Nature

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" *To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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Reviews and Our Bookshelf.

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A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

THURSDAY, NOVEMBER 3, 1910.

THEORETICAL MECHANICS.

Cours de Mécanique Rationelle et Experimentale, spécialement écrit pour les physiciens et les ingénieurs, conforme au programme du certificat de mécanique rationelle. By Prof. H. Bouasse. Pp. 692. (Paris: Ch. Delagrave, n.d.) Price 20 francs.

A NOTICEABLE feature of this treatise on theoretical mechanics is the large number of practical examples discussed. The majority of these are of a physical rather than an engineering character, some of them dealing with physical apparatus. Investigations of oscillations under various conditions occupy a considerable part of the book. The author claims mechanics as a branch of physics, the first chapter of physics, and aims at supplying a treatise of the kind which is likely to be useful to those whose interest in the subject depends on its applications to practical physical questions. He protests against the unpractical character of the French treatises on the subject written by mathematicians, and of the questions asked in examinations.

To a considerable extent the book fulfils its aim. It contains a great deal of information (including some useful fragments of mathematics connected only incidentally with mechanics), and it is for the most part written in a pleasant, lucid style, slightly marred by occasional eccentricities. As much of the theory is included as is generally needed for practical use, no attempt being made to restrict the use of mathematical methods. There are, however, some slips. An important one, which should puzzle a reader unacquainted with the subject, occurs in the investigation of Euler's equations. Occasionally also the methods adopted are clumsy or unduly ponderous.

A case of ponderous treatment of theory occurs in so simple a matter as the investigation of the composition of angular velocities. The author hints at reasons, not fully explained, which appear to him to make it desirable, "in order to avoid all difficulty," to derive the composition of angular velocities from the study of a succession of finite angular displacements. He goes on to discuss the theory of this at considerable length, a rather tiresome procedure.

Now the meaning of the composition of simultaneous motions is not a very easy thing to understand, and ought to be a matter for clear definition. Without a definition, expressed or implied, it is unintelligible. Prof. Bouasse does not give a definition of it, but he implies that the resultant motion is to be calculated from the limiting case of successive displacements when these are small. Such a method of treatment is not uncommon, but surely the method afforded by the consideration of relative motions taking place simultaneously is preferable. In the case of angular velocities, the mounting of a body in gimbals provides the mechanism which is needed for a clear conception of the composition, the angular velocity of the body being the resultant of its angular velocity relative to an intermediate base and the angular velocity of this base relative to the final one. The difference between the two methods of treatment is not solely one of style. The resultant is given by either method, and an experienced reader would pay no attention to any other feature of the arrangement adopted. But inexperienced readers, for whom the more elementary parts of a book like this must be intended, might reasonably be puzzled by perceiving that successive displacements do not give results identical in all respects with what is proposed. The path of a point of the moving body remains a zigzag up to the limit, and if the length of this path were the thing to be calculated the method of successive displacements would not give a correct result. If the limit of successive displacements is to be regarded as the definition of the composition, it ought to be a correct method for calculating everything about the motion.

It might be expected that a professor of physics, who regards mechanics as a branch of his subject, would give some attention in detail to the physical laws which form the basis of his calculations. Our author, however, frankly ridicules the idea of questioning the truth of them, and does not even take the trouble to state them correctly. He professes to deal with the subject from the beginning, but any reader who had no previous knowledge of it would be bewildered. No pure mathematician could be more careless as to what the equations which he desires to write down are based upon, or show less interest in the question whether the results to which they lead are verified. Moreover, he does not explicitly refer to the base, relative to which the motions studied are reckoned, according to the theory which he is using, or appear to take any interest in the remarkable fact that the observed motions of bodies define such a base, which presumably has some relation to other physical phenomena. The only occasion on which he attempts to deal with the foundations of the subject is in connection with the law of action and reaction in statics, the treatment of which is clumsy and unconvincing, perhaps even unintelligible.

As in the case of the rest of physics, there are two ways of looking at mechanics, each of which has its own proper place. One is to regard all parts of the subject as coordinated by means of a generalisation which is as comprehensive as possible. The other is to aim rather at isolating the points involved in the subject, so that any degree of independence which they possess may be recognised, and so that it may as much as possible be seen how far the most precisely ascertained results carry us, and whether a doubt cast on any particular doctrine affects the whole foundation of the subject or not. Though the attainment of the former is the constant aim of scientific study, the latter is the proper attitude in which to approach it, and it seems to be a mistake to write the first chapter of physics in a different spirit. W. H. M.

CANNIZZARO'S COURSE OF CHEMICAL PHILOSOPHY.

Sketch of a Course of Chemical Philosophy. By Stanislao Cannizzaro (1858). Alembic Club reprints, No. 18. Pp. iv+55. (Edinburgh: The Alembic Club, 1910.)

THE Alembic Club have done well at this juncture to publish a translation of Cannizzaro's famous letter to De Luca—a letter which, to use Davy's phrase in connection with an equally memorable pronouncement, acted like an alarm-bell on Europe. Indeed, now that he has joined the majority, no more fitting monument to the perspicacity and genius of the great Italian chemist could be conceived than the publication, in the form of an admirably executed translation, of that statement of doctrine which astonished and ultimately convinced the chemical world of the mid-Victorian epoch.

To the chemists of the present age it is hardly possible to convey an idea of the profound sensation which this letter created. The effect was immediate and irresistible. At that time the name of Cannizzaro was hardly known beyond a limited circle of French and Italian men of science. With the appearance of the message came the conviction that a Daniel had come to judgment—that a prophet and a law-giver had arisen amongst us. The middle period of the last century was a time of political ferment and social unrest, and here and there it culminated in revolution. It was equally a period of disturbance and upset in other spheres of human activity than politics and sociology. In chemistry, more perhaps than in the case of any other science at that time, the old order was changing, but the process was destructive rather than constructive. Old faiths were being undermined and thrown down, but the new dogmas had not stability enough to supplant them.

Cannizzaro's letter appeared at what, in the cant-phrase, is termed the psychological moment. It brought order, method, and arrangement into what hitherto had been a mass of inconsistency and contradiction. Its logic was so clear, its appeal to history and to well-ascertained fact so irrefutable, its statement of proof so admirably marshalled, that criticism was silenced, and the doubter disarmed. Before a decade had passed its principles were everywhere accepted, and it is not too much to say that Cannizzaro effected a revolution in chemical thought as momentous in its way as the revolution he was subsequently concerned in bringing about in the political development of Italy.

To the student of chemistry it would be superfluous to enter into an analysis of Cannizzaro's letter, as its principles are now intimately woven into the web of modern chemical doctrine. Indeed, so indissolubly associated is the fundamental basis of Cannizzaro's chemical philosophy with the chemical philosophy of to-day that the statement of these principles, or of the course of argument upon which they are based, would have the semblance of a platitude. But we can assure the student that, however familiar he may be with the outcome of the doctrine with which the name of Cannizzaro will be imperishably connected, he will read with admiration and delight the *pronunciamento* in which the Genoese chemist makes known to his friend and colleague, and through him to the world, the dogma of what was henceforth to be the new chemistry—with admiration for the extraordinary perspicacity and conviction of its argument, and with delight at the simplicity and force of its statement.

T.

PRUNING OF FRUIT TREES.

Fruit Tree Pruning. A Practical Text-book for Fruit-growers working under the Climatic and Economic Conditions prevailing in Temperate Australia. By George Quinn. Pp. vi+230. (Adelaide, Australia: R. E. E. Rogers, Acting Government Printer, 1910.) Price 1s. 3*d*.

THE pruning of fruit trees is an operation that demands, on the part of the operator, first, an intimate knowledge of the natural habits of the particular trees, and, in the second place, considerable experience of the general results which follow a proper system of pruning. Unfortunately, every gardener and amateur who cultivates ever so few trees gets the conviction that, come what will, he must prune, and, if he is ignorant of the methods, nevertheless he mutilates the branches and imagines that his trees will respond satisfactorily to the treatment given them. In these circumstances it is not to be wondered at if the value of pruning in any form or degree has come to be questioned by certain fruit-growers and experimentalists, who have had very little diffi-better to expose all parts of the tree to the sun and of diminishing the crop.

It still remains incontrovertible, however, that young trees are benefited by a moderate degree of pruning if this is carried out by intelligent operators possessing the knowledge and experience necessary for the task. Such pruning is necessary for forming a proper foundation for the tree, for the removal of cross-branches, and the thinning out of the centre in order to better expose all parts of the tree to the sun and air.

This volume, prepared by the horticultural instructor for the Department of Agriculture, South Australia, under the direction of the Hon. Minister of Agriculture, is issued for the purpose of teaching the technique of pruning to fruit-growers having to work under the climatic and economic conditions prevailing in temperate Australia. The author's qualifications for teaching are clearly shown in his sensible and pertinent remarks upon the facts on which the theory of pruning is based, and his description of the objects the pruner seeks to obtain. Having instructed the reader in these matters, he describes the opposite effects of winter and summer pruning, the parts of a tree, and their different values; also the forms of tree to be encouraged, and the best means of developing fruit-bearing wood in place of foliaceous but barren branches. He next passes to a description of the specific treatment of different kinds of fruit, including apricot, plum, cherry, almond, peach, apple, pear, quince, fig, orange, lemon, and loquat.

There are 200 illustrations from photographs, most of these being valuable as a means of explaining the text, but others are inferior, and their omission would not have detracted from the appearance of the volume.

UNCONSCIOUS MEMORY.

Unconscious Memory. By Samuel Butler. New edition. With an Introduction by Prof. Marcus Hartog. Pp. xxxvii+186. (London: A. C. Fifield, Clifford's Inn, E.C., 1910.) Price 5*s.* net.

IT is probable that Butler will live in history as the writer of "Erewhon," but his more serious works, dealing with what may be called the philosophical side of biology, are still worth reading, and Mr. Fifield's re-issue will be welcomed by many. The volume under review consists partly of rather personal polemic against Darwin, and partly of a further development of Butler's views as expressed in his "Life and Habit." These views may be summarised as follows.

It is a fact of hourly observation that practice makes things easy which once were difficult (*e.g.*, the playing of a sonata), and even results in their being done without consciousness of effort. It follows that the fact of an intricate action being done unconsciously is an argument for the supposition that it must have been done repeatedly already. Now take the case of a newly-hatched chicken, which pecks at once and perfectly. How is this? It is because something in the chicken remembers having pecked before, and consequently knows how to do it. An individual is not a new being; it—or part of it—has existed in the bodies of its parents. Thus heredity is memory. Cells remember what they have done before, and know how to do it again.

This, followed to its conclusion, involves the attribution of some kind of intelligence even to atoms. Indeed, we can hardly avoid it. Atoms have their likes and dislikes. Carbon and oxygen are sociable, fluorine is reserved and stand-offish. "The distinction between inorganic and organic is arbitrary." (This view is closely akin to that of Haeckel.) All action is purposive and intelligent. When an organism develops a new quality, it is because the organism has felt the need of it. Evolution is therefore teleological from within; differentiation of species, and variations of all kinds, are not entirely due (or as much as Charles Darwin supposed) to natural selection. Here Butler follows Buffon, Lamarck, and Erasmus Darwin.

Mr. G. Bernard Shaw has said that Butler was, in his department, the greatest English writer of the latter half of the nineteenth century; and, though he was only a *dilettante,* it is surprising how illuminating and suggestive his ideas seem, even now, thirty or forty years after first publication. It is noteworthy that Dr. Francis Darwin quoted him with special approbation in his presidential address before the British Association in 1908.

Prof. Marcus Hartog furnishes a useful introduction, discussing Butler's whole work and his place in the history of science.

The first edition of "Unconscious Memory" was reviewed in NATURE, January 27, 1881.

THE MAMMALS OF EUROPE.

Faune des Mammifères d'Europe. By Prof E.-L. Trouessart. Pp. xvii+266. (Berlin: R. Friedländer and Sohn, 1910.) Price 12 marks.

IN issuing an up-to-date descriptive catalogue of the mammals of Europe Prof. Trouessart has conferred a real and lasting benefit on zoological science, since, owing to the great increase of species and races du· to modern methods of discrimination, the well-known work of Blasius has long been practically useless. Indeed, if the two works be compared, it might at first sight be difficult to believe that they treat of the same subject, so great has been the increase in the last few years in the number of recognisably distinct forms, and so extensive the changes in nomenclature. Nowadays views differ—and will probably continue to differ—as to the limitations of species and races; but Dr. Trouessart appears inclined in most cases to use the former term in the most restricted sense, Justifying himself in doubtful instances by the dictum of Desmarest that "il est plus misable de trop réunir que de trop diviser," he might, if we remember rightly, have supported an opposite view by a statement of Huxley to the effect that it is more important to recognise resemblances than to overlook differences; and in the excessive multiplication of genera and species (as distinct from division into races) there is undoubtedly a great danger of losing sight of mutual affinities.

As instances of this multiplication, reference may be made to the specific separation of the Irish from the Scotch hare, of the Scotch from the English wild cat, and of the British from the Continental water-rats. On the other hand, the British squirrel is regarded merely as a local race of the Continental species, a classification difficult to reconcile with that adopted in the case of the species just mentioned. Whatever may be individual views on such matters, we venture to think that most naturalists will agree in objecting to the principle of introducing the names of one or more species between those of the typical form and the races of another, as is done in the case of the wild cats. In regard to generic grouping, it may be mentioned that, in the case of mice, the long-tailed species appears as *Mus sylvaticus*, and the harvest-mouse as *Apodemus minutus*, whereas the latter (if generic splitting be adopted), should be *Micromys minutus*, and the former *Apodemus sylvaticus*. The weasels, again, are included in the same genus as the polecats, from which they are sundered by many modern naturalists. As regards the distribution of the European fauna, the author recognises four distinct areas, viz., Central European, Arctic, Eastern or Steppe, and African or Mediterranean.

While congratulating Dr. Trouessart on the completion of a laborious task, we may take the opportunity of mentioning that his work strongly emphasises and confirms a reply the present writer was compelled to make some months ago to Dr. A. R. Wallace, namely, that to give, even approximately, the number of species of mammals inhabiting the various zoological provinces is, under present conditions, an absolute impossibility. It is very largely a case of "go as you please." R. L.

THE SCIENCE OF PATHOLOGY.

The Principles of Pathology. By Prof. J. G. Adami, F.R.S., and Prof. A. G. Nicholls, F.R.S. (Can.). Vol. II., Systemic Pathology. Pp. xvi+1082. London: Henry Frowde and Hodder and Stoughton, 1910.) Price 30*s*. net.

THIS second volume of Prof. Adami's great work on the science of pathology deals with systemic pathology—the pathology of the individual tissues and organs of the body, or special pathology, as it is often termed—and has been written in conjunction with his colleague, Prof. Nicholls. In the preface the authors offer an (unneeded) apology for the bulkiness of the first volume on general pathology (reviewed in NATURE of November 25, 1909, vol. lxxxii., p. 94), and the relative brevity of this second volume, for many would consider that special pathology requires at least double the space devoted to general pathology. They point out, however, that, provided the student has acquired a good grasp of general pathology, he has but to apply those principles in order to become possessed of a sound basis of special pathology, a proposition with which we are in complete agreement.

But for the inclusion, therefore, of the pathology of the blood and cardio-vascular system, and also of the disorders of function as well as of structure of the various organs, even the present volume might have been curtailed in length. At the same time, we think that this attempt at brevity has in some cases been carried too far, and although the subjects may have been dealt with at length in the first volume on general pathology, some repetition would not have been out of place. As instances, we may mention the bare reference to diabetes in the section dealing with the pancreas, and the omission of blackwater fever as a disease in which hæmoglobinuria occurs. Otherwise, we confess we have found little to criticise, and the work gives a very full and accurate account of the subject.

Each organ is dealt with on a systematic plan; first a brief summary of its developmental history, anatomical structure and physiological functions, followed by a description of the congenital and acquired abnormalities, circulatory disturbances, inflammations and parasitic infections, and retrogressive and progressive metamorphoses to which it may be subject. In the division devoted to the blood and cardio-vascular system, the sections dealing with leukæmia seem somewhat brief in view of the importance of the subject, and no mention is made of cases of the lymphatic variety in which the total number of leucocytes is not markedly increased, but in which nearly all the leucocytes present are lymphocytes. In the section dealing with pernicious anæmia also no mention is made of the almost invariable leucopenia present, a point of considerable diagnostic importance in the numerous cases in which the blood picture is not typical. In discussing the origin of œdema, the authors hold that the facts demand the assumption (with Heidenhain) that the lymphatic and capillary endothelium is endowed with a certain grade of selective secretory activity.

In the section dealing with the diseases of the nose it is surely not expedient to refer to the common polypus as a "polyp," a term which now has a more or less definite zoological signification.

We congratulate the authors heartily on the completion of their labours; the work is not a mere compilation, but is the outcome of a ripe personal knowledge of the subject. Divergent views are stated fairly, and if the authors' views do not always agree with those current, the reasons are given, and they merit careful consideration.

The book is profusely illustrated with plates and figures (some coloured), drawn or photographed directly from patients, specimens, and sections, which are admirably reproduced. We think it a mistake, however, not to have given the magnification of the photomicrographs; simply to state, as is done, the lenses with which the photographs were taken does not sufficiently indicate the magnification of the object depicted.

OUR BOOK SHELF.

Household Foes. A Book for Boys and Girls. By Alice Ravenhill. Pp. xxiii+359. (London: Sidgwick and Jackson, Ltd., 1910.) Price 2s. 6d.

MISS RAVENHILL has written this small work with the object of arousing the interests of boys and girls in the practice of daily domestic cleanliness, and at the same time of furnishing them with reasons for this practice. She also aims at indicating the links which should be made to connect school lessons with home habits, and prominence is given to the value of good habits and to the necessity for their constant daily practice. She directs attention to the broad educational value of the subject of "hygiene," in exercising observation and reason, and in cultivating the habit of tracing effects to their causes. The text of most of the chapters is "dirt"—the dirt of home surroundings, of air, water, and food; and at the end of each chapter references are given to works in which the subject-matter may be further studied and developed, more especially on the practical and experimental side. Young people are slow to learn that there are no rights apart from responsibilities, which in this connection include duties to self, to home, to community, to empire, and to race; it is well, therefore, that Miss Ravenhill devotes her two concluding chapters to "the citizen's power to control dirt, decay, and disease," and "imperial safeguards against dirt and disease."

Hygiene has gradually found a footing in the elementary school code; but one cannot hope, for some years to come, to get the best results of this teaching and training, for the reason that school teachers as a body do not possess the necessary knowledge to enable them to present the subject with judgment and discrimination. This small work well serves as a very useful guide to them, and to this end it is perhaps the best statement hitherto published, for the essential facts are dealt with in an appropriate and impressive manner, and the book contains little (if anything) which is unsuitable or unnecessary, while the authoress tells practically all that it is necessary to tell. A child with the elementary knowledge of hygiene which Miss Ravenhill seeks to convey, and trained to act in accordance with its precepts, should be well equipped from the standpoint of hygiene. The book may be confidently recommended to all those parents and teachers who are concerned with the education of the young.

History of Chemistry. By Sir Edward Thorpe, C.B., F.R.S. Vol. i., From the Earliest Times to the Middle of the Nineteenth Century. Pp. viii+148. Vol. ii., From 1850 to 1910. Pp. viii+152. (Issued for the Rationalist Press Association, Ltd.) (London: Watts and Co., 1909 and 1910.) Price 1s. net each volume.

SIR EDWARD THORPE, who has enriched chemical literature with so many valuable biographical contributions, has added greatly to our indebtedness by the publication of these two small volumes of chemical history. In method and style they follow the eminently readable work of Thomas Thomson, which has been so long out of print, and in many respects out of date, and the modern student is now supplied with a brief history of chemistry, which is well within his intellectual and material means, and cannot fail to add greatly to the interest of his studies. The divorce of historical and other human interest from the study of science, resulting from our examination system, is greatly to be deplored. It gives good ground for the allegations of aridity so often made against scientific teaching and scientific text-books, and it deprives the student of much that would aid him in the comprehension of modern chemical theory. It is to be hoped that these volumes will have a very wide circulation, and that students may be encouraged to proceed to study some of the works which are indicated in the appended bibliographies.

The first volume, beginning with the chemistry of the ancients, brings the reader to the early part of the nineteenth century, whilst the second volume follows the subject to the present day. This last volume is naturally highly compressed, but, like the first, it bears the imprint of a master-hand in the exact and readable presentation of chemical history. A series of admirable portraits is inserted throughout the work.

A. S.

A Course of Elementary Science, Practical and Descriptive. By John Thornton. Pp. vi+216. (London: Longmans and Co., 1910.) Price 2s.

THIS book, which contains chapters on measurement, mechanics, and heat, is intended by the author for junior pupils who are attending class and laboratory instruction. As the title implies, it is partly descriptive and partly practical in character. After perusing the book one is led to the conclusion that the author has not a very wide acquaintance with physics or much experience of up-to-date laboratory methods. The book has the characteristic of those many manuals on this subject which appeared so hurriedly ten or twelve years ago. The language is often loose, *e.g.* p. 13, Expt. 1, "Draw a large circle on a sheet of cardboard and divide it into degrees." On p. 29 the author states that results need not be carried beyond the second decimal place as a rule. In determining quantities in the laboratory where the final result is obtained by arithmetical operations on quantities actually measured, it is the degree of accuracy with which these several quantities are measured that determines the number of significant figures in the final answer. Such examples as Expt. 11, p. 35:—Weight of lead in air, 17 oz.; weight of lead in water, $15\frac{1}{2}$ oz.; specific gravity, 11·3; or the example on p. 41:—3000/0·85=3529·4 c.c., are ill-chosen. On p. 131 we are told that the steel rails of a tram line have a small space left between their ends, when laid, to allow for expansion. How many observant boys have looked for such spaces and failed to find them? On p. 144 it is stated that water expands regularly from ordinary air temperature to 100° C.

