THURSDAY, AUGUST 3, 1905.

RECENT FRENCH MATHEMATICAL WORKS.

La Philosophie naturelle intégrale et les Rudiments des Sciences exactes. By Dr. A. Rist. Part i. Pp. vi+132. (Paris: A. Hermann, 1904.) Price 3.50 francs.

Étude sur le Développement des Méthodes géométriques. By Gaston Darboux. Pp. 34. (Paris: Gauthier-Villars, 1904.) Price 1.50 francs.

Sur le Développement de l'Analyse et ses Rapports avec diverses Sciences. By Émile Picard. Pp. 168. (Paris: Gauthier-Villars, 1905.) Price 3.50 francs.

Introduction à la Géométrie générale. By Georges Lechalas. Pp. ix+65. (Paris: Gauthier-Villars, 1904.) Price 1.50 francs.

Introduction à la Théorie des Fonctions d'une Variable. By Jules Tannery. Vol. i. Second edition. Pp. ix+422. (Paris: A. Hermann, 1904.)

Correspondance d'Hermite et de Stieltjes. Edited by B. Baillaud and H. Bourget. Vol. i. Pp. xxi+477. (Paris: Gauthier-Villars, 1905.) Price 16 francs.

THE part which France has played in the development of modern mathematical methods, especially in connection with geometry and analysis, is well known to every mathematician. Of recent years, however, the trend of mathematical thought has considerably changed in every country, and while France has produced a large school of writers on the philosophy of mathematics, it is in the opinion of the present reviewer doubtful whether this school can forge more than a very small link in the chain of mathematical development. The doubts which arose in the minds of mathematicians regarding Euclid's eleventh axiom led to the new science of non-Euclidean geometry, but it was not so much the mere philosophical speculations concerning the axiom itself as the examination of the consequences of making alternative assumptions that led to substantial progress being made. The discovery that we cannot be sure that two and two make four except as the result of experience is undoubtedly of importance, but it is in the development of the consequences of a more extended hypothesis, of which this one is or is not a particular case, that substantial progress must be sought.

Dr. Rist's book may be taken as affording a good example of the kind of philosophical speculations which arise when we try to analyse the why and wherefore of the various processes and operations occurring in even so elementary a subject as arithmetic. It contains chapters on the prolegomena of both geometry and arithmetic, but it is in connection with the latter subject that the discussion is most extended. The mere act of *counting* forms the subject of a number of paragraphs of which the general character may be fairly understood from an enunciation of the headings:—"The number considered as the result of an act," "What do we count?" "Why do we count?" "The different modes of counting." From counting the author proceeds to *calculation,* and in the following chapter gives a detailed discussion of the various processes and symbols involved in the two operations of addition and subtraction. One would naturally expect multiplication and division to be treated in the same way, but instead, Dr. Rist sets out an alternative method of approaching this study, and this first volume closes with a chapter showing how numbers serve for evaluations.

The book seems to appeal more particularly to elementary teachers who only possess a rudimentary training in algebra and geometry, for there is little or nothing in it which assumes more than an elementary knowledge of these subjects. The highly trained mathematician would hardly benefit by reading such a book, as he would probably have already formed ideas of his own on the subject, and in all likelihood would consider the treatment to be unsatisfactory in a good many respects.

Of the useful purpose that can be served by popular addresses containing the survey of wide regions of mathematical thought we have two excellent examples before us. America, with that spirit of internationalism the absence of which from our islands is so greatly to be regretted, loses no chance of picking the brains of the world's greatest mathematicians, irrespective of nationality. Prof. Darboux's pamphlet and the second part of Prof. Picard's contain the substance of addresses delivered at St. Louis last year. The two addresses are to a great extent complementary. Prof. Darboux treats of the development of geometry during the nineteenth century, and Prof. Picard gives a historical account, similar in character, of the development of analysis, with especial reference to its relations with geometry, mechanics, and mathematical physics. Prof. Picard's St. Louis address also forms a sequel to the series of three lectures delivered by him in 1899 at Clark University which form the first part of the same book. The first of these deals with the gradual extension of the meaning attached to the word "function" during the last century, and the numerous new regions of mathematical thought opened up by this development. The second deals with the theory of differential equations, and the third with analytic and certain other functions. In concluding, M. Picard advises students not to specialise in mathematics at too early a stage, but to endeavour to form a general survey of different branches of the science first, and his lectures afford an excellent preliminary step towards the formation of such a survey in the case of analysis.

An English translation of M. Darboux's addresses has appeared in recent numbers of the *Mathematical Gazette.*

M. Lechalas's small volume in the series of "Actualités scientifiques" deals with Euclidean and non-Euclidean geometry. The subject is introduced by a chapter on Euclidean geometry of one, two, and three dimensions. The geometry of Riemann's space is deduced from the Euclidean geometry of four dimensions. That the properties of a Riemann plane and a Euclidean sphere are identical so long as only the surface itself is concerned is admitted, but whether the Riemann space is identical with, or only analogous to, spherical space in a hyperspace of four dimensions remains a subject of controversy between the author of the book and M. Mansion. At any rate, M. Lechalas does not discuss space of positive curvature independently of its connection with four-dimensional Euclidean space, and accordingly the book contains only one more chapter devoted to the geometry of Lobatchefsky and Bolyaï. In this respect the treatment is analogous to that given in some books on conics where the properties of the ellipse are proved by three-dimensional methods (orthogonal projection) and those of the hyperbola by plane geometry. Whether this is the best plan is open to question; many mathematicians seem to prefer it, and an author cannot please everybody.

In his preface, which is printed in *italics,* M. Tannery fairly well defines the scope and object of his book. Although this is a second edition, it has been entirely re-written. It is primarily intended for readers who do not possess a very extended knowledge of mathematics. It covers mainly those portions of analysis which are commonly found in English text-books on higher algebra, viz. properties of irrational numbers, continued fractions, aggregates, convergency and divergency of series and of infinite products, the binomial theorem, the exponential and logarithmic series, and expansions of trigonometric functions treated without the aid of imaginaries. Finally, we have a chapter on derived functions containing applications of the formula

$$f(x+h)-f(x)=hf'(x+\theta h),$$

and an illustration of functions which have no differential coefficient. The subject-matter may all be included under the heading "functions of real variables treated algebraically," as M. Tannery has avoided the use of geometrical methods in the present volume. A second volume is promised dealing with functions of complex variables, in which geometrical methods are to be freely used.

The treatment is clear and full, and the book gives the impression of being as good an exposition of the subject as could well be written on the lines laid down by the author. It does not profess to give historical or bibliographical information, for which the reader is referred to the "Mathematical Encyclopædia," of which the French edition is now coming out.

An interesting insight into the thoughts of two eminent mathematicians is afforded by the first volume of correspondence between Hermite and Stieltjes, covering the period 1882–1889. The intimacy seems to have arisen in 1882, out of a letter addressed by Stieltjes to Hermite dealing with a theorem of M. Tisserand relating to the expansion of the disturbing force when the mutual inclination of two orbits is considerable. The subject-matter of this letter (which is missing from the collection) was published in the *Comptes rendus* for November 13, 1882.

At this time Thomas Jean Stieltjes was attached to the Observatory of Leyden, and the influence of Hermite doubtless accounts in large measure for his activity in mathematical research during the years which followed, culminating in his migration to France in 1885, after his failure to obtain a mathematical chair in his own country.

A noteworthy feature of Stieltjes's work is his partiality for simple arithmetical tests of general theorems. The value of his examinations of numerical details must have been enormous to a man of Hermite's calibre. It seems as if Hermite in many cases furnished the ideas which Stieltjes elaborated and extended. It was not with Stieltjes alone that Hermite carried on an extensive correspondence, for he was evidently fond of writing letters, and even many of his contributions to journals appeared in epistolary form. But among his various correspondents Stieltjes played a prominent part, and it was Hermite's own wish that the letters of his colleague should be published after the premature death of the latter in 1894. One thing is unfortunately wanting. Hermite was to have written an introduction, but he did not live to do so. In its place we have a preface by M. Picard and a biographical notice by M. H. Bourget, who, in conjunction with M. Baillaud, were colleagues of Stieltjes in the University of Toulouse from 1886 until his death, and who have jointly edited the present volume.

It would be difficult to give a general summary of the subject-matter of this correspondence, which deals with continued fractions, hypergeometric series, Legendre's functions, semi-convergent series, and, indeed, analysis generally. Portraits of Hermite and Stieltjes complete the volume. There is a certain brightness and freshness about the way one of the two mathematicians writes to the other announcing some new result and the second takes up the clue and develops it, and one can imagine the delight that the two kindred spirits must have had in working together.

While the volumes before us are widely different in character, it may be well to warn the busy reader, as has been done on previous occasions, that they all possess one objectionable feature in common. While the guillotine was originally invented in France, the modern instrument of that name has not been applied to its proper use on the pages of any one of the series, consequently readers, unless they are prepared to set up a private guillotine, are compelled to waste hours in hacking and jagging the leaves with a paper knife, producing a very untidy result.

G. H. B.

THE MUTATION THEORY OF THE ORIGIN OF SPECIES.

Species and Varieties: their Origin by Mutation. By Hugo de Vries. Edited by D. T. MacDougal. Pp. xviii+847. (London: Kegan Paul and Co., Ltd., 1905.)

AT the present time, when naturalists are beginning to turn again to the problem of the origin of species, this account of Prof. de Vries's theories and experiments is sure of a welcome, partly as the most recent exposition of that naturalist's views and researches, and partly as the first account of them available in the English language.

It has been maintained by those who attack biological problems by methods by which they insist that they do not hope to account for anything, that it is idle to attempt to explain the phenomena of variation and heredity until they have been adequately described; and although it is certain that the danger of a too premature attempt to account for things is greater among those who use methods by which they believe the fundamental nature of the things will ultimately be revealed than it is among statistical evolutionists, it does not follow that it is better to adopt the second course on account of these (really not very dangerous) pitfalls in the first. Of the possibility of adopting it without falling into them at all Prof. de Vries's work is a rare example. The book before us consists of twenty-eight lectures delivered at the California University by Prof. de Vries, and prepared for the press by Mr. D. T. MacDougal. It will be of immense value to the student whose lack of knowledge of German renders "Die Mutationstheorie" a sealed book to him, as well as to the investigator; but two features of it, which result from the mode of its origin, render it a less valuable work than "Die Mutationstheorie." One of them, which affects the student and general reader, is the absence of illustrations; the other, which affects the investigator, is the absence of references, which is a real drawback in a book that puts into circulation the details of many unfamiliar and interesting breeding experiments.

Seeing that this book is likely, and intended, to appeal to the student, there is one feature of it which might have been different with advantage; and we believe the defect to be serious, because the general reader will notice it as little as he will deplore the absence of pictures much.

The publication of a book in which there is set forth for the student a new and profoundly important biological theory, and a collection of facts in support of it, seems to us to have been a most suitable opportunity for discarding that scientific jargon which is still believed to have a meaning by those who do not understand it, and still used by those who know that it means nothing. In the very first sentence it appears in its old vigour.

"Newton convinced his contemporaries that natural laws rule the whole universe. Lyell showed, by his principle of slow and gradual evolution, that natural laws have reigned since the beginning of time."

Of course Prof. de Vries and Mr. MacDougal know that natural laws do not really rule the universe, and that they have not reigned since the beginning of time, and that this latter expression stretches even poetical licence. But the general reader and student do not know this, and when they see this kind of statement scattered through scientific literature they can be pardoned for going away with the idea that there must be laws existing somewhere ruling and reigning and being obeyed, and that it is the business of the man of science to discover them.

A few examples from the body of the book will suffice. For instance, on p. 3, "If an origin by natural laws is conceded for the latter, it must, on this ground, be granted to the first also"; on p. 90, ". . . wild species, which obey the laws discussed in a previous lecture"; on p. 175, ". . . and liable to reversions by the ordinary laws of the splitting up of hybrids"; and on p. 547, "The physiological laws, however, which govern this process are only very imperfectly revealed by such a study."

We are perfectly aware that such expressions are continually to be found in the memoirs of men of science who in their other writings have exposed the meaninglessness of such phrases; but this only leads to the necessity of a stronger insistence on the desirableness of discarding them, in the conviction that the curious image of nature which such expressions call up would be less erroneous and more eradicable than it is now if they were never used.

The fact that entirely different things sometimes have the same name leads to the need for caution in the interpretation of another expression the meanings of which are about as numerous and as different as those of the term "law." The word regression in Prof. de Vries's book denotes a biological phenomenon of singular interest; but it must not be forgotten that it is also the name of a purely statistical conception. It is very necessary that these two significations should be kept absolutely distinct in the mind of the reader.

The book is, considering its bulk, very free from misprints; the few that occur do not lead to any difficulty, *e.g.* "begining" on p. 118, "hnudred" on p. 475, "of" for "on" in the last line of p. 560. There is one inconsistency of spelling; Macfarlane is spelt thus on pp. 21 and 268, and with a capital F on p. 255. We have some doubt as to which is the more correct, "morphologic" or "morphological," though we have none as to which is the more euphonious; but surely one or the other should be used throughout; yet on p. 141 we find "morphological" and on p. 144 "morphologic," and similarly on p. 144 "physiologic" and on p. 547 "physiological," on p. 709 "empiric" and on p. 733 "empirical."

We think that scant justice is done to the greatness of Mendel's work and to the conceptions based upon it which bid fair to put us on the track of accounting for some of the phenomena of heredity; and by confining Mendel's law to the description of the mutual properties of varieties only, the meaning and tendency of Mendelian investigation that is now being carried on seem to be missed. That Hurst can predict the difference between the result of mating two pairs of rabbits externally identical, by means of a knowledge of the difference between their gametic constitutions acquired by previous breeding from them, constitutes, it seems to us, the longest stride the study of heredity has made for some time past.

The zoologist who confines himself as strictly to the study of animals as Prof. de Vries does to that of plants will be disappointed if, trusting to the comprehensiveness of the title of the book, he expects to find as much about the one half of living nature as about the other in it.

The most fruitful source of progress is a new way of looking at things, and such new points of view result in the destruction of old classifications and the need for new ones; in biology, investigators will soon cease to be classified according to the group of animals or plants with which they deal, but according to the particular phase of the problem of the "fundamental nature of living things" (which is the ultimate goal of biological inquiry) which interests them. In the study of heredity, for example, there is already a number of investigators who are as familiar with that phenomenon in the case of animals as in the case of plants. Nor does it seem reasonable to doubt that, by thus broadening the basis of material used by the investigator, the conclusions arrived at by him are likely to be less wide of the truth than they are apt to be if they are based on the result of experiment with a single animal or plant. The moral of this is, not that Prof. de Vries ought to have said something about animals in his book, but that the disappointed zoological reader ought to know something about plants for the sake of his work.

To bestow praise on any work of Prof. de Vries would be impertinent; to cite points of particular interest in the book is unnecessary, for it has already begun to form part of the indispensable equipment of the student of evolution in the broadest sense of that term. A. D.

ASPHALT PAVEMENTS.

The Modern Asphalt Pavement. By Clifford Richardson. Pp. vii+580. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1905.) Price 12*s.* 6*d.* net.

THIS is a book dealing with an important practical subject which up to the present time has not received much attention from writers of text-books. Asphalt pavements of various kinds are now so largely used that a text-book dealing with this subject has been a long-felt want.

The book is divided into sections, and the author has appended to the end of each chapter a brief summary of the matter dealt with, enabling the reader to determine quickly whether or not the chapter contains the information he is seeking for. The first section deals with the construction of the road base upon which the surface carrying the traffic is supported, and it is evident that Mr. Richardson is of opinion that the ideal base is hydraulic concrete. Between this base and the surface proper is interposed a binder, or intermediate, course; where the traffic is heavy, the best material for this is a layer of compact asphaltic concrete. The next section is concerned with the materials employed in making the asphalt surface mixture, and a detailed account is given of the sands used for this purpose and of their origin and physical characteristics. After a brief explanation and classification of the various hydrocarbons of which native bitumen is composed, the author describes the native bitumens which have so far been used in paving work.

In section iv. the technology of the paving industry is taken up; the preparation of the surface mixture is explained with the help of elaborate tables, and the theory which underlies the practical work is described; the author points out that an asphalt surface in order to be successful must resist both weathering and impact. The mechanical appliances used for combining the various materials into the surface mixture are described with diagrams.

Sections v. and vi. deal with the handling of the material in the street and with the hand-tools needed by the workmen, and in the latter section a description of an ingenious machine for impact tests is given. In section vii. there is a complete specification for an asphalt pavement; this will be found of great value to engineers who have to draw up specifications for work of this nature. Mr. Richardson points out that the popular idea as to the limiting gradient for an asphalt pavement is erroneous, and that in the eastern part of the United States, for example, a gradient of 8 per cent. on an asphalt road is not excessive. There is no doubt that asphalt has great advantages when compared with most of the other pavement materials; it is free from mud if properly washed down at regular intervals; unlike wood, it is practically non-absorbent; when kept in a clean condition it gives a good foothold for horses; tractive effort is considerably reduced, and even under heavy traffic asphalt wears remarkably well. Although the initial cost is heavy, still the cost of upkeep is lower than that for most of the other paving materials. The last section of the book, one of the most valuable, deals with the testing of the various materials used in asphalt pavement work; it gives a complete account of this necessary branch of the work, and data are given of the equipment required in a municipal laboratory where such testing work is carried out.

The book is likely to prove of great value to municipal authorities who are faced with the problem of determining the most satisfactory road material to employ both where traffic is heavy and where it is moderate. T. H. B.

