar, supported at one end and at some other point in its length, vibrates under its own mass only, the expression from which the frequency can be determined is of considerable complexity. When different values are assumed for the ratio of the overhanging length to the distance between the supports, the expression reduces to a customary form with a coefficient depending on this ratio. This coefficient is given here to six figures for different ratios from zero to unity. The results show that Dunkerley's approximate values cannot be relied on to more than two figures, and that Chree's simple formula gives remarkable accuracy for cases in which the overhanging length is less than half the span.

Zoological Society, November 12.—Dr. F. DuCane Godman, F.R.S., vice-president, in the chair.—Mammals collected at Beira by Mr. C. H. B. Grant, being No. 8 of the series of papers on the Rudd exploration of South Africa: Oldfield **Thomas** and R. C. **Wroughton.** Twenty-eight species were included in the collection, represented by 127 specimens, all, as before, presented to the National Museum by Mr. C. D. Rudd. The region not having been previously worked, the series was of much interest from a geographical point of view.—The feeding of serpents in captivity: Dr. P. C. **Mitchell** and R. I. **Pocock.** The different habits of python-like, non-poisonous and poisonous colubrine and viperine snakes were described, and it was stated that no evidence was found as to the existence of a specific fear of snakes in the case of any vertebrates except Primates, and that, amongst Primates, lemurs were distinguished from true monkeys by their complete indifference to snakes.—Descriptions of some new loricariid fishes, viz. five species of Plecostomus and an Otocinclus from eastern Brazil, and two species of Arges from Colombia: C. Tate **Regan.**—Notes on Mayer's pigeon: Lieut.-Colonel N. **Manders.** The habits of this nearly extinct bird were described.—Observations on the structure of the rare Madagascar mammal, *Galidictis striata*: F. E. **Beddard.**

Institution of Mining and Metallurgy, November 21.—Prof. W. Gowland, president, in the chair.—The deviation of Rand bore-holes from the vertical: J. **Kitchin.** Although there are altogether 235 bore-holes sunk in the Witwatersrand area, of which forty-five have reached a depth of 3000 feet or more, the author has contented himself with a review of twenty-two only, in respect to which results sufficiently full for tabulation are available. As regards these, the general characteristics were such that he has tabulated the following ascertained effects:—(1) the bore-holes almost invariably deviate in a northerly direction; (2) they almost invariably deviate against the strata; (3) the deviation tends to be greatest when the dip is least; (4) the deviation is not confined to any particular spot or spots in the bore-holes, but seems in most cases to be more or less general throughout; and (5) there is no appreciable deviation in the case of the flat-lying surface dolomite and any amygdaloidal diabase underlying it, or in the case apparently of surface igneous rock, but in all other instances the deviation is usually marked, and its rate of increase comparatively uniform. In other words, deviation is not observed except where the rocks passed through are bedded and have a dip. The average horizontal displacement of the twenty-two bore-holes specially submitted for analysis was 440 feet at a depth of 2000 feet, the minimum being 160 feet in a bore-hole 2000 feet deep, and the maximum 2370 feet in a bore-hole 4200 feet deep. As an appendix, the author gave particulars of a further twenty bore-holes, data of which were less detailed.—The separation of tin-oxide from wolfram: A. **Treloar** and G. **Johnson.** A record of experiments made by the authors in Cornwall upon "tinny-wolfram" with the view of saving the tin left in the product of the magnetic separator. The most successful results were obtained by taking the separated product in a dry state and boiling it in dilute sulphuric acid, which in a fairly large-scale experiment gave an extraction of 20 per cent. of tin-oxide. Hitherto, since the introduction of magnetic separation for Cornish ores, large quantities of tin-oxide have been given away in the parcels of wolfram sold, owing to a lack of means to effect this further separation from the tinny-wolfram.

PARIS.