The Brooks Patent T-square Lock. (Letchworth, Herts: Wm. J. Brooks and Co.) Prices 4s. 6d. and 5s. 6d.

THIS very useful adjunct to the ordinary T-square is one of the best of the devices which have recently been introduced to facilitate the work of the draughtsman, and it will be much appreciated by all who are engaged in mechanical and architectural drawing. The contrivance is simple in character, moderate in price, and well made, and is designed so as to be readily attachable to any existing square, no alteration of the drawing board being required. By its use the T-square, without loss of freedom, is instantly locked in any desired position on the board, thus freeing both the hands of the operator. The lock may be put out of action at will, and the T-square manipulated in the ordinary manner. The "lock" attachment will be found extremely serviceable when used with a board which rests horizontally, as on a table, but when the board is much inclined or is vertical, the employment of this or a similar device is indispensable. There are many teachers who might with great advantage utilise this apparatus for black board work.

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.*]

Helium and Geological Time.

IN NATURE of October 27 (p. 543) a short notice appears relative to some experiments of Prof. A. Piutti, of Naples, on the occlusion of helium from the air by salts in the act of solidification. Prof. Piutti apparently considers his results as throwing doubt on the figures which I have given for the age of different geological formations from the accumulation of helium in them. I wish to give my reasons for dissenting from this criticism.

In the first place, it is not clear from Prof. Piutti's description that the gases extracted from his solidified salts contain any more helium than normal atmospheric air. He has not attempted to show, if I understand his description rightly, that there is any *selective* absorption of helium in preference to the other atmospheric gases; nor is it at all likely that such a selective absorption exists, for we have no knowledge of chemical affinity between helium and other gases, while, in respect of solubility, it would probably be inferior to them. Again, on account of its low molecular weight, it would, if anything, be better able to escape from mechanical retention. But the gases from minerals are in practically all cases many times richer in helium than is atmospheric air. Mere retention of air cannot therefore account for any appreciable proportion of the helium found.

There remains the question, also alluded to by Prof. Piutti, of whether helium can have been absorbed from any source in the interior of the earth. I have already discussed this question, as regards igneous rocks, in Proc. Roy. Soc., A, vol. lxxxiii., p. 298. As regards the bulk of the rock, it is impossible to exclude such an origin, and I have carefully avoided drawing conclusions which might be vitiated by it. My inferences have been drawn from minerals like zircon and sphene, which are immensely more radio-active than the rock in general, and immensely richer in helium. It is without plausibility to assume that the excess of helium in these has any extraneous origin.

R. J. STRUTT.

Imperial College of Science, South Kensington.

Pwdre Ser.

ON my return from a field season beyond the reach of periodicals, I have just seen, for the first time, Prof. McKenny Hughes's article on "Pwdre Ser" in NATURE of June 23, and the correspondence relating thereto in the succeeding numbers. It may interest your readers to know that a substance of this sort was found by Mr. Rufus Graves (at one time lecturer on chemistry in Dartmouth College) at Amherst, Mass., on August 14, 1819, and by him identified with a luminous meteor which had been seen to fall at that spot on the previous evening. His report of the occurrence appeared in the *American Journal of Science*, vol. ii., pp. 335–7, 1820. The mass of jelly was circular, about 8 inches in diameter and about 1 inch thick. It was of a bright buff colour, and covered with a "fine nap similar to that on milled cloth." The interior was soft, of an insufferable odour, and liquefied on exposure to the air. Some of this liquid was allowed to stand in an open glass for a few days, when it had entirely evaporated, leaving only a small quantity of a "fine ash-coloured powder without taste or smell," which effervesced strongly with sulphuric acid, but not with nitric nor hydrochloric.

Mr. Graves's account was noted by Arago in the *Annal. de Chimie*, vol. xix., pp. 67–9 (1821), who quoted also several similar occurrences cited in earlier chronicles. It is probable, of course, that Mr. Graves was mistaken in his identification, that the meteor actually fell at some other point, and that the jelly was confused therewith only because no other unusual substance was found at the point where the meteor was *supposed* to have fallen. Mr. Graves himself considered that there was "no reasonable doubt that the substance found was the residuum of the meteoric body," but the evidence which he states is hardly satisfactory to the modern, more critical inquirer.

It seems probable that these jellies are, in general, plasmodia of some form or forms of Myxomycetes, and that their common identification with falling stars may have its basis in the frequent recurrence of this error into which Mr. Graves seems to have been led. It is well known that visual estimates of the distance of falling stars are almost invariably far too low. If, then, an untrained observer of a meteor goes next morning to the near-by place where he *thought* he saw the body fall, and finds there no unusual body excepting one of these plasmodia, the jelly and the meteor are almost sure to be associated in his mind. Especially is this probable, since the plasmodia, in general (at least in my experience), have the appearance of having fallen on the grass rather than of having grown there.

EDWARD E. FREE.

United States Department of Agriculture, Bureau of Soils, Washington, D.C., October 17.

On Hydrogen in Iron.

AT the recent meeting of the British Association at Sheffield, Sir Norman Lockyer referred to the relationship between hydrogen and iron at stellar temperatures. Some observations of mine, made several years ago, are of interest in this connection. I also note that at the recent meeting of the Iron and Steel Institute, in a discussion on the influence of carbon in iron, it was suggested that the gases known to be present should also receive attention.

Iron contains ten times its volume of hydrogen, and in many instances 20 volumes of hydrogen; even 100 has been noted. Iron therefore contains from about 0·013 to 0·026 per cent. of hydrogen, 100 volumes equalling 0·13 per cent., all deemed important in metal with like proportions of carbon and sulphur and phosphorus. It is now fully admitted that hydrogen hardens iron, and should therefore be estimated: 1 gram frozen H, *ice*=7·2 c.c., 0·1=0·72 c.c. I note also iron=1 c.c.=7·2 gram iron. 1111 c.c. of solid H=1/10 gram in 100 iron=14·4 c.c.=7 grams per 1000 c.c., and 1000 ordinary pressure=only 0·08961 gram. The figures quoted are apparently in accordance with the periodic law, series 1–7.

As regards the above, more might be said if space permitted.

JOHN PARRY.

October 19.

Research Defence Society.

IN connection with the cases of plague in Suffolk, let me say that this society has lately published an illustrated pamphlet on "Plague in India, Past and Present," by Lieut.-Colonel Bannerman, director of the Bombay Bacteriological Laboratory. It gives a full account of the experiments which proved that fleas carry the plague from rats to man; it also gives a full account of Haffkine's preventive treatment, and of the many thousands of lives which have been saved by this treatment. I am sorry that the Research Defence Society cannot afford to give away this pamphlet in large quantities, but I shall be happy to send it to any of your readers who will send me seven stamps. I shall also be happy to send copies, on sale or return, to all booksellers.

STEPHEN PAGET.

(Hon. Secretary Research Defence Society.)

21 Ladbroke Square, London, W.

British Mammals.

I AM grateful for your reviewer's good wishes for the success of my book (NATURE, October 20). He writes that he has only one fault to find, namely, that a paper of Dr. K. Andersen's dealing with the authority for the names *Nyctalus noctula* and *N. leisleri* is not mentioned anywhere. I beg to state that the title of this paper is given on p. 53. It could not be cited in the synonymy, as the names *Nyctalus noctula* and *N. leisleri* do not actually occur in it. In fact, I believe that my book is the first in which these names occur.

G. E. H. BARRETT-HAMILTON.

THE OCEANOGRAPHICAL MUSEUM AT MONACO.

IN the history of the development of the study of the sea all the sciences find an application, and all were worthily represented at the inauguration of the Oceanographical Museum of Monaco on March 29 of this year. The ceremonies and festivities incident to the occasion have already been chronicled in the columns of NATURE (April 14, vol. lxxxiii., p. 191). It is proposed here to give an impression of the life-work of the Prince of Monaco, which found expression in the solemnities of that occasion. The accompanying illustrations[1] afford an idea of the magnificence of the building and of the richness of the collections. Fig. 1 gives a view of the museum from the sea. The scale on which it is built can be judged from the fact that the height of the roof above the lowest masonry is 75 metres. Fig. 2 is the statue of the Prince standing on the bridge of his yacht. It is an artistic work, and a good portrait. It gives fine expression to the modesty as well as to the power of the creator of the great monument in the centre of which it stands.

The museum and the vessels attached to it, with their staffs and general organisation, are only one-half of the great enterprise which is entitled, "Institut Oceanographique Fondation Albert I[er] Prince de Monaco." Its seat is in Paris, where it possesses its own buildings and a rich endowment, both of them the gift of the Prince. It has professors of physical and biological oceanography and of the physiology of marine animals, and the lectures delivered during last year had the most numerous attendance of any in Paris. During the life of the Prince he exercises supreme authority. Both in Paris and at Monaco there is complete organisation for giving effect to his wishes, and, in the event of his death, for carrying on the work without interruption, and on the lines inaugurated by himself. Thus continuity and permanence have been assured.

It will be readily realised that the establishment of these two great institutions has not been accomplished without the expenditure of large sums of money and the devotion of much time and labour to it. It is almost impossible for anyone to realise the greatness of the work which is being accomplished without having been intimately connected with it, and even with this advantage the development of the conception is slow. As with all great achievements, it will take at least a generation before it is thoroughly understood and adequately appreciated.

The museum at Monaco bears testimony at every turn to the great lines on which the Prince has himself worked, and in which his work is fundamental. Thus, in the purely hydrographical department, we see his bathymetrical chart of the world, on which all the trustworthy deep soundings are entered. This great document may be said to be the foundation-stone of oceanographical work. Another and much earlier piece of hydrographical work is the current chart of the North Atlantic, which gives the result of his laborious work on board the *Hirondelle*. By the methodical dispersion of floats, especially constructed to expose the least possible surface above water, along different lines radiating generally from the group of the Azores, by patiently awaiting their recovery, and by then combining their records, he furnished the demonstration that this portion of the ocean is practically a lake, bounded, not by land, but by the motion of its own peripheral waters, thus enclosing a roughly circular portion of the sea, part of which is generally associated with the Sargassum weed and called the Sargasso Sea. The water, thus self-confined in the warm, dry subtropical region, is exposed to powerful evaporation, and to a considerable annual variation of temperature at the surface. The combination of these two thermal factors furnishes the mechanical power by which the deeper layers of the water obtain more heat and attain a greater density in this sea than they do in any other part of the open ocean, as was pointed out by the writer in a paper "on the vertical distribution of temperature in the ocean," read before the Royal Society on December 17, 1874, and published in its Proceedings, vol. xxiii., p. 123.

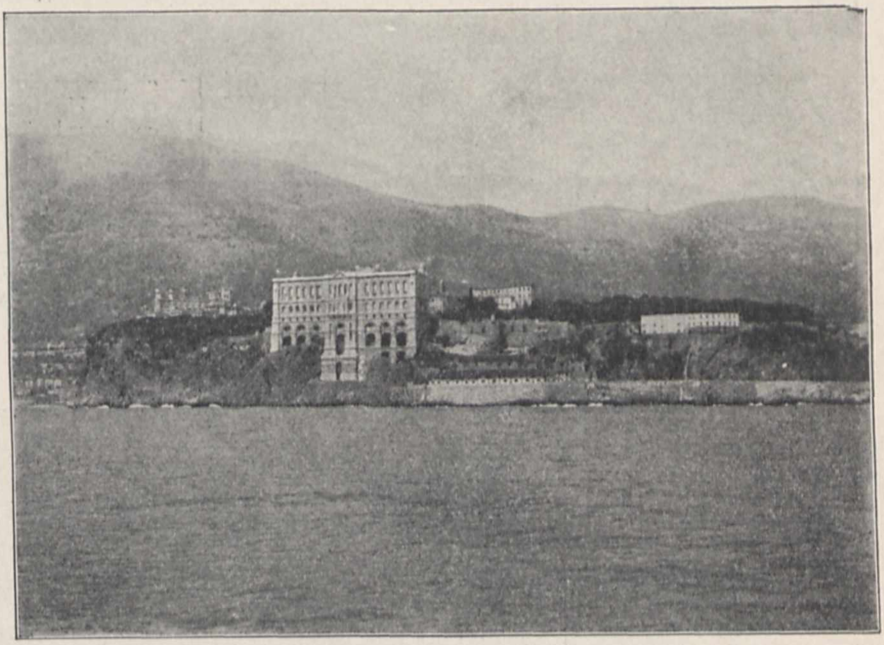


FIG. 1.—General view of the Oceanographical Museum at Monaco as seen from the sea.

In the great hall to the left of the entrance the visitor is at once struck by the magnificent collection of skeletons of Cetaceans, which includes those of many species. These are skeletons of individual whales, nearly all of which have been killed by the Prince himself, and each is complete, every bone in the animal being accounted for. From all points of view this collection is at once the most attractive and the most interesting in the museum, and in it we see the Prince reflected as a hunter and as a naturalist.

In Fig. 3 we have the Orca, with its formidable double row of teeth. It preys on other Cetaceans, and always shows plenty of sport. The specimen figured belonged to the leader of a school of three, which was

[1] For the illustrations in this article we are indebted to the courtesy of the proprietor of the *Naturwissenschaftliche Wochenschrift*. They are reproduced from photographs by Prof. Döflein, of Munich, and illustrate an article by him in that periodical.—Editor. NATURE.

met with a few miles outside of Monaco. They fought to the death, and when killed they were towed in and beached on what is now the new harbour of Monaco.

FIG. 2.—Statue of Prince Albert I. of Monaco in the Museum

Not far from the Orca is a skeleton, Fig. 4, of the best known of the toothed Cetaceans, the cachalot or sperm-whale. It was not taken by the Prince himself, but he was present at its capture, and his scientific instinct enabled him to seize an opportunity which would probably have been missed by another. The cachalot had been struck by a crew of whalers from Terceira, one of the islands of the Azores. The Prince followed the chase in his yacht, and was close to the animal when it became evident that its end had come. At this moment these animals always charge whatever they see, and in their death agony they usually render whatever they have last eaten. This animal charged the *Princesse Alice*, but the charge did not get home. The animal stopped, and a large mass of something came out of its mouth close to the yacht and began slowly to sink. The Prince at once jumped into the dinghey, and, with a long landing net, retrieved the object before it sank out of sight. The object is represented in Fig. 5, and is a unique piece. It is a fragment of the gigantic scaled cephalopod which Prof. Joubin, who described it, named *Lepidoteuthis Grimaldii*.

A healthy cachalot is valued for the spermaceti, or wax, which is contained in its head, and a sick one is still more valued for the ambergris which it may contain. This curious substance, which has at all times been so highly esteemed in pharmacy and perfumery, forms the subject of a very interesting "Account of Ambergris" by Dr. Schweidawer, which was read before the Royal Society on February 13, 1783, and published in the Philosophical Transactions, vol. lxxiii., p. 220. From his investigations it appears that ambergris is a by-product of an inflammation of the intestine, which has probably been started by the "beaks" of the cephalopods which it has swallowed, for these are the invariable and characteristic ingredient of all genuine ambergris. He further states that the whalers are convinced that the cachalot feeds only on squids, which, when unmutilated, must be of great size. One whaler reported a case where the whale in its death-throe rendered a single tentacle, which, though incomplete from having been partially digested, still measured 29 feet in length, and he held that this justifies the common saying of the whalers that the squids are the biggest fish in the sea.

The work of the Prince amongst the toothed Cetaceans has had an interesting sentimental result. The combat of the "thrasher" and the whale, so dear to the nautical mind, seems to be

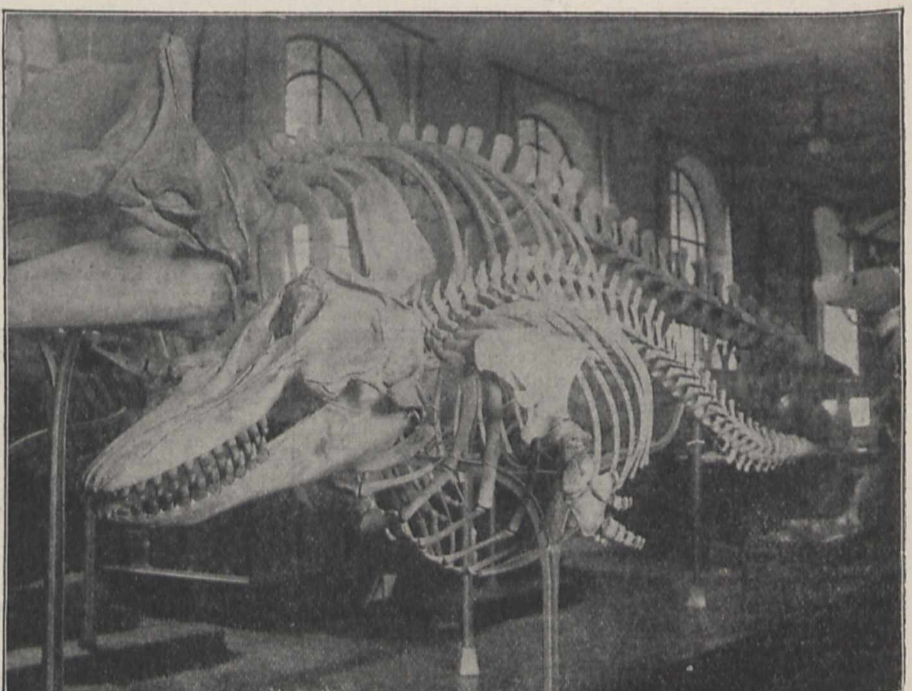


FIG. 3.—Skeleton of the great Orca killed by the Prince of Monaco near Monaco.

nothing but the violent and desperate resistance of the giant squid to being swallowed when brought to the surface by the cachalot.

The whalebone whale, shown in Fig. 6, was struck by the Prince in May, 1896, not many miles from

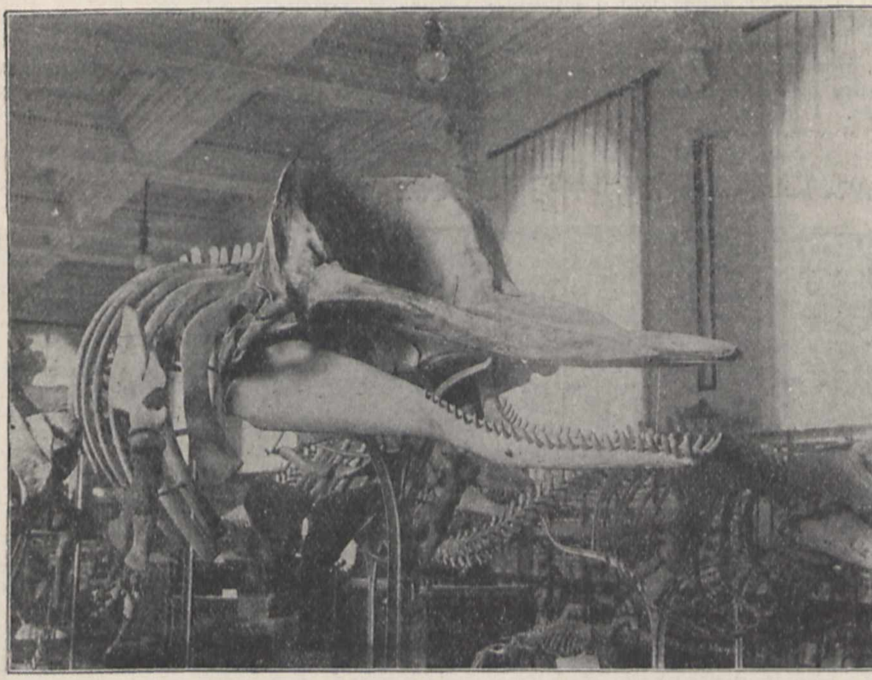


FIG. 4.—Skeleton of the Cachalot which furnished the fragments of gigantic Cephalopods

Monaco, but it escaped. Its carcase was washed ashore in September of the same year, near Pietra Ligure, on the Italian Riviera. A remarkable feature of this skeleton is the evidence of fracture and repair of a number of ribs of its left side. This has been ascribed to collision with a steamer, but it is very unlikely that such an experience would leave its mark in nothing but a number of perfectly repaired ribs. It would seem to point to a type of accident to which whales are certainly exposed, and from which they perhaps not infrequently suffer.

The habitat of the whale is the air and the water, and its functional economy has to be adapted to life in both elements, or rather, to life sometimes in the one, at other times in the other element.