OUR BOOK SHELF.

Die physikalischen Eigenschaften der Seen. By Dr. Otto Freiherr von und zu Aufsess. Pp. x+120. (Brunswick: Vieweg and Son, 1905.) Price 3 marks.

THERE are many books and pamphlets dealing with one or several of the properties of lakes; the aim, however, of the present work is to gather into a handbook the principal facts known, and to give a general view of the results arrived at, so as to incite the lover of nature to interesting observations as well as to provide a guide for the more specialised limnologist.

In a short introduction the author deals with Prof. Forel's work as having caused the important development of limnology which recent years have witnessed, and gives this authority's definition of a lake as being "a mass of still water, closed up on all sides, situated in a depression of the ground, without direct communication with the sea." The lake surface being a part of the earth surface represents a section of a sphere, the curvature of the same being, with large lakes, important enough to prevent the observer from seeing low objects situated on the opposite shore.

Some preliminary remarks deal with general considerations on pressure, density, and compressibility of the water. The mechanical part includes the study of the different movements to be observed in lakes, viz. progressive waves, such as are known to everybody, stationary waves or "seiches," and currents. "Seiches" were first rationally studied by Prof. Forel in the Lake of Geneva, and have been found to exist in many other lakes; they are, for instance, now being investigated in the lochs of Scotland by the Lake Survey. Being waves as long as the lake, they cause periodical rising and falling of the water-level, though these tides are very often inconspicuous, and only to be recorded by limnimeters or registering apparatus; they vary from some millimetres up to 1·87m. (highest "seiche" in the Lake of Geneva), and much more in the great lakes of America. This special kind of wave, which affects the whole body of the lake, is probably due to several factors acting together or separately, such as sudden variation of atmospheric pressure, changes in the strength or direction of the wind, &c. Older explanations, as lunar attraction or earthquakes, have been shown to be untenable as general causes of "seiches."

The acoustic properties of lakes are dealt with in a short chapter. The most attractive feature of any lake is its colour, its greater or less transparency, its reflection of the surroundings, and other optical phenomena, such as refraction in or above the water. The explanation, however, of all these facts, which anybody may observe and enjoy, is often difficult and intricate even to men of science. The author of the present work has the merit of dealing with this optical chapter in a very intelligible and attractive way, giving briefly the most accredited theories of the phenomena treated of.

The last chapter deals with the thermic properties of lakes, such as distribution of temperature, seasonal changes, formation of ice, and storage of the summer's heat by the water.

A bibliographical list of the most recent and important works on physical limnology concludes the book, and makes of it a very useful guide and an excellent *résumé* of the actual state of our knowledge of this subject.

A Catalogue of North American Diptera or Two-winged Flies. By J. M. Aldrich. (Smithsonian Miscellaneous Collections, part of vol. xlvi.) Pp. 680. (City of Washington, 1905.)

THE second edition of Osten-Sacken's "Catalogue of North American Diptera" was published in 1878, and an enormous amount of work in the order has naturally been accomplished since. Prof. Aldrich's catalogue takes in the whole of North America, from Panama on the south to Greenland and the Aleutian Islands on the north; and also the whole of the West Indies, even down to Trinidad, adjoining Venezuela. "There is no place to draw a line between the islands. The Bermudas and the Hawaiian Islands are not included."

According to our own knowledge of other orders, we cannot quite agree with Prof. Aldrich. The fauna of Trinidad appears to us to have no relation to that of the islands further north, and to be purely South American, while the Bermudas clearly belong to North America. On the other hand, that of the Hawaiian Islands (apart from introduced species) is one of the most insular in the world; and, in this respect, may be compared with that of New Zealand, though far less conspicuous or extensive.

Prof. Aldrich has not numbered or mentioned the number of species admitted in his catalogue (which is brought down to January 1, 1904); but we may say that the introduction occupies 4 pages, the system of classification 1, the bibliography (with additions) 77, the index of (59) families 1, and the index of genera 12. The catalogue itself occupies 582 broad pages, and the distribution and synonymy appear to be very fully given. To criticise such a work in detail would only be possible for a specialist in Diptera, and in any case would occupy much more space than we could give to it; and we have, therefore, confined ourselves to observations on its scope and contents.

Elementary Experimental Science. An Introduction to the Study of Scientific Method. By W. Mayhowe Heller, B.Sc., and Edwin G. Ingold. Pp. 220. (London: Blackie and Son, Ltd., 1905.) Price 2*s.* 6*d.* net.

THE course of work in elementary science presented by the authors of this little book is modelled upon the plan which, it is satisfactory to know, is adopted in all good modern secondary schools. The consequence is that there is little which is new in the volume, though the methods of presenting familiar experiments and of setting forth practical instructions for laboratory exercises supply abundant evidence of the experience and teaching ability of the authors.

The book is quite suitable for the use of young pupils except for the paragraphs containing hints to teachers which are scattered up and down the chapters. It is unwise to lead children to suppose their teachers to be in need of instruction, and it may be asked, "May it not be supposed that most teachers have acquainted themselves nowadays with the aims and methods of elementary science instruction?" In any case, the teacher should not be addressed directly in the book intended for the use of his pupils.

The book is interesting since it shows that in the opinion of some at least of the most enthusiastic advocates of "heuristic" methods of instruction there is a good purpose served by a well-arranged text-book in introducing children to the study of scientific method. Teachers looking for a book containing a sensible, practical course of work in science should examine this one with care.

Astronomischer Jahresbericht. By Walter F. Wislicenus. Vol. vi., containing the literature of the year 1904. Pp. xxxvii+612. (Berlin: Georg Reimer, 1905.) Price 19 marks.

THIS is the sixth year of the issue of this very valuable publication, and it possesses all the vitality of the former volumes. It was thought by the reviewer of the previous year-books that the publication of the branch E, astronomy, an annual issue of the International Catalogue of Scientific Literature, would take the place of the present compilation, since they both for the most part cover the same ground. This, however, seems not to be the case, and perhaps the reason lies in the fact that the volume before us gives in many cases a brief *résumé* of the contents of the book or publication to which reference is made.

The present volume contains 2280 references, and as these with their brief summary of contents cover 595 pages, and an excellent "name" index which follows is responsible for another 17 pages, the matter contained therein is considerable.

The high standard maintained throughout reflects the greatest credit on the compiler and his seven co-workers, and renders the volume a necessary and valuable addition to every astronomical library and observatory. W. J. S. L.

LETTERS TO THE EDITOR.

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

The Problem of the Random Walk.

THIS problem, proposed by Prof. Karl Pearson in the current number of NATURE, is the same as that of the composition of *n* iso-periodic vibrations of unit amplitude and of phases distributed at random, considered in *Phil. Mag.*, x., p. 73, 1880; xlvii., p. 246, 1899; ("Scientific Papers," i., p. 491, iv., p. 370). If *n* be very great, the probability sought is

$$\frac{2}{n}e^{-r^2/n}rdr.$$

Probably methods similar to those employed in the papers referred to would avail for the development of an approximate expression applicable when *n* is only moderately great.

RAYLEIGH.

Terling Place, July 29.

The Causation of Variations.

IT is sometimes said that natural selection has ceased as regards civilised man; but very clearly this is an error. All civilised and most savage races are very stringently selected by various forms of zymotic disease. Thus in England practically everyone is brought into contact with the organisms which give rise to tuberculosis, measles, and whooping-cough; those individuals who are the most resistant to the organisms repel infection (*i.e.* do not fall ill), the less resistant suffer illness but survive, the least resistant perish. Abroad, malaria, dysentery, and many other complaints play a similar *rôle*. Probably no one is absolutely immune to any disease; but since illness only follows invasion of the tissues by a sufficient number of the microbes (the sufficiency of the number varying with the individual attacked), and since the microbes are more abundant in some localities than in others, the stringency of selection as regards any disease is greater in some places than elsewhere. For example, selection by tuberculosis is more stringent in the slums of cities than in the country. It should be noted, also, that resisting power against any one disease does not imply resisting power against any other; thus an individual innately strong against measles is not necessarily strong against tuberculosis. The result of all this elimination by diseases demonstrates the action of natural selection very beautifully. Every race is resistant to every disease strictly in proportion to its past experience of it. Thus Englishmen who have suffered much from tuberculosis are more resistant to it than West African Negroes who have suffered less, and much more resistant than Polynesians who have had no previous experience of it; that is, as a rule, Englishmen, under given conditions, contract the disease less readily, or if infected recover more frequently, or if they perish do so after a more prolonged resistance than Negroes and Polynesians. Negroes, on the other hand, as South American plantation experience proves, are more resistant to malaria than Asiatic coolies, who in turn are more resistant than Englishmen and Polynesians.

Against some diseases (*e.g.* tuberculosis) no immunity can be acquired, that is, experience of the disease confers no increase of resisting power, the disease pursuing a course of indefinite length. Against other diseases (*e.g.* measles) immunity may be acquired, that is, experience of the disease, if not fatal, confers after a definite time a more or less permanent immunity on the sufferer. In the former case the survivors are mainly those who have an inborn power of *resisting* infection; in the latter they are those who have an inborn power of *recovering* from infection. Evolution has proceeded on these lines. Thus Englishmen are less readily infected with tuberculosis than Polynesians, but nearly all Englishmen, like Polynesians, readily take measles, though a much greater proportion of them survive and acquire immunity. Lastly, in relation to such very "mild" diseases as chicken-pox, which render the individual very ill while they last, but cause hardly any elimination, no race appears to have undergone any change; for instance, no race, apparently, is more resistant to chicken-pox than any other race.

The pathogenetic organisms of all prevalent human diseases are more or less entirely parasitic on man. Most of them, therefore, flourish best in crowded populations, where they can pass readily from one susceptible individual to another. Thus tuberculosis is most prevalent in the slums of great cities. An important exception is malaria, the parasites of which require special conditions, and which, therefore, is more prevalent in the open country than in towns. The inhabitants of the eastern hemisphere have been afflicted by a multitude of zymotic diseases for thousands of years. Of old, with the increase of population, the conditions slowly became worse, the stringency of selection became greater, and the human races underwent continual evolution. But before the voyage of Columbus zymotic disease, with the exception of malaria, appears to have been almost, if not quite, unknown in the New World. We have fairly definite accounts of the first introduction of most Old World diseases to this and that aboriginal race, and of the frightful destruction of life that followed, the principal agent of elimination being tuberculosis. With their diseases the European immigrants introduced modern civilised conditions of life, especially churches, schools, and other enclosed spaces in which the natives, crowded together, conveyed infection to one another, and clothes, which acted as a deterrent to cleanliness, and which, besides, harboured the microbes of disease better than the naked skin. As a consequence, except when protected by malaria in extensive forests or when dwelling remote in unsettled regions, the natives rapidly perished. It is a significant fact that, whereas in Asia and Africa every town inhabited by Europeans has its native quarter, no European town in the temperate parts of the western hemisphere (*i.e.* where tuberculosis is most rife) has its native quarter. Published health statistics demonstrate quite definitely that the abnormally high mortality of the natives is caused by introduced diseases. Since civilisation implies a dense and settled population, it follows that no race can now achieve civilisation that has not undergone evolution against tuberculosis and kindred diseases. The case of the Negroes is interesting. In Africa they had undergone some evolution against tuberculosis. In America, when they were first taken to it, the disease prevailed to a comparatively slight extent, especially amongst the agricultural population; but the conditions slowly became worse, and the descendants of the early slaves underwent concurrent evolution. To-day they are able to persist in the northern cities, though their death-rate there is still abnormally high. But though a constant stream of Negro slaves and soldiers (*e.g.* in Ceylon) was poured for centuries into parts of Europe and Africa, they have left no trace on the population. All perished in a few generations, the elimination being so stringent as to cause extinction, not evolution. It is tolerably certain that a fresh immigration of African Negroes to America would end as disastrously.

These facts appear to establish conclusively two truths, first that evolution is due solely to natural selection, and second that variations, except, perhaps, in rare instances, are not due to the direct action of the environment on the germ-plasm, but are "spontaneous." The Lamarckian doctrine is quite out of court. If ever acquirements are transmitted, it should be in the case of the profound and lasting changes affecting the whole body which result from disease; but in no instance is the effect produced by any disease on the race similar to that produced by it on the individual. Thus tuberculosis injures the individual but confers resisting power on the race; measles confers immunity on the individual, but none on the race. Were the Lamarckian doctrine true, man could not persist on the earth. Presumably this is true of all other species, since probably all organisms are subjected to causes of slow deterioration similar to disease. If ever external agencies acting directly on the germ-plasm alter its composition and so cause variations (of any sort) in offspring, it should be when germ-cells are literally soaked for prolonged periods in some virulent toxin such as that of malaria. Presumably the effect should be a harmful one, and it should act in much the same way on the germ-cells of one individual as on those of another; the race should, therefore, by the accumulation of injury, steadily deteriorate until it becomes extinct; but in no case is this observable. A disease may exterminate a susceptible race, but there is no evidence that it is ever a cause of racial degeneration. The same is true of races exposed to the complex of harmful agencies which surround urban life—filth, over-crowding, lack of light and air, of suitable food and exercise, and so forth. None of the races which have been longest and most exposed to them have become degenerate—for example, the Chinese, the Hindoos, the Egyptians, and the inhabitants of Europe. These races have merely become permanently resistant, preeminently capable of an urban existence. Red Indians and Polynesians perish *en masse* under such conditions. There is not an iota of evidence which demonstrates that the children of peasants if removed at birth to the city would on the average be better developed than the descendants of a line of slum dwellers. The legend that urban families tend to become extinct within four generations is founded on the fact that migration and inter-marriage betwixt town and country is so great that no families purely urban for four generations exist.

Bearing in mind the fact that races grow resistant to all diseases to which they are exposed, the only conceivable non-miraculous cause of evolution (*i.e.* adaptation) is natural selection. But natural selection cannot act when any agency (*e.g.* malaria) causes a drift in a particular direction, *i.e.* when all variations are unfavourable, and offspring tend always to fall below the parental mean. Students of evolution have generally thought of elimination in terms of sudden death as by the agency of carnivorous animals, when the individual who perishes dies in the fulness of his strength, and the individual who survives is strengthened rather than weakened by his efforts to evade destruction. It is clear, however, when considering causes of slow deterioration, which affect practically the whole population during youth, that the doctrine of natural selection is incompatible with the doctrine that variations are caused by the direct action of the environment. It is clear also that natural selection itself must always tend to establish a high degree of insusceptibility to direct action. A greater or lesser degree of susceptibility of the germ-plasm is itself a variation. The more susceptible type of germ-plasm tends continually to be eliminated, and a high degree of insusceptibility established. This is not the same thing as saying that the germ-cells are inviolable and cannot be injured. It is only implied that their "hereditary tendencies" are implanted in them almost as firmly as life. The behaviour of somatic cells confirms this view. A gland, for example, may be diseased for twenty years, yet on recovery we do not find a new type of cells; on the contrary, the descendant cells are quite of the old type.

No doubt many instances of the alleged direct action of the environment on the germ-plasm have been recorded. Thus medical men have published statistics to prove that the children of alcoholics and consumptives tend to be insane; but as a rule this evidence is inconclusive in that it fails to demonstrate that the proportion of insane is higher among them than among the offspring of normal parents. Numerous other factors of error, also, are not taken into account. In some cases published by biologists acquirements do not seem to have been clearly differentiated from variations. Thus in the well known case of Weismann's butterflies ("Germ-Plasm," p. 399) we are not told that the darkening of colour produced by a higher temperature was accentuated during subsequent generations by similar treatment, nor that the darkened individuals reproduced their like in the absence of the high temperature. *A priori* there is no apparent reason why acquirements should not be made in the germ-cell stage of the individual as well as during subsequent stages of development. In other cases, as when plants have been removed to a new environment, the effects of a different survival of the fit have not apparently been taken into account. It must be remembered that natural selection not only adapts organisms to changing environments, but keeps them stable in stable environments, and so eliminates the variations which appear in the new surroundings.

It is not necessary, of course, to believe that variations are never caused by the direct action of the environment. Presumably the insusceptibility of the germ-plasm is due to evolution, and evolution is never perfect. It is only necessary to believe that in circumstances normal to the species the insusceptibility is so high that the amount of variations produced by the direct action of the environment is so minute as to be negligible, *i.e.* not a cause of racial change. It is possible that when species are removed to very new environments (*e.g.* European dogs to India or horses to the Falkland Islands) the germ-plasm is sometimes changed by conditions to which natural selection has not rendered it highly insusceptible; but the deterioration which is said to result in such cases is clear evidence of the necessity of this insusceptibility. If it be not established the species must perish.

G. ARCHDALL REID.

The Empire and University Life.

IN your issue of July 6 your powerful advocacy of a higher and broader education in our great universities casts me back in memory to more than fifty years ago, when I first was transported with delight at F. von Schlegel's great generalisation of the unity of the Indo-European family of languages. I was then astounded that Oxford and Cambridge, through so many centuries, had not seen this great truth.