Academy of Sciences, November 23.—M. Henri Becquerel in the chair.—Remarks concerning the nitrous isomerisation of isobutyl alcohol: Louis **Henry.** The conversion of the hydrochlorides of the fatty amines into alcohols by sodium nitrite results in the simple replacement of the (NH_2) group by (OH) for methylamine and ethylamine. Higher members of the series undergo a more complicated change, isomeric alcohols being produced. Isobutylamine gives isobutyl alcohol,

$$(CH_3)_2.CH.CH_2.OH,$$

and trimethylcarbinol, $(CH_3)_3.C.(OH)$, the proportion of the latter (about three-quarters) being determined by converting it into tertiary butyl chloride.—The determination of the solar elements and the masses of Mars and Jupiter by meridian observations of Vesta: G. **Leveau.** The whole of the observations made at Greenwich and Paris between the years 1807 and 1904, and numbering 5440, are utilised, and the results compared with those of Le Verrier and Newcomb.—Observation of the passage of Mercury across the sun's disc made with the Gautier equatorial (40 cm.) at the National Observatory of Athens: D. **Eginitis.** The atmospheric conditions at Athens were bad, and accurate measurements, in consequence, were impossible. The brilliant ring round the disc of Mercury observed in the transit of 1891 was not seen on this occasion.—The order of the function D(λ) of Fredholm: T. **Lalesco.**—Some points in the theory of fundamental functions relating to certain integral equations: Bryon **Heywood.**—The irregular points of convergent series of analytical functions: P. **Montel.**—Some properties of integrals passing through a singular point of a differential equation: H. **Dulac.**—The rotatory magnetic dispersion of crystals in the neighbourhood of absorption bands: Jean **Becquerel.**—Influence of the reaction of the medium on the size of the colloidal granules: André **Mayer,** G. **Schæffer,** and E. **Terroine.** Numerous examples are given showing that the addition of traces of acid to negative colloidal solutions, or of alkalies to positive solutions, has the effect of increasing the size of the colloidal granules.—A new compound of uranium, the tetra-iodide: Marcel **Guichard.** Metallic uranium and iodine are sealed up in a vacuous tube, the iodine being heated to 180° C. and the uranium to 500° C.; the iodide UI_4 is thus formed. It is unstable, and readily acted upon by moisture or oxygen.—The synthesis of ammonia by catalysis starting from its elements: Léon **Brunel** and Paul **Woog.**—A method for estimating very small quantities of zinc: Gabriel **Bertrand** and Maurice **Javillier.** The method is based upon the insolubility of calcium zincate, and allows of the separation of 0·1 mg. of zinc from three litres of solution, a dilution of 1 in 30,000,000.—Lupeol: P. **van Romburgh.** A comparison of the lupeol obtained from *bresk* (the juice of *Dyera Lowii*) with that extracted as cinnamate from the gutta-percha of *Palaquium Treubii*.—Two isomeric methylsparteines: Charles **Moureu** and Amand **Valeur.** An account of two isomeric bases obtained by the decomposition of α-methylsparteinium hydrate.—Experiments on the synthesis of β-campholene lactone and on the lactone of 2 : 4-dimethyl*cyclo*pentanol-2-acetic acid: G. **Blanc.**—The primitive form of the male fig: Leclerc **du Sablon.**—The signification of the redden-