In one of the Prince's recent cruises in the Mediterranean the yacht was found to be steaming in the wake of a whale, which was evidently making a passage, and in a leisurely way. The Prince seized the opportunity to follow the animal without pursuing it, and this was done with such skill that it remained unconscious of being followed. It kept a steady course, and, to "keep station" with it, the *Princesse Alice* had to steam at a speed of about ten knots. In these conditions the whale came up to breathe at regular intervals of between ten and eleven minutes, the intervals between the spouts being the same almost to a second. This experiment supplies an important constant in the natural history of the whale. It looks very simple, but it will not be readily repeated, except perhaps by the Prince himself. As the whale was on passage, it is unlikely that it went far below the surface, but there is abundant evidence that, in the search for food or to escape enemies, it penetrates to very considerable depths. In these excursions its body is exposed to rapid and considerable variations of pressure. These have to be borne by the structural frame of the animal, of which the ribs are an important part.

It is generally assumed that, before sounding, the whale fills its lungs with air, but this, being at atmospheric pressure, is of no use in assisting the body to resist the external pressure of a column of water equivalent, it may be, to many atmospheres. How the power of resistance is, in fact, provided, I am not anatomist enough to know, but it must be finite, and it is easy to imagine conditions in which the animal, whether in the pursuit of prey or in the endeavour to escape being made itself a prey, may strain it beyond its limits, and the ribs of one side, whichever is the weaker, may give way. In such an accident, beyond being broken, the ribs need not be seriously disturbed, and with the return to the surface or more moderate depths, they would fall into their places again, and that all the more easily because there is little or no pressure of one part on another, every part of the body of a totally immersed animal being

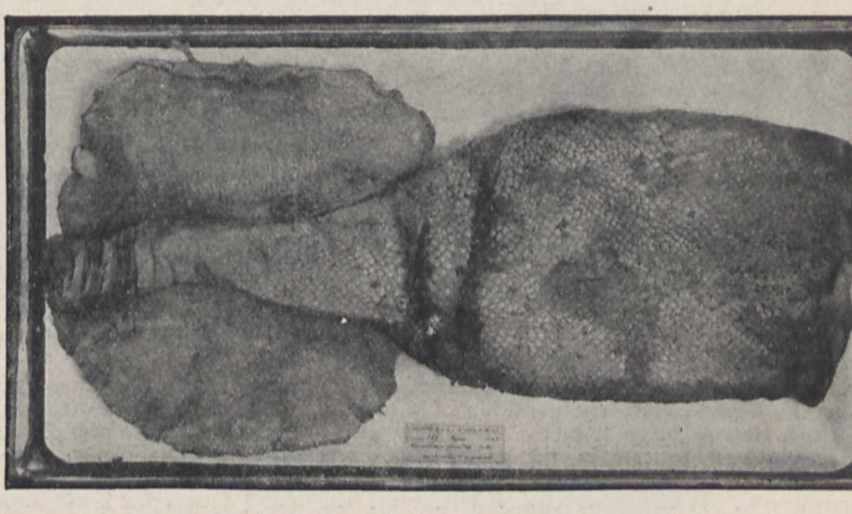


FIG. 5.—The principal fragments of *Lepidoteuthis Grimaldii*, Joubin.

water-borne. In such conditions recovery would be rapid and the joints perfect, as can be seen to be the case in the skeleton in the museum.

The accident to this whale is very suggestive. In a well-known experiment, Paul Bert reduced the pressure of the air in the lungs of a dog by a not very large fraction of an atmosphere, when the thorax immediately collapsed, every rib being broken. When a whale is struck and sounds, if only to a depth of one hundred metres, the pressure on its body is increased tenfold in a few seconds. How does its body stand it?

It is certain that the cachalot finds its prey in water of considerable depth. When it has seized it, can it swallow it *in situ*, in a medium of water under very high pressure? The dentition of this animal, a formidable row of teeth in the lower jaw fitting into corresponding sockets in the upper jaw, makes it certain that, when it has seized its prey it can hold it indefinitely. It has been observed that the cachalot sometimes takes its prey to the surface and swallows it there. Is this accidental or habitual? If habitual is it not another link with the far-back time when its habitat was the air and the land? These are some questions suggested by an attentive visit to the Museum of Monaco.

In the museum, room is provided for a department of meteorology, a science which, especially as regards its application to the higher regions of the atmosphere, owes much to the participation of the Prince in its development. Until he directed his attention to it, the *ballons-sonde*, carrying their freight of valuable instruments, were very frequently lost. Now, thanks to the method of keeping the "dead reckoning" of the balloon, developed and brought to perfection on the *Princesse Alice*, if it is followed for a few minutes during its ascent, it may disappear in the clouds, and its recovery, when it descends at sea, is almost a certainty. This department of investigation has been prosecuted outside the Mediterranean, and in the Prince's cruises of the last two or three years it has been carried from the Cape Verde Islands in the heart of the tropics to the north of Spitsbergen, within five hundred miles of the Pole.

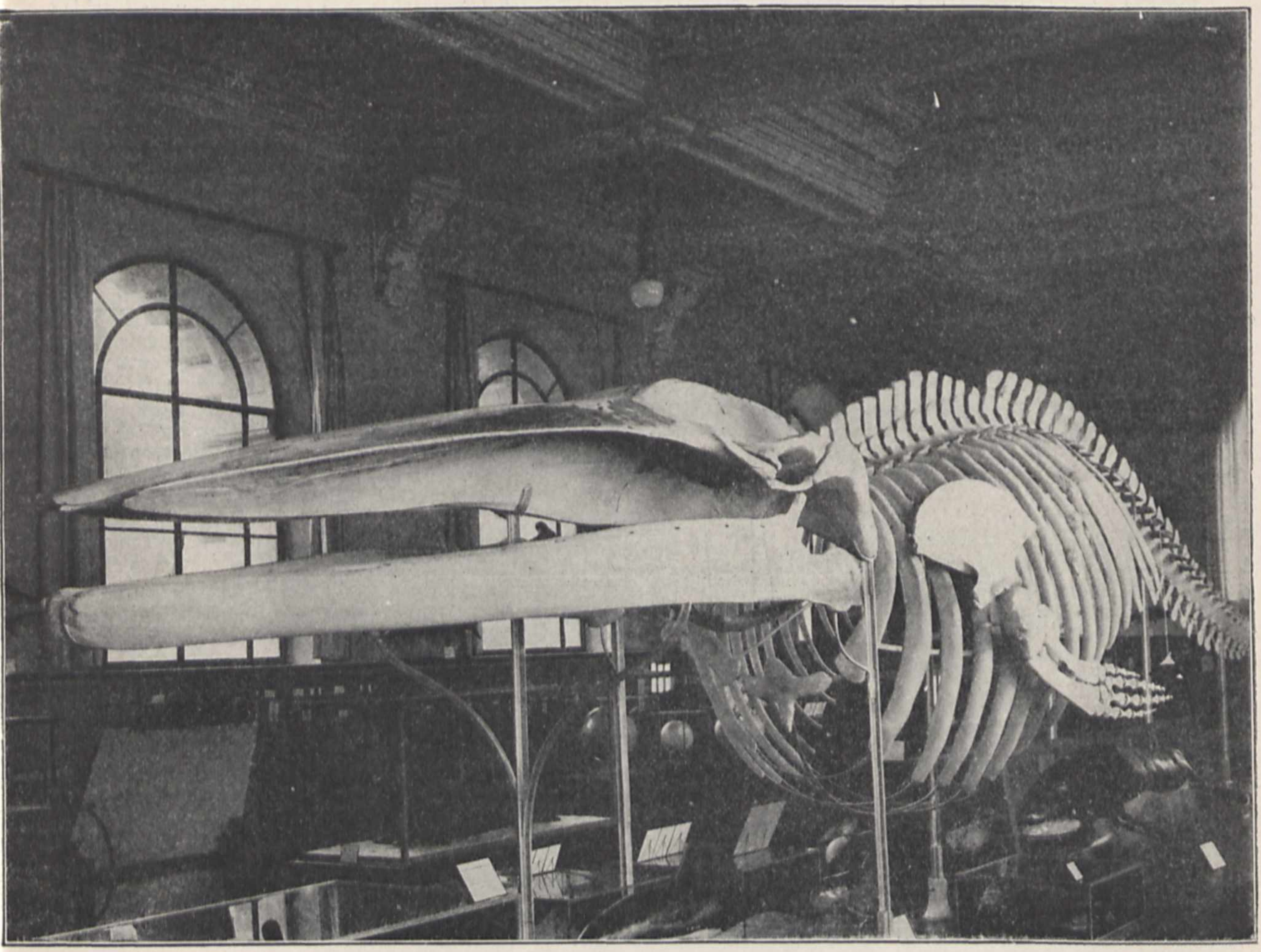


FIG. 6.—Skeleton of whalebone whale the ribs of which have been broken and mended.

Besides the collections of animals and the instruments for their capture and study, there is in the lower part of the museum an aquarium, remarkable for its size and the completeness of its installation. This already commands a constant flux of visitors, chiefly the curious, but it is also frequented by men of science for serious study. It is already proposed to enlarge it considerably. The storey above the aquarium is divided into separate laboratories, fitted with a service of both fresh and sea water, and everything else required for chemical, physical, and biological study. In these laboratories the occupant has all that a laboratory can supply, and at any time fresh material from the sea, collected by one of the small steam tenders of the museum.

Any notice of the museum of Monaco would be incomplete without an acknowledgment of what it owes to its director, Dr. Richard. None of the many men of science who have enjoyed the hospitality, either of the museum or the yacht, will require to be reminded of this, nor will they forget what they individually owe to Dr. Richard's never-failing courtesy and helpful aid. Personally, I have more thanks to offer than I can express for the countless services that he has rendered me during our friendship of twenty years. The Prince was fortunate in being able to attach him to his service in the early days of the *Hirondelle*. Since that time Dr. Richard has been his never-failing aid and assistant. It is not too much to say that without Dr. Richard's strenuous and unselfish work during these many years the museum with its rich collections and complete equipment would not be, as it is now, the greatest institution of the kind in the world.

J. Y. BUCHANAN.

ENVIRONMENT VERSUS HEREDITY.[1]

THE question of the assimilation of immigrants under American conditions has long been looked upon as of vital importance, and it has been much discussed, but heretofore with little accurate information. Speaking from general personal observation, people have thought that under the influence of the existing educational, social, and political conditions the immigrants gradually change their habits of life and their ways of thinking, and thus become Americans. The statement is often made that American citizens tend to resemble the American Indian, meaning thereby some generalised type of plains Indian, but this has never been put to scientific test. Little or no thought, however, has been given to the possible effect of the physical and social environment on the physical type of descendants of immigrants. The establishment by Congress of the Immigration Commission in February, 1907, gave the opportunity for a thorough investigation of the problems of immigration, and the inquiry into the anatomical characters of immigrants and their descendants was put under the direction of Prof. Franz Boas, of Columbia University, than whom no better selection could have been made. The present short report deals with only a portion of the material collected, but results obtained are of unexpected interest and importance.

The results so far worked out may be summarised as follows :—

1. The head form, which has always been considered as one of the most stable and permanent characteristics of human races, undergoes far-reaching changes due to the transfer of the races of Europe to American soil. The East European Hebrew, who has a very round head, becomes more long-headed; the south Italian, who in Italy has an exceedingly long head, becomes more short-headed; so that both approach a uniform type so far as the roundness of the head is concerned. Fig. 1 shows at 1 and 1 the cephalic index of foreign-born Hebrews and Sicilians; at 2 and 2 that of those born within ten years after the arrival of their mothers in the United States; at 3 and 3 that of those born more than ten years after the arrival of their mothers in the United States. The diagram shows the very rapid approach of the two types among children born shortly after the arrival of their mothers in America, and the slower continuation of this approach among those born later. Fig. 2 roughly indicates the general form of (1) the foreign-born Hebrew, (2) the foreign-born Sicilian, and (3) the average form of the head of the American-born Hebrew and Sicilian-born more than ten years after the arrival of the mother in America.

2. The influence of American environment upon the descendants of immigrants increases with the time that the immigrants have lived in the country before the birth of children.

3. The changes in head form consist in the increase of some measurements and in the decrease of others. The length of the head of Hebrews is increased; the width of the head and the width of the face are decreased. Among the Sicilians the length of the head is decreased, the width increased, but the width of the face is decreased.

4. The differences in type between the American-born descendant of the immigrant and the European-born immigrant develop in early childhood and persist throughout life.

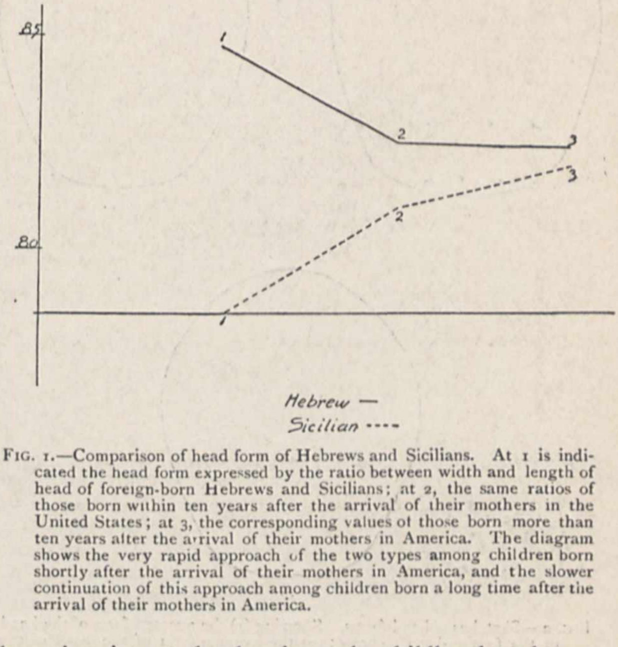


FIG. 1.—Comparison of head form of Hebrews and Sicilians. At 1 is indicated the head form expressed by the ratio between width and length of head of foreign-born Hebrews and Sicilians; at 2, the same ratios of those born within ten years after the arrival of their mothers in the United States; at 3, the corresponding values of those born more than ten years after the arrival of their mothers in America. The diagram shows the very rapid approach of the two types among children born shortly after the arrival of their mothers in America, and the slower continuation of this approach among children born a long time after the arrival of their mothers in America.

5. Among the East European Hebrews the environment, even in the congested parts of the city, has brought about a general more favourable development of the race, which is expressed in the increased height of body (stature) and weight of the children. The Italian children, on the other hand, show no such favourable influence of American environment, but rather a small loss in vigour as compared to the average condition of the immigrant children; so that it appears that the south Italian race suffers under the influence of American city life, while the East European Hebrew develops under these conditions better than he does in his native country.

6. The type of the immigrant changes from year to year, owing to a selection which is dependent upon the economic conditions of the country. This is shown by the fact that after the panic of 1893 a sudden decrease in the general development of immigrants may be observed, which persisted for several years. A similar change seems to have taken place

[1] "Changes in Bodily Form of Descendants of Immigrants." The Immigration Committee, Document No. 208 presented to the 61st Congress, 2nd Session. (Washington, D.C., U.S.A., 1910.)

after the panic of 1907. The significance of these changes is at present obscure.

7. It has been observed that, while immigrants have large families, the size of the family is very materially reduced in the second generation. This reduction of the size of the family goes hand in hand with the improvement of the physical development of the individual, as is demonstrated by the fact that children belonging to small families are considerably taller than children belonging to large families.

In connection with this last statement it is worth noticing that Prof. Boas points out that statistics taken on the school children of Toronto, Ont., and Oakland, Cal., show that there is a decided decrease in development of the individuals according to the increasing size of the family, and the Toronto material proves that the decrease in stature with increasing size of family takes place on every economic level. This

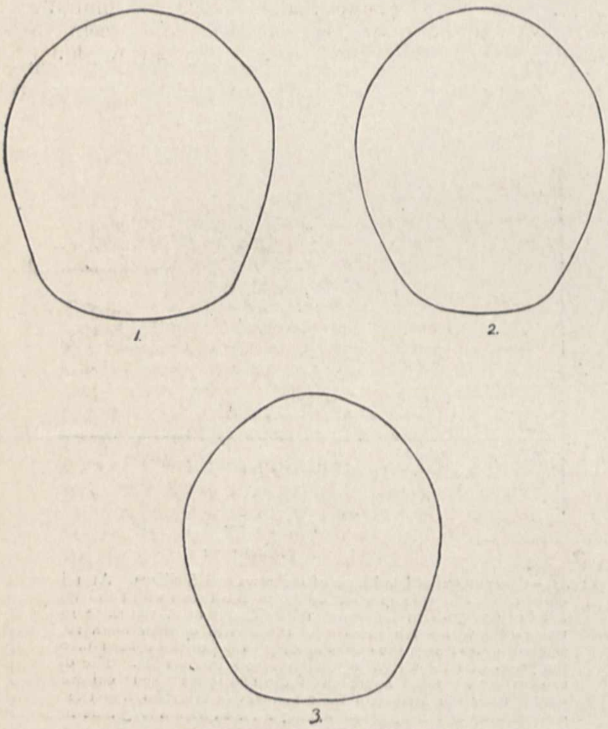


FIG. 2.—Sketches of head forms. Showing (1) the average form of the head of the foreign-born Hebrew; (2) the average form of the head of the foreign-born Sicilian; (3) the average form of the head of the American-born Hebrew and Sicilian born more than ten years after the arrival of the mother in America. These sketches are intended only to give an impression of the change in proportion. They do not represent the head forms in detail.

does not seem to be due entirely to inherited physiological causes nor to differences of nutrition. The fact, however, comes out with greatest clearness that reduction in the size of families goes hand in hand with the improvement of physical development.

The data upon which these conclusions are based are given in tables of measurements, and synthesised in curves. Their trustworthiness depends upon several conditions being carefully investigated. The wide experience of Prof. Boas as a physical anthropologist and his mastery of statistical methods give us confidence that his conclusions are well founded. He acknowledges that the problem is an exceedingly complicated one, and he describes the various ways in which he has endeavoured to arrive at trustworthy results; for these the reader is referred to the report.

One of the most important problems of physical anthropology is to determine what effect environment has upon the human species. In his address to the Anthropological Section of the British Association at the Dublin meeting in 1908, and again in his presidential address to the Royal Anthropological Institute on "The Influence of Environment on Man," delivered on January 25, 1910 (which will shortly be published), Prof. W. Ridgeway has directed attention to this question. Reference may also be made to Dr. R. Humphrey Marten's presidential address to the South Australian Branch of the British Medical Association (Adelaide, 1900), on "The Effects of Migration from the Northern to the Southern Hemisphere." The investigations Prof. Boas is now undertaking are of prime importance, as they are based on careful measurements, but many more similar studies must be made before general conclusions can be drawn. It is also obvious that this is not a matter of purely anthropological interest, but is of significance to the sociologist, and should not be neglected by the statesman.

A. C. HADDON.

PRESENT CONDITION OF AMERICAN BISON AND SEAL HERDS.

FROM the third annual report of the American Bison Society, recently published at Boston, we learn that the condition and prospects of the three herds of bison maintained by the Government of the United States are all that can be desired, and that, in the opinion of Dr. Hornaday, the future of the species is now secured. These herds comprise one in the Yellowstone Park, with ninety-five head, a second in Wichita, with nineteen head, and a third in Montana, with forty-seven head, the total number of animals thus being 161. Of these herds the one in Montana, which occupies a tract of twenty-nine square miles, has only recently been brought together (as described in the present report), and promises to be the best of the three. Indeed, Dr. Hornaday is of opinion that this herd alone would be sufficient to safeguard the species against extinction, since, owing to the extent of the area on which it is established, it is secure against any ill-effects from in-breeding. Regarding the Yellowstone herd, Dr. Hornaday is less confident, as the relatively small tract on which it is kept may lead to deterioration. The Wichita herd, on the other hand, is as well situated as the one in Montana.

In another part of the report is given a census of the total number of pure-bred bison living in captivity in America on May 1st, 1910. This total is 1633, against 1592 in 1908, and 1010 in 1903, thus showing a well-marked and progressive increase. Out of the 1633, 626 are in Canada, and the remaining 1007 in the United States. In 1903 Canada possessed only forty-one head, the enormous increase being apparently due to the transference of the Pablo herd from the United States. Of wild bison the total number is estimated at 475, of which twenty-five are in the Yellowstone, and the remaining 450 in Canada. In 1908 the number of wild Canadian bison was estimated at 300. The grand total of pure-bred animals living in North America is thus approximately 2108, against 1917 in 1908.

A considerable portion of the Montana herd was purchased from Mrs. Conrad, of Kalispell, in that State, who also presented the magnificent herd-bull shown in the foreground of the illustration herewith reproduced.

The selected portion of the Conrad herd was driven by cowboys, without any noise, to the nearest railway siding. Here "each animal was driven singly into the corral that communicated with the loading chute.