The theological and catastrophetic method had darkened the mental vision of both Oxford and Cambridge; even the mighty Whewell, in 1846, wrote from Cambridge:—"Not only, then, is the doctrine of the transmutation of species in itself disproved by the best physiological reasonings, but the additional assumptions which are requisite to enable its advocates to apply it to the explanation of the Geological and other phenomena of the earth, are altogether gratuitous and fantastical."[1]

From Oxford, her powerful son, the G.O.M., could not rise to feel that the first chapter of Genesis was a sublime poem; he could not rise to feel the truth of the most elementary facts of geology; so enchained was his mind that he could not feel the poetry and spirituality of the "Sacred Books of the East"; the Hindu philosophers and poets give their ideal demi-gods a vast age, even to 900,000 years; but they know that it is poetry and ideal. But Oxford's greatest son could not rise to such elementary generalisation; he saw the great doctrine of "continuity" no wider than the concrete mythology of the Hebrews—he believed in the literal and personal Methuselah of 969 years!

These modern examples of bad method are but glaring "instances" of the general bad method which permeates society, permeates the professions, above all, the professions of theology and medicine.

The Method (see Coleridge) of Oxford and Cambridge in its influence on its sons always reminds me of the words of Sismondi[2]; writing of the "erudition" of the Greeks of the tenth century, Sismondi says:—"Few (of their) books seem better constructed to show the vanity of erudition, and to place in strong contrast a vast extent of knowledge, with a total incapacity of deriving any useful results from it." "Were it necessary to choose between the whole experience which has been acquired and collected from the beginning of time, the whole rich store of human wisdom, and the mere unschooled activity of the human mind, the latter ought, without hesitation, to be preferred. This is the precious and living germ which we ought to watch over, to foster, to guard from every blight. This alone, if it remain uninjured, will repair all losses; while, on the contrary, mere literary wealth will not preserve one faculty, nor sustain one virtue."

We do not want revolution, but an active evolution, both at Oxford and Cambridge, based, as Coleridge said, on the "historic sense."

May I add my personal experience, that I have been able to converse in a more genial, enlightened spirit and

1 "History of the Inductive Sciences," 3rd ed., 1857, vol. iii. p. 481.
2 "Fall of the Roman Empire," vol. ii., pp. 258, 261 (1834).

method with Hindu Brahmans and gentlemen, and with cultured Moslems, in India, than I find it possible to do with clerics, the professional classes, and society magnates in Britain.

It is to be hoped that "more light" will evolve at Oxford and Cambridge, and a higher and truer method permeate their sons. GUNGA-GUNGA.

A Solar Outburst (?).

REFERRING to the note on solar activity in your issue of July 20, I shall be glad to know whether any correspondent observed a luminous outburst in the tail end of the great spot on the evening of July 16. I had been observing in the afternoon with an 8½-inch reflector, but remarked nothing of the sort. At 5.30, however (the sun having got beyond range of my reflector), I was observing him with a small refractor, power 12, and sun-cap, when I at once noted the luminous appearance in question. It was roundish and about the size of the small spot near following limb, and it was brighter than the bright bridge in the large group. I watched this bright spot until 7.30; next morning it had practically disappeared. Father Cortie courteously informs me that the Stonyhurst magnets were perfectly quiet on July 16, but that next morning, at 8.15, there was a "very small but sudden and sharp movement on both the declination and horizontal force curves." By that time the locality where the luminous appearance occurred would not be far from central meridian. I also noticed a rosy hue pass over the bright bridge of great spot, but this may have been a mistake. I am, however, certain of the luminosity.

Cardiff, July 24. ARTHUR MEE.

A CENTURY'S PROGRESS IN WARSHIP DESIGN.

THE interesting paper read by the Director of Naval Construction at the summer meeting of the Institution of Naval Architects brings vividly home to us the progress made in the design of warships since Nelson fought, off Cape Trafalgar, our last great sea fight. In our account of the proceedings at the meeting, printed last week, we referred to Sir Philip Watts's paper, but it is worthy of more attention than brief mention in a report of a society's meeting.

We reproduce from among the illustrations accompanying the paper the sheer draught of Nelson's last ship, the *Victory* (Fig. 1). The original drawing of this most famous of all vessels of the Royal Navy was shown at the meeting when the paper was read. We also reproduce the sheer draught of the 36-gun frigate *Syrius* (Fig. 2), as affording an interesting comparison with a modern cruiser. As is well known, the *Victory* was forty years old at the date of Trafalgar, so that as she now floats in Portsmouth Harbour she numbers 140 years. She was, however, reconstructed in 1798, seven years before Trafalgar, and again in 1820. The effect of her first reconstruction is shown by the dotted lines of the engraving. The long time that the *Victory* remained on the active list is indicative of the slower progress of invention that characterised former times. If we go somewhat further back we have a still more striking example in the *Royal William*, a model of which 100-gun line-of-battle ship was shown at the Naval Exhibition of 1891. She was built at Chatham Yard in 1670, was rebuilt at Chatham in 1692 on the same lines as those on which she was originally designed by Phineas Pett, and was again rebuilt at Portsmouth in 1719. As she was not broken up until August, 1813, she was in existence when the battle of Trafalgar was fought; but as Sir Philip Watts does not include her in his table of ships of the Royal Navy, October, 1805, we may conclude that before that date she had ceased to be considered efficient.

The long life of the warships of past times was not due to their more durable construction as compared to modern vessels, but to the lack of that inventive enterprise now made possible, primarily, by James Watt's labours. A steel vessel well built and properly kept up would be practically indestructible with fair treatment; but the same cannot be said of wooden ships. It is not because sound wood in itself is less strong than iron or steel, weight for weight, so much as that it cannot be procured in sufficiently long and conveniently sized pieces, a large number of joints and overlappings thus being necessary; but the chief drawback to wood is that it is not so suitable a material for making joints; as Sir Philip Watts says, "The fastenings cannot develop the strength of the main body of the material." A seam of rivetting in a properly designed steel vessel will join plates to frames or beams, or plates to plates in a way that no buffeting of the winds and waves will affect. That is not the case with the fastenings of wooden ships; as a matter of fact, most of the old men-of-war became "hogged" after some years of service. The frequent reconstruction of wooden vessels of which we read was the result of these conditions.

The causes which thus led to the decay of wooden ships, as individual structures, contributed to the permanence of their respective types, especially in regard to ships of the line. As Sir Philip Watts points out, it was "owing to the limitations imposed on shipbuilding, when wood was the only available material, that length could not be largely increased without reducing to a dangerous extent the longitudinal strength of ships, and the only practicable means of largely increasing the number of guns was to increase the number of decks for carrying them." There were, however, limitations to the extension of vertical dimensions as well as to the increase of horizontal dimensions. A few four-deck ships were built, but the advantages of the extra gun positions thus secured were more than counterbalanced by the defects of a high, unwieldy structure above water. Even three-deckers were at a disadvantage owing to their high sides; they were "worse sailors and less handy in manœuvring than two-deckers"; and, indeed, when one looks at the old *Victory* towering above water, riding to her moorings in Portsmouth Harbour, one wonders how these ships were ever sailed in any direction excepting broad off the wind. The high positions of the guns also necessitated a greater amount of ballast to give stability. All these circumstances joined in confining the naval architect to short ships; and once Phineas Pett had developed construction to the full extent allowed by the limitations of wood as a material, and wind as a source of motion, there was little more to be said. Charnock, speaking of the *Prince Royal*, designed by Pett at the beginning of the seventeenth century, has said, "This vessel may be considered the parent of the identical class of shipping which, excepting the removal of such defects or trivial absurdities as long use and experience has pointed out, continues in practice even to the present moment." That sentence bridges over a period of more than 200 years of the history of naval design.

When it was recognised that iron could be used for the construction of ships—that it was not, as some averred at the time, "contrary to the laws of Nature" —then the horizon of the naval architect widened as when fog lifts at sea. To design a ship of adequate strength became a science, for the stresses that hull structure of given scantling would stand could be calculated with precision; mathematics and a knowledge of physics took the place of bolts and trenails. Before this era English models had fallen sadly behind those of our chief rivals. It was by hard fighting, not by superiority or even equality of design, that victories were gained for our arms. Creuze, in his "Treatise of Naval Architecture," published in 1846, speaks of the inferiority of British ship design, quoting Charnock to the same effect. "When an English fleet was in chase of a French fleet it was ships which were British built that fell into our possession; but almost on every occasion the French ships could evade ours. The losses sustained in the French Navy by foundering at sea, or by wrecks were principally those ships which had been taken from us. On the contrary, the favourite ships in our fleets were those which had been taken from the French, and the instances in which French ships in our service were ever recovered possession of by them were extremely rare; we as far exceeding them in all that related to the manœuvres and management of ships as they did us in designing them." As is well known, the *Foudroyant*, a two-deck ship captured from the French in 1758, served as a model for a new class, or, again to quote Creuze, "a very superior class of man-of-war which was adopted."

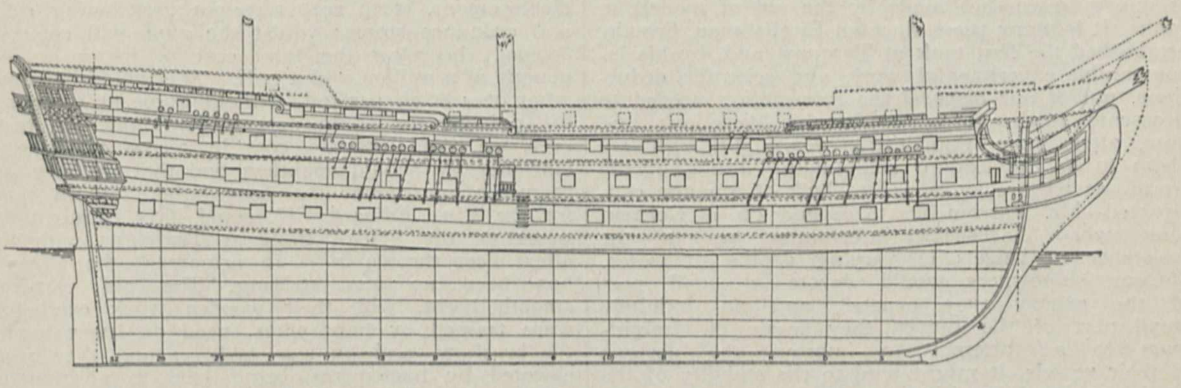

FIG. 1.—Navy Office, June 6, 1759. Sheer draught of 100-gun vessel *Victory*. Length on the gun decks, 186 ft.; Length of the keel for tonnage, 151 ft. $3\frac{5}{8}$ in.; breadth extreme, 51 ft. 10 in.; breadth moulded, 50 ft. 6 in.; depth in hold, 21 ft. 6 in.; burthen in tons, No. $2162\frac{22}{94}$; the dotted outline shows the vessel as altered.

It was not, however, with the abandonment of wood that England ceased to follow the lead of France in ship construction. We remember that the first iron-clad ocean-going war vessel, *La Gloire*, was French; and Sir William White in 1887 said, "it must be frankly admitted that the lead taken by the French on both the steam and ironclad reconstructions was the primary cause of most subsequent activity in warship building."

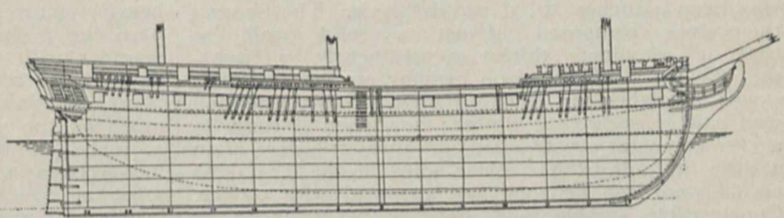

FIG. 2.—Navy Office, September 30, 1795. Sheer draught of 36-gun frigate *Syrius*. Length on the lower deck, 148 ft. 10 in.; length of the keel for tonnage, 124 ft. $0\frac{3}{4}$ in.; breadth extreme, 39 ft. 7 in.; breadth moulded, 38 ft. 11 in.; depth in hold, 13 ft. 3 in.; burthen in tons, No. $1033\frac{55}{94}$.

We dwell on this point because it illustrates the evil of neglecting the application of scientific principles to practical affairs. Happily, since the period to which we have referred Great Britain has done much to remove the reproach under which she formerly rested. The labours of Scott-Russell, Rankine, William Froude, and many others raised ship design in this country to a position of which we may well be proud. Some of the later workers, like the late William John, have passed away, but, happily, the majority—and we may cite the author of the paper as among the most distinguished—are still with us. It is fair to add that it is to the establishment of the Institution of Naval Architects this improvement is mainly due; and, since its foundation in 1860, the application of scientific principles to ship design has made progress rapid beyond all precedent. Annual meetings bring together the leading members of the profession for the interchange of ideas, and in the *Transactions* of the institution may be found memoirs by the best authorities on all subjects connected with the science of naval architecture.

It is well to remember, however, that, whilst there is much room for congratulation, the need for effort towards progress still exists, and perhaps to a greater degree than ever. For long after the introduction of steam propulsion, Great Britain, as the leading shipbuilding nation, held a position not seriously challenged. We gave examples to the rest of the world; others took their practice from us. Of late, however, our supremacy has been attacked. There are shipyards and marine engine works, many of them splendidly equipped, in all the most important countries, and we may depend every effort will be made to employ them fully and develop them further. The naval Powers are determined to construct their navies within their own domains, and some foreign Governments are giving inducements to shipowners and shipbuilders of a substantial nature, and such as are not offered in this country. It is well to remember that Germany for some time past has not only possessed, but has constructed within her own domains, the mercantile vessels which hold the premier position in the world.

In shipbuilding, as in nearly all other manufacturing industries, we must neglect no chances. To design a complex structure such as a high-class modern steamship needs an amount of accurate knowledge intelligently applied—that is to say, an amount of science—which is only within the command of those having every advantage for its acquirement. We here say "design," not copy, for the man or the nation that copies must necessarily lag behind those who originate. It is not a good sign—it is distinctly a bad sign—that, in spite of the efforts of some public-spirited and thoughtful members of the Institution of Naval Architects, shipowners and shipbuilders at large have not subscribed the really modest sum needed for establishing the proposed experimental tank at the National Physical Laboratory. It is by the aid of such a tank that the data needed for the scientific design of a vessel can be worked out in their completeness; and such accurate knowledge as we have about resistance of ships is due to researches made by the aid of models in tanks. It is many years since an Englishman, Froude, established the first tank at Torquay, and, by his incomparable experimental work and scientific deductions, put at our disposal the information needed to prosecute further inquiries in this direction; and now, after more than thirty years, although we claim to be the leading shipbuilding nation of the world—as we are in regard to bulk of tonnage constructed—Mr. Yarrow has to depend on a German tank when he seeks information as to the resistance of vessels in varying depths of water. If our shipowners would devote a small part of the energy they expend, and an infinitely small part of the money they waste on freight-wars to an attempt to improve the designs of their vessels, it might tend to the stability of the British shipbuilding industry and to more satisfactory balance-sheets; it certainly would to a more worthy record of the country's progress in ship design.

Sir Philip Watts, who, as Director of Naval Construction, has at his command the well equipped and admirably staffed Government tank at Haslar, does not feel the need of such an establishment, and naturally does not refer to it in his paper. He gives, however, a sketch of the plan followed in scarphing frames and planking together so as to reduce the working of the different pieces on each other. The science of the metallurgist has removed that necessity by giving us a material which enables the side of a ship to be made practically a continuous structure. The outer planking of ships of the line at the time of Trafalgar was 8 inches to 4½ inches thick above water, and planking on the inside of the frames was from 4 inches to 5 inches thick. The frames themselves composed almost a solid wall, so that a combined thickness of nearly 2 feet—the thickness of the iron armour on the *Inflexible*—was available for resisting shot. Great attention was paid to seasoning timber; but when it came to a case of metal construction our ancestors were often a little at fault. "The older ships of the Trafalgar period were iron fastened and sheathed with copper. Considerable trouble was, however, experienced by the corrosion of the iron fastenings, so much so that in some cases, after three or four years, the ship was rendered unfit for foreign service. The intervention of substances such as felt, tarred paper, &c., between the copper and the wood bottom failed to protect the iron entirely, and at one time the Board of Admiralty contemplated discontinuing the sheathing of ships lying in ordinary and fitting it to them immediately before going to sea." Thus do we see how the want of a little knowledge of natural laws caused inefficiency and loss of money; but there was excuse for our predecessors which we, who have their accumulated experience, cannot plead.

Sir Philip Watts gives some interesting figures as to the cost of the older ships, and these may be compared with that of modern vessels. In 1719 the cost of the *Royal William*, of 1918 tons, was 30,800*l*., or about 16*l*. per ton. Whether or not this refers to Pett's *Royal William*, reconstructed in 1719, is not certain, but probably it does. In that case a good deal of the original structure might have remained, thus lessening the cost. The *Royal George*, of 2046 tons, built in 1756, cost 54,700*l*., or 26·7*l*. per ton. "In 1800 ships of the line cost 21*l*. per ton, whilst in 1805 the cost had risen to 35·4*l*. per ton." These figures presumably refer to displacement tonnage, but whether guns are included we are not aware; we will conclude they are not, and see how former figures compare with those of the present day. The first class battleship *King Edward VII.*, of 16,350 tons displacement, is to cost 1,410,901*l*., excluding guns and ordnance stores; whilst the guns will come to 89,070*l*., bringing the total cost to within a few pounds of a million and a half. This would be somewhat over 86·2*l*. per ton, without guns, as compared to 35·4*l*. per ton at the date of Trafalgar. If, however, we could measure cost in terms of fighting efficiency we should doubtless find that we now get more for our money than our fathers did in 1805, for the *King Edward VII.* could have engaged the whole of the British Fleet at Trafalgar with the allied fleet thrown in. In armament the advance has been no less striking. The old cast-iron smooth bores, with their wooden truck carriages, were trained by handspikes, used as levers under the brackets, and by side tackles; and they were elevated by handspikes, being held in position by quoins. Sir Philip Watts says that "a 32- or 24-pounder, fought on the lower deck, had a range of only about 2000 to 2500 yards with 8° elevation, and of about 1500 yards with 4° elevation. The powder charge was generally one-third to one-quarter the weight of the shot. At close quarters a 24-pounder was said to be able to penetrate nearly 5 feet of solid oak and an 18-pounder half this amount." These were not the heaviest guns in the service at the beginning of the last century, there being 42-pounders also; but guns of this nature, designed to form the principal armament for the lower decks of the largest battleships, were found to be too heavy to be worked quickly by the rude appliances then in use. A still heavier piece was later introduced, namely, the 95cwt. 68-pounder.