ing ("maladie du Rouge") of the fir: L. **Mangin.**—A remarkable case of autotomy of the floral peduncle of the tobacco plant, caused by traumatism of the corolla: Paul **Becquerel.**—Contribution to the anatomical study of some textile Cyperaceæ of Madagascar: P. **Claverie.**—Contribution to the chemical study of mistletoe, *Viscum album*: M. **Leprince.** An account of the method of isolating an alkaloid from this plant, 25 kilograms of the dried material giving 1·6 grams of the chlorohydrate of the base, $(C_8H_{11}N)HCl$.—The physiological action of the mistletoe, *Viscum album*: Réne **Gaultier** and J. **Chevalier.**—A new sign of true death: E. de Bourgade **de la Dardye.** Referring to a communication by M. Vaillant in the last number of the *Comptes rendus*, the author refers to a communication of his on the same subject published in 1898, in which the immobility of the heart, diaphragm, and intestines after death showed up clearly in radiographs.—Artificial parthenogenesis: Jacques **Loeb.** Criticisms of the work of M. Delage on the same subject.—The comparative morphology of *Pachydavularia erecta* and *Suavopsis elegans*: Louis **Roule.**—The diagnosis of tuberculosis in animals, especially in cattle, by the simultaneous use of the ophthalmo- and cutidermo-reaction: J. **Lignières.**—The comparison of the secretions of the two kidneys in hydruric diabetes: C. **Fleig** and E. **Jeanbrau.**—Tuberculosis cultures *in vivo* and antituberculous vaccination: M. **Moussu.**—The sterilisation of the human ovary by the X-rays: Foveau **de Courmelles.**—The individualisation, graduation, and methodical localisation of the altitude cure applied to the treatment of tuberculosis: Christian **Beck.** The author proposes to send the patients up in groups attached to captive balloons.—The systematic position of the fossil stems known as Psaronius, Psaroniocaulon, Caulopteris: Fernand **Pelourde.**

DIARY OF SOCIETIES.

THURSDAY, DECEMBER 5.

ROYAL SOCIETY, at 4.30.—Experiments in Optics: Prof. A. A. Michelson, For.Mem.R.S.—Reciprocal Innervation of Antagonistic Muscles. Eleventh Note, Further Observations on Successive Induction: Prof. C. S. Sherrington, F.R.S.—On the Distribution of the Different Arteries supplying the Human Brain: Dr. C. E. Beevor.—Localisation of Function in the Lemur's Brain: Dr. F. W. Mott, F.R.S., and Prof. W. D. Halliburton, F.R.S.—On the Supposed Extracellular Photosynthesis of Carbon Dioxide by Chlorophyll: Prof. A. J. Ewart.—The Influence of Increased Barometric Pressure on Man, No. 4, The Relation of Age and Body Weight to Decompression Effects: L. Hill, F.R.S., and M. G. Greenwood, jun.—On the Present Distribution and Origin of the Calcareous Concretions in Coal Seams known as "Coal Balls": Miss Stopes and D. M. S. Watson.—On the Structure of *Sigillaria Scutellata*, Brongn., and other Eusigillarian Stems, in Comparison with those of other Palæozoic Lycopods: E. A. Newell Arber and H. H. Thomas.

CHEMICAL SOCIETY, at 8.30.—The Affinity Constants of Bases as Determined by Methyl Orange. Preliminary Communication: V. H. Veley.—The Velocity of Reduction of the Oxides of Lead, Cadmium, and Bismuth by Carbon Monoxide, and the Existence of the Suboxides of these Metals: F. J. Brislee.—The Relation between Unsaturation and Optical Activity, Part i., The Menthyl and Bornyl Esters of β-Phenylpropionic, Cinnamic, and Phenylpropiolic Acids: T. P. Hilditch.—The Constituents of the Essential Oil of Nutmeg: F. B. Power and A. H. Salway.—Methyl Ethers of some Hydroxy-anthraquinones: A. G. Perkin.—The Colouring Matters of the Stilbene Group, Part iv., The Action of Caustic Alkalies upon Paranitrotoluene and its Derivatives: A. G. Green, A. H. Davies, and R. S. Horsfall.—The Replacement of Alkyl Radicals by Methyl in Substituted Ammonium Compounds: H. O. Jones and J. R. Hill.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Automatic Cab-signalling on Locomotives: J. Pigg.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Retaining Walls: A. T. Walmisley.

LINNEAN SOCIETY, at 8.—Report on Alcyonaria of the Sudanese Red Sea: Prof. J. Arthur Thomson.—Report on the Crinoidea of the Sudanese Red Sea: H. C. Chadwick.—Notes on some Marine Algæ from the Red Sea: Prof. R. J. Harvey Gibson.—*Exhibitions*:—Specimens of *Spartina Townsendi*, as illustrating its Distribution in Britain: Dr. Otto Stapf.—Lantern Slides showing Stages of Soil-denudation consequent on the Removal of Forests: A. P. Young.