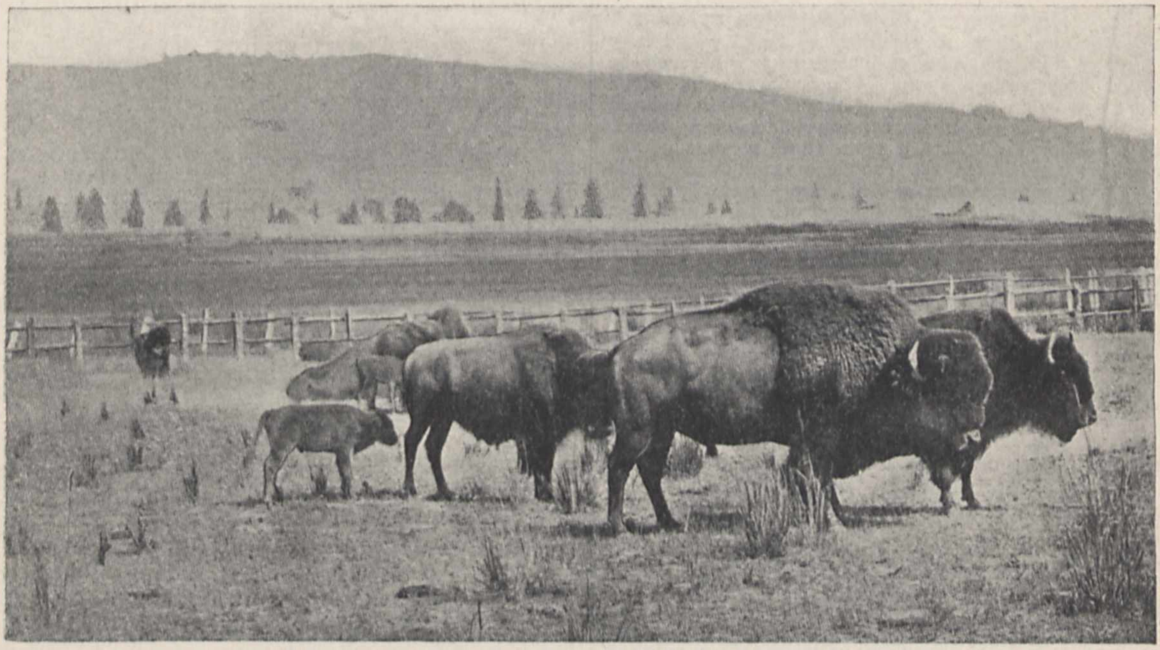
. . . The chute of a railway cattle-yard is a long, narrow cañon with wooden walls, sloping upward rather steeply, and ending in the open door of a cattle-car. . . . A crate was placed in the middle of the chute; the sliding door at the outward end of the box was lifted high and carefully poised for a quick drop. An animal specially fitting the crate was then cut out from the bunch, driven into the chute, driven on into the crate, and shut in with a bang. After that the crate was hauled and shoved into the stock-car and settled in its place."

In NATURE of July 28 appeared a paragraph relating to the danger threatening the Alaskan fur-seals owing to unrestricted pelagic sealing by the Japanese. Since that paragraph was written the editor has received a copy of an "open letter" addressed by the Camp-Fire Club of America to the people of the United States, together with certain letters addressed by the committee of the club to Mr. Secretary Nagel, and the replies to the same. From a covering letter it appears that the Camp-Fire Club comprises about 350 members, all interested in the preservation of American big game, and the opinions of whom ought therefore to carry considerable weight. According to the "open letter," the Pribilov Islands, when purchased from Russia about the year 1867, were the resort of at least 4,500,000 fur-seals, or sea-bears; at the present day the number is only from 30,000 to 50,000. Formerly the islands yielded a large revenue to Government; now they involve a heavy expenditure. The Camp-Fire Club is of opinion that all slaughter of seals on the islands should be prohibited for ten years, in order to permit of the recuperation of the herds to a point when they will yield an annual revenue of 200,000*l.*, and at the same time to make treaties with the British, Canadian, Japanese, and Mexican Governments for the suppression of pelagic sealing, the latter being an even more urgent matter than the former.

The secretary to Government, on the other hand, acting apparently on expert advice, demands a renewal of a killing licence on the ground that unless 95 per cent. of the younger male seals are annually killed the "surplus bulls" will fight with "the breeding bulls" over the females, and seriously retard the breeding of the herd. To this the committee, after indicating their opinion of the experts concerned by printing the word with inverted commas, make the following reply:—"As if a wild species does not know how to breed and multiply successfully without the help of man! The excuse is most inadequate, and in any event it is no excuse whatever for not dealing squarely with Congress, and in accordance with a very plain understanding."

From this it will be manifest that the controversy has entered a somewhat acute and embittered stage, the details of which I have neither space nor inclination to discuss. If, however, pelagic sealing weighs heavily, as I understand it does, on female seals, there may be something in the contention that a certain number of young males should be annually killed off, although 95 per cent. certainly seems a heavy toll. On the other hand, there is no doubt whatever that unrestricted pelagic sealing should be stopped, this being a matter, not of American, but likewise of world-wide interest.

R. L.



The Best Bull Bison in the Montana Herd. (From the Third Annual Report of the American Bison Society.)

THE FUTURE OF AGRICULTURAL RESEARCH IN GREAT BRITAIN.[1]

THE announcement recently made to the effect that the Board of Agriculture has applied for a large sum of money from the development grant for the purpose of aiding agricultural research lends a peculiar interest to two publications just issued, the report of the Board of Agriculture on the grants made for the last two years for agriculture education and research, and the statement of the British Science Guild recently submitted to the Prime Minister in an influentially signed memorial. The report may

[1] Report on the Distribution of Grants for Agricultural Education and Research in the Years 1908–9 and 1909–10. Board of Agriculture and Fisheries. Cd. 5388. Price 7½*d.*
The British Science Guild. The Present Position of Agricultural Research in the United Kingdom.

be taken as an indication of the official attitude, and the memorial as the attitude of the professed man of science, towards agricultural research, and it is interesting to compare them, to see what they have in common and how far their differences are fundamental.

From the fact that both publications, after a few preliminary statements, come straight to one and the same point, we may take it that this is regarded as the real issue: Does Research pay? The position of the Board of Agriculture is thus set out:—

A public department when authorising the expenditure of money on research is bound to take into consideration the probable value of the work to the State. It cannot rest satisfied with the assurance that sooner or later all accessions to knowledge will benefit the country. The taxpayer of to-day naturally wishes to see a return for his contribution, if not in his own lifetime at least in that of his children. It is obvious therefore that, as a matter of elementary justice, the question of time must receive consideration from any department entrusted with the expenditure of State funds on research.

On the other hand, the memorial states:—

The committee of the British Science Guild would urge very strongly that the value of investigation can rarely be translated directly into terms of pecuniary gain. The benefits lie more in the method of thought that is induced among the farmers and those concerned in advising them, in the stimulus it gives to a more exact conduct of the business of farming, in the confidence with which men take up the fresh resources which science and the industries are always putting at the disposal of agriculture, than in any sudden revolutions effected by research. The fact that the countries whose agriculture has made the greatest advances in recent years are those which pay the greatest attention to research is itself sufficient justification for the action of the British Science Guild in urging the British Government to move in this direction.

Between these two positions there is a great gulf, but one may hope that it will not prove impassable. The Board of Agriculture has recently appointed a committee, including several distinguished men of science, to advise on questions dealing with research, and doubtless a broad view will be taken of "the probable value" of a piece of really good research work. The memorial gives several instances where research has directly resulted in financial gain to farmers. An outstanding case is the use of superphosphate, which was discovered by Sir John Lawes, and has been of enormous benefit to farmers. Denmark affords at least two good illustrations. Sonne's work on barley has resulted in the general adoption of a particular type of malting barley, so that the yield has gone up three or four bushels per acre, and the malting quality has become more uniform. The whole butter industry is founded on scientific control. Nilson's work in Gothland, Sweden, is also mentioned. More than 30,000 hectares of this island consisted of sterile swamps. Nilson proved by careful investigations that the factor causing sterility was deficiency of phosphates; when these were supplied the richest crops of corn, rape, and sugar-beet could be secured. He further devised a suitable phosphatic manure out of a rather poor phosphatic mineral in the north of Sweden. Coming to our own Colonies, the control of live stock diseases in the Transvaal furnishes an illustration.

At the end of the war the whole country was ravaged by various diseases, which had reached the country at an earlier period, but had been distributed broadcast by the movements of horses and stock during the war—rinderpest, redwater, East Coast fever, in succession had attacked the cattle, until few were left in the colony, and importations died as rapidly as they were introduced. Sheep and horses were equally affected, until stock raising of any description seemed an impossibility. The investigations, however, conducted by Dr. Theiler for the Transvaal Department of Agriculture into the causes of these diseases have resulted in a number of methods of immunisation, which, coupled with veterinary regulations as to the movements of stock, are now rendering the country habitable by cattle again and the business of agriculture once more possible.

Many other instances might have been given, but the memorialists very wisely do not allow themselves to be drawn into a false position, and repeatedly urge that the results of research work cannot usually be translated direct into terms of general practice. They decline, in short, to regard the probable financial value of a particular piece of work as the only criterion of its usefulness. This is, of course, the position one expects from the British Science Guild, but it must also be remembered that the attitude of the Board is unquestionably that of a large body of the public.

In reading the two publications it becomes evident that the word "research" is used in rather a different sense in each of them. The Board's report states that "research must satisfy one or both of two conditions (1) it must, as a result of observation or experiment, result in the collection of fresh facts; (2) it must involve an examination of the facts collected, or phenomena observed, and the reduction of them to a form in which they constitute an addition to knowledge." This definition is not adhered to, and work that is primarily educational, such as demonstration trials and tests, is apparently classed as research. The memorial recognises the difficulty of drawing a hard and fast line, but adopts this as a working definition:—"Work which is published only in the annual reports of the institution may be regarded as educational, work also published by one of the learned societies or in the *Journal of Agricultural Science* may be treated as research."

This difference of view explains why the memorialists only put the number of colleges where research has been done at seven, whilst the Board consider that research is being done at all the colleges. So far as the demonstration trials are concerned the Board's position is sound; such demonstrations are intended to improve practice, and must obviously be judged on their profitableness. Only in regard to research proper is there any difference of opinion, and here the difference is fundamental. It would, however, be premature and ungracious to labour this point; the Board's advisory committee is only just appointed, and it is clear that an open mind prevails:—"It is not usually a difficult task to distinguish research from spurious imitations, on the other hand it may at times be difficult to say whether a particular piece of research is, or is not, entitled to receive aid from agricultural funds. One may be permitted to express the hope that the public interested will not take a narrow view on this point."

The object of the British Science Guild memorial was to urge the necessity of "granting adequate assistance for the continuous conduct of scientific investigations having for their object the development of agricultural production." No scheme is foreshadowed; indeed, any attempt would have been out of place.

The report of the Board of Agriculture, whilst it does not set out a scheme, discusses the general lines on which one might be based. In the first instance, "At the present time the number of well-qualified men engaged in agricultural investigation in this country is relatively small and one of our chief aims in expending additional funds should be to establish a system which will bring agricultural science suitable recruits." But when we come to inquire the meaning of "suitable recruits," we learn that "the chief demand of the present time is for 'spade workers' and 'quarrymen' to prepare foundations and material." It is to be hoped that on this point at least the Board will allow itself to be converted. Unless men of outstanding ability can be attracted to the research stations and agricultural colleges, there is not much hope that the taxpayer will see anything like the return he ought for the money expended. This, indeed, is the vital question; if the right sort of men are got to do the work all the other questions of administration sink into insignificance. But here also the Board is on what appears to be the safe ground. The idea of a central experimental station is dismissed, and a wider policy is suggested:—"It would probably be advisable, therefore, to use part of the Development Fund in making such grants to universities and university colleges as would induce them to make provision for agricultural research."

At no period in its history has agricultural science had a greater opportunity than at present. It is no longer hampered by lack of funds or by apathy on the part of the farmer. The problems are more numerous and more interesting than ever they were. But unfortunately the workers are few, and fresh workers are not readily forthcoming. The hopeful feature is that a number of eminent men of science are giving up time and thought to the organisation of the new work, and, further, that the Board of Agriculture and the large agricultural societies are manifestly and genuinely anxious to render all the help they can.

RATS AND PLAGUE.

ALTHOUGH the recent epidemics of bubonic plague in China, India, and other parts of the world have been always associated with outbreaks of the same disease amongst rats, the historical study of plague throughout the world reveals the singular fact that previous to 1800 very few references to a coincident mortality amongst rats have been put on record. Many excellent accounts of the older outbreaks, notably of the Black Death in Europe in 1347, and the Great Plague of London in 1665, are in existence, but careful research into these documents by modern historiographers—Haeser, Hirsch, Abel, and Sticker—has shown that for reasons difficult to discover very scanty mention of associated rat mortality has been made.

The earliest recorded instance is perhaps that given in the Bible in the account of the pestilence amongst the Philistines, which they ascribed apparently to "the mice that marred the land." Avicenna refers to the association between rats and plague in his description of the epidemic in Mesopotamia about the year 1000 A.D. Nicephorus Gregoras, writing of the Great Plague of 1348, which entered Europe by way of Constantinople, makes a similar reference. Rats are mentioned in connection with the plague in Yunnan about 1757, and later in 1871–3. In India an association between rats and plague is noted in the *Bhagavata Purana,* by the Emperor Jehangir in the plague epidemic of 1615, and in a report of the Pali plague in Rajputana in 1836. Lastly, Orraeus refers definitely to rat mortality in his account of the epidemic of 1771 in Moscow.

The identity of the disease in rats with that affecting man was established by the discovery in 1894 of *B. pestis* by Yersin and Kitasato.

Within the next few years the relationship between rat and human plague was investigated in many parts of the world—by Thompson and Tidswell in Sydney, Clark and Hunter in Hongkong, Snow, Weir, Hankin and James in India, and by Kitasato in Japan. In 1905 the Plague Research Commission was appointed to investigate plague in India, and the reports of this Commission represent the results of the most exhaustive inquiry into the subject that has yet been carried out.

The Commission early turned its attention to the relationship of rat plague and human plague, and instituted an extensive examination of the rats in Bombay and elsewhere for the presence of plague infection. The maps and charts, representing graphically the results of this examination, clearly show the correlation between the epizootic and the epidemic—the rat epizootic preceding the epidemic by an interval of ten to fourteen days. Every outbreak of bubonic[1] plague, when adequately investigated, was found to be associated with the disease amongst rats. The conclusion must be drawn that every epidemic of bubonic plague is caused by the concomitant rat plague.

In Bombay the rat population is an enormous one, *Mus decumanus* (the brown or grey rat) swarming in the sewers, gullies, and outhouses in the city, and *Mus rattus* (the black rat) living in countless numbers in the houses of the people. The latter species is of especial importance in plague epidemics, because it is essentially a house rat: it may almost be said to be a domesticated animal. The severity of the epizootics in the two species will be appreciated when it is stated that during one year the examination of 70,789 *M. decumanus,* taken from all parts of Bombay city, proved that 13,277 were plague-infected = 18·8 per cent., and that out of 46,302 *M. rattus* examined 4,381 were plague-infected = 9·4 per cent. The heavier incidence of plague in *M. decumanus* is explicable by the circumstance that the flea infestation of this species is more than twice that of *M. rattus.*

Some interesting observations on the distribution of different species of rats in India have been made recently by Captain R. E. Lloyd, I.M.S. The most common rats in India are *M. rattus, M. decumanus,* and *Gunomys* (*Nesokia bengalensis*). *M. decumanus* is common both in Bombay and Calcutta, but is absent from the city of Madras. It is significant that Madras is the one port in India which has never been seriously infected with plague. *M. rattus* appears to be universally distributed in India, whereas *M. decumanus* does not seem to occur in India except in seaports. *Nesokia bengalensis* is found in every part of India.

The question of the transportation of plague by ship rats is an extremely important one, but has not so far been thoroughly worked out. It would appear that *M. decumanus* is the species most commonly infesting ships, although *M. rattus* is also found.

Sticker, in his history of plague epidemics, quotes the statement that *M. decumanus* got into Europe from Persia about the year 1725. In England *M. rattus* was displaced by the invasion of *M. decumanus* about this time. At the present day the predominating species in this country is undoubtedly *M. decumanus*; *M. rattus* is, however, becoming increasingly common in the seaports.

An important question in plague epidemiology is the mode of conveyance of the infective organism from the plague rat to man. It is impossible even to summarise here the numerous experiments and observations on this subject, but it may be said that from many sides, and especially from experiments in the laboratory and in actual plague-infected houses, a mass of evidence has been raised which incriminates and indeed convicts the rat flea as the transmitting agent of the infection.

[1] Pneumonic plague differs from bubonic plague in its mode of spread. When a series of cases of plague pneumonia occurs, the infective organisms are conveyed directly from case to case by coughing and inhalation. It is probable that the usual source of infection in the first case of the series is a severe secondary pneumonia occurring in a patient with septicæmic plague.

In India the rat flea, *Loemopsylla cheopis*, which closely resembles the human flea, *Pulex irritans*, in appearance, is by far the most commonly found species. In England the common rat flea is *Ceratophyllus fasciatus*; a single specimen only of *L. cheopis* has been found up to the present time.

L. cheopis, especially if hungry, will bite man; *C. fasciatus* does not take to man with any readiness, but will undoubtedly bite on occasion. This difference in the appetite of the two species for human blood may be of significance in determining the likelihood of the spread of rat plague to human beings.

G. F. PETRIE.

PROF. D. P. PENHALLOW.

WE regret to announce that Prof. D. P. Penhallow, D.Sc., F.R.S. (Canada), president of the American Society of Naturalists, and professor of botany in McGill University, Canada, died on October 20, in consequence of an apoplectic seizure, whilst on board the ss. *Lake Manitoba*, on voyage to Liverpool. His remains were brought to Liverpool, and were, in accordance with his wishes, cremated at Anfield Cemetery on Friday, October 28. Prof. and Mrs. Penhallow were about to begin a year's vacation, and had intended spending the winter in the south of England. In consequence of the severe strain of work which Prof. Penhallow had undergone during the last few years, his previously excellent health had shown signs of giving way, and under medical advice he was about to take a prolonged rest, when the lamentable event of his decease occurred.

Prof. D. P. Penhallow was born in 1854 at Kittery Point, in Maine, where his parents had a summer cottage, but their home was in New Hampshire, and Prof. Penhallow always regarded himself as a New Hampshire man. His family were in the direct line of descent from Governor Wentworth, of pre-Revolutionary days, and Prof. Penhallow was a splendid embodiment of the best type of New Englander. He received his scientific education in Boston University, and after graduation he was offered the post of professor of botany in the Imperial College of Agriculture in Japan. In the same year (1876) he married Miss Sarah Dunlap, who, like himself, could boast of a distinguished New England ancestry, and the first four years of his married life were spent in Japan. He thus enjoyed the distinction of being one of the group of Western students who were chosen by the Reformed Japanese Government to inaugurate the epoch of Meiji (intellectual enlightenment) in Japan.

Returning to America in 1880, he undertook work in connection with the summer school of botany in Harvard University, and in 1883 he was offered the newly-created chair of botany in McGill University, Montreal, where the rest of his professional life was spent. He had a very uphill fight in Montreal, which he manfully fought. There was no botanical laboratory and there were no funds to provide one; but as Prof. Penhallow gained the respect and esteem of the community help was forthcoming, and before he died the botanical laboratory was exceedingly well equipped. When he was appointed obscurantist views prevailed in Montreal, both in the city and in the University, and Prof. Penhallow was one of the very first to teach evolution, and may thus be said to have helped to inaugurate the epoch of "meiji" in Montreal. In his own science he devoted special attention to the anatomy of woods, both recent and fossil; on this subject he published many valuable papers, and in his great work on "Gymnosperms," which appeared in 1908, he summed up the results of twenty years' labour. His eminence in his special department was cordially recognised by the American scientific world, and when he died he was not only president of the American Society of Naturalists, but vice-president of the American Society of Botanists.

But Prof. Penhallow's activities were by no means limited to teaching in his special subject. He threw himself into every movement calculated to bring a wider intellectual outlook into Montreal and Canada generally. He instituted courses of lectures to teachers, which had for many years a beneficial effect on those engaged in instruction in the public schools of the city. He was a leading member of the Canadian Royal Society, and in 1897, when the British Association met in Toronto, he was appointed a member of a committee to impress on the Canadian Government the desirability of founding a marine biological station. The Government acted in accordance with the advice of this committee, and in 1899 a small floating station was started, which was moved from placed to place in eastern Canadian waters.

When in 1907 the Government was persuaded to give a grant towards the foundation of a permanent station at St. Andrews, Prof. Penhallow was deputed by the Biological Board to supervise its erection. When he arrived at St. Andrews it was found to be necessary not only to build the station, but to cut a road through a mile of forest and to build a wharf. No one was ready to undertake the contract for this work, and those who were ready to undertake part of it, when they discovered that it was to be paid for by "Government money," would only do so at exorbitant prices. With characteristic American energy and versatility, Prof. Penhallow threw himself into the breach, became contractor himself, and constructed the road, the station, and the wharf in one-third the time he was told it would require, and at a great saving in cost. Next year he superintended the activities of the station, but a political crisis at Ottawa temporarily stopped supplies, and the anxiety and financial strain which he underwent undermined his health, and, in the opinion of his friends, constituted the first link in the chain of causes which led to his death.

Prof. Penhallow is survived by his wife and by his son, Dr. P. Penhallow, who is engaged in medical practice in Boston. By his death McGill University loses one of its most distinguished professors, the city of Montreal one of its most public-spirited citizens, and the science, not only of botany, but of marine biology generally, a devoted supporter who could ill be spared.

E. W. M.

NOTES.