We have not information as to the thickness of solid oak which the round shot fired from these heavier natures would penetrate, but we may compare the 5 feet that would be pierced by the 24-pounder with the power of the guns of the present day. The modern 12-inch wire-gun of the Royal Navy, weighing 50 tons (about twenty times as much as the 32-pounder), is estimated to penetrate 42 inches of wrought-iron at muzzle velocity of 2580 foot-seconds and a muzzle energy of 39,280 foot-tons; at 1000 yards the penetration would be 38 inches of wrought-iron, at 2000 yards 34·6 inches, and at 3000 yards 32 inches. The penetration of Krupp steel armour at 3000 yards would be but 14 inches. These results are with uncapped projectiles. The longer 12-inch guns of Armstrongs or of Vickers will penetrate more than 51 inches of wrought-iron and will fire two rounds per minute.

It will be seen from the above facts how enormously the powers of both attack and defence have increased during the century. They would seem to have progressed in about equal ratio, for Sir Philip Watts says that "the capability of the wooden ship to take punishment from the guns of her time was, except in one important respect, much the same as that of a modern ironclad." The important respect, of course, refers to the shooting away of spars and rigging.

A table given by Sir Philip Watts comparing the weights apportioned to the different elements of design in a battleship of 1805 and of a modern battleship respectively is interesting. The old ship is one of 74 guns, and 20 per cent. of the total displacement was awarded to general equipment as against 4 per cent. for the 1905 battleship. Armament in 1805 was 10 per cent. of the displacement; in the present day it is 19 per cent. The propelling arrangements are somewhat in the nature of a surprise, masts, sails, and rigging absorbing 8·5 per cent., and steam machinery only 10·5 per cent. of the displacement. There is, however, to be added to the latter figure 5·5 per cent. for coal, but this is more than balanced by the 6·5 per cent. of the weight apportioned to ballast for giving the stability needed under sail. Armour is naturally the great point of difference, for it takes up 26 per cent. of the displacement of a modern battleship. As against this but 35 per cent. of the total displacement is needed for the construction of steel hulls, whilst the wooden hull absorbed 55 per cent. of the total tonnage. It must be remembered, however, that the construction of the "wooden walls" was far more massive than was needed for ordinary purposes, and a good part of the 55 per cent. might be set down as wooden armour. The remarkable thing is that iron plates were not applied earlier, before the French constructors set us the example; or, rather, it would be remarkable were the very conservative nature of the old admirals not remembered.

THE LIGHT-PERCEIVING ORGANS OF PLANTS.[1]

THE subject of this most suggestive book has already been dealt with by the author in a preliminary way.[2] In its present form it has gained greatly in force and interest, and whether or no we are finally converted to Prof. Haberlandt's views there can be no doubt that they are worthy of serious attention.

It is well known that the majority of leaves have the power of placing themselves at right angles to the direction of incident light, but the question of how the light stimulates the leaf to perform the curvatures and torsions which bring it into the "light position" is a problem which hitherto has hardly been attacked.

The first question to be solved is what part of the leaf is sensitive to light. By covering the blade of the leaf with black paper, &c., Haberlandt shows that the principal and most delicate sensitiveness resides in the blade, although a coarser and secondary sensitiveness to the incident light is found in the stalk. It results from this part of the inquiry that the lamina of the leaf must contain the organs for light-perception, if such organs exist. Anything corresponding to a visual organ may be expected to be on the surface, although in such a translucent organ as a leaf this does not necessarily follow. It may, however, be said that Haberlandt is amply justified in looking for what he calls the ocelli of plants in the epidermis covering the upper surface of the leaf. We may therefore narrow the problem thus. Imagine a horizontal leaf illuminated by light striking it obliquely from above at 45°; such a leaf is not in the "light position," and will execute a curvature through 45°, in fact until it receives light at right angles to its surface. Then curvature ceases and the leaf remains in a state of equilibrium—satisfied, as it were, with the "light position." The question is how the leaf differentiates between oblique and perpendicular illumination. Direct observation suggests an answer. If the epidermis of such a leaf as that of *Begonia discolor* be removed by a surface section, and mounted upside down and illuminated from below, then with a low power of the microscope it can plainly be seen that there is a bright spot of light on the basal (inner) walls of the epidermic cells. It can further be seen that the relation of the spot of light to the surrounding zone (which is more or less dark) changes when the specimen is obliquely illuminated. Thus in the case of the obliquely illuminated leaf we should have to imagine that the leaf is stimulated to curvature by the fact that the spots of light are not central in the cells, and that curvature ceases when the brightest illumination is once more central. Thus the plasmic membrane of the basal wall of each epidermic cell is supposed to have a quasi-retinal function by which the leaf is believed to orientate itself in regard to light. There is here, as Haberlandt points out, a certain resemblance to the mechanism by which plants are by many botanists believed to react to gravitation, namely, by the pressure of solid bodies on different parts of the cell walls, just as the statoliths (otoliths) of certain animals, by pressure on different parts of the membrane of the statocyst, enable them to orientate themselves in space.

Haberlandt shows that the epidermic cell is well fitted to concentrate light. It is very commonly lens-like in form, its outer wall being convex, its inner wall either plane or curved. Haberlandt shows by geometrical construction that, taking the refractive index of the cell sap as equal to that of water, the focus is usually at a point either within the cell or below it in the other tissues. In either case a central illuminated region and a surrounding dark zone is produced on the basal cell wall. A further development of this type is the papillose epidermic cells which give the velvety appearance to certain tropical leaves. This does not differ essentially from the first described type, but it has, according to the author, certain advantages which will be referred to later on. It must not be supposed that all leaves have lens-shaped epidermic cells; some leaves, known as aphotometric, are indifferent to the direction of incident light, and even in photometric leaves Haberlandt shows that discrimination is possible without the epidermis playing the part of a lens. Where the outer wall of the epidermis is flat, it often occurs that the inner wall bulges into the subjacent tissues or projects into them in the form of a truncated pyramid. In this case, when the light strikes the leaf at right angles, the central part of the basal wall, being more or less parallel to the surface, is more strongly illuminated than its peripheral parts, which are oblique. Thus without any lens-effect we get stronger illumination in the central region of the basal walls of the epidermis; and this may conceivably serve as a means of orientation.

The most conclusive proof of the author's theory is given by the results of placing the experimental plants under water. If he is right in claiming a lens-function for the epidermic cells, it is clear that immersion in a fluid which has approximately the same refractive index as the cell sap must interfere with the plant's power of light-perception; and this is, in fact, the outcome of his experiments.

His first experiments (p. 89) were made with the hop (Humulus). Here, as in other cases, the stimulus of light is perceived by the leaf, and less perfectly by

[1] "Die Lichtsinnesorgane der Laubblätter." By Dr. G. Haberlandt o. ö. Professor der Botanik a. d. Universität Graz. Pp. viii+143 (Leipzig: Engelmann, 1905.) Price 6*s*. net.

[2] *Berichte d. deutsch bot. Gesellschaft*, Bd. xxii., 1904 (February), and in an address given in 1904 before the Gesellschaft deutscher Naturforscher und Aezte, and published by Barth, of Leipzig.

the leaf-stalk. Four leaves were immersed, two (D) having their leaf-stalks darkened with tin-foil, while the stalks of the other two (L) were exposed to oblique light. After three or four days the D leaves showed no signs of taking up the light-position, while the two L leaves showed well marked curvature towards that position. The experiment is of importance, since it shows that immersion in water does not prevent heliotropic curvature by interfering with respiration or by depressing the energy of the plant in any other way. The only explanation seems to be that of the author, viz. that in the leaves (D) with darkened stalks the lens-like epidermic cells of the leaf-blade are the only organs of light-perception, and they being thrown out of action by the presence of water, perception (and therefore curvature) is absent.

Experiments of the same type were made with a like result on *Ostrya vulgaris* and *Begonia discolor*. It is to be regretted that the light-perceiving organs of such leaf stalks as were sensitive to light under water were not investigated.

A striking result was obtained with Tropæolum (p. 92). The leaves of this plant are unwettable, and when immersed remain coated with a silvery mantle of air. The waxy layer, which gives this quality, may be removed by painting the surface with dilute alcohol without injury to the leaves. The result of immersion is that the normal leaves protected by a layer of air react normally to oblique illumination, whereas the wettable leaves have lost the power of so reacting. This interesting result suggests to the author a new function for the waxy "bloom" of leaves, *i.e.* that it saves them from being blinded by a shower of rain. This theory he extends to velvety leaves, the strongly papillated epidermic cells of which stand up like islands when the surface of the leaf is wetted (p. 65). This is a striking fact in relation to the distribution of velvet-leaved plants, which are especially common in damp tropical regions.

Another section of Haberlandt's evidence depends on the existence of highly specialised lenses. One of the most curious is that of *Fittonia Verschaffeltii* (Acanthaceæ), shown in Fig. 1. Here we have a

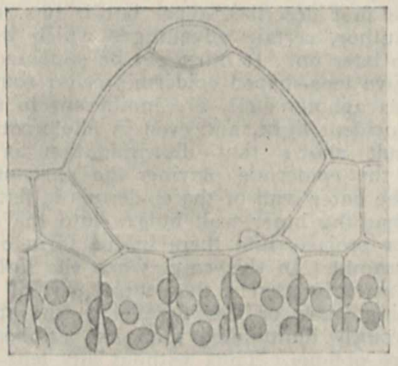

FIG. 1.—Ocellus of *Fittonia Verschaffeltii*.

dwarfed, two-celled trichome, of which the apical cell has the form of a biconvex lens. In this case there is a division of labour, the light focused by the lens-cell being perceived by the large basal cell. Direct experiment shows that, as might be expected, painting the leaf with water in no way interferes with the effect, since the lens is raised above the layer of wet. Similar ocelli occur in *Impatiens mariannae*, and here, as in Fittonia, it is interesting to note that the ordinary epidermic cells, among which the ocelli occur, are markedly bad lenses.

Quite a different type of lens occurs in *Campanula persicifolia*; here (Fig. 2) the formation of a spot of light does not depend on the form of the epidermic cell as a whole, but on the existence of a lens-shaped silicified region in the outer wall of the cell. These structures only occur in perfection in a shade-loving form of the species, where they were noted by Heinricher, who was unable to suggest a function for them. Direct observation proves that they are highly effective lenses. Similar organs are found in *Petraea volubilis*. We must pass over a number of other interesting specialised organs, but it is of importance to note that whenever ocelli occur they

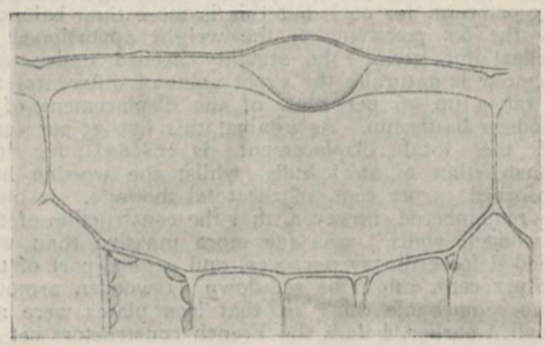

FIG. 2.—Ocellus of *Campanula persicifolia*.

are to be found on the upper, and not on the lower, surfaces of leaves. It is also particularly interesting to find that ocelli tend to occur especially near the edges of leaves, *i.e.* just in those regions where the amount of movement, corresponding to curvature through a given angle, is greatest.

The author has once more earned the gratitude of his fellows by his suggestive discoveries and speculations He must be allowed to have made out a strong case for his theory, but he would be among the first to grant that more work is needed before it can be considered as completely established.

F. D.

RECENT PUBLICATIONS IN AGRICULTURAL SCIENCE.

EVERY civilised State has recognised a special duty towards its farmers in the way of endeavouring to secure them against the purchase of adulterated manures, fraudulent feeding stuffs, and dead or impure seed, but different countries have taken very various means towards securing the desired end. The United Kingdom, probably because its representative farmers are men of substance, rather holds by the old *caveat emptor* maxim, and is content with providing the farmer with a machinery for getting an analysis below cost price, but a machinery sufficiently cumbrous to ensure that no one sets it in motion. Other nations, less intent, perhaps, upon a plausible case in Parliament, and more concerned in getting the thing itself done, have devised various systems of controlling the trade in such materials, so as to ensure that the smallest farmers shall be supplied with seed or manures reaching a certain standard of purity. The laws and methods adopted for securing such a control in the various States Prof. Giglioli passes in review,[1] giving an account of the testing stations, the regulations, the fees, and even notes on the working details employed in the labor-

[1] "Concimi, Mangimi, Sementi, &c., Commercie, frodi, e repressione delle frodi, Specialmente in Italia." By Italo Giglioli. Pp. xvi+759. (Rome: Annali d'Agricoltura, 1905.)

atories. To anyone interested either in the technique or in attempting to secure a more thoroughgoing system in this country, Prof. Giglioli's book will provide a storehouse of information.

We have before had occasion to comment upon the gigantic undertaking of the United States Department of Agriculture, which has embarked on the preparation of a map of the soils of the whole country on a scale of one inch to the mile, accompanied by analyses of each soil type with descriptions of its agricultural features and suitability to particular crops and methods of management. Criticism has not been wanting of the manner in which the work is being executed, but when something like 26,000 square miles are being surveyed and mapped in the course of a year at a cost of about 12*s.* per square mile little more than a first approximation can be expected. Objection has been taken to the system of adopting a local name, *e.g.* Norfolk sand, attaching it to a given soil type, and using it all over the continent for soils of that category, whatever their situation or origin. But the argument is after all a formal one, and the value or otherwise of the survey can only be judged by the farmer on the spot, who finds that it does or does not represent his own soil conditions and assist him to utilise them to the best advantage.

To the foreign reader these volumes[1] are chiefly valuable as giving details of the nature of the soil, the climate, and other factors of the notable farming areas in the United States. Here one can compare the conditions under which the very different wheats of the north-west or of the Pacific slope are grown, or make out the climatic and soil requirements of such crops as cotton in Louisiana or tobacco in Connecticut. We miss in the present volume the photographs of the country which, to the outsider at least, were one of the most interesting features in the former issues.

For many years Mr. T. Jamieson has been carrying on a series of agricultural experiments, or rather demonstrations, on a comparatively small scale, but in a very careful and neat fashion. Reports on the work done have been issued from time to time, and now the results, which extend over something like twenty-eight years, have been gathered together in the little volume before us.[2] The experiments illustrate the well known principles of plant nutrition, and the account of them affords a brightly written *résumé* of the elementary facts connected with manures and their application to various crops. When here and there we read that this or that fundamental fact has been discovered or proved by the Aberdeenshire Research Association, much as though Mr. Jamieson should tell us that he has discovered water is composed of eight parts of oxygen and one of hydrogen, we can only admire the innocence in which Mr. Jamieson has managed to preserve his mind. Not for him the knowledge of good or evil that comes of reading other men's work, either past or contemporary. We miss, indeed, in this volume some of Mr. Jamieson's engaging speculations, as when, in his 1903 report, he told us that potash "appears to be the element chosen in nature to neutralise acidity, and facilitate transmission within the plant, for which purpose it is specially fitted by its alkalinity, solubility and soft or slippery character. Soda, which closely resembles it, but is of a harder drier nature (as seen in the soft Potash Soap as compared with the hard Soda Soap) is unable to take the place of Potash in plants, as has been found by former experiments." But as a result the book forms a sufficiently sound and quite clearly written introduction to agricultural chemistry, which, like a visit to Mr. Jamieson's orderly demonstration plots at Glasterberry, may well be useful to set farmers thinking about the way their crops grow.

1 "Field Operations of the Bureau of Soils, 1903." Fifth Report. Pp. 1310, and a case containing 78 maps. (Washington: U.S. Department of Agriculture, Bureau of Soils, 1904.)

2 "Science and Practice of Agriculture—Farmer's Handbook.' By T. Jamieson, Director of the Aberdeenshire Agricultural Research Association. Pp. 173. (Aberdeen: The Author, 10 Belmont Street, 1905.) Price 2*s.* 6*d.*

NOTES.

THE address on "Imperial Defence" delivered by Lord Roberts at a special meeting of the London Chamber of Commerce on Tuesday was a clear statement of the unsatisfactory condition of the armed forces of this country, in comparison with those of other great military Powers. Lord Roberts believes that we could not hope to be successful against an enemy of anything like equal strength, trained and organised as are the armies of leading nations. It appears, therefore, that we are as unprepared for war as Sir Norman Lockyer showed we are for the industrial competition of the future, in his presidential address to the British Association; and as to the way to remedy our deficiencies Lord Roberts's address—*mutatis mutandis*—supports the views expressed on that occasion. Higher education and scientific study must be applied to the arts of war as well as to those of peace if our country is to occupy a position in the first rank of progressive nations. Less attention must be paid to such trivial matters as the shapes of headdresses or the cuts of jackets, and more must be given to education and scientific training from early youth. In the war in the Far East, the Japanese have been successful because of their superior intelligence and scientific spirit. Let our statesmen learn from this that intellectual efficiency is now a truer safeguard of a nation than physical strength.