FRIDAY, DECEMBER 6.

GEOLOGISTS' ASSOCIATION, at 8.—Notes on the Geology of the Tenby District, with Special Reference to the Carboniferous Limestone: A. L. Leach.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Methods of Vaporising Liquid Fuels, used with Internal-Combustion Engines, as Applied to Road Vehicles: R. T. Deane.

MONDAY, DECEMBER 9.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Jamaica Earthquake and After: Dr. Vaughan Cornish.

SOCIETY OF ARTS, at 8.—The Theory of the Microscope: Conrad Beck.

SOCIOLOGICAL SOCIETY, at 8.—The Problem of Education, a Criticism of Principles, Curricula and Methods: A. E. Crawley.

VICTORIA INSTITUTE, at 4.30.—On Primeval Man in Belgium: Rev. D. Gath Whitley.

TUESDAY, DECEMBER 10.

ZOOLOGICAL SOCIETY, at 8.30.—On the Origin of the Mammal-like Reptiles: Dr. R. Broom.—A Revision of the African Silurid Fishes of the Subfamily Clariinæ: G. A. Boulenger, F.R.S.—On a Hæmogregarine from the Blood of a Himalayan Lizard (*Agama tuberculata*): Prof. E. A. Minchin.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Arc Lighting: W. Krause.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Predetermination of Train Resistance: C. A. Carus-Wilson.

WEDNESDAY, DECEMBER 11.

SOCIETY OF ARTS, at 8.—Radio-active Phenomena: Sir William Ramsay, K.C.B., F.R.S.

THURSDAY, DECEMBER 12.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Preliminary Note on the Operational Invariants of a Binary Quantic: Major MacMahon, F.R.S.—Further Consideration of the Stability of the Pear-Shaped Figure of Equilibrium of a Liquid Earth: Sir G. H. Darwin, K.C.B., F.R.S.—The Action of Ozone on Water-colour Pigments: Sir W. Abney, K.C.B., F.R.S.—On Kinetic Stability: Prof. H. Lamb, F.R.S.—The Absorption Spectra of the Vapours of Benzene and its Homologues at Different Temperatures and Pressures, and likewise of Solutions of Benzene: Prof. W. N. Hartley, F.R.S.—The Spectrum of Magnesium and of the so-called Magnesium Hydride as obtained by Spark Discharges under Reduced Pressure: E. E. Brooks.—Magnetic Declination at Kew Observatory, 1890 to 1900: Dr. C. Chree, F.R.S.—The Effects of Temperature and Pressure on the Thermal Conductivities of Solids. Part ii., The Effect of Low Temperatures on the Thermal Conductivities of Pure Metals and Alloys: Prof. C. H. Lees, F.R.S.—On Exterior Ballistics, No. 2: Prof. G. Forbes, F.R.S.

SOCIETY OF ARTS, at 4.30.—Big Game in India: R. Gilbert.

FRIDAY, DECEMBER 13.

MALACOLOGICAL SOCIETY, at 8.—Additions to the Marine Molluscan Fauna of New Zealand, with Descriptions of New Species: H. Suter.—Alteration to the name of *Mitra recurva*, Sow. (preoccupied): G. B. Sowerby.—Descriptions of New Species of Fresh-water Shells from Central Africa: C. A. Smith.—New Land and Marine Shells from West Africa: H. B. Preston.

SOCIETY OF ARTS, at 8.—Industrial Poisons—Lead and Phosphorus—with Special Reference to the Manufacture of Lucifer Matches: Prof. T. Oliver.

PHYSICAL SOCIETY, at 7–10.—Exhibition of Electrical, Optical, and other Physical Apparatus.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, DECEMBER 14.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Conference on Rivers Pollution from the Naturalist's Point of View: Opened by Prof. R. Meldola, F.R.S.

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