WE learn with great regret that it has been found necessary to postpone the festivities arranged to take place at Leyden to-day (November 3). On this date Prof. van Bemmelen completes his eightieth year, and he was to have received the personal congratulations of friends and disciples from all parts of the world. Owing to his illness, the ceremony is to be confined to the formal presentation of the jubilee volume by Prof. Lorentz, if, as is hoped, Prof. van Bemmelen is sufficiently recovered to receive him. The jubilee volume is a remarkable testimony to the regard which is felt throughout the world for the distinguished second founder of colloidal chemistry. It contains a portrait, together with a biography and a bibliography of the professor's published works. Sixty papers on subjects connected with the colloidal state have been contributed by workers from all parts of the world. Amongst the authors are le Chatelier, Duhem, Zsigmondy, Liesegang, von Wiemarn, Hissink, Freundlich, Biltz, Spring, Hardy, Svedborg, Jordis, Wolf. Ostwald, Lottermoser, Nietzk, Spiro, Bechold, Tamman, Barus, Bredig, Lorenz, Malfitano, &c. The volume is published by C. de Boer, Helder, Holland.

THE Allahabad *Pioneer Mail* of October 7 contains a melancholy review of a resolution recently passed by the Punjab Government regarding the prevention of plague. This resolution records that, in the opinion of a committee consisting of plague experts and district officers of experience, "no remedy has been found for the disease; that the people generally will not go to plague doctors to be treated when suffering from plague; that disinfection of houses by means of chemicals, or even by heat, as a means for checking or preventing an epidemic is useless; that rat destruction by poison or trapping is almost equally useless; and that inoculation, though a splendid means of individual protection, cannot be used to check the epidemic owing to popular prejudice." As the result of this, the Punjab Government propose, while keeping on the field the establishment of plague doctors, to reduce the cost if possible, and make suggestions as to how this can be done. It is not easy from this report in the *Pioneer Mail* to analyse the evidence upon which the Punjab Government acts, but the paper must cause melancholy reflections among the friends of India. Is it not true that the words *non possumus* are somewhat frequently heard from the mouth of the Government of India? We have just listened to them in connection with malaria prevention, and we have heard them over and over again in connection with the prevention of cholera. Perhaps a complete reform in the sanitary service of the country, with much more attention to sanitary investigation and a more generous employment of trained scientific workers, would not only save the Government the waste of much money on fruitless efforts, but would also do more to ensure success in the future.

COLONEL W. C. GORGAS, who has done such splendid work in removing mosquito-borne diseases from the Panama Canal zone, sends a short letter to the *Times* of October 28 in which he gives the death-rates for that area; and they are so remarkable that we here reprint his facts. Colonel Gorgas says:—"For the years since our occupation the statistics for the city of Panama have been as follows:—

Year	Population	No. of deaths	Death-rate per 1000
1905	21,984	1,447	65·82
1906	25,518	1,142	44·75
1907	33,548	1,156	34·45
1908	37,073	1,292	34·83
1909	40,801	1,038	25·44

The rates for the Canal Zone, under American jurisdiction, including the cities of Colon and Panama, are as follows:—

Year	Population	No. of deaths	Death-rate per 1000
1905	56,624	2,828	49·94
1906	73,264	3,544	48·37
1907	102,133	3,435	33·63
1908	120,097	2,983	24·83
1909	135,180	2,459	18·19

Among employés the rates have been as follows:—

Year	Employés	Death-rate per 1000
1905	16,511	25·86
1906	26,475	41·73
1907	39,343	28·74
1908	43,890	13·01
1909	47,167	10·64

There has been no case of either plague or yellow fever on the Isthmus since 1905. We admitted to our hospitals for malaria in the year 1905, 514 cases for each thousand employés; in 1906, 821 cases for each thousand employés; in 1907, 424 for each thousand employés; 1908, 282 for each thousand employés; and 1909, 215 for each thousand employés."

THERE seems little doubt that the four deaths reported recently at Freston, in Suffolk, were due to plague. To prevent any further development of the disease, active measures are being adopted to effect a general destruction of rats in Freston and the neighbourhood. The southern part of rural Ipswich has been systematically explored, and large quantities of poison laid down. The Samford Rural District Council has issued a warning notice pointing out that it is dangerous to touch dead rats with the naked hand, and urging their burial without delay. The public has been requested not to eat rabbits or hares killed in the district. The notice also urges a general campaign against uncleanliness and insects. The question of destroying rats over a wider area than that proposed has been raised, as many dead rodents have been found north of the Orwell. It is pointed out that the increase of rats can be traced to the practical extinction of their natural enemies—owls, kestrels, and hawks, which are now seldom seen in the locality. The origin of the disease is still uncertain, but there is reason to believe, in view of the plague at Odessa, that grain vessels from the Black Sea to the River Orwell may have brought over plague-stricken rats. The position of knowledge as regards the relation between rats and the spread of plague is described in an article elsewhere in this issue.

IN the gardens of the Zoological Society of London, Regent's Park, there is now in flower a specimen of *Agave Americana*. The Agaves are popularly known as "American" Aloes; but there are no true Aloes in America, the genus being almost entirely confined to South Africa. Agave is a member of the natural order Amaryllidaceæ, and Aloë of the natural order Liliaceæ. Another popular fallacy connected with the Agaves is the belief that the plants flower after 100 years and then die, hence the Agave is sometimes called the century plant. The facts are these, that the plants, being monocarpic, are only capable of flowering once, but the age at which a particular specimen will flower is determined by many circumstances, including constitutional characters and the suitability or otherwise of the conditions in which the plant is growing. These remarks apply specially to *Agave Americana*, for another species, namely, *A. Sartori*, is capable of flowering from year to year. *A. Americana* has very thick leaves of from 4 feet to 6 feet in length. They have sharp prickles all along the margins, and each leaf has a stiff, sharp point 1 inch to 2 inches long; these latter are sometimes called "Adam's needles." The plant contains fibre in the roots and leaves, and the fibre is used for commercial purposes. Agaves are cultivated for ornamental purposes in this country, being used frequently as terrace plants in large boxes or tubs. The flower spikes grow very rapidly when once they have formed, their height varying from about 15 feet to upwards of 20 feet. The numerous flowers are greenish-yellow, occasionally quite yellow, but scarcely golden as they are sometimes described. The plant which is now flowering at Regent's Park has stood out of doors during the summer, but it is blooming in the warm atmosphere of the reptile house. Another specimen bloomed in the same gardens in 1906, and two specimens flowered in the Victoria Park, London, in 1902. In Mr. Smith's gardens in the Scilly Islands a dozen or more specimens flowered out of doors in 1875, and in the south of France Agaves in flower are not uncommon objects. There is a variegated variety of *A. Americana* which is more ornamental than the type.

IT is announced in the *Revue scientifique* that Prof. Kammerling Onnes, of the University of Leyden, has put his cryogenic laboratory at the disposal of Madame Curie for her researches on radio-activity at low temperatures.

THE daily Press has recently given currency to a vague report that a "vast lake" has been discovered in an unexplored part of north-western Canada by Indians, which they declare to be as large as Lake Superior. The report is hardly likely to be correct so far as the size of the lake is concerned.

A COURSE of twelve lectures on "The Coasts of Great Britain and Ireland" (Swiney lectures on geology) will be delivered by Dr. T. J. Jehu in the lecture theatre of the Victoria and Albert Museum, South Kensington, on Mondays and Tuesdays at 5 p.m., and Saturdays at 3 p.m., beginning Saturday, November 5. Admission to the course is free.

A REUTER message from Vienna states that on October 28 the Radium Institute created there by the Academy of Sciences was formally opened by the Archduke Rainer. The new institute is to be devoted solely to chemical and physical research, and will be open to scientific men of all countries. The institute has at its disposal three grams of radium from Joachimsthal.

AT the annual general meeting of the Cambridge Philosophical Society, held on October 31, the following officers were elected:—*President*, Sir George H. Darwin, K.C.B.; *vice-presidents*, Dr. Fenton, Prof. A. C. Seward, and Prof. H. F. Newall; *treasurer*, Prof. E. W. Hobson; *secretaries*, Mr. A. E. Shipley, Dr. Barnes, and Mr. A. Wood. The new members of the council elected are Mr. E. A. Newell Arber, Sir Joseph J. Thomson, and Mr. J. E. Purvis.

THE Chemical Society's banquet to past presidents, which was postponed from May 26, will be held at the Savoy Hotel (Embankment entrance) on Friday, November 11. The banquet is in honour of the following past presidents who have attained their jubilee as fellows of the society:—Prof. William Odling, F.R.S., the Rt. Hon. Sir Henry E. Roscoe, F.R.S., Sir William Crookes, F.R.S., Dr. Hugo Müller, F.R.S., and Dr. A. G. Vernon Harcourt, F.R.S.

THE Berlin correspondent of the *Times* states that the German Ministry of the Interior has called a meeting to be held within the next few days to consider whether the foundation of a special institute for aviation research is practicable, or whether the work can be better carried out by existing institutions. Delegates from the Imperial Government and the Federal States will be present, together with representatives of the German technical universities, of various associations connected with aviation and motors, and of the industries concerned.

THE death is announced of Dr. D. J. B. Gernez, member of the Paris Academy of Sciences and a former collaborator of Pasteur. From a notice in the *Times* we learn that Dr. Gernez was born in 1834. On the completion of his studies he filled various posts as a teacher of scientific subjects. While engaged upon professorial work at the Lycée Louis-le-Grand he assisted Pasteur in some of his researches, and was for many years an intimate friend and collaborator of the great French investigator. For more than twenty years Dr. Gernez was a lecturer at the Ecole Normale of Paris, a post which he held simultaneously with professorships at other great educational institutions, and from which he retired in 1904. Dr. Gernez was the author of a number of treatises on scientific subjects, and was an Officer of the Légion d'Honneur.

AT the general meeting of the Royal Society of Edinburgh, held on October 24, the following office-bearers were elected:—*President*, Sir William Turner, K.C.B., F.R.S.; *vice-presidents*, Prof. Crum Brown, F.R.S., Prof. J. C. Ewart, F.R.S., Dr. J. Horne, F.R.S., Dr. J. Burgess, Prof. T. Hudson Beare, Prof. F. O. Bower, F.R.S.; *general secretary*, Prof. G. Chrystal; *secretaries to ordinary meetings*, Dr. C. G. Knott, Dr. R. Kidston, F.R.S.; *treasurer*, Mr. J. Currie; *curator of library and museum*, Dr. J. S. Black; *councillors*, Prof. J. W. Gregory, F.R.S.; Dr. A. P. Laurie, Prof. Wm. Peddie, Prof. H. M. Macdonald, F.R.S., Prof. D. Noël Paton, Dr. W. S. Bruce, Prof. F. G. Baily, Dr. J. G. Bartholomew, Dr. R. H. Traquair, F.R.S., Prof. James Walker, F.R.S., Prof. A. Robinson, and Dr. W. S. M'Cormick.

A MEETING of the Optical Convention executive committee was held on October 25 in the rooms of the Chemical Society to consider the desirability of holding a second convention in the year 1912. On the motion of Dr. R. T. Glazebrook, C.B., F.R.S., it was resolved that a meeting of the permanent committee, which all members of the trade and others interested be invited to attend, be held some time in November to consider what action should be taken with the view of organising an optical convention in 1912. The time and place for this meeting will be announced as early as possible. The chair will be taken by Dr. Glazebrook, director of the National Physical Laboratory, as chairman of the permanent committee, and a statement of the principal matters to be brought forward for consideration at the meeting will be published in due course.

THE magnetic survey yacht *Carnegie* left Para, at the mouth of the Amazon, under the command of Mr. W. J. Peters, on October 15, bound for Rio de Janeiro. This vessel, since leaving Brooklyn last June on her present cruise of three years in the Atlantic, Indian and Pacific Oceans, had covered nearly 7000 miles up to Para, during which portions of the first cruise were several times intersected by the introduction of loops. It is reported that the magnetic results obtained on the present cruise up to Para have fully confirmed the errors revealed by the first cruise in the existing magnetic charts of the North Atlantic. From Rio de Janeiro the *Carnegie* will proceed to Montevideo and Buenos Aires, and thence across to Cape Town, where she is due towards the end of March, 1911. At the latter port the director, Dr. Bauer, expects to rejoin the vessel, and be with her on the portion of the cruise in the Indian Ocean. *En route* to Cape Town, Dr. Bauer is to visit certain magnetic institutions in Europe in order to perfect arrangements for cooperative magnetic survey work.

THE *Morning Post* National Fund Airship made a flight from Moisson to Aldershot on October 26. The airship left Moisson at 10 a.m. (French time), the coast of France near St. Valery en Caux at 12 noon, passed over the English coast-line near Rottingdean at 2.18 p.m., and reached Aldershot at 3.28 p.m., being brought to earth at 4.5 p.m. The distance of 197 miles was accomplished in 5h. 28m. The rate of speed was about 36 miles an hour, including partially adverse wind conditions. The airship carried a crew of eight. During the journey 528 lb. of ballast were used; 400 litres of petrol were consumed by the engines, and at the moment of landing there were 880 lb. of water ballast, 990 lb. of petrol in reserve, in addition to at least 200 litres in the reservoirs. The engines started at 850 revolutions; they then worked up to 900 revolutions, and fell again to 850, and only finally during the landing worked at their full power of 1000 revolutions. The highest altitude reached was 2120 feet, and throughout the sea passage there was a steady level of about 200 feet. The overall length of the airship is 337·75 feet, and the water- and gas-proof envelope has a capacity of 353,165·8 cubic feet.

An appeal is made for funds to erect a new building for the Royal Society of Medicine. Of the sum required, the society has already provided 17,000*l*., and it asks that not less than 26,000*l*. may be contributed from without, so that it may not be compelled to curtail its very valuable public and scientific work. Towards the money in hand 8500*l*. has been subscribed by members of the medical profession. The Lord Mayor has become chairman of a Mansion House committee formed to promote the raising of upwards of 30,000*l*. for the new building. The governor of the Bank of England has opened an account for the receipt of donations, which may be sent to the Bank of England, payable to "The Royal Society of Medicine Building Fund," or to the Lord Mayor at the Mansion House. The society now has 3200 fellows and members, and possesses a library of nearly 100,000 volumes. It was originally founded in 1805, under the name of "The Royal Medical and Chirurgical Society." A new charter was granted it in 1905 under the new name of "The Royal Society of Medicine."

Several of the Parisian hospitals entertained their visitors last Christmas to kinematograph exhibitions, in which very realistic phases in the life-history of various pathogenic organisms were thrown on the lantern screen. On October 28 Messrs. Pathé Frères, of Paris, gave the members of the Medical Society of King's College Hospital an opportunity of seeing some of their most successful applications of the kinematograph to bacteriological photomicrography. The films shown represented (1) the experimental production of sleeping sickness in a rat, and the movements of the trypanosomes in the blood; (2) the spirochæta of recurrent fever, and the ticks which convey the parasite; (3) the spirochæta of fowls, some of which were seen imprisoned and revolving within the red corpuscles; (4) the movements of the infusoria from the intestine of a mouse; (5) *Trypanosoma lewisi* of the rat; (6) *Spirochaeta pallida*, which, although only 1/2000th of a millimetre in width, could be followed in its movements across the field of the microscope. Other films were shown representing involuntary movements of the embryo of the Axolotl and its emergence from the egg, and the movements of the human stomach as seen during an X-ray examination of a patient. There can be no doubt that these films are a triumph of technique, but the gain at present is rather in favour of the public entertainer than of the worker in science. The main advantage from a scientific point of view is that rapid movements may be slowed and analysed, while slow movements may be accelerated, and thus realised. Such films will become an essential part of the equipment of every physiological and medical workroom.

Three years ago the council of the Royal College of Surgeons, England, instituted demonstrations in connection with the museum. At one of these, given in the theatre of the college on October 28, the conservator, Dr. Arthur Keith, showed a series of specimens illustrating irregularities in the differentiation of sexual characters. The museum is peculiarly rich in specimens of this nature owing to the fact that John Hunter, its founder, had preserved many preparations which illustrated the influence of the sexual organs in determining the growth and features of many parts of the body. Amongst these are the specimens which show the assumption of the male plumage of aged pea-hens and hen pheasants. Preparations added to the museum by Mr. S. G. Shattock show that such an alteration of secondary sexual characters is accompanied by a change in the sexual glands, usually of an atrophic nature. A Leghorn fowl, in which the external characters were those of a cock rather than of a hen, had genital glands of an ovo-testicular type. The Hunterian preparations, illustrating the sexual organs of the "Free-Martin"—a form of ox born as the twin of a perfect bull calf—were also exhibited. Although these specimens had been preserved for more than 150 years, their tissue was in perfect condition for microscopical examination. In one case Hunter was of opinion that both testes and ovaries were present in the same individual (a true hermaphrodite), but on microscopical examination it was found that the "ovary" was really a mass formed by a remnant of the Wolffian body. A higher vertebrate with both testes and ovary has not yet been seen. Hunter explained all irregularities in the development of the accessory sexual organs and of "secondary" sexual characters as the result of an "imperfection" in the development of the testis and ovary. All museum specimens and recent experiments are in favour of his interpretation.

The third part of the fourth volume of Memoirs of the Peabody Museum is devoted to an account by Mr. Teobert Maler of a series of adventurous journeys starting from the north of Yucatan and extending to the great lake of Peten-itza, in Guatemala. The value of the memoir would have been enhanced by a sketch of the routes, which are not traceable on ordinary maps. Several important sites representative of the Maya-Toltec culture were identified, such as Motul, where a remarkable stela depicting a pair of dancing priests was found, Tubusil, Silbituk, and the remarkable island city of Itza-Flores. When the country passes under the control of a decent government the great lake of Peten will be brought into connection with the sea, and vast economical resources of this region will be developed, with the result that the remarkable ruined cities connected with the career of Cortes will receive adequate examination.

In the *Oxford and Cambridge Review* for Michaelmas term Dr. A. Smythe Palmer concludes his study on the luck of the horse-shoe. He arrives at the conclusion that it is derived from the cult of the new moon, which was adopted by primitive races as a symbol of recovery and good fortune. Incidentally, he has collected some curious examples to show that the symbol was regarded as possessing magical power among the prehistoric people of Europe, as is proved by various records of the discovery of horse-shoes in ancient interments, by the shape of many tumuli, and by the ring of trilithons at Stonehenge. He further points out that, following Babylonian precedent, the rising moon lying on her back was believed to be a silver boat. He thus disposes of the controversy between two sets of people who use the talisman in our days—one preferring to fix it with the heels upwards, the other downwards—in favour of the former.

In the *Field* of October 22 Mr. Lydekker points out that the new antelope described in NATURE of September 29 (p. 397) as *Strepsiceros buxtoni*, with the alternative name of *Tragelaphus buxtoni*, should be known by the latter title.

IN the *Zoologist* for October Mr. F. J. Stubbs adduces further evidence, especially an Act of 1564 (2 Eliz. c. 15), to show that egrets were formerly common in England. "At the middle of the sixteenth century England was the home of an egret that was highly esteemed for the table. It nested with us, and was protected by law; and the same, or an allied, species inhabited an adjacent part of the Continent, and was brought to this country alive for food. Probably the bird was not altogether white, thus differing from any existing European egrets or herons, and resembling species now found in America."

VARIATION in the oyster-boring whelk (*Urosalpinx cinereus*) forms the subject of an article by Dr. H. E. Walter in the October number of the *American Naturalist*. This mollusc is a native of the Atlantic coast of North America, but was unavoidably introduced when oysters were transplanted to the Pacific shore. It was the original object of the article to compare these introduced Californian whelks with their Atlantic prototypes, but comparisons were extended to a wider basis. As the result of the investigation, it appears doubtful whether Urosalpinx is more variable in its new than in its original home.

As fossilised birds' feathers have hitherto been recorded from only some fourteen localities—with one exception of Tertiary age—brief reference may be made to Mr. F. Chapman's description in vol. xxiii., part i., of the Proceedings of the Royal Society of Victoria, of a fossil of this nature from the Tertiary ironstone of Redruth, Victoria. No definite determination of the genus of the specimen, which is in the form of impressions on the two halves of a split nodule, is attempted, although it is suggested that it may have belonged to one of the smaller waders, such as the ibises.

THE third botanical number of the current volume of the *Philippine Journal of Science* contains a compilation of new or noteworthy Philippine plants, and a sixth part of an index to Philippine botanical literature, both prepared by Mr. E. D. Merrill. Among the new plants, about a hundred in number, mostly trees or shrubs, there are eleven additions to the genus Ardisia, ten to Ixora, and six to Hiptage; also new genera, Astrocalyx and Cephalomedinilla, are proposed under the family Melastomaceæ, Curraniodendron under Saxifragaceæ, and Pygmæopremna under Verbenaceæ. With reference to Ixora, it is noted that *Ixora coccinea* does not grow wild, but a closely allied species, *I. philippinensis*, is abundant and widely distributed.

AN enumeration of twenty-eight flowering plants and ferns growing on a London building site, about half an acre in extent, in Farringdon Street that has been vacant for two years is communicated by Mr. J. C. Shenstone to the *Selborne Magazine* (October). As the author points out, the chief interest lies in the methods of distribution by which the plants have reached the spot, and he has classed them as wind-distributed, kitchen refuse weeds, and forage or packing weeds. It is extremely puzzling to find a growth of bracken fern, since the plant is very difficult to transplant, and the appearance of *Ficus Carica* is not immediately explicable. Three casuals, that is, plants not indigenous to Britain, are provided by *Epilobium angustifolium*, *Senecio viscosus*, and *Erigeron canadense*.