THE Government Eclipse Expedition organised by the Solar Physics Observatory will leave for Gibraltar on Friday. The expedition, in charge of Sir Norman Lockyer, K.C.B., will tranship there to H.M.S. *Venus*, which will proceed to Palma, where, by permission of the Spanish Government, the instruments will be erected. Mr. Howard Payn, one of the volunteer observers, is already there superintending the location of piers for the instruments. It was originally intended to observe at Philippeville, as Bona is occupied by two American parties, but the French Government would not give the necessary authorisation.

THE official party of the British Association, consisting of the president-elect and general and sectional officers, as well as other leading representatives of science, left Southampton on Saturday last by the mail steamer *Saxon* to attend the meeting of the association in South Africa.

DR. A. C. HOUSTON has been appointed director of water examinations under the Metropolitan Water Board.

THE death is announced, at the age of forty-six years, of Mr. H. Lamb, of Maidstone, author of "The Flora of Maidstone."

A REUTER telegram from Halifax, Nova Scotia, states that the Arctic exploration steamer, the *Roosevelt*, sailed from Sydney, Nova Scotia, on July 26. Commander Peary said he hopes to succeed in reaching the Pole, if not early in 1906, then the next year. He proposes to start on his final dash for the Pole from the eighty-fourth parallel.

ACCORDING to the *British Medical Journal*, a new society has been started in Paris for the scientific study of tuberculosis. The work of the society is to be purely scientific. The membership is restricted to thirty members, who are to be chosen irrespective of school or opinion, and there is to be no president. The members are in turn to preside at the meetings.

AT the opening meeting of the council of the Liverpool Institute of Tropical Research, held on Monday, Sir Alfred Jones, the chairman, remarked that in many respects countries such as Germany, France, and Belgium are applying scientific methods to their commercial enterprises, especially to those conducted in the tropics, with greater success than Great Britain; and that it is necessary for the British merchant to bestir himself and take advantage of every assistance that science can offer. He guaranteed the institute 1000*l*. a year for four years; and among other guarantees were:—Mr. W. H. Lever, 1000*l*. a year for four years; Mr. T. Sutton Timmis, 250*l*. a year. It is proposed to take steps to obtain a charter of incorporation for the institute.

THE tenth session of the International Statistical Institute was opened on Monday by the Prince of Wales, as honorary president of the institute, and of the Royal Statistical Society. In the course of his address, the Prince said:—"My revered grandfather, the late Prince Consort, who did so much for the progress of science, was instrumental in rendering special assistance to the first effort of statistical science to secure for itself an assured and prominent position in the ranks of the older and better recognised sciences. Quetelet, whose name stands pre-eminent in that science, was at one time the Prince Consort's mathematical teacher, and later on his close personal friend. It was on the occasion of our great exhibition of 1851 that a large and distinguished company of statisticians was assembled in London. It was chiefly at the instigation of Quetelet that the question of instituting periodical international congresses for the discussion of questions of common interest and international concern was proposed. In consequence of this proposal an international organisation was formed, and the first international statistical congress was held in Brussels in 1853. Later on, in 1860, London welcomed the international congress, which met under the presidency of the Prince Consort, who, in his opening address, remarked:—'The importance of these international congresses cannot be overrated. They not only awaken public attention to the value of these pursuits by bringing together men of all countries who devote their lives to this work, and who are thus enabled to exchange their thoughts and varied experiences. They also pave the way to an agreement among different Governments and nations to follow up these common inquiries in a common spirit, by a common method and for a common end.' This watchword of the congress of 1860 I would endeavour to commend to the congress of 1905 as worthily embodying its aims and its objects. National and social tendencies are to-day capable of increasingly accurate measurement with the aid of the very numerous statistical tabulations which now exist. In the future all branches of social science must look for their advancement and increase of precision to the continually improving character of the raw material furnished them by statisticians. For scientific progress, however, a primary essential is active and effective cooperation among scientific workers in all countries in order that publicity can be given to their results and uniformity obtained in the collection and arrangement of data for the purpose of their common employment."

THE first number of a periodical for the publication of original investigations in economic biology will appear on September 29. The new magazine will be entitled the *Journal of Economic Biology*, and will be edited by Mr. W. E. Collinge, with the cooperation of Prof. A. H. R. Buller, Prof. G. H. Carpenter, Mr. R. Newstead, and Mr. A. E. Shipley, F.R.S.

Nos. 1 and 2 of vol. xxvi. of Notes from the Leyden Museum are entirely occupied by a memoir by Dr. O. Finsch on the birds collected by Dr. A. W. Nieuwenhuis in Dutch Borneo, more especially in the districts of Mahakam and Kajan. No less than 209 species were represented in the collection. The paper is illustrated with a coloured plate of the new species *Poliolophus nieuwenhuisi*, as well as with a map of the districts traversed by the explorer.

THE most generally interesting item in the June number of the *Victorian Naturalist* is the description by Mr. J. A. Hill of fights between two species of ants. One of the two is the large soldier-ant (*Formica purpurea*), a species which forms huge nests, and is capable of overpowering such creatures as small snakes. Nevertheless, this species is vanquished and exterminated by a small black ant scarcely one-third its size, the battles between the two often lasting months, and the victors finally taking possession of the nests of the vanquished.

AT the annual meeting held in May last of the Boston Society of Natural History, the curator of the museum reported (*Proceedings*, vol. xxxii., No. 5) that the plan for re-arranging the collections referred to at the previous meeting had been in great measure carried out, and that the New England mammals and birds now occupy all the cases on the main floor of the building with the exception of one temporarily devoted to the palæontology of the district. This special attention to the proper display of the local fauna is a feature which should be copied by all provincial museums.

THE July number of the *Zoologist* contains a full report of a lecture on the migration of birds delivered at the recent International Ornithological Congress by Mr. Otto Herman, director of the Hungarian Central Office of Ornithology. The lecturer directed special attention to work which had been accomplished in Hungary in the matter of recording the dates of arrival and departure of migratory species by means of the services of a very large number of observers scattered all over the country. It has been ascertained, for example, that it takes one hundred and five days for swallows to complete their migration throughout Europe, that is to say, from Gibraltar in the south to Lulea in the north, the young being fully fledged in the former locality by the time the old birds have reached the latter. Even in Hungary itself the period of arrival may last as long as seventy days, the time that the species spends in that country averaging one hundred and sixty-seven days.

IN recording a collection of fishes obtained by Dr. B. Dean from Negros Island, Philippines, Messrs. Jordan and Seale (*Proc. U.S. Nat. Mus.*, No. 1407) take occasion to mention that a large percentage of the small species, so often neglected by collectors, appear to be new. Taken generally, the Philippine fish fauna seems to be very similar to that of the Indo-Malayan archipelago, although a few species are identical with Indian forms. In the course of their list the authors give an example of one of those transpositions of generic names which are so hostile to the real progress of zoology. In this particular instance the name Amia, so universally in use for the American bow-fin, is employed to designate the perch-like fishes commonly known as Apogon.

WE have recently received five parts of the *Proceedings of the U.S. National Museum*. In the first of these (No. 1408) Mr. T. Gill contributes the results of investigations into the life-history of the sea-horses (Hippocampus), a subject which has hitherto received but little attention. One of the illustrations shows a male discharging the young from its brood-pouch. In the second (No. 1409) Mr. B. A. Bean describes and figures an adult specimen of the extraordinary Japanese goblin-shark (*Mitsukurina owstoni*). The third (No. 1411) contains a list, by Mr. H. C. Oberholser, of birds collected by the well known traveller Dr. W. L. Abbott in the Kilimanjaro district, several of which are described as new. A descriptive list of a collection of caterpillars and chrysalises of Japanese Lepidoptera, by Mr. H. G. Dyar, constitutes the fourth fasciculus (No. 1412); while in the fifth (No. 1413) Mr. W. H. Asmead records Hymenoptera new to the Philippine fauna, with descriptions of new species.

PROF. A. GIARD, of the Sorbonne, has favoured us with separate copies of three articles by himself from vol. xxxix. of the *Bulletin scientifique de la France et de la Belgique*. In the first of these, entitled "Pœcilogonie," the author discusses whether in the case of organisms of which the adults are more or less similar to one another, while their embryogeny is different, more importance should be attached to the evolutionary dissimilarities or to the similarity of the adults. The title for the phenomenon is new. The second paper will delight the hearts of lovers of the oyster, the author remarking at the conclusion of this communication, which is entitled "La Prétendue Nocivité des Huîtres," that he "could wish there existed in the world no other cases of typhoid save those induced by eating tainted oysters." In the third communication Prof. Giard discusses the drift (*tendance*) of modern morphology and its relations to other sciences.

A PAPER on the development of the ascus and on spore formation in the Ascomycetes, by Mr. J. H. Faull, published as vol. xxxii., No. 4, of the *Proceedings of the Boston Society of Natural History*, gives a detailed description of the nuclear changes for *Neotiella albocincta*, *Sordaria fimicola*, and a species of Hydnobolites. The origin of the asci was in most cases traced to the penultimate or terminal cells of ascogenous hyphæ, and it was found that the uninucleate stage of the young ascus was always preceded by a fusion of two nuclei. From his observations of the method by which the spores are delimited, the author favours the view that the ascus is homologous with a zoosporangium, and would derive the Ascomycetes from such a group as the Peronosporeæ or Saprolegnieæ.

IN a paper forming No. 1405 of the *Proceedings of the U.S. National Museum*, Mr. R. MacFarlane, the chief-factor of the Hudson Bay Company, contributes a series of highly interesting notes on mammals collected and observed in the northern Mackenzie River district, North-Western Territories of Canada. For two-and-forty years (1852–1894) Mr. MacFarlane was stationed as a post and district manager in these territories, and therefore had unrivalled opportunities for observing the fauna in its days of abundance. Unfortunately, as he himself confesses, except when stationed at Fort Anderson the author did not take full advantage of these opportunities either in the matter of collecting or observing; nevertheless, such observations as have been recorded are of the highest interest and value, and one cannot help regretting that they were not published in a British or colonial serial, and also that the author's services were not long ago enlisted on behalf of the British Museum. The paper was, indeed, it appears, prepared to a great extent for publication at Cumberland House, the headquarters of Cumberland District, in the winter of 1890–1, but for various reasons it was not completed, and several sheets of the MS., together with various memoranda, were subsequently lost. The paper is a perfect mine of information with regard to the fur exports of the Hudson Bay Company in the old days.

TWO memoirs have lately been published by the Carnegie Institution of Washington which contain results of interest in reference to problems of heredity. The first of these, by W. E. Castle, discusses the phenomena of coat characters in guinea-pigs and rabbits. Three alternative pairs of coat characters in guinea-pigs are shown to conform generally to Mendel's law. These are:—albinism *v.* pigmentation, smooth *v.* rough coat, and long *v.* short coat, the first named in each pair of characters being recessive with respect to the second. The author distinguishes between characters which are recessive and those which are latent; by the latter he means certain "dominant" features which depart from Mendel's law in being capable of renewed activity under certain conditions even in "recessive" gametes. The facts given in the paper supply abundant illustrations of the variety of conditions under which blended inheritance, as in Mendel's Hieracium experiments, may occur in place of the strict Mendelian segregation. In the second paper, which is by D. T. Macdougal, assisted by A. M. Vail, G. H. Shull, and J. K. Small, a full account is given of the various forms of Œnothera which have constituted the chief material for De Vries's "mutation" theory, and of the relation between them. It is shown that *O. lamarckiana* is in all probability a true and independent species native to America; and the authors record the re-discovery of the habitat of *O. grandiflora*, the place of habitat of which in the American flora had become doubtful. Both memoirs are well illustrated by woodcuts and half-tone plates.

DR. H. MIGLIORATO announces in vol. ii., part ii., of *Annali di Botanica* that he is preparing an analytical dictionary of vegetable teratology as a subsidiary work to Penzig's "Pflanzen Teratologie," and requests that workers in this subject will cooperate by sending copies of their papers to him at 89b rue Panisperna, Rome.

PROF. F. W. OLIVER, in an article in the *Biologisches Centralblatt* (June 12) on the newly discovered seeds of the Carboniferous ferns, summarises the results of recent investigations in fossil botany which have led to the formation of a separate group, the Pteridospermeæ, including the Lyginodendreæ and Medullosæ. The paper is illustrated with figures of sections and a model of the seed in its cupule of *Lagenostoma Lomaxi*.

WE have received from Brazil the first number of the *Revista da Sociedade Scientifica de São Paulo*. It contains the first instalment of a report, written in French, of a voyage made in 1825 by Hercules Florence from the Tiete to the Amazon by the Brazilian provinces of St. Paul, Matto Grosso, and Gran Para. There is also a valuable memoir on the Brazilian Tabanidæ, written in German, by Dr. A. Lutz, director of the bacteriological institute of the State of São Paulo. Lastly there is a paper, written in Portuguese, by Erasmo Braga, on the gold mines of Ophir.

THE seeding of pastures is a matter of primary importance to owners of grazing land, and it is certain that many farmers will obtain useful information from the experiments conducted under the direction of Mr. A. N. M'Alpine, which are described in Bulletin No. 31 of the West of Scotland Agricultural College. Fourteen different mixtures were tried, three containing rye-grass in excess, three without rye-grass, and four were special mixtures; of the latter Timothy and cock's-foot mixtures in suitable quantity were especially efficacious in checking Yorkshire fog and bent grass. With respect to rye-grass, it was demonstrated that both the perennial and the Italian varieties should be sparingly sown.

THE cultivation of oranges in Dominica is discussed by Mr. H. Hesketh Bell in No. 37 of the pamphlet series issued by the Imperial Department of Agriculture for the West Indies. Mr. Hesketh Bell has been growing oranges for some years on two experimental stations, and has shipped sample boxes at different times to England which have realised remunerative prices at Covent Garden. Experience has proved that budded oranges are much superior to seedlings, and the varieties "Parson Brown" and "Jaffa" are recommended as being hardy and prolific, while the "Washington Navel" also appears to thrive well. Emphasis is laid on the necessity for exercising the greatest care in handling and packing the fruit, so that Dominica brands may secure a good name on the market.

THE banana industry was unknown to Costa Rica twenty-five years ago, says a writer in the *Journal of the Society of Arts* (July 28), but it has reached such proportions, especially within the last few years, that bananas now form the main export of the country. At the close of 1904, about 50,000 acres were devoted to banana growing in Costa Rica. The trade was exclusively confined to the United States until 1902, when the fruit was exported to England, with gratifying results. France, Germany, Italy, Spain, and other European countries do not as yet consume the banana, but as soon as a substantial increase in the acreage is reached, and with the present facilities for transportation and the use of ships equipped with cold storage, the market will be extended probably to those countries. The amount exported from Port Limon during the five years ended with June 30, 1904, was as follows, in bunches:—1900, 2,804,103; 1901, 3,192,104; 1902, 4,427,024; 1903, 5,261,600; and 1904, 5,760,000. The following figures show the probable cost and profit on a tract of 100 acres planted in bananas. Original outlay:—land (4*l.* per acre), 400*l.*; reducing land and bringing it to a banana-bearing condition (10*l.* per acre), 1000*l.*; total, 1400*l.* Gross returns, 180 stems per acre per annum, 1116*l.* Expenses:—cutting and hauling the fruit, and keeping the plantation clean, 288*l.*, manager (20*l.* per month), 240*l.*; total, 528*l.* Net return on investment, 588*l.* Under favourable conditions, a banana plant may give a stem of fruit in nine months, but it generally takes from fifteen to eighteen months for the average plantation to be in full bearing. The life of a plantation varies according to the fertility of its soil and topographical situation. Some soils may need a rest in six or seven years, while others may last practically for ever, as in cases where periodically enriched by alluvial deposits. It is understood that fine flour can be made from bananas, and that fibres from the leaves and stalks could be extracted and successfully worked, but as yet nothing in this direction has been done in Costa Rica.

THE *Engineering and Mining Journal* directs attention to the increasing tendency to use copper as the collecting agent instead of lead in smelting gold and silver ores. Smelting on the copper basis is decidedly cheaper than on the lead basis.

WE have received part i. of the annual report of the director of the Philippine Weather Bureau for the year 1903, containing hourly observations of atmospheric phenomena at the Manila Central Observatory. The assistant director contributes a useful climatological summary for the year, together with monthly and daily amounts of excessive rainfall that have occurred since 1865. Photographic illustrations are given of the havoc wrought by one of the two destructive cyclones which traversed the archipelago. Unfortunately, there was no good anemometer at any of the towns that suffered most severely. Manila itself escaped these violent storms.

THE Hamburg Meteorological Institute has issued vol. xiii. of "Deutsche überseeische meteorologische Beobachtungen," 1905. As may be inferred from the title, the work contains observations made at places abroad, under German control. In the present case it refers entirely to some twenty-two stations in German East Africa, and the tables have been prepared and printed with the liberal assistance of the Colonial Department of the German Foreign Office. It contains more than 300 pages of valuable observations, and is a very important contribution to the climatology of Africa, with explanatory details relating to each of the stations. For some of them hourly observations are given from self-recording instruments; at others eye observations have been made several times daily.