OF the flowers which undergo marked changes after fertilisation, tropical orchids afford some striking examples. For instance, it frequently happens that after the pollinia reach the stigma the flowers fade prematurely, the column swells, the stigmatic surface becomes enclosed, and eventually the ovules begin to develop. It would generally be assumed that these changes can only be induced by the stimulus of the pollen on the stigmatic surface, and the subsequent growth of the pollen tube. It has, however, been observed by Dr. H. Fitting, as is pointed out in the *Gardener's Chronicle* (October 29), that certain of these effects can be produced by inorganic means. Thus scratching the stigmatic surface suffices to cause premature withering, and the application of dead pollinia or an extract therefrom may bring about swelling of the column; but apparently development of the ovules does require the stimulus induced by the pollen grains penetrating the ovary.

AMONG the numerous articles now appearing in agricultural publications on the growth of sugar-beet in England, one, by Mr. Chas. Bathurst, M.P., in the *Agricultural Students' Gazette* (vol. xv., part i.) deserves some attention. The importation of beet sugar into Great Britain is steadily increasing, and amounted in 1908 to nearly eighteen and a half million pounds sterling in value. Much of this could be produced in England, but the operation of the sugar bounties rendered the industry financially impracticable. Now that the bounties are abolished by the Sugar Convention, active steps are being taken in several counties to start factories, which, in Mr. Bathurst's view, should prove distinctly profitable unless an excise duty is placed on the sugar. An average crop is given as 18 tons per acre, selling at the factory for 18*s*. per ton, or 16*l*. 4*s*. The cost of production, including the rent of the land, should not exceed 9*l*. per acre, leaving a profit to the cultivator of 7*l*. 4*s*. per acre.

THE summary of the weather issued by the Meteorological Office shows that for the eight weeks of autumn as yet expired the aggregate rainfall has been largely deficient over the entire area of the British Islands. The greatest deficiency occurs in the north of Scotland, where the total rainfall is only 2·89 inches, which is 6·24 inches less than the average of the corresponding period for the last twenty-five years. In the west of Scotland the deficiency is 5·13 inches, the aggregate rainfall being only 3·10 inches. In the north of Ireland the deficiency is 3·98 inches, and in the north-west of England 3·60 inches. In the south-east of England, which comprises London, the deficiency amounts to 1·16 inches. The duration of bright sunshine for the period is deficient, except in a few northern districts, the greatest deficiency being fifty-eight hours in the east of England and fifty-six hours in the Midland counties. The mean temperature was not very different from the average, but its maximum readings were lower than usual, the absolutely highest temperature since September 4 being 76°, in the Midland counties. Frost at night has, as yet, only occurred in a very few districts. The aggregate rainfall since the commencement of the year is not very different from the average, but there is an excess, except in a few of the northern districts. The duration of bright sunshine as yet this year is generally deficient, the deficiency exceeding one hundred hours in the eastern districts of England.

IN the Proceedings of the Amsterdam Academy of Sciences of June 25 Dr. W. van Bemmelen and Dr. C. Braak give a preliminary report upon the investigation of the upper air, begun at Batavia in 1909. The observatory is now equipped with registering balloons and suitable instruments, but it was thought advisable to proceed cautiously in using them so near to the sea before obtaining more knowledge of the drift of the upper currents by means of pilot balloons. The following data showing the mean decrease of the temperature gradient per 100 metres of the lower 2 kilometres were obtained (1) above the land with a captive balloon and light wind; (2) above the land with a moderate westerly wind, with kites; and (3) above the sea (January 14–20), weather rainy, with kites; but the results are not strictly comparable, owing to differences of time of day:—

Metres	100–500	500–1000	1000–1500
Balloon ...	0·77° C. ...	0·57° ...	—
Kite (land)...	0·87 ...	0·72 ...	0·44° (<1500 M)
Kite (sea) ...	0·91 ...	0·59 ...	0·71

Further kite observations over sea gave for 1500–2000 m., 0·34°; 2000–2500 m., 0·50°; 2500–3000 m., 0·46°. At about 1000 m. the gradient shows a sudden decrease, probably due to the formation of cumulus clouds. The observations of wind direction for the period September–May show that the upper air-current has easterly components up to the greatest heights attained (10–15 km.). The average altitude of the west monsoon was 5·4 km. The upper easterly, as well as the lower westerly, winds were sometimes affected by strong northerly or southerly components. It is mentioned that diagrams of a registering balloon sent up on May 19, during the passage of the earth through the tail of Halley's comet, showed no other noteworthy feature than an inversion of temperature between 6 and 7 km.; the balloon burst at about 7 km.

THE various methods of finding the height of an airship are discussed by Captain Paul Renard in the *Revue scientifique* for September 17. Of the several methods of observing the height from the airship itself, Captain Renard considers that the use of the barometer affords the only practicable one. Of the methods of observing the height from the ground the large majority involve simultaneous measurement of several angles, and this is, in general, impracticable. Captain Renard considers that the best methods are by observation with a telemeter, coupled with a determination of the altitude, or by two simultaneous observations of the altitude at the instant the airship is in the vertical plane joining the two observers.

THE *Builder* for October 29 contains an illustrated article descriptive of the fine building now being erected in London for the Y.M.C.A. This building occupies an island site of some 33,000 square feet, bounded by Great Russell Street, Bedford Avenue, Tottenham Court Road, and Caroline Street. Reinforced concrete plays an important part, and has been employed for the solution of various structural problems of considerable magnitude. The building is not one of the reinforced concrete skeleton class merely sheathed in masonry, but rather is a combination of masonry with reinforced concrete, the latter material taking the duties hitherto very generally assigned to structural steel-work in modern architecture. Thus we find reinforced concrete columns, beams, and wall lintels forming the backbone of masonry features, and bearing a large proportion of the loads to be supported, yet without involving any noticeable departure from the familiar aspect of masonry. In some important respects reinforced concrete is exclusively adopted, as in floor, roof, gallery stairway, and swimming-bath construction, and in the form of exceptionally large girders. The details of the reinforced concrete work were prepared by Messrs. L. G. Mouchel and Partners, in accordance with the Hennebique system.

AN article by Mr. Fullerton L. Waldo on recent progress in the construction of the Panama Canal appears in the *Engineering Magazine* for October. Rapid progress has been made in the great lock-works and the huge dam that is rising at Gatun. The three lock flights divide the vertical distance to the 85-foot level between them, whereas the locks of the Pacific division have lifts of 33⅓ feet and 54⅔ feet respectively. The usable dimensions of the locks are 1000 feet by 110 feet, giving ample margin for even the new White Star liners, the overall dimensions of which are 890 feet in length and 92 feet in width. It is calculated that the lock-stair at Gatun will require about 1½ hours for the transit; the Pacific locks will detain the vessels for about the same length of time. The total passage across the Isthmus will take about 10 to 12 hours. The train takes about 2½ hours, so that passengers will probably prefer this method of transit. About 15 minutes are required to fill the lock chamber, but in case of need for haste the process can be completed in about half this time. The available water supply will allow of 48 lockages per day, which might mean an average of something like 80,000,000 tons of traffic annually as compared with 21,000,000 tons in the case of the Suez Canal and the 40,000,000 tons of the Sault Ste. Marie.

WE have received the first five numbers of a leaflet entitled *Hygieia*, which is published by the Bureau of the International Congress of Hygiene, which is to be held in Dresden in 1911. It contains notices with regard to the congress and brief abstracts of papers dealing with subjects appertaining to hygiene, *e.g.* sugar as a food-stuff, taverns as hospitals, cleansing of towns, &c.

MESSRS. NEWTON AND CO., Fleet Street, London, have issued a supplementary list of lantern-slides for the present session. Among many others, we notice numerous astronomical slides dealing with Halley's comet, the moon, and Greenwich Observatory; a set of slides showing Sicily and Messina after the earthquake; sets to illustrate eight lectures on India, drawn up by Mr. H. J. Mackinder for the Visual Instruction Committee; and slides showing aërial experiments and aëroplanes.

THE Penny Science Lectures at the Royal Victoria Hall, Waterloo Road, S.E., during November include:—November 8, "Early Men in Britain," W. Lower Carter, and November 22, "Liquid Air," Dr. R. Whittan Gray.

MR. H. K. LEWIS, of Gower Street, London, has published a catalogue of new books and new editions added to his well-known medical and scientific circulating library during July, August, and September of this year.

OUR ASTRONOMICAL COLUMN.

FIREBALL OF OCTOBER 23.—Mr. W. F. Denning writes:—"The fireball of Sunday, October 23, 8h. 12m., was observed at Kenley (Surrey), Ilford (Essex), and in Wales, as well as at other places. It appears to have passed over the sea N.E. of the mouth of the Thames at heights of 84 to 40 miles. The length of the luminous course was about 75 miles, and the velocity 19 miles per second. Radiant near α Arietis.

"The observation of the meteor from stations in Wales is interesting, and it is probable that the object was seen from a great many towns in England, for it appeared at a time when many people would be out of doors. The sky was, it is true, cloudy at some places and veiled the brilliant light of the meteor, but it was a very fine one, and gave several flashes as it slowly sailed along the E.N.E. as seen from the neighbourhood of London. It is important that if any further observations of an exact character were made they should be published, so that the flight of the object may be investigated accurately."

THE MOTION OF MOLECULES IN THE TAIL OF HALLEY'S COMET.—In a recent note in these columns (September 29, p. 404) attention was directed to some results published by Prof. Lowell in which he showed that particles repelled by light-pressure along the tail of Halley's comet travelled with accelerating velocities. An important addition to these results is now published in No. 48 of the Lowell Observatory Bulletins. By comparing the images shown on direct photographs with those shown on contemporaneous objective-prism spectrograms, taken under conditions which permit the comparison, Prof. Lowell has educed evidence that the gaseous molecules of the tail were repelled by light-pressure.

A series of spectrograms, taken during April and May, shows that the constituents of the tail varied considerably from one date to another. But the evidence indicates that on May 23 about 70 per cent. of the radiations represented on the spectrograms was due to emission, the remaining 30 per cent. being taken up by the continuous spectrum. That is to say, that the knots previously measured, on the direct photographs for May 23, were composed chiefly of gaseous molecules. As these knots showed, by their accelerating velocities, the action of a repulsive force exerted from the sun, it follows that light-pressure is competent to repel gaseous molecules.

Confirmation of this important result is derived from a similar comparative study of the direct and spectral images of the tail of Morehouse's comet. The spectroscopic evidence in that case indicated that practically all the light recorded on the plates was emitted by gaseous particles, yet the direct photographs afforded evidence of the action of light-pressure.

THE DARK BAND SURROUNDING THE POLAR CAPS OF MARS.—Readers of these columns will remember the discussion raised by M. Antoniadi's contention that the dark band seen circling the polar cap on Mars is simply a contrast effect. In support of this contention M. Antoniadi stated (see NATURE, December 23, 1909, vol. lxxxii., p. 227) that photographs of the planet, taken in America, did not show the dark band, although at the same time they showed that the cap was not brighter than the continental areas, and therefore irradiation could not be adduced as the reason for the absence of the band. Prof. Lowell, in a note appearing in No. 4448 of the *Astronomische Nachrichten*, emphatically states that the photographs do show that the polar cap is brighter than the "continents," and actually irradiates in consequence beyond the confines of the disc. Further, the screen through which the photographs were taken was such that the relative brightness of the caps would be considerably modified.

THE SPECTRUM OF NOVA SAGITTARII NO. 2.—The nova recently announced by Mrs. Fleming appears on sixteen photographs taken at Arequipa between March 21 and June 10; the magnitude varied from 7·8 to 8·6 between those dates. The spectrum is quite faint, but shows the hydrogen lines, $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$, $H\zeta$, and $H\eta$, bright; a trace of $H\gamma$ as a dark line is seen on the less refrangible edge of the bright $H\gamma$ line.

The star does not appear on seventeen photographs taken between July 23, 1889, and October 7, 1909, although stars down to magnitude 12·0 are shown on the majority of the plates; one plate shows the fifteenth magnitude or fainter.

A visual observation by Mr. Leon Campbell, using the Harvard 24-inch reflector on October 3, showed the magnitude of the nova to be 10·5.

Prof. Millosevich, on October 15, determined the position, reduced to 1910·0, as 17h. 54m. 26·28s., -27° 32′ 52·1″, and the magnitude as 10·4 (*Astronomische Nachrichten*, No. 4448).

A NEW VARIABLE STAR OR A NOVA, 97·1910 CYGNI.—In No. 4448 of the *Astronomische Nachrichten* Mr. Hinks records the discovery of what appears to be a new star, or an unrecorded variable, on plates taken by him on August 7, 10, and 12, 1909. The position of the object is R.A. = 19h. 49m. 55·01s., dec. = $+36^{\circ}$ 46′ 57·4″ (1900), and the approximate magnitudes on the dates named were 10·4, 10·2, and 10·5 respectively.

Plates taken on August 17, 19, and 26 show no trace of an object in this position, although those of August 17 and 26 show stars down to magnitude 12·5; nor could the star be found visually on September 19 and 26, when it should have been visible if brighter than mag. 13·0.

Mr. Hinks publishes a chart of the region around the object, and asks for any available information as to its appearance on photographs which may have been taken elsewhere.

NEW VARIABLE STARS IN HARVARD MAP, NO. 52.—In Circular No. 162 of the Harvard College Observatory Prof. Pickering announces the discovery, by Miss Cannon, of twenty-two new variable stars on No. 52 of the Harvard maps. The region of the plate is 18h. -60°, and altogether thirty-five variables were found. Some of the new variables have ranges of three or four magnitudes, one, D.M. -57° 8613, varying from 7·6 to 10·0; this is of the Algol type, and has a spectrum of the fifth class.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE Anthropological Section at the Sheffield meeting was presided over by Mr. W. Crooke, whose works dealing with the ethnology of India are well known and highly valued by all anthropologists. His address has already appeared in NATURE (September 29) and need not be alluded to here, except to refer to the tribute that was paid to the work of Dr. Tylor, who has so lately resigned his professorship at Oxford, and who presided over the department (as it then was) of anthropology at the last Sheffield meeting, held thirty-one years ago.

A feature of the section's work was the joint discussion with Section L (Education) on the measurement of intelligence in school children, to which Dr. Spearman, Dr. Lipmann, Dr. Myers, and Messrs. Burt, Brown, and Gray contributed. A report of this discussion will be given in the account of the proceedings in Section L.

Beyond this the work of the section ran on the usual lines, the number of archæological papers being again a prominent feature. The section, as usual, had the advantage of hearing reports on their work by members of the British Schools of Archæology at Athens, Rome, and in Egypt, and also from gentlemen who have been excavating and exploring in the British Isles.

In the following summary the papers are broadly grouped together under the various subjects with which they dealt.

Archaeology.

Mr. T. Ashby described the excavations which have taken place at Caerwent, the site of Venta Silurum. These have consisted of the uncovering of several more houses, and of the excavation of the central insula to the north of the city, which contains the Forum and Basilica. This latter had no apses, and from its S. aisle at each end were entrances into the streets. The Forum was surrounded by an ambulatory and shops. Numerous skeletons were found in another part of the city, but were not contemporary, being obviously of post-Roman date. Closely akin to this paper was Prof. Bosanquet's account of the excavations at Caersws, undertaken by the Liverpool committee for excavation and research in Wales and the Marches.

Mr. H. D. Acland presented a paper on some prehistoric monuments in the Scilly Isles, which consisted of a description of two groups of menhirs. Several of those of one group have a constant orientation differing 4° from a normal bearing. A group of intersecting banks was also described, which have a similar variation as the menhirs.

The excavation of a broch at Cogle, Watten, Caithness, was described by Mr. Alexander Sutherland. The building had been overgrown with vegetation, and five successive layers of ashes and pavement were found. Among the Neolithic remains were several stone pestles, discovered in the lowest stratum; these were of a basalt-like stone and were originally of oval or oblong shape, but had been worn down by constant pounding until some of them had become circular. The broch was 30 feet in diameter.

The Rev. Dr. Irving read a paper on the prehistoric horse, found some little time ago at Bishop's Stortford. Careful comparisons have been made with other skeletons, and the conclusion seems warranted that it represents a late Pleistocene race, which has survived into Neolithic, Bronze, or the Early Iron period, the age of the deposit being difficult to judge, as stone, bronze, and iron have all been found. The site, however, shows promise of proving to be of some importance, and a committee has been appointed by the association to assist in its examination.

A suggestive paper was contributed by Mr. George Clinch on some unexplored fields in British archæology, in which he directed attention to the amount of destruction of antiquities which is occurring annually, urged the establishment of regular and systematic oversight of great engineering works which involve excavation and removal of soil, and directed attention to certain promising forms of archæological exploration, such as blown sands, peat mosses, marshes, and dried river sites.

The committee appointed to investigate the lake villages in the neighbourhood of Glastonbury reported the results of the work carried out at Meare, on two distinct groups of low circular mounds. The excavations included the examination of three dwellings and trenching with the object of finding the palisading, but although the ground was examined for some 100 feet from the mounds, no such border protection was discovered. The relics found were all of the greatest interest and importance, and show clearly that the Meare people lived under similar physical conditions and civilisation as did their neighbours at Glastonbury.

In what may be termed Mediterranean archæology four papers were presented. Messrs. A. M. Woodward and H. A. Ormerod described a group of prehistoric sites excavated by them in south-west Asia Minor. Nineteen prehistoric mounds were examined, extending from the plains of Elmeli in N.E. Lycia to Lake Kestel in Pisidia. The potsherds found were mainly of a red hand-polished ware, assignable to the Bronze age, but fragments of a black polished ware were also discovered, some of which may possibly be of Neolithic origin. Painted pottery showing affinities to Cappadocian and Early Cypriote Iron age fabrics were also discovered, but this pottery appears to be independent of Ægean influence or importation. The remains of a megalithic rectangular house were found.

A paper on excavations carried out in Thessaly in 1910 was submitted by Messrs. A. J. B. Wace and M. S. Thompson, the sites chosen for the season's work being Tsangli and Rachmani. On the first of these, remains of Neolithic houses were discovered, square in plan with internal buttresses. Celts and vases were found, and also terra-cotta statuettes, of which the male figures, rare in Thessaly, showed markedly phallic characters, while the female were steatopygous.

At Rachmani houses were discovered, and a considerable amount of pottery and a few figurines. A comparison of the two excavations enables the prehistoric age in Thessaly to be divided into four periods:—(1) Neolithic, with red and white painted pottery; (2) Neolithic, with Dhimini and kindred vases; (3) sub-Neolithic, to which period belongs the remarkable encrusted ware; and (4) Chalcolithic, in which period the pottery is unpainted, and the latter part of it is apparently contemporary with Late Minoan II and III.

Dr. T. Ashby, the director of the British School at Rome, described the excavations carried out by him at Hagiar Kim and Mnaidra, Malta, under the auspices of the Maltese Government. The object of the work was to discover whether the excavations carried out many years previously had completely revealed the ground plan and to endeavour to find sufficient pottery to enable the date of the structures to be determined. In both respects the action was justified by results. A large, hitherto unknown, roughly paved area was discovered at both places, and at Mnaidra subsidiary buildings, perhaps devoted to domestic uses, were disclosed. The small objects found, fragments of pottery and flint, corresponded absolutely with those from the hypogeum at Halsaflieni, so that it seems clear that Hagiar Kim and Mnaidra are also of the Neolithic period.

Some cup and ring markings and spirals from the hypogeum at Halsaflieni were described by Dr. Dukinfield Astley. The markings are done in red paint on two of the roofs of the buildings.

Prof. Petrie gave an account of the work carried on by the British School in Egypt at Meydum and Memphis. At the first place the archaic sculptured tombs were removed, owing to the damage they had suffered from native plunderers. Two of these chambers are unique, the colours being inlaid in deep undercut hollows. The burial chamber of the largest tomb was excavated, in which was found a sarcophagus of red granite, the oldest known, dating about fifty years earlier than that in the Great Pyramid. In the course of the work at Meydum quarry marks were found on many of the blocks. As these name the months of quarrying, it makes it possible to fix the shifting months of the Egyptian calendar, as the season of quarrying is closely fixed by the inundation. The result is the fixing of the reign of Sneferu at 3200 or 4700 B.C.

At Memphis work was begun on the temple of Ptah The main result has been the discovery of a large shrine built by Amenhotep III, and a portrait head of King Amasis. Sealings were found on the palace site, while pottery kilns were also carefully explored.

Dr. Seligmann contributed a paper on a Neolithic site in the southern Sudan, at which hammerstones, pygmy implements, and implements of hornstone were found, all on the surface.

A description of the archæological activities in the United States, as carried on by the various universities and public bodies, was given by the well-known American anthropologist, Miss Alice Fletcher, who was appointed a vice-president of the section for the meeting.

Ethnology and Ethnography.

Several papers on general ethnology and ethnography were presented to the section. Mr. E. Torday described the Bu-Shongo of the Congo Free State, a tribe inhabiting the district between the fork of the Kasai and Sankuru rivers. The nation is composed of a number of subtribes all under one paramount chief. The most famous of the chiefs was Shamba Bolongongo, who has become the national hero, and is venerated because he was a man of peace and a great lawgiver and philosopher. The organisation of government now existing is that remodelled by this chief, although it has become greatly weakened. In theory the king is absolute, but his power is limited by two bodies, somewhat analogous to two houses of parliament. Above all is the king's mother. There is a form of totemism. The people are great wood-carvers, amongst the most interesting products of this art being portrait statues of their kings. Five of these are known and three of these are now in the British Museum, amongst these being that of Shamba Bolongongo himself.

Mr. Mervyn W. H. Beech contributed a paper on the Suk of east Africa. These people, who live to the north of Lake Baringo, are akin to the Nandi, but with a large aboriginal element. This is especially seen in their language, which, although it contains a large percentage of Nandi and a little Turkana, has a considerable amount of what is probably aboriginal. The tribe is divided into totemic and exogamous clans, and the social system resembles the Nandi; but, on the other hand, the dress, ornaments, and dances are like those of the Turkana and differ entirely from those of the Nandi.

Mr. G. W. Grabham read a paper on native pottery methods in the Anglo-Egyptian Sudan. He described the various kinds of pots made, the most interesting, perhaps, being the gobanas, or coffee-pots. Two cup-shaped saucers are made and roughly dove-tailed together; the join is then smoothed down, a handle and spout added, and the whole is then scraped, polished, ornamented, and baked.

Dr. W. H. R. Rivers, in his paper on kava drinking in Melanesia, explained that many facts point to this custom being indigenous and not an importation from Polynesia, or, if introduced, that it has a far greater antiquity than other Melanesian customs to which a Polynesian origin has been ascribed. In the southern New Hebrides the method of preparation resembles the Polynesian, and the name is the same, so that here the practice may have been influenced by the Polynesians; but in the northern New Hebrides, Banks and Torres Islands, the name is indigenous, and the whole ceremonial of making and drinking the infusion differs fundamentally from that of Polynesia. In many cases its use has a clearly religious and social character. The occurrence of the practice in the Fly River region of New Guinea suggests that the distribution of the custom may have been very wide, and that in New Guinea and northern Melanesia kava has been replaced by betel.

In his paper entitled "A Search for the Fatherland of the Polynesians," Mr. A. K. Newman endeavoured to prove, partly by the evidence of place names, that the first home of the Polynesians was in the Ganges Valley.

Two papers of general ethnological interest were contributed by Miss Fletcher and Mr. E. S. Hartland. In the former—a sidelight on exogamy—the author directed attention to the exogamic character of the Omaha social organisation, while in the latter Mr. Hartland discussed the origin of mourning dress, and held that mourning was worn not so much as a disguise, as suggested by Dr. Frazer, but as a means of typifying the union of the dead and as an expression of sorrow and abasement, so as to deprecate the malice of a spirit, naturally annoyed at finding itself disembodied.

It is particularly gratifying to record that the committee appointed at Winnipeg to consider the feasibility of starting an ethnographic survey of Canada reported that, owing to representations made by the council of the Association and by a deputation of the committee and others, which waited upon Sir Wilfrid Laurier, the Dominion Government has included in its estimates the sum of 420*l.* to establish a department of ethnology under the Geological Survey. This most gratifying result may be considered as entirely due to the initiative taken by the Association at the Winnipeg meeting.

Two ethnological papers of great interest were those by Prof. Elliott Smith on the people of Egypt, and by Prof. H. J. Fleure and Mr. T. C. James on the people of Cardiganshire. The latter of these should perhaps be classified under physical anthropology, as the survey was largely an anthropometrical one.

Prof. Elliott Smith began by urging the impossibility of reconstructing the history of man in Egypt unless the work is based on the study of physical characters, as apart from mere measurements, of accurately dated human remains from the three great divisions of the Nile Valley—Lower and Upper Egypt and Lower Nubia. Of the origin of the predynastic Egyptians, all that at present could be safely said was that they showed affinities to both the Mediterranean race and to the Arabs. Although just before the end of the predynastic period some slight change in the character of the population can be seen, it is not until the Third Dynasty that the significance of the change can be fully appreciated. At this date it becomes clear that each of the three divisions of Egypt had its own distinctive population: Lower Nubia, a people identical with the predynastic but tinged with negro; Lower Egypt, the descendants of the predynastic peoples, mixed profoundly with white immigrants, who came in by way of the Delta, while Upper Egypt, though not directly affected by either of these alien stocks, was yet indirectly affected by both, through the intermingling of its people with those of the two other districts.

In the time of the Middle Kingdom this white and Nubian influence became more marked in the Thebaid, and thus the gradual gradation of physical characters, from the black of Nubia to the white of the Levantine population in the north, began to set in, a gradation which has persisted to the present day.

Messrs. Fleure and James pointed out in their paper that the basis of the population of Cardiganshire appears to be the Mediterranean type, that is, a type marked by considerable dolichocephaly, dark hair, slight prognathism, and a stature a little below the average. But as the type becomes fairer these marked characteristics disappear, prognathism ceases to exist, and the head becomes shorter. Amongst this population there is also a fair type, in which the heads become still shorter and the stature higher, while the face becomes opisthognathous.

Physical Anthropology.

In purely physical anthropology two papers only were presented, there being still the marked decline in papers of this nature which has been noticeable during the last five years. It is very much to be regretted that the anatomists and other workers in the field of physical anthropology have ceased from presenting the results of their work to the Association, and it is to be hoped that a turn in the opposite direction will soon set in.

Prof. C. J. Patten described a rare form of divided parietal in the cranium of a chimpanzee. Cases of this kind are extremely rare, and the one under consideration appeared to be an example of complete division of both parietals, each by a horizontal suture, running the entire length of the bones and joining the coronal and lambdoid sutures. The case is of further interest owing to the way in which the upper segment of each bone is again subdivided. Correlated with this condition there is a thinning out of the bones of the cranial vault and a reduction in the size and strength of the zygomatic arch and of many of the processes at the base of the skull.

Dr. W. L. H. Duckworth exhibited a microtome, made by the Cambridge Scientific Instrument Company, which provides a means of preparation of anthropological material possessing great interest. Some of the preparations thus made were mounted as lantern-slides and exhibited; for example, in a section of the leg of an adult man, tissues so distinct in consistency as bone, tendons, and muscles could be seen. Other specimens exhibited were sections of the larynx and tongue.

Finally, the report of the committee to conduct archæological and ethnological researches in Crete contained long reports on Cretan anthropology, by Mr. C. H. Hawes, and physical observations, viz., head form and pigmentation, of Cretan school children, by Dr. Duckworth. Both these reports contained a mass of detailed measurements and observations which it is impossible to summarise. One point may, however, be mentioned. Dr. Duckworth is of opinion that the general physique of Cretan children is frequently, if not always, poor, being markedly inferior to that of British children of the same age.

AGRICULTURE AT THE BRITISH ASSOCIATION.

IN drawing up the programme for the Sheffield meeting the organising committee of the Agricultural Subsection adhered to the lines laid down last year. Certain problems of current interest and importance were discussed at joint meetings so far as possible, and attention was directed particularly to those aspects of the problems on which men of pure science could throw much needed light. There were, therefore, very few general papers, and such as were read were regarded rather as preliminary accounts of work that must come on later for discussion.

The chairman's address has already been printed *in extenso* in these columns (September 8). It dealt with fertility, the eternal and fundamental problem in agriculture, and traced the history of the views that have been held since the early experimenters of the seventeenth century began their work. Fertility depends on several factors, any one of which may at a given time become a limiting factor and determine the growth of the plant. The amount of available mineral food, the supply of water, and the supply of nitrates all enter into the problem. All that science can do as yet is to ascertain the existence of these factors one by one, and bring them successively under control; it is not yet possible to disentangle all the interacting forces the resultant of which is represented by the crop.

Dr. Crowther and Mr. Ruston discussed the impurities of the town atmosphere and their effect on vegetation. Rain water falling within the industrial section of Leeds is highly charged with mineral and tarry matter, and also contains a good deal of acid. The rain of the residential districts is much purer, but still not as pure as country rain. Pot experiments, and observations made in gardens, parks, &c., showed that the effect of the impurity was complex; the stomata of the plants were blocked, especially if they happened to be sunk as in the conifers; the soil also suffered. These actions produced marked results on vegetation; in extreme cases the plants were actually killed, and even those surviving were much affected. The case of grass was examined in some detail because of its technical importance. It was found that the impure rain reduced the yield and the protein-content of the herbage but increased its fibre-content. The feeding value was therefore much diminished.

Prof. Berry followed with an account of the ether extract of the oat kernel. It has long been known in a general way that the ether extract is not all fat, although so labelled as a matter of convenience. Prof. Berry has examined the extract in detail, and the great value of his work is that he is dealing with definite varieties of oats grown under known conditions. It is understood that the research is being continued, and some interesting conclusions may be looked for.

Mr. A. S. Horne gave an account, illustrated by photographs, of a bacterial disease of potatoes. Not long ago it was supposed that plant diseases were caused by fungi, but cases are steadily accumulating where bacteria are the active agents. Several cases have been worked out at Newcastle, and it was felt that on a future occasion more time will have to be devoted to this important branch of study.

The second day was given up to a discussion of two subjects now coming much into prominence. Sugar-beet growing was dealt with by Mr. Sigmund Stein and Mr. G. L. Courthope, M.P. Later in the day nitrogen fixation was discussed by Mr. Golding and Prof. Bottomley. It has always been known that sugar beet could be grown in England, but the industry never had an opportunity of development by reason of the Continental sugar bounties. The Brussels Convention, however, has so altered the position of affairs that a reasonable prospect of success seems assured; already factories are springing up in different parts of the country, and farmers are contracting to supply the necessary beets. For many years Mr. Stein has advocated beet-sugar production, and in his paper he gave a summary of the various experiments he has made to meet the objections that have from time to time been raised. He claimed that the practical difficulties, both in the field and the factory, are now overcome, and the time is ripe for active development. Mr. Courthope dealt with the financial aspects of the question, and gave a number of carefully prepared statistics showing that the new industry has every probability of success. This paper created a very favourable impression, and the speakers that followed agreed that a good case had been made out. There has, as usual, been a good deal of exaggeration about the possible effect of a new rural industry. If sugar beet is grown, some other crop will have to go out; the gain to the country will therefore be the difference between the new and the old, and not, as is commonly stated, the whole amount that the new crop will bring in. Still, there is no doubt that a new industry and a new market would have a useful steadying effect on agricultural prices.

Nitrogen fixation was the next subject. Prof. Bottomley brought forward the evidence in favour of his proposition that Azotobacter, in conjunction with Pseudomonas, both obtained from the root tubercles of Cycas, will "fix" more nitrogen than either alone. He further argues that this mixed culture will grow in soils and "fix" nitrogen to form compounds readily transformable into plant food. Some discussion arose as to the interpretation of the results; the quantities involved are small, and the experimental errors known to be considerable. The great difficulty arises, however, in the absence of a satisfactory standard by which one experiment may be compared with another.

Mr. Golding dealt with his subject in a more general way, his researches having been directed to the whole question of nitrogen fixation in the root nodules of leguminous plants. This fixation is brought about by bacteria which invade the root hair as infection threads, pass through a rod-shaped stage, and finally assume the bacteroid (Y) form. Mr. Golding is steadily overcoming the difficulties of working with the organism in artificial media, and is succeeding in making it pass through the changes that it undergoes in the plant. During the period of active nitrogen assimilation an alkaline substance is formed; after a time, if the products are not removed, assimilation stops, the alkali disappears, and the medium becomes acid. Dr. Russell pointed out that this change from alkaline to acid reaction indicated that the organisms were now utilising the nitrogenous base already formed, and therefore setting the acid free, a change known to go on in other cases.

On Monday, September 5, a joint meeting was held with the Zoological Section to discuss the effect of partial sterilisation of soils. Dr. Russell read a paper which he and Dr. Hutchinson had prepared, giving an account of the work they have been doing at Rothamsted during the past three years. There is a notable increase in productiveness when a soil is heated or treated with volatile antiseptics like toluene. This was traced to an increase in bacterial activity, which, in turn, was shown to be the result of removing some factor that had in the original soil limited bacterial activity. By drawing up a systematic plan of experiment it was possible to find what processes would, and what would not, put the injurious factor out of action, and so the authors had arrived at a list of properties the factor possessed. According to their results it appears to be a living organism larger than bacteria, but developing more slowly, killed at or below 50° or by prolonged drought. It might actively destroy bacteria, or, on the other hand, it might form a protoplasmic layer round the soil particles containing organic matter, and thus keep off and starve the bacteria. The zoologists present made some very useful suggestions. Dr. Shipley recommended sewage-farm soils as the best place to start hunting for the organism. Dr. Ashworth suggested that the amœbæ or amœboid organisms of the soil might be the culprits, and considered that methods of investigation like those used by Musgrave and Clegg or by Noc might with advantage be tried. Mr. T. J. Evans, on the other hand, thought that the results indicated a mycetozoan plasmodium, while Mr. J. J. Lister urged that mycetozoa would require vegetable matter, which, however, they would have in the soil.

Mr. K. J. J. Mackenzie followed with an account of the "points" prized by the breeder of high-class stock, and gave the results of measurements he had made to find out how far the "points" really are correlated with the characters they are supposed to indicate. So far as he has gone—he is pursuing the problem further—the correlation is very slight, and it can only be inferred that the breeder arrives at his eminently successful results rather by an intuitive process than by any use of his "points." The question is of great economic importance, because England is, and seems likely to remain, the stud-farm of the world.

A joint meeting with the Geological Section followed, at which soil surveys were discussed. A paper by Mr. Hall and Dr. Russell was read, dealing with the objects and methods of agricultural soil surveys. The ordinary drift map is not sufficient, although it makes an admirable starting point. It is necessary to classify the soils further, to study them in their relation to the local agriculture, and to ascertain the effect of manures, of rainfall, topographical position, &c. Illustrations were given to show that a soil may be sufficiently described from the agricultural point of view when its mechanical analysis, and its positions on the geological, orographical, and rainfall maps are known. Mr. L. F. Newman gave a preliminary account of his survey of the drift soils of Norfolk, which seems to indicate a fairly regular distribution of the various types of soil. Mr. C. T. Gimingham described the "teart" land of Somerset, on which animals "scour" badly. This condition is confined to one formation, the lower lias, and disappears when even the most superficial covering of alluvium occurs. A large acreage is affected. Evidence is adduced that the cause is to be sought in the physical state of the soil; if this is so, it should be capable of remedy. It is much to be hoped that the field trials which Mr. Gimingham has drawn up to test this view will be carried out.

The last day opened with a paper by Mr. Hall on the cost of a day's horse labour on the farm. This fundamental problem of agricultural economics has been but little investigated, and Mr. Hall's estimate of 2*s*. 7*d*. per day must be regarded as the most complete we have at present. Another economic paper followed, by Mr. Turnor, on costs in the Danish system of dairy farming. The data were gathered during a tour of Denmark, and represent a good deal of study of the subject. Mr. Turner is shortly bringing out a book in which the results of his investigations will be more fully dealt with.

The rest of the day was devoted to a discussion jointly with the Economic Section of the errors of agricultural experiments. Prof. Wood opened the subject with three papers prepared in conjunction with Messrs. Stratton and Bruce. From the results it appears that many of the feeding trials carried out in the country are of very doubtful value. Agriculturalists have usually neglected the experimental error; in few, if any, of the numerous county council experiments, for instance, is it ever taken into account. Prof. Wood's papers, along with one by Mr. Hall and Dr. Russell on field trials, have emphasised the importance of the matter, and steps are being taken to distribute these papers among agricultural experimenters.

A paper by Mr. Collins on the errors of milk analysis concluded the session.

The position of agriculture at the British Association is not yet settled. Whatever the council decide to do, it is hoped they will continue to give a separate organisation to agriculture, and thus afford to workers in agricultural science an opportunity—the only opportunity for some of them—of meeting their fellow workers in pure science and discussing their problems. It is necessary to get help from several sides and not simply from one, as from the chemical or the botanical, which seems to be the theory of a sub-section. However, whether lawfully or not (it appears to have been unlawfully) the organising committee has hitherto enjoyed the fullest liberty, and has succeeded in arranging a series of meetings that have proved extremely helpful to agricultural investigators, and promise to play no small part in the encouragement of agricultural research.

PHYSIOLOGY AT THE BRITISH ASSOCIATION.

In addition to the presidential address, which has appeared already in NATURE, there were a number of interesting papers communicated to the section. Physiology was unique in that it was the only section that met at the University; and thus, although somewhat isolated from the other sections, enjoyed the advantage of the laboratories for demonstrations.

There were two joint meetings, one with Chemistry (Section B) and Botany (Section K) on the biochemistry of respiration, and the other with Education (Section L) on speech; the latter will be reviewed in the proceedings of the section of Educational Science. In addition, Dr. Leonard Hill, F.R.S., gave an interesting address on the prevention of caisson disease. The individual papers will be reviewed, as much as possible, so as to form groups in a logical sequence.

The discussion on respiration, held in the meeting-room of Section K, was opened by Dr. F. F. Blackman, F.R.S., who dealt with the subject under three headings.

(1) The series of chemical reaction which take place during oxidation. He took glucose as a typical example, of which the final products are carbon dioxide and water, but the intermediate steps are difficult to follow. Buchner's zymase produces alcohol and carbon dioxide from glucose, but it has been shown that alcohol cannot be oxidised by plants, and hence it must be surmised that some other substance, before the breakdown has reached the alcohol stage, is what is actually oxidised. There are probably many of these fugitive compounds, amongst which may occur lactic acid and di-hydroxy acetone. An alkaline sugar solution, as the result of exposure to sunlight, gives rise to substances which are easily oxidised. He then dealt briefly with oxidases, peroxide formation, and Palladin's hypothesis of respiratory chromogens, which are oxidised by oxidases to peroxides, and then pass on the oxygen to oxidisable material.

(2) The physical chemistry of the processes involved in oxidation. Influence of temperature on velocity of reaction (usually shows a coefficient of about 2·5 within the limits of temperature at which living processes can occur); the uniformity of the respiratory quotient (O_2/CO_2) at different temperatures and the effect of the concentration of the reacting substances were discussed. He illustrated these points by referring to his experiments with green leaves and potatoes (starchy and rich in sugar). The output of carbon dioxide by green leaves is reduced to zero by exposure to sunlight. The potatoes rich in sugar show a greater rate of oxidation than the starchy ones. The conclusion is arrived at that there is a minimal tissue respiration and an excess of respiration depending on the supply of respirable material.

The influence of accelerators, paralysators, and other substances was mentioned.

(3) Special influences of colloidal nature of cell protoplasm. Oxidation and reduction take place side by side, and death of the cell mixes up these two processes. Alterations of permeability of protoplasmic septa may account for changes in physiological oxidation processes.

Dr. H. M. Vernon referred to Dakin's work on oxidation of fatty acids and amino-acids by hydrogen peroxide and traces of ferrous salts. If zymase is allowed to act upon glucose for a short time, then the solution is boiled and oxidase and hydrogen peroxide are added, there is almost complete oxidation to carbon dioxide and water; this suggests that oxidases may act in living cells if organic peroxides can replace hydrogen peroxide. His own experiments on survival respiration (kidney) point to the presence of oxidases, and that certain poisons act by combining with aldehyde or similar groups. Some substances act especially on the "high-grade" process (formation of carbon dioxide) and not so much on the "low-grade" process (oxygen absorption), and thus the respiratory quotient is lowered. In relation to minimal protoplasmic and excess respiration, he directed attention to the fact that minced tissues show at first a greater output of carbon dioxide than when intact, but that the respiration soon falls to a much lower level.

Dr. E. F. Armstrong pointed out that in many respects oxidases differed from the other kinds of enzymes (they are heat stable and not specific in action), that their action can be imitated by colloidal suspensions of inorganic matter, and that traces of inorganic material are usually present in them. There are, however, specific oxidases. He then demonstrated the blackening of laurel leaves by the action of toluol (other chemically inert substances with little affinity for water act similarly), which he ascribed to a general breakdown of the protoplasm with liberation of oxidases.

Mr. D. Thoday spoke about the result of experiments on anæsthetised leaves. Small doses of chloroform cause a temporary increase of oxidation. A large dose causes a diminution in the output of carbon dioxide; with Helianthus and cherry laurel there is a great increase in oxygen intake, which quickly falls off, but with Tropæolum the oxygen intake falls at once. It was suggested that tannins oxidise first, and as there are no tannins in Tropæolum there is no initial increase of oxidation. Probably the result is brought about by an increase of permeability.

Prof. H. E. Armstrong, F.R.S., referred to Leathes' work on the splitting of fats at intermediate points in the carbon chain, and to the formation of peroxides by manganese and iron with hydroxy-acids. Oxidation may take place by decomposing water with liberation of hydrogen; in plants the hydrogen may be used to reduce carbon dioxide to formaldehyde. The leaf surfaces show a permeability similar to that found by Adrian Brown for barley grains.

Prof. Waller and Dr. Reynolds Green spoke, and Dr. Blackman replied.

Dr. Leonard Hill, F.R.S., reviewed the work done in relation to the prevention of compressed air illness. Whilst exposed to high pressure the body dissolves a larger amount of gas than at ordinary atmospheric pressure, and when the pressure is reduced bubbles of gas may be set free in the blood vessels. The solubility of the gas follows Henry's law; owing to the capacity of the tissues to absorb oxygen it is only the nitrogen that is set free in the vessels. The symptoms depend on the portion of the circulation which is stopped by the nitrogen embolus. Different portions of the body saturate at different rates, but work, by increasing the circulation, increases the rapidity with which the body takes up and gives off nitrogen. By analysis of the gases in urine it can be shown that it takes an appreciable time for the body to get into equilibrium with the pressure of the nitrogen in the atmosphere, or, in other words, the blood does not get into equilibrium with the gas on passing once through the lungs.