A PAPER entitled "Records of Differences of Temperature between McGill College Observatory and the Top of Mount Royal, Montreal," by Prof. C. McLeod, was read at the meeting of the Royal Society on June 8. The chief object of the paper was to show the advantage of Prof. Callendar's electrical recorders, in connection with the use of platinum thermometers, in obtaining trustworthy indications of the variations of temperature at a distance in a situation inaccessible for the greater part of the winter. The horizontal distance between the stations was 3300 feet, and the difference of altitude 620 feet. The first year's working (July, 1903, to May, 1904) showed that range of variation was considerable, and often changed very rapidly; on some occasions the temperature at the higher station was 6° F. or 7° F. above the lower, on others it was 25° below. A comparison of the records showed that any marked change of temperature at the lower station was almost invariably preceded by a similar change at the higher station at an interval of twelve to twenty-four hours. It is claimed, we think with fairness, that this system of recording meteorological data appears to overcome the difficulty and expense of maintaining a staff of observers at an inaccessible station.

AT the last annual meeting of the Royal Meteorological Society, the president, Captain D. Wilson Barker, gave an interesting address, illustrated by a number of lantern slides, on the connection of meteorology with other sciences. He pointed out several of the most evident influences of meteorology to the geological observer, such as rain, ice, snow, &c., and the rock-splitting action of great changes of temperature. As regards zoology, the influence of meteorology on animal life is all-pervading. Among the most common results are mentioned the winter sleep of various animals, and the summer sleep of some fishes and reptiles. Dr. Dickson, Dr. Mill and others are studying the effects of changes of climate on sea organisms generally. Agriculturists are more dependent on the weather than any other class of persons. Were it possible to issue forecasts for a longer period in advance, farmers would be much benefited. Captain Barker considers that the effect of weather upon health has not received a fair amount of scientific notice. While medical officers write voluminous reports on the public health, many of them ignore the meteorological conditions of the districts under review. We think we are justified in claiming exception for the reports of the various registrars-general, which contain carefully prepared meteorological statistics.

IN the *Rendiconti* of the Lombardy Academy, xxxviii., 2, Prof. Ernesto Pascal gives a classification of the various forms of twisted sextic formed by the intersection of a quadric and a cubic, with special reference to the number of their real tritangent planes.

WE have received the third edition of Dr. Richard Dedekind's pamphlet on "Stetigkeit und irrationale Zahlen," which may now fairly claim a place among the mathematical classics. It originated about the year 1858, when the author was charged with a course of lectures on the calculus, and found no satisfactory treatment of the continuity hypothesis in existence. On November 24, 1858, Dedekind discovered a definition of continuity which he imparted to Durège a few days later, and the present pamphlet was written in 1872 in commemoration of his father's jubilee.

IN the Bulletin of the American Mathematical Society for June, Dr. Edward Kasner directs attention to a significant dialogue in Galileo's "Discorsi e dimostrazioni mathemetiche" of 1638, in which modern concepts of infinity as laid down by Bolzano, Cantor, and Dedekind appear to have been foreseen by that philosopher. In this dialogue Salviati points out to Simplicio that since every number has a square there must be as many squares as there are numbers, but, on the other hand, since there are many numbers which are not squares there must be more numbers than squares. In answer to Simplicio's question "What is to be our conclusion?" Salviati gives the following remarkable reply:—"I see no escape except to say: the totality of numbers is infinite, the totality of squares is infinite, the totality of roots is infinite; the multitude of squares is not less than the multitude of numbers, neither is the one greater than the other; and, finally, the attributes of equal, greater and less are not applicable to infinite but solely to finite quantities."

MR. J. J. HICKS, of Hatton Garden, has submitted a two-foot rule designed by Mr. Scott which is worthy of notice. When opened out like an ordinary carpenter's rule one face shows inches and sixteenths along one edge and millimetres along the other, while between them the divisions are repeated in juxtaposition for the purpose of more accurate comparison. It is the other face of the rule, however, where the greater novelty is to be found. Here there are four double comparison scales of English and French measures of length, weight, capacity, and fluid measure. Taking the first as an example of the system, a length of about 10 inches shows comparison quantities from 1 inch to 60 miles juxtaposed, but the divisions are not equispaced, as in that case nothing much less than a mile would be visible. They are therefore spaced logarithmically, so that the first inch covers a space of nearly half an inch. This is divided into eighths, and each of these by estimation could be read to tenths. The next two inches occupy the same space, and so, of course, do the next four, and so on. In a distance of $1\frac{1}{2}$ inch or 38 millimetres, a reading is increased ten-fold. Of course such comparison scales have the advantage of the ordinary slide rule that at all parts of the scale readings are made with the same proportional accuracy. For instance, on the scale now referred to 1 inch is opposite 25 and a small half-millimetre, $11\frac{1}{2}$ yards is opposite $10\frac{1}{2}$ metres, 5 miles is half the thickness of the line beyond 8 kilometres, and similarly 50 beyond 80. In short, the accuracy with which any of these comparison scales may be read is the same as that which would apply to a slide rule in which the A line from 1 . . . 100 was 3 inches long. For quick and fairly accurate comparison of lengths, weights, cubic and fluid measures, this face of the rule is most convenient.

WE have received several papers dealing with projects (not performances) of artificial flight the general character of which is sufficiently shown by the following brief summaries:—Arnold Samuelson, in a lecture published at Hamburg (London: E. and F. N. Spon), asserts that all flying animals (insects and birds) have flat, not curved, wing surfaces, that the normal air-pressure on a thin supporting plane is independent of the angle of incidence at which the plane moves forward, that the pressure on a rectangular plane decreases uniformly from front to back, giving a centre of pressure at one-third the distance from the front to the back surface, and other conclusions equally at variance with many generally accepted theories. Dr. Federico Sacco, in a paper entitled "L'Aerovoie" (Turin: P. Gerboni), proposes a captive balloon attached to a small trolley running along a kind of elevated cable railway as a cheap and rapid means of locomotion which would be unaffected by such trifling terrestrial obstacles as rivers, mountains and lakes; in windy weather a voyage on such an apparatus would doubtless be highly thrilling. For the argument of cheapness Dr. Sacco is responsible. M. René de Saussure, writing in the *Revue scientifique* for May 27, describes the "hélicoptère aéroplane" of MM. H. and A. Dufaux, which, roughly speaking, consists of a pair of double-surface gliders placed fore and aft, with two screw propellers arranged side by side between them rather nearer to the front than to the back gliders. Of this apparatus only small models have been tried, and a large sized machine 8 metres long and 3 metres broad which has been constructed has not yet been experimented on; the authors, however, give full details as to how to start the machine and to land safely. The latter operation, as shown in the diagram accompanying the article, bears a rather ominous resemblance to the motion of a dynamically unstable glider previous to capsising. We cannot close the list without referring to a paper by Mr. F. W. H. Hutchinson, read at Cambridge and published in *Knowledge and Scientific News* for June, describing experiments on models with bird-like wings, which have already yielded some interesting results in the study of natural flight. The wings in this case were not assumed to be flat, but of the curved form, which the author describes as the "Hargreave curve."

MESSRS. WITHERBY AND CO. have issued the prospectus of a book on "The Birds of Hampshire and the Isle of Wight" which they have in preparation. The work is by the Rev. J. E. Kelsall and P. W. Munn, and is claimed to be the first complete history of the birds of Hampshire and the Isle of Wight published. The work will contain a large-scale coloured map, and be illustrated by reproductions of drawings and photographs.

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF JUPITER'S GREAT RED SPOT.—In No. 4034 of the *Astronomische Nachrichten* Mr. Stanley Williams gives the results of the observations of the Great Red Spot on Jupiter made by him during the period June 20, 1904–January 21, 1905.

During this opposition the phenomena proved of exceptional interest on account of the vagaries in the relative motions of the Red Spot and its immediately surrounding features.

When the first observation was made, on June 20, it was seen that the immense mass of dark material, known as the south tropical disturbance, had, after making a complete circuit of the planet, again overtaken and enveloped the Red Spot. On July 26 nearly all this dark material had drifted past the Red Spot, which in August was quite separate, but very faint.

Mr. Williams's observations also afforded further evidence of the variable rate of motion of the Great Red Spot.

SUN-SPOT SPECTRA.—During the year ended March, 1905, Mr. W. M. Mitchell, of the Princeton Observatory (N.J.), made an exhaustive series of observations of that part of the sun-spot spectrum which is included between F and α. These observations took note of the two separate features of the spot spectrum:—(1) the nearly continuous absorption known as the spot-band, and (2) the affected Fraunhofer lines. A rapid survey of the whole region was first made on each observing day, and was followed by an exhaustive examination of some smaller portion. In regard to the first of the above features, Mr. Mitchell arrived at the conclusion that the band-lines are lines which do not appear in the Fraunhoferic spectrum at all, and he submits facts in favour of this view.

In observing the affected Fraunhoferic lines, the observer recorded nine different phenomena (*e.g.* widening, reversal, obliteration, &c.), and in his table of the 680 lines which he observed in the spot spectrum, he classifies each line according to the manner in which it was affected. The intensities of the widened lines, their intensities in the normal solar spectrum, the number of times each line was observed, and various other details concerning the affected lines are also recorded in the table.

Each element involved is then considered separately, and a number of valuable conclusions are deduced. Whilst vanadium and titanium are the most important elements concerned in sun-spots, as previously shown by Young, Cortie, and Lockyer, Mr. Mitchell finds that manganese plays an important *rôle*, 45 per cent. of its lines being affected. A striking comparison is drawn between the behaviour of certain manganese lines in the successive observations of the great sun-spot of February last. On February 3 and 4 they were noted as being strongly reversed, whereas on March 3 they were no longer reversed, but were excessively widened and very hazy.

The following general conclusions were arrived at by Mr. Mitchell, and agree, in general, with those recently published by Prof. Fowler in the Monthly Notices:—(1) Lines frequently seen in the chromosphere are, with two exceptions, but little affected in spots; (2) high-level chromospheric lines are not affected in spots; (3) lines greatly affected in spots are seen but rarely in the chromosphere.

From his observations and conclusions Mr. Mitchell deduces that sun-spots are, at least, below the chromosphere, and are probably caused by the heated vapours from the lower levels oozing through and vaporising the clouds of the photosphere (*Astrophysical Journal*, No. 1, vol. xxii.).

AN INTERESTING ASTEROID, OCCLO [475].—Owing to its large southerly declination, −62°, at the time of its discovery, the minor planet Occlo was looked upon as of special interest, and when the orbit was computed and found to have a greater eccentricity than that of any other known asteroid the interest in this object was increased. This great eccentricity suggested that Occlo might be looked upon as the connecting link between the asteroids and the periodic comets. In order that the object should not be lost sight of, Prof. Kreutz had an ephemeris for 1905 computed, and this was communicated to Mr. R. H. Frost at Arequipa, who successfully photographed the planet's trail, with the 24-inch Bruce telescope, in April, 1904. The plates have now been measured by Mrs. Fleming, and the positions of both ends of the trail on April 4 and on April 7 determined. The results are given in Circular No. 101 of the Harvard College Observatory.

OBSERVATIONS OF PHŒBE.—Saturn's ninth satellite, Phœbe, was photographed by Mr. R. H. Frost at Arequipa on four nights during May, and the following positions have been obtained from measurements of the plates:—

Date 1905	G.M.T. h. m.	Exp. m.	Dist. ′	Difference in decl. ′	Position angle °
May 9	21 3	112	10·6	+5·8	56·8
,, 10	20 40	120	11·0	+6·4	54·4
,, 12	20 49	120	11·6	+6·3	57·1
,, 13	20 48	145	12·0	+6·6	56·6

The above quantities all refer to the position of the satellite in regard to Saturn's centre. A comparison of these positions with those computed from Dr. Ross's ephemeris shows that on the mean date, May 11, the computed distances should be diminished by 0′·3, and the position-angles should be increased by 0°·9 (Harvard College Observatory Circular, No. 102).

PERIODS OF THE VARIABLE STARS S SAGITTÆ AND Y OPHIUCHI.—From a discussion of the observations made by himself, combined with those of other observers, M. M. Luizet has deduced the following elements for the light-curve of the variable star S Sagittæ (Ch. 7149):—

Maximum 2409863·33 (M.T. Paris) }
Minimum 2409860·37 ,, } + 8·38209d. (E. − 389)

The light-curve of this star presents a double oscillation, and, according to M. Luizet's scale, the magnitude varies between 5·4 and 6·2.

For Y Ophiuchi (Ch. 6404), the same observer finds that M. Hisgen's elements,

Maximum 2408694·25 (G.M.T.) }
Minimum 2408688·03 ,, } + 17·1207d. E.,

as published in No. 3424 of the *Astronomische Nachrichten*, agree very well with his own recent observations. From a comparison of these observations with those made by Mr. Sawyer, it appears that during the last fifteen years the magnitude of Y Ophiuchi has slightly increased, but this apparent increase may be due to the difference of observer and of observing conditions (*Astronomische Nachrichten*, No. 4030).

THE MEETING OF THE BRITISH MEDICAL ASSOCIATION.

THE seventy-third annual meeting of the British Medical Association was held at Leicester last week under the presidency of Mr. Cooper Franklin, surgeon to the Leicester Infirmary. The proceedings were conducted in twelve sections, and were well attended, nearly 1000 members registering their names.

Mr. Cooper Franklin chose for his presidential address the subject of medical education, past, present, and future. He dealt with the various Acts of Parliament regulating medical education and practice, the condition of medical education in London forty years ago, and insisted on the necessity of a good general education if the medical student were to become a good practitioner, and advocated a study of Latin and Greek. He said:—"I think the advantages of a good classical education early, to a man entering our profession, cannot be over-rated. Nothing will, or can, make up for it; there would not be so many candidates deficient in ordinary spelling and composition if there had been a good classical education. To my mind there is nothing really superior to the old-fashioned Latin and Greek training, but it seems hopeless to insist nowadays upon the retention of Greek. I think it is twenty-five or thirty years ago since, in the matriculation examination of the University of London, students were allowed to take up German instead of Greek. I venture to think that, so far as medical students are concerned, that was a retrograde step. I do not envy the student sitting down to learn his anatomy who has not learnt even a little Latin and Greek; his Gray's 'Anatomy,' perchance, in front of him, his Latin dictionary on one side, and his Greek lexicon on the other. The student, too, must not begin to specialise too soon; he wants a liberal education, an education for its own sake. This goes when the technical education begins—that is, when he leaves school or college to learn to be a 'doctor.'"

Dr. Henry Maudsley delivered an address on medicine, present and prospective, in which he discussed preventive medicine, heredity in disease, &c. He sounded a note of warning with regard to our present sanatorium treatment of tuberculosis which may be quoted:—"But is phthisis so very curable in these special hospitals, nowise endued with any special grace, I imagine, by reason of their being called sanatoriums? Adequate statistics are not yet available, but thus far the modest outcome of experience seems to be that many patients who are sent in the early stage of the disease recover, if they are kept long enough; that most of those in a more advanced stage improve while there, frequently relapsing afterwards; and that those who are badly diseased ought not to be sent at all. Is that, after all, to say much more than might be said of sensible treatment before the erection of sanatoriums?

"Can we, again, eliminate the predisposing influence of heredity? Actual tubercle may not be inherited, but the poor constitutional soil inviting and suiting the bacillus still passes from parent to child; and we do not get rid of the essential fact by changing the name. Do we, indeed, in the end get such a valuable addition to the life-capital of the nation? It is easy enough, noting that some 60,000 consumptives die annually in England and Wales—I do not vouch for the figures—fancifully to rate the value of each life at an arbitrary figure and then by multiplication to make an appalling computation of the loss to the community; but is the loss so real? Might not the ultimate cost to the commonwealth be greater were these persons to go on living and breeding in it? An addition to the nation's life-capital is all very well, but the quality of the capital counts for a good deal, and it will not count for much if it is not realisable. What does the realisation amount to in practice? The patient who comes out of the sanatorium recovered or improved must usually go back to his former work and surroundings; he cannot adapt the world to the weakness of his nature and its ideal needs, but, like other mortals, must adapt himself to the rude world and perforce do much as they do. That is what he quite naturally does; returns to his work and his old ways, perhaps gets married if he is not married, and begets children who can hardly have the confidence of a good descent. Meanwhile, when he relapses, he sows bacilli broadcast, thus multiplying such life-capital to fulfil its ordained function in the universe, that apparently being to make away with weak mortality."

The address in surgery by Mr. C. J. Bond, surgeon to the Leicester Infirmary, dealt with ascending currents in mucous canals and gland ducts. The results of a number of experiments proved that by some means or other, and under certain conditions, particles of an insoluble substance, such as indigo, inserted into the orifices of a mucous canal or duct are conveyed along the mucous channel in a reverse direction to that taken by the contents of the tube, or by the secretion or excretion of the glands along such ducts. The conditions which seem to favour this passage are—some interference with the normal flow of the contents of the mucous tube or duct; some arrest or diversion of secretion, such as is produced by a fistulous opening, though it is by no means necessary that this should be complete.

In the section of medicine an interesting discussion on the treatment of sleeplessness was opened by Sir Lauder Brunton. Many of the speakers dwelt on the importance of indigestion and of high arterial tension in inducing sleeplessness, and Dr. Collier (Oxford) considered that much of the present day insomnia might be referred to over-education, especially in preparing for scholarships, the successful competitors often suffering after the age of nineteen years from nervous failure and insomnia. He thought that the occasional employment of narcotics was of value in breaking a vicious circle before the habit of sleeplessness was established.

In the section of State medicine an important discussion on hospital isolation was introduced by Dr. George Wilson (Warwick), who stated that the deductions he would bring forward were the outcome of thirty-two years' experience. With regard to small-pox isolation, he contended for a special block at the general infectious hospital, and, in his opinion, there was very little risk of the spread of infection. With regard to scarlet fever, he stated that hospital isolation had failed in reducing the incidence and mortality of the disease. He was also sure that it did not cause the presence of the milder form of the infection, and was strongly in favour of separate isolation rather than aggregation in large wards.

Several speakers considered that hospital [illegible] for scarlet fever was a failure, and a resolution was adopted requesting an inquiry by the Local Government Board into the subject.

In the section of industrial hygiene the subject of physical deterioration naturally attracted a good deal of attention, and an important discussion was introduced by Dr. Dawson Williams (London), who, by means of several tables illustrating a series of observations on the height and weight of boys in primary schools, showed that after the eighth year of age the weight of [illegible]tisan classes was very much below the [illegible] being more noticeable in the lowest [illegible] same remarks applied to the height of [illegible] less degree. The first striking statement about physical degeneration was made some years ago by Mr. J. Cantlie, who challenged any person to produce a Londoner of the fourth generation. This challenge had never been answered. Dr. Dawson Williams attributed this physical deterioration to various causes, among which he mentioned—improper feeding in infancy; the fact that among the poorer classes mothers worked hard almost up to the time of their confinement; intemperance in fathers, which was said by French authorities to be more injurious to the children than maternal intemperance; and the practice of large numbers of children in London sitting out of doors until midnight, which involved a great expenditure of nervous energy.

Mr. William Hall (Leeds), in a paper on the influence of environment on physical development, said that fifty years ago the slum mother was much more sober, cleanly, and domestic than she was to-day. She was better nourished herself, always suckled her children, and after weaning them gave them nutritious bone-making food, which she prepared at home. This had all been done away with by our elaborate education system, costing 20,000,000*l*. yearly. Children were now fed on cheap stale food, well seasoned with condiments, which educated them for the love of stimulants in later life and produced also a tendency to scurvy, rickets, and purpura. A little while ago he had examined more than 100 adult skeletons in the crypt of Hythe Church, where they had lain for several centuries. He was struck by the fact that the bones were small but not rickety, the bony palates not much vaulted and the alveolar arches regular, and the teeth that remained were good. It had been said truly that there were hundreds and thousands of our countrymen now living whose skeletons, if preserved, would some day show highly vaulted bony palates, contracted alveolar arches, anterior protrusion of the upper jaws, the remains of unsound teeth, and abundant general signs of rickety bony framework. It was remarkable that Jewish children in the slums were superior to Christian children in physical development, which was due to the fact that the pregnant Jewess was better cared for, that 90 per cent. of the infants were fed on breast-milk, and that during later childhood they were abundantly fed on bone-making material. Eggs and oil, fish, fresh vegetables, and fruit entered largely into their diet. Yet the Jews had not been taught to safeguard their pregnant wives and to nourish their growing children by the instructors in the modern and costly State education which they were told at Oxford was to be at the root of everything.

Prof. R. J. Anderson (Queen's College, Galway) remarked that he thought it would be a most important thing to secure a complete anthropometric survey of the whole of the British Isles. He doubted if improper food was the chief cause of physical deterioration, because, in his opinion, food had of late years greatly improved in quality.

Mr. W. D. Spanton (Leeds) considered that the most prominent causes of physical degeneration were—efforts to rear premature and diseased infants, absurd educational high pressure, cigarette smoking in the younger generation, and late hours at night; in fact, the love of pleasure, and ergophobia in all classes of society. He considered that there was too much cheap philanthropy, that life was made too easy for the young poor, and that by modern educational methods proper parental discipline was rendered almost impossible.

Mrs. F. M. Dickinson Berry (London) said that in her opinion children in London schools were not underfed so much as improperly fed, and that they preferred to eat bread and pickles, dried fish, &c., and had to be forced to eat a proper dinner. She quite endorsed Mr. Hall's remarks about Jewish children.

In the section of pathology, a discussion on the relationship of heredity to disease was opened by the president, Dr. Mott (London), in an interesting and suggestive paper. He exhibited charts of hereditary hæmophilia and ataxy with statistics of longevity, presenility, psychoses, and neuroses bearing on these and other diseases.

Mr. Charles Bond contributed a paper on sex-correlation and disease, with special reference to deaf-mutism. While deaf-mutism occurs almost equally in males and females, in any given family the incidence is almost limited to the members of one sex, and when members of both sexes in one family suffered the births were either twin or contiguous.

Mr. C. Hurst described experiments on the correlation of sex. When black and yellow cats were crossed, all male kittens were yellow, all female kittens tortoiseshell, but in the second generation the colours were uniformly distributed between the two sexes.

In the section of tropical diseases, an important paper on human tick fever in the Congo Free State by Dr. Todd and the late Mr. Everett Dutton was read. The conclusions arrived at were:—(1) that tick fever is clinically identical with relapsing fever, and has for a pathogenic agent a spirillum; (2) the spirillum is probably the *Spirochaete Obermeieri*; (3) a tick, the *Ornithodorus monbata*, can transmit the spirillum from animal to animal; (4) the transmission is probably not simply mechanical, but a developmental cycle is passed in the body of the tick.

In the naval and military section, Fleet-Surgeon Beadnell read an interesting paper on some dynamical and hydrodynamical effects of the modern small-bore bullet, in which he claimed that the so-called "explosive" effects of the modern bullet were due to sudden enlargement of the "impact area" resulting from a modification either in the form or in the motion of the projectile. Many of the "explosive" phenomena were due to eccentricities of flight such as the various "spinning-top" and "pirouetting" motions of the bullet.

An invitation to hold the annual meeting of the British Medical Association next year in Toronto was cordially accepted.

SOLAR AND TERRESTRIAL CHANGES.

IN a recent article we referred to the formation of an International Commission to deal with the important question of the possible action of solar changes on the earth's atmosphere. We stated that a meeting is to be held at Innsbruck in September. We are now enabled to give some details of the meeting at Cambridge last year.

The members assembled in the Old Library of Pembroke College on Thursday, August 18, and letters were read from the following:—Prof. H. H. Hildebrandsson, Prof. H. Mohn, General M. Rykatcheff, Prof. G. Hellmann, Dr. A. Paulsen, Hofrath J. M. Pernter, Prof. S. P. Langley, M. A. Angot, Prof. J. Violle, Prof. J. Hann, Mr. A. S. Steen, Prof. W. Köppen, Prof. A. Riccò, Prof. G. E. Hale, Prof. F. H. Bigelow, Mr. W. G. Davis, Prof. K. Ångström, Mr. A. R. Hinks.

The members present proceeded to the election of a president and secretary, and it was unanimously resolved that Sir Norman Lockyer, director of the Solar Physics Observatory, South Kensington, be elected president, and Sir John Eliot, of Bon Porto, Cavalaire, formerly meteorological reporter to the Government of India, secretary.

It was resolved to add the names of MM. Max Wolf, Scheiner, Julius, and Wolfer to the commission if they should be willing to serve.

At the next meeting the name of Sir Arthur Rücker was added to the commission.

The following question was considered:—

"(1) The selection of (*a*) meteorological, and (*b*) magnetic elements, which should be collated for the purpose of comparison with solar observations, and the form in which the observations might be presented with the greatest advantage for the purposes of comparison. The preparation of a list of meteorological and magnetic observatories which should be asked to contribute observations for the purpose."

It was resolved

(1) That, in the first instance, for the purpose of comparison with solar phenomena, the meteorological observations to be considered should be monthly means of pressure, rainfall and temperature (including maximum temperature and minimum temperature).

(2) That the members of the commission be requested to communicate to the secretary a short report on the data available in their respective countries, and the number of years over which they extend.

(3) That the members of the commission be requested to make suggestions with regard to additional stations from which it is desirable that data should be obtained in view of the comparison of solar and terrestrial data.

(4) That the secretary be requested to consult Dr. Chree as to the stations from which magnetic data are at present available, and to refer to a paper by Prof. von Bezold as to additional magnetic stations from which information is desirable, and to circulate the information among the members of the commission, it being understood that the data appropriate for the purposes of comparison are monthly means of the three magnetic elements for the quiet days and data as to magnetic storms.

A letter from Prof. Hale was laid before the commission.

At the third meeting the questions of the selection of meteorological stations and of the establishment of additional meteorological stations were again considered, and it was resolved that the members of the commission should hand in their list of selected stations to the secretary after the close of the British Association meeting, and that it would be desirable that observations should be obtained from two stations in the Pacific. The stations selected were Tahiti and Numea, to be established by the French Meteorological Bureau.

The name of Mr. A. L. Rotch was added to the commission.

The letter received from Prof. Hale suggesting cooperation of the commission with the committee on solar research of the National Academy of Sciences was read. It was resolved that the commission thank Prof. Hale for his letter, and express their desire to cooperate with the committee on solar research of the National Academy of Sciences on questions of common interest.

Mr. Rotch was requested to communicate this resolution personally to Prof. Hale at the conference at St. Louis.

The question of the selection of solar observations for the comparison of data was taken into consideration.

A scheme prepared by Messrs. Riccò and W. J. S. Lockyer was read and provisionally approved.

(1) *Suggested observations of the sun for direction, intensity, and amplitude of "boiling of the limb."*

Present observations:—

Twenty years' observations made in Palermo and Catania, and (?) many years' observations in Madrid.

(2) *Number, area, and position of spots.* Existing arrangements suffice.

(3) *For visual observations of prominences on limb, it is suggested that America or Japan be invited to contribute.* (Places widely separated in longitude required.)

Monthly values of the percentage frequency of prominences for every 5° of latitude north and south.

(4) *Sun-spot spectra.*

Available observations are taken at the Solar Physics Observatory, South Kensington; Poona in India; Stonyhurst in England; and Kodaikanal in India; and are sufficient for the present.

(5) *Spectroheliograph.*

(1) "Discs" in "K" light { Kensington, Chicago, Kodaikanal, Catania (later).

(2) "Limb" in "K" light ditto.

At the fourth meeting further consideration was given to the question of the solar observations which it is desirable should be collected for the purposes of comparison.

(1) It was resolved, that in connection with the observations of solar radiation, observations of the transparency of the air should be made, more especially

(*a*) on the visibility of distant and high mountains when possible;

(*b*) photometrical observations of Polaris.

(2) It was resolved that a circular be addressed to the various meteorological organisations, asking them to send to the secretary for the purposes of the commission a copy of the publications of their offices embodying the data specified in resolution of August 19, and that the organisations be also requested to obtain and forward copies of similar publications from the colonies and dependencies of their respective countries.

(3) It was resolved that a circular should be sent in the following terms:—The commission desire to direct attention to the concluding paragraphs of Prof. Violle's report to the International Meteorological Committee 1903, and would be greatly obliged if the commission could be informed of the arrangements for observing solar radiation adopted at the observatories of the various meteorological organisations and the methods employed to render the observations comparable with those of other observatories.

(4) Mr. Shaw reported that an apparatus for recording solar radiation was in process of being established, and tested at the Cambridge Observatory, and that Mr. W. E. Wilson, of Daramona, who had presented the apparatus to the observatory, had promised a note upon the apparatus for the information of the commission.

At the fifth meeting the question of the magnetic observations for the purposes of comparison was taken into consideration.

It was resolved in connection therewith:—

That the establishment of magnetical observatories in about lat. 70° N. (*e.g.* Bosskop in Norway) and in very high latitudes of the southern hemisphere is of the highest importance for the advancement of science.

Prof. Riccò informed the commission that it is intended to establish in Italy or Sicily a magnetic observatory with self-recording instruments belonging to the Italian Meteorological Office.

The secretary was directed to ascertain from the members of the commission whether they consider it desirable that a meeting should be held at Innsbruck next year (1905).

It was also resolved that the secretary should report to the International Meteorological Committee the proceedings of the meetings of the commission held here, and ask that the proper steps be taken to bring before the International Association of Academies their suggestions relating to Government action.

Letters from Messrs. Bigelow and Davis were read. It was resolved that Prof. Pernter's letter should be translated and given in the proceedings.

Prof. Riccò informed the meeting that he had been charged by Prof. Rizzo to say that he will willingly undertake to carry out any investigation the commission may be pleased to entrust to him, and it was resolved that Prof. Rizzo should be thanked for his offer, and that a written communication be addressed to him later.

It was agreed that all communications for the commission should be received at a central address, viz. the Solar Physics Observatory, South Kensington.

It was further resolved that

The commission considers it is desirable that the data for the purposes of comparison should be sent to the president of the commission, South Kensington (Solar Physics Observatory), for tabulation and comparison. The commission attaches the greatest importance to this work, more especially as it may lead to a practical system of long-period forecasting, and hopes that if it be necessary, an increase of staff at that observatory may be authorised to bring all old observations up to date.

The commission, after a vote of thanks to the president, adjourned *sine die*.

The commission has circulated in the appendix to its report much valuable correspondence, but we have not space to refer to it.

With regard to the Innsbruck meeting, the following members of the commission are expected to be present:—M. A. Angot, Bureau Central Météorologique, Paris; Prof. H. J. Ångström, University, Upsala; Prof. F. H. Bigelow, Weather Bureau, Washington; Prof. Birkeland, University of Christiania; Rev. P. R. Cirera, S.J., Observatorio del Ebro, Tortosa, Spain; Dr. W. G. Davis, Oficina Meteorologica Argentina, Cordoba, Argentine Republic; M. Deslandres, Observatoire d'Astronomie Physique, Meudon, Seine et Oise; Sir John Eliot (secretary), 54 Prince of Wales Mansions, Prince of Wales Road, Battersea, and Bon Porto, Cavalaire, Var, France; Prof. G. E. Hale, 678 St. John Avenue, Pasadena, California, U.S.A.; Hofrat Prof. J. Hann, XIX Hohe Warte, Vienna; M. Janssen, Observatoire d'Astronomie Physique, Meudon, Seine et Oise; Prof. W. H. Julius, Rijks Universiteit, Utrecht, Holland; Prof. W. Köppen, Deutche Seewarte, Holland; Prof. S. P. Langley, secretary of the Smithsonian Institution, Washington; Sir Norman Lockyer (President), Solar Physics Observatory, South Kensington; Dr. W. J. S. Lockyer, Solar Physics Observatory, South Kensington; Hofrat Prof. J. M. Pernter, Hohe Warte, Vienna, Austria; Prof. Riccò, University de Catania, Sicily, Italy; Prof. G. B. Rizzo, University of Messina, Sicily, Italy; Prof. L. A. Rotch, Blue Hill Meteorological Observatory, Cambridge, Mass.; Sir Arthur Rücker, 19 Gledhow Gardens, S.W.; Prof. J. Scheiner, Königl. Friedrich Wilhelms Universität, Berlin; Dr. W. N. Shaw, Meteorological Office, 63 Victoria Street, Westminster; Prof. A. Steen, Meteorological Institute, Christiania; Prof. J. Violle, Conservatoire des Arts et Métiers, Paris; Prof. C. H. Wind, University of Utrecht, Holland; Prof. A. Woeikoff, St. Petersburg, Russia; Herrn Prof. Max Wolf, Grossherz Ruprecht-Karls Universität, Heidelberg, Germany; Prof. A. Wölfer, Zurich Observatory, Switzerland.

THE TEACHING OF PRACTICAL CHEMISTRY AND PHYSICS.[1]

DR. FISCHER has set himself the almost limitless task of describing and comparing the various methods of science teaching adopted by the principal nations of the world, but he has succeeded in collecting a good deal of useful and accurate information, which he has given in a concise and interesting form.

He deals with the present state of the teaching of physics and chemistry in Germany, Austria, Hungary, Italy, France, Sweden, Norway, Holland, Russia, Finland, Great Britain, Ireland, and the United States of America. In each instance he not only describes the methods of instruction now prevailing, but in a few words indicates the gradual way in which all branches of science are slowly but surely obtaining a recognised place in education.

The chief point dealt with in connection with the teaching of physics and chemistry is the establishment of practical classes for students in the secondary and other schools. In this Great Britain, Ireland, and America are far ahead of the other countries. In Germany, at the present time, comparatively few schools, especially in South Germany, have laboratories where the pupils themselves can carry out experiments in chemistry and physics. Where such practical work has been allowed, it has elicited much interest from the pupils, even when the classes have had

[1] Abhandlungen zur Didaktik und Philosophie der Naturwissenschaft. Heft 3. "Der naturwissenschaftliche Unterricht bei uns und im Auslande." By Dr. Karl T. Fischer. Pp. 72. Price 2 marks. Heft 4. "Wie sind die physikalischen Schülerübungen praktisch zu gestalten?" By Herr Oberlehrer Hahn. Pp. 67. Price 2 marks. (Berlin: Julius Springer, 1905.)

to be held outside the proper school-hours. At the German universities, however, laboratory instruction began relatively early, and now stands on a high level compared with other countries. In Austria, science teaching has been considerably developed, but practical classes have not yet been introduced. In Italy, laboratories for the students at the secondary schools are still unknown, but in France they have been building school laboratories for practical work throughout the country ever since the official regulations of 1902.