The relative merits of uniform decompression and decompression by stages were discussed. Long shifts are better than short, as there are fewer decompressions for the same amount of work, and the danger is due to decompression. When symptoms occur they can be abolished, or the danger minimised by recompression to the original pressure.

He recommended that, during decompression, occasional inhalations of oxygen should be taken (to lower the partial pressure of the nitrogen in the lungs, and thus hasten the removal of nitrogen from the blood) and that exercise should be taken to increase the circulation, and thus remove the nitrogen from the "slow" parts more quickly.

Prof. F. S. Lee, of Columbia University, read two papers. (*a*) "The Cause of the Treppe." During the course of the staircase the excitability of the muscle increases. Clamping the trachea causes a second treppe. Fröhlich states that the treppe is due to slowing of relaxation, so that the increase in height of contraction is only apparent, as the contraction starts at a higher level; but at one stage of the treppe the contractions are not prolonged, while there is no delayed relaxation during fatigue of mammalian muscle. (*b*) "Summation of Stimuli," with Dr. M. Morse. Repeated subminimal stimuli can cause contraction. Traces of lactic acid, carbon dioxide, and other substances that are formed during fatigue increase the excitability of muscle. Gotschlich finds that muscle becomes acid as the result of repeated subminimal stimuli. Prof. Lee suggested that the treppe and summation of stimuli are both due to traces of fatigue substances.

Prof. C. S. Sherrington and Miss S. C. M. Sowton presented two communications dealing with the constant current as a stimulus of reflex action, and the effect of the intensity of the current on the response to stimulation. The preparation used was the isolated extensor of the knee in decerebrate rigidity. Non-polarisable electrodes were placed on an afferent nerve of the limb. A weak stimulation caused a reflex increase of tonus. This is a nearer approximation to the artificial production of reflex tonus than has hitherto been obtained. Otherwise the result of artificial stimulation is a reflex inhibition, as indeed it is with this stimulus when stronger. A stronger stimulus causes an increase of tone, followed by inhibition. A strong stimulus abolishes the preliminary increase of tone, and only inhibition results. In fact, the results obtained are exactly the same as have long been known for the direct stimulation of the opening muscle of Astacus claw. Stimulation occurs at the make and break of the constant current, and not usually during its passage. With a strength of current which gives a reflex increase of tone, chloroform converts the response to inhibition, and as the chloroform passes off the response to the stimulus again becomes an increase of tone.

Dr. J. Tait: (1) "The Conditions Necessary for Tetanus of the Heart." Refractory period of heart consists of absolute and relative refractory stages. The former lasts during systole, and the latter gradually diminishes from the end of systole. The stronger the stimulus the earlier it can be made effective in the relative refractory period. If the stimuli are sufficiently strong they can be effective at the end of systole, and tetanus results. Very strong stimulation causes electrolysis, which produces a series of contractions that gradually die away. (2) "Neurogenic Origin of Normal Heart Stimulus." Excised frog's heart-beat sometimes shows grouped beats (Luciana groups). These are probably due to waves of excitation from rhythm-producing centre. The tendency to grouped beats is increased by lack of oxygen, and the rate and rhythm correspond to that seen in tracings of Cheyne-Stokes respiration; hence the normal heart-beat is regulated by some mechanism similar to that which is affected in Cheyne-Stokes respiration. A constant stimulus with waves of increasing and diminishing strength would, as the strength increased, become effective earlier in the relative refractory period, and hence the increase of rate of beat.

Dr. H. M. Vernon reported the results of some experiments on the combination of poisons with the contractile substance of cardiac muscle. He used the tortoise heart, and perfused it with the various solutions. Alcohol, chloroform, and ether all cause effects proportional to their concentration, and recovery occurs on removal of the drug by fresh saline. Hydrocyanic acid and sodium fluoride cause a marked effect in small concentrations, but the action does not increase much when the strength of solution is increased. Recovery is not good, and is less with the stronger strengths. On removal of the sodium fluoride the heart-beats show remarkable oscillations of amplitude. The vitality of the heart is always permanently injured, as a second test with the same strength causes a greater effect than at first. The season and condition of the heart cause minor differences in the result.

Prof. C. S. Minot, of Harvard University, gave his views on the morphology and nomenclature of blood corpuscles. Present nomenclature not satisfactory. Both red and white cells originate from the primitive wandering cells (mesamœboid). Leucocyte = white cell, and can be subdivided into lymphocyte (young leucocyte), finely granular, and coarsely granular. Erythrocyte = red cell, and they can be subdivided into ichthyoid stage (cells like those in fish with a nucleus showing chromatin network), sauroid stage (like birds and reptiles, nucleus homogeneous, usually called normoblast), and plastid (non-nucleated or mammalian type).

Prof. C. S. Sherrington, F.R.S., Dr. E. E. Laslett, and Miss F. Tozer communicated the results of some experiments indicating the existence of afferent nerves in the eye muscles. The sensory nerve-endings maintain a primitive reptilian type; many "brush" and "creeper" endings are found in the region where muscle and tendon join. No muscle-spindles are found, but a clasping form of ending, which is probably a simple form of spindle. The eye muscles have a greater nerve supply than any other muscles. By cutting the nerves and examining the muscles after the nerves had degenerated it was proved that the third, fourth, and sixth cranial nerves contain sensory fibres in addition to the motor fibres, which are usually stated to be the only kind present. These nerves are therefore afferent-efferent nerves. No sensory fibres to the extrinsic eye muscles were traceable from the first division of the fifth nerve. There are a few small medullated nerve-fibres which do not degenerate after section of all of the foregoing nerves; these are apparently vasomotor, and come from the otic ganglion.

Dr. Dawson Turner and Dr. T. George recorded the results of the X-rays in therapeutic doses on the growing brains of rabbits. The development of the exposed side of the brain was slower than the other side. Fatty degeneration of the irides and loss of weight occurred during treatment. The subject is important, as X-rays are frequently used on children in the treatment of ringworm.

Prof. A. B. Macallum, F.R.S., read three papers: "The Origin of the Inorganic Composition of the Blood Plasma," "The Inorganic Composition of the Blood Plasma in the Frog after a Long Period of Inanition," and "The Microchemistry of the Spermatic Elements in Vertebrates."

The first two deal with the relative amounts of the inorganic salts in the blood. The ratios of these to each other are fairly constant throughout, and agree with the relative amounts of the same substances in sea-water; but there are some variations, and the total amounts of inorganic material are different in the different species. He explains the distribution of the salts as reflecting the composition of the ocean at that epoch when the blood plasma of the species in question ceased to respond to changes in the salts of the ocean. The vertebrate kidney is the factor that maintains the ancestral composition of the blood.

The third paper dealt with the distribution of iron and potassium in the spermatic elements. The iron in the nucleus diminishes through the series spermatogonia, spermatocyst, spermatid, and is absent from the head of the sperm itself. Mode of elimination masked. Potassium abundant in spermatic elements, gathered at anterior and posterior ends in frog, and only in posterior region and in bands in man. No potassium in the head itself.

Prof. W. H. Thompson spoke on the nutritive value of beef extract. Dogs were fed on a constant amount of dog biscuit until their weight was steady. The addition of beef extract caused an increase of weight ten or twenty times as great as the amount of extract added. Boiled egg-white was not nearly so efficacious. Nitrogen apparently not retained, and when beef extract was discontinued the dogs returned to their former weight. The increase in weight is not due to retained water, but to an increased digestion and absorption of the dog biscuits, as the nitrogen and total amount of fæces were diminished.

The reports of research committees were, as usual, of a technical nature. They often briefly referred to papers which have been published elsewhere, and thus are not suited for detailed description here. Arising out of the report on anæsthetics was a brief discussion on the advisability of legislation to improve the training of those who are destined to administer anæsthetics, and to prohibit unqualified persons from administering them. Prof. A. D. Waller, F.R.S., in connection with the report on electromotive phenomena in plants, read a paper describing the method used to estimate hydrocyanic acid in plants and animals, with an application of the method to medico-legal purposes. The committee on ductless glands report on a considerable number of researches, the results of some of which have already appeared. The reports on body metabolism in cancer and on mental and muscular fatigue each contain instructive and suggestive material.

Some interesting photomicrographs of muscle fibres were shown by Dr. Murray Dobie, who published his first paper on the structure of muscle in 1848.

Prof. J. S. Macdonald exhibited the respiration calorimeter on two separate occasions. The heat production of a resting man was compared with that of a man riding a bicycle.

A SUGGESTED RESEARCH FUND FOR TROPICAL DISEASES.

THE *Times* of November 2 publishes the subjoined appeal which Lord Northcote has addressed to the Lord Mayor in favour of the allocation of a part of the fund raised for a London memorial to the late King to the establishment of an Edward VII. Tropical Research Fund. The proposal has received the support of leading representatives of many national interests, including Lord Crewe, Secretary of State for the Colonies, Lord Elgin, Lord Kitchener, and Mr. Joseph Chamberlain.

Letter to the Lord Mayor.

My Lord Mayor,—Having noted that you are taking steps to form a representative Mansion House Committee for the purpose of raising a fund to provide a memorial of the late King in London, and that you are receiving numerous suggestions as to the form which that memorial should take, we desire respectfully to offer the following suggestion for your earnest consideration.

(2) The late King, in his beneficent activity for the welfare of his people, was inspired by two ideals—peace for mankind and war on disease. His work in the former of these directions has been recognised by the world at large; it is in following his lead in the second that we think that a fitting tribute to his memory will be found.

(3) Only recently, but now unmistakably, has the nation become alive to the vital importance of its tropical possessions. Their development proceeds apace, but at a heavy cost in human life and vital energy. Rarely does a mail arrive which does not bring sorrow into at least one home in these islands.

(4) For generations mankind have been willing to accept in a fatalistic spirit the death toll levied upon them by what was vaguely known as "the climate." Now this is no longer so. Thanks to the devoted labours of scientific men—among whom our own countrymen hold an honoured place—we know in many instances what the enemy is and how it is to be met.

(5) Those who are not conversant with the subject will be surprised and almost startled to hear the effect on human life of measures taken as the result of such investigations. We give three illustrations, drawn from the history of three of the greatest scourges of the tropics :—

(*a*) Malaria.—In Klang and Port Swettenham, two towns within the protected Federated Malay States, remedial measures were commenced in 1901. The deaths from malaria were in 1901 368 and in 1905 45. In the surrounding districts, where no measures were taken, the deaths for these years were respectively 266 and 351. In Hong Kong remedial measures were commenced in 1901. In that year the admissions to hospital were 1294 and the deaths 132. In 1905 the admissions were 419 and the deaths 54. In 1904 the United States took over the administration of the zone of the Panama Canal; the deaths from malaria, which in 1906 were 821, had sunk in 1908 to 282.

(*b*) Yellow Fever.—In the city of Havana 35,952 persons perished of yellow fever between 1853 and 1900. The United States Government commenced remedial measures in 1900, and in 1907 only one case of yellow fever was reported.

(*c*) During the last three years steps have been taken in Uganda to stamp out sleeping sickness, an epidemic which in one district alone had destroyed some 200,000 people out of a total population of 300,000. In 1907 the deaths in the kingdom of Uganda numbered less than 4000, and in 1908 they fell to 1700.

(6) It will be seen that, tested by results, these figures are full of promise, and prove conclusively that the measures taken have proceeded on sound lines.

(7) It will naturally be asked: How have these results been achieved? The answer, so far as this country is concerned, is by private effort in close cooperation with the Government. Leaving out of account the Liverpool School of Tropical Medicine, which has been generously endowed by the citizens of that city, the bodies which are responsible for sustained and organised effort are the Royal Society, the London School of Tropical Medicine, the Sleeping Sickness Bureau, and the African Entomological Research Committee, all of which are associated with the metropolis. The first of these enjoys no direct Government support, and has carried out its work by a committee which includes some of the most eminent names in the profession of tropical medicine, who have given their services freely and gratuitously. The London School of Tropical Medicine at the Albert Dock, which owes its establishment, in part, to private generosity, receives an annual grant from Government of 1300*l.* The Sleeping Sickness Bureau is supported entirely by Government, the annual cost being some 1200*l.* The African Entomological Research Committee has recently been established to investigate the insects which convey disease to men, animals, and plants in the tropics, and includes among its members the best authorities on the subject. It receives a Government grant of 2000*l.* a year, and it is working in close cooperation with the Natural History Museum. In addition to the foregoing grants, a grant of 750*l.* a year is made to the University of London for the purpose of assisting work which has an important bearing on tropical medicine.

(8) The three cases which we have mentioned above are those in which the most striking results of scientific research have hitherto been obtained, but it is hardly necessary to say that they cover only a small portion of the field. Notwithstanding the rapid advance of knowledge in tropical diseases, there are many as yet unknown or imperfectly understood. The causation of blackwater fever, of dengue, of beri-beri, and of many other diseases still calls for investigation.

(9) We submit to your committee that no more appropriate memorial to our late Sovereign could be proposed than the establishment of a fund to carry on and extend the work of research into tropical disease. We further submit that it is eminently appropriate that London, the metropolis of the Empire, should take the lead in a movement for giving the full benefit of British administration to these outlying portions of the King's dominion, which have contributed in no small measure to her prosperity in the past, and will, by their development, give still ampler ground for her gratitude in the future.

(10) There can be no class in this great city to which the scheme will not appeal. To the rulers, the missionaries, the philanthropists, and all those who concern themselves with the welfare of the millions of coloured races whom Providence has committed to our charge it will appear of transcendent importance. To those whose kith and kin have gone out to bear their part in the work of civilising our tropical possessions, in whatever station of life, it will appeal no less strongly. To the man of business, in whose profit and loss account the dangers to the health of his employés figure so largely, our proposal will need no further recommendation. The ultimate aim is the creation of a Tropical Britain whose peoples are freed from the scourge of sickness, and where

the work of civilisation moves forward without the present toll of life and health. It is impossible to overestimate the results, both moral and material, that such a consummation would entail.

(11) We suggest that a fund should be established—to be known as the Edward VII. Tropical Research Fund—the interest of which should be devoted to furthering the objects which we have indicated. We think that the cause which we have at heart will be best served by not attempting to define too strictly the way in which this revenue should be appropriated. It is probable that in the first instance, and to a large extent, it would be most usefully expended in subsidising the efforts of the institutions to which we have already referred, being administered by a body whose composition will be a guarantee to the subscribers that their moneys are being wisely and economically applied.

We are, my Lord Mayor, yours faithfully,

NORTHCOTE.

25 St. James's Place, S.W., October 27.

MODERN SCIENTIFIC RESEARCH.[1]

RESEARCH is a word much used in newspapers and in public discussions nowadays, but few people outside purely scientific circles have any clear idea as to its meaning. Of course, the dictionary tells us that it signifies a searching again or a careful search, but the question then arises, What is the object of the search and are there any rules to guide?

The object may be purely visionary, as was the object of the early chemists and alchemists, whose operations, extending through the dark centuries of the Middle Ages, left behind practically nothing but an extensive, though barren, literature, the witness of the credulity and ignorance of those times. The lesson to be derived from the whole of this strange history is one which needs to be continually revived and set in the new light of modern discovery and invention. The lesson is simply that until men began to observe and interrogate nature for the sake of learning her ways, and without concentrating their attention on the expectation of useful applications of such knowledge, little or no progress was made. In other words, until a sufficient foundation of pure science has been successfully laid there can be no applied science. Real progress comes from the pursuit of knowledge for its own sake.

I say, again, this truth needs to be continually reiterated, for there are still too many people who think that the true and only business of science is to find out useful things, and who regard all the rest as waste of time.

The first qualification for research is undoubtedly that kind of inspired curiosity which can never be eradicated, and which we know by many examples is not defeated by such obstacles as poverty, or ill-health, or pressure of other necessary occupations. Another qualification is some knowledge of the subject chosen for inquiry. As to this latter qualification considerable differences of opinion have been expressed. Priestley, whose statue stands near the Town Hall in Birmingham, and many of the chemists of his time, had very little preparatory instruction, but some of them made discoveries of fundamental importance. Priestley seems to have been of opinion that very little preparation is necessary, and the discoveries which might result from experiment were regarded by him as largely the result of chance and to be compared with the game which might fall to the gun of a sportsman in a new country, and whether fur or feather cannot be foretold. But though this might have been partly true in Priestley's time, it is certainly very far from true in our day, when the accumulation of knowledge, however imperfect, is still immense.

Every great discovery is the culmination of a long series of discoveries each of which is a necessary step, and ignorance of these preliminaries stands in the way of advance.

It will be worth while to examine a few cases by way of illustration. No better example can be found than the establishment of the great principle in chemistry commonly called the periodic law. According to this law, the properties of the elements and of their compounds stand in a definite relation to their atomic weights.

Modern views concerning the constitution of gases affords another illustration of the way in which the possession of one kind of knowledge leads to more knowledge. Forty years ago students were led to believe that there were two kinds of gases, namely, on the one hand, those which by the action of cold, or pressure, or both together could be liquefied, and on the other hand some half a dozen which could not be reduced to the liquid state. This was attributed to some fundamental difference of constitution in the two kinds of gas.

If we look for an example drawn from the domain of biology there is the doctrine of evolution, now universally accepted, which is based on the results of the patient collection of facts by Darwin and Wallace. But those facts would perhaps not have been collected, and they would certainly have been without meaning, but for the results of the study of comparative anatomy by previous generations of naturalists and palæontologists, as well as the recognition of the great doctrine of uniformitarianism in geology proclaimed and established by Lyell.

The examples cited will not appeal to the practical man in the same way as some instance taken from a direct application of science to business or practical affairs. If it is really necessary to consider a case of that sort, nothing could be better than the *dynamo*, which, as a transformer of energy, comes into prominent daily use in connection with lighting, traction, and as a general motive agent. The detailed history of the evolution of the dynamo would be a long story, and on this occasion it is only necessary to point out one or two facts. For the fundamental principles involved we must go back to Benjamin Franklin, and Galvani and Volta, all in the eighteenth century, and later to 1831, when Faraday discovered the generation of induced currents by moving a conductor in a magnetic field. But doubtless the experiments made by Franklin with the kite, by Galvani on frogs' legs, and by Volta and Faraday with bits of wire, were by the people of their day looked upon with a mixture of amusement and contempt, just as some people even at the present time are apt to exclaim, "Who cares whether there is oxygen in the sun?"

It is obvious, then, that whatever may have been possible in Priestley's time, the wholly uninstructed person cannot expect to meet with much success in these days in the discovery of new facts; and although the exceptional man may acquire in a very short time some knowledge of a special part of a subject, he is in perpetual danger of falling into great mistakes. It seems to me that a considerable amount of knowledge, skill, and experience is an indispensable equipment for anyone who enters seriously into the practice of scientific research. Not that these qualifications alone serve as inducements to such a career, for it would be quite easy to point to examples of learned people who have added nothing new to the branch of knowledge with which they are best acquainted. This is not necessarily due to indolence, nor to ignorance of the methods of research, but is merely the result of peculiarity of temperament which lacks that divine curiosity which alone supplies the stimulus.

I am speaking now only of real scientific research, the inquiry into the secrets of nature, not of the occupation of those who have only practical ends in view.

Looking back over the great principles of natural science, we see that in every case they have been established by the efforts of the amateur, and by amateur I mean all who have undertaken the work for the pure love of it. This includes, not only men of independent position like Cavendish, Lyell, and Darwin, but a large number of men who have held the office of professor or teacher, but who, in this country at any rate, are neither paid to do such work nor required by the conditions of their appointments to undertake it. So far as I know, there is but one institution in this country in which the professors are not required to teach, but only to press forward into the unknown, and that is the Royal Institution in London. But the character which that famous place has assumed during the last hundred years is not that with which it began its career. It was started at the end of the eighteenth century by Count Rumford with purely utilitarian purposes in view, namely, for teaching the

[1] Presidential address delivered to the Vesey Club, Sutton Coldfield, on October 13, by Sir William A. Tilden, F.R.S.

applications of new discoveries in science to the improvement of arts and manufactures and to "facilitating the means of procuring the comforts and conveniences of life"; and while retaining that character and those pretensions it soon came to the verge of collapse. But Davy's lectures and discoveries changed all that, and Faraday's genius consecrated the laboratories for all time to the service of pure science.

Let us review very briefly the great principles on which physical science is based.

First, of course, there are the fundamental principles of the conservation of matter and of energy, the latter finally established on a quantitative basis by Joule in 1843. There is the principle of uniformitarianism introduced into geology by Lyell now extended so as to include, not only the phenomena of this earth, but of the whole cosmos, such extension being mainly due to the use of the spectroscope by Kirchoff and Bunsen, and only a little later by Huggins. The principle embodied in the so-called periodic law of the elements, already referred to, has led to a general belief in the evolution of matter from one primary material, and physicists and chemists are vying with each other in the endeavour to gain evidence as to the details of the process. I need scarcely say that the principle of evolution as applied to living beings is associated indissolubly with the names of Darwin and Wallace.

Notwithstanding the discovery of radium and its allies, and the discoveries by J. J. Thomson as to the disintegration of atoms into