In Sweden, the time devoted to natural science is now being increased; scholars can, in most cases, carry out experiments in chemistry, but practical work in physics is almost unknown in the secondary schools belonging to the State. In Norway, there are no secondary school laboratories, although natural science is compulsory. Then again, in Holland, the secondary schools have no practical classes, but the study of physics there is carried further than even in Germany. In Russia, science laboratories are being introduced with considerable success. Until two years ago, physics was the only scientific subject taught in the secondary schools, but since then botany and zoology have been added. The experience gained in Russia in connection with laboratory work has been favourable, in spite of many hampering circumstances. Several recently erected school-buildings have physical departments which have been built regardless of cost; the Physical Institute at St. Petersburg has cost about a million marks, and a still larger one is being built at Moscow.

Dr. Fischer has already shown by his book, "Der naturwissenschaftliche Unterricht in England," that he has an intimate knowledge of English methods of education. His book was the outcome of a visit to this country.

In treating of the teaching of science in the United States of America, reference is made to the alterations in the curriculum of a great number of schools, necessitated by the recent regulation that previous experience in practical physics and chemistry is essential before being admitted to Harvard University and the Lawrence Scientific School.

Finally, various details relating to the universities, technical, medical, and other schools in the countries previously enumerated are given in tabular form; this clearly shows the rapid progress instruction in practical physics has made during the last thirty years. The illustrations include plans and views of laboratories in Munich, Hamburg, Rotterdam, Meppel, Alkmaar, London, &c.

Although space permits of only a very brief reference to some of the principal points dealt with, it is enough to indicate that this pamphlet can hardly fail to interest and to be of use to those who are concerned in the teaching of chemistry and physics.

The pamphlet by Herr H. Hahn, entitled "Wie sind die physikalischen Schülerübungen praktisch zu gestalten?" like that by Dr. Fischer, is one of the separate parts issued, from time to time, by the well known *Zeitschrift für den physikalischen u. chemischen Unterricht*.

Herr Hahn is undoubtedly one of the many teachers of science in Germany who are convinced that the time has now come to introduce the practical teaching of physics into all schools throughout the German Empire. He is endeavouring to attract attention to this subject by describing what has been, and is being, done in other countries, more particularly in England and America. This is probably the best way of refuting the objections of those who oppose this advance.

The first portion is devoted to suggestions as to the best methods of conducting practical physics classes in schools and to the aim of such work. It is pointed out that formerly the object was merely to impart knowledge, but that now it is to show the pupil the way he has to set about to acquire knowledge for himself, to confirm laws which are known to him, and also to discover those of which he is as yet unaware. Much rational advice is given regarding the management of practical classes; special stress is laid upon the advisability of avoiding the use of unnecessarily elaborate and expensive apparatus, and of attempting, when possible, to go back to the simple and ingenious means by which a law was first discovered by one of the great men of science. The author advocates students working singly, and argues that, as all boys, as a rule, work at about the same speed, it is possible to put the whole class at the same experiment; usually one finds, however, it is only the most elementary apparatus that can be stocked on so extensive a scale.

Various other questions are gone into, such as the writing-up of note-books in the laboratory, the supplementing of laboratory work by demonstrations, the training of teachers, &c. From the numerous extracts and foot-notes, one observes that Prof. Hahn has made a most careful and thorough digest of all the existing English and American literature bearing on this branch of science teaching.

The second part deals with laboratories and their fittings, and is illustrated with a number of drawings of fittings, small but clearly executed. These, apparently, are all taken from other books; in fact, about half of them have been reproduced from an English work—Russell's "Planning of Chemical and Physical Laboratories." After some introductory remarks on the size and arrangement of suitable rooms, a description is given of each of the fittings separately, beginning with the simple work-bench for physical laboratories in schools. The ideal is considered to be a bench made to accommodate one worker only, or two in cases of necessity, but it is pointed out that this is too extravagant of floor-space and money to be really practicable. Details of the arrangement, construction, and material of the work-benches are briefly discussed. All the other fittings usually provided are described, and some useful information is given concerning the actual room itself, schemes for heating and ventilating, the supply-pipes, &c.

Again, one notices that a diligent search has been made for English, American, and German books and papers dealing with the fitting-up of laboratories; from these much information and data have been extracted and compared. The search, however, has as usual been most unproductive; one finds in the list of literature merely some five English books and magazine articles, together with two American and three German ones.

Although only a general survey has been attempted of the arrangement and equipment of school laboratories, it would probably be difficult to find a more complete abstract on this subject, and the pamphlet contains much information which will prove useful to those who are fitting-up laboratories.

STANDARDISATION IN PHARMACY.[1]

THE principle of standardisation and its embodiment in daily practice marks the most important advance which pharmacy has witnessed within recent years. Standardisation as applied to a crude drug or a preparation is understood to imply that by a method of appropriate treatment ascertained by direct experiment it has been made to conform to a predetermined standard. The required standard may have a physical, chemical, or physiological basis, and may have reference either to one or more definite principles or to a mixture of indefinable substances. The object of standardisation is to secure uniformity of product, more especially in respect of medicinal activity. It is not necessary to hark back more than a generation to see the ever-lengthening strides which pharmacy has taken in the direction of plant analysis and the isolation of definite principles. To this fact the text-books on materia medica and lectures of twenty-five years ago bear indisputable testimony. Then the maximum of knowledge of the constituents of many of even the best known and most potent drugs was summed up in the statement that they contained a crystalline principle, generally an alkaloid, and a few remotely proximate and chemically unclassified substances. Before standardisation could be brought within the range of pharmaceutical possibility it was necessary to make a more thorough systematic and accurate investigation of crude drugs, with a view of obtaining precise information as to the nature of their constituents.

To this task the younger generation of workers in the field of pharmaceutical research have mainly directed their efforts. Latterly they have occupied themselves more

[1] Abridged from the Presidential Address delivered by Mr. W. A. H. Naylor before the British Pharmaceutical Conference at Brighton on July 25.

especially in seeking to devise trustworthy processes for the assay of crude drugs and their preparations, and to the extent to which they have succeeded they have contributed in their measure to the benefits conferred on suffering humanity by the healing art.

A few pointed observations reflecting my personal opinion on certain aspects of the question of standardisation may not, I trust, be considered inappropriate with which to conclude my address. In my estimation the aim should be to produce preparations that will represent the sum total of therapeutic activity of the drugs operated on except in cases where it is desired to obtain the medicinal effects of certain definite principles the physiological action of which is indisputable. As an illustration a preparation of opium may be cited where the presence of narcotine may be considered objectionable. Further, in respect of a given preparation it must be required of the pharmacist to devise suitable processes not only for the estimation of the chief medicinal constituent, but as far as possible the several medicinal constituents and the proportion in which they are present. I would go even further, and say that in the near future it may be necessary to determine certain principles hitherto disregarded, which modify the therapeutic activity of the drug. The pharmacologist may be depended on to point the way, and despite the heavy tax this call for fuller investigation will put upon the resources of the pharmacist, I am encouraged to believe he will prove equal to the demand. Without reflecting on modern methods of standardisation, which undoubtedly have met with general acceptance, I cannot suppress the conviction that their tendency is not free from a suspicion of narrowness. The besetting temptation consists in a disposition to restrict the medicinal properties of a drug to a potent principle, the therapeutics of which are universally recognised by clinicians, and acting on this assumption to proceed to produce a preparation and to standardise it on the basis of the particular principle and with little or no regard to other constituents that may directly or indirectly be of value. For instance, according to present-day knowledge, the chief active principle of the three drugs belladonna, scopola, and henbane is hyoscyamine. If a tincture of each be prepared so as to contain the same percentage of alkaloid or alkaloidal content, will it be seriously contended that therapeutically considered the three are interchangeable, and therefore it is a matter of indifference which of them is selected for use? If the physician finds it a distinct advantage to administer the belladonna tincture in one case and the henbane tincture in another, surely it is because he is satisfied that the two preparations do not produce identical results. May this not be taken as *primâ facie* evidence that there are in the tinctures constituents present, other than hyoscyamine or alkaloidal content, which claim to be reckoned with?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—The senate has accepted the offer made by the Secretary of State for the Colonies of the sum of 700*l.* a year for five years for the purpose of instituting a chair of protozoology. Of this sum, 200*l.* a year is a contribution from the Rhodes trustees, and 500*l.* a year represents a moiety of a grant originally made from the tropical diseases research fund to the Royal Society for the promotion of research work, and by the Royal Society surrendered for the purpose of endowing the chair. It was decided to devote the whole amount as salary of the professor, and to set aside a further sum of 200*l.* a year to defray the cost of assistants and laboratory expenses in connection with the chair.

Mr. Edgar Schuster, the Francis Galton research Fellow in national eugenics, has presented a report containing a preliminary account of inquiries which have been made into the inheritance of disease, and especially of feeble-mindedness, deaf-mutism, and phthisis.

Of the five commissioners under the Bill promoted by the university and University College for the determination of the conditions under which the college will be incorporated in the university, which measure received the Royal assent on July 11, Lord Justice Cozens-Hardy and Sir Edward Busk were nominated by the university, and Sir John Rotton and Prof. J. Rose Bradford by the college. The remaining commissioner is to be appointed by His Majesty in Council, and will act as chairman. Sir Edward Fry, late Lord Justice of Appeal, has consented to allow his name to be submitted to His Majesty in Council for this post, and it is expected that the Order in Council announcing his appointment will shortly be published.

Under the will of the late Dr. Nathaniel Rogers, a prize of 100*l.* is offered for an essay on "The Physiology and Pathology of the Pancreas." Essays, preferably type-written or printed, must be sent to the secretary of the senate by, at latest, May 1, 1907.

THE services rendered to science by the late Dr. T. M. Drown, president of Lehigh University, are to be fittingly recognised, subscriptions having been invited for the purpose of erecting at the university a building to be called Drown Memorial Hall in his honour.

PROF. W. A. TILDEN, F.R.S., has been appointed dean of the Royal College of Science, South Kensington, in succession to Prof. J. W. Judd, C.B., F.R.S., who retired from the position on July 31.

MR. H. J. HUTCHENS has been appointed demonstrator of bacteriology in the University of Durham. He will continue his work for the Royal Commission on Tuberculosis.

THE subject of the health essay (Durham University) for 1908 is "Injuries and Diseases of the Arteries, Veins and Capillaries, and their Treatment." Essays must be typewritten or printed, and reach the professor of surgery not later than March 31 of the year for which it is to be awarded.

A REPORT on the work of University College, London, for the session 1904–5, was read by Prof. Cormack, dean of the faculty of science, at the assembly of the faculties of arts and laws and of science on July 5. The report records that the Bill for the incorporation of the college in the University of London has passed the House of Lords, and has also passed its first and second readings, as well as the committee stage, in the House of Commons. It is therefore expected that the Bill will receive the Royal assent before the end of the present Parliamentary session. In that case the commissioners, appointed under the Bill to carry out the incorporation of the college in the university, will begin their meetings after the long vacation, and it ought to be possible to complete the actual incorporation by September, 1906. Of the sum of 200,000*l.* required for this purpose, all but 17,000*l.* has been obtained. In the department of applied mathematics the most important event of the session was the generous grant by the Worshipful Company of Drapers of 400*l.* yearly for five years to continue the biometric and research work of the department. This grant has put on a more permanent footing the work already instituted by the same company two years ago. Six memoirs have been specially published as a Drapers' Research Series, and a number of others are in preparation. The work for these has been rendered possible almost entirely by the financial aid provided by this gift. The number of research papers emanating from this department is eighteen, and among them may be noted a paper on "Some Disregarded Points in the Stability of Masonry Dams," which directs attention to a number of complicated and highly important technical questions, and is a valuable contribution both to theory and practice. The research work done in the Pender laboratory during the session has included such practically important matters as:—additional improvements in means for the photometric measurement of the value of incandescent electric lamps; a long research on the magnetic qualities of alloys, not containing iron, which promises to be of great technical importance; and the invention of instruments called cymometers, which are, in effect, electrical spectroscopes, and enable the frequency of the oscillations in any electric circuit to be measured with great accuracy. Several important contributions to science have come from the department of chemistry; and the list of publications by investigators in this and other departments shows that the activity of the college in producing original work is being maintained.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 24.—M. Troost in the chair.—On the total eclipse of August 30: M. **Janssen.** Observations will be taken at Alcocebre, near Valencia, in Spain.—On a simple case from which can be easily calculated the mutual action of consecutive rings constituting a tube, and on the influence of this mutual action on the propagation of liquid waves in this tube: J. **Boussinesq.**—On the nature of the hydrocyanic glucoside of the black elder: L. **Guignard** and J. **Houdas.** The bruised leaves were macerated with water for twenty-four hours at a temperature of 25° C.; the liquid gave a distillate from which semicarbazide separated a crystalline precipitate, identical with benzaldehyde semicarbazide. This result, together with the formation of hydrocyanic acid, shows that the elder leaf contains amygdalin.—The catalytic decomposition of monochlor-derivatives of methane hydrocarbons in contact with anhydrous metallic chlorides: Paul **Sabatier** and A. **Mailhe.** The chlorides of nickel, cobalt, iron, cadmium, lead, and barium, at a temperature of about 300° C., readily decompose the fatty alkyl chlorides, giving hydrochloric acid and the corresponding ethylene. The reaction does not take place with methyl chloride, but ethyl, propyl, isobutyl, and isoamyl chlorides readily decompose under these conditions, barium chloride being the most convenient catalytic agent.—The convergence of rational fractions: H. **Padé.**—Experimental researches on the effect of membranes in liquid chains: M. **Chanoz.** The effect of the membrane on the observed electromotive force may be provisionally explained by the formation at the expense of the electrolyte of a double electric layer in contact with the membrane.—The hysteresis of magnetisation of pyrrhotine: Pierre **Weiss.**—On a dihedral stereoscope of large field, with bisecting mirror: Léon **Pigeon.**—On fluorescence: C. **Camichel.** An experimental proof that the coefficient of absorption of a fluorescent body does not vary at the moment of fluorescence, and that the intensity of the light emitted by the fluorescence is proportional to the intensity of the exciting light.—The influence of water vapour on the reduction of carbon dioxide by carbon: O. **Boudouard.** The reduction of carbon dioxide by carbon at temperatures between 650° C. and 1000° C. is practically unaffected by the presence of water vapour, the state of equilibrium being nearly identical whether the gases are dry or moist.—On an extension to oxide of zinc of a method of reproduction of silicates of potassium and other bases: A. **Duboin.**—On a sub-iodide of phosphorus and the part played by this body in the allotropic transformation of phosphorus: R. **Boulouch.** The sub-iodide is produced by the action of sunlight on a solution of iodine and phosphorus in carbon disulphide; it is formed as a precipitate, being insoluble in carbon disulphide, and has the composition P_4I. It is decomposed by dilute potash solution, losing its iodine and apparently forming P_4OH.—On a potassium iridiochloronitrite: L. **Quennessen.**—The action of sodium sulphite upon ethanal: MM. **Seyewetz** and **Bardin.** Under certain conditions, details of which are given, crotonic aldehyde is formed in this reaction, the yield (40 per cent.) being sufficiently good to make this a preparative method.—On sparteine: the hydrates of methyl-, dimethyl-, and trimethylsparteine: Charles **Moureu** and Amand **Valeur.**—On gentiine: Georges **Tanret.** Gentiine is the glucoside accompanying gentiopicrin. Hydrolysed with dilute sulphuric acid, gentienine, glucose, and xylose are formed. It is noteworthy that this is the first known glucoside which gives xylose amongst its products of hydrolysis.—The chemical equilibrium of the system: ammonia gas, isoamylamine chlorhydrate: Félix **Bidet.** Pressures are given both for the direct and inverse reaction at −23°, −9°, −5°, 0°, and 16°, the concordance between the two sets of observations being quite satisfactory.—On the regeneration of the bruised radicle: P. **Ledoux.** There is no regeneration of the parts cut, and in the case of the lateral roots there are other anatomical differences.—On the shrimps of the genus Caricyphus arising from the collections of the Prince of Monaco: H. **Coutière.**—On the growth in weight of the chicken: Mlle. M. **Stefanowska.** Curves of growth are given for both sexes; there is a point of inflection in the curves for the male when it has attained 77 per cent. of its maximum value, and for the female at 21 per cent. The results of the observations are expressed empirically in two hyperbolas.—Experiments on the mechanical washing of the blood: Ch. **Répin.**—Intra-organic combustions measured by the respiratory exchanges as affected by residence at an altitude of 4350 metres: G. **Kuss.** These observations were carried out on several subjects at the summit of Mt. Blanc. There were seven persons under experiment; they stayed at the observatory on the summit from four to ten days, their respiratory coefficients being determined several times daily. Both before and after their stay on Mt. Blanc observations were made at Chamonix (1065 metres) and at Angicourt (100 metres). The conclusions drawn from the whole of the experiments are that the respiratory exchanges are not sensibly modified by a prolonged stay at great altitudes, and a slight attack of mountain sickness is also without influence on the results.—On the presence of poison in the eggs of bees: C. **Phisalix.** The eggs of bees contain a small amount of poison of the same nature as that present in the adult bee. Each egg contains about 0·001 mgr. of the venom, and as each egg weighs about 0·15 mgr. it follows that the toxic substances present amount to about 1/150th part of its weight.—On the production of mechanical work by the adductor muscles of the Acephalæ: F. **Marceau.**—On the structure of the muscles of the mantle of cephalopods with respect to their mode of contraction: F. **Marceau.**—The germination and growth of the artificial cell: Stéphane **Leduc.**—The study of the diaphragm by means of orthodiascopy: H. **Guilleminot.**—The general movements of the atmosphere in winter: Paul **Garrigou-Lagrange.**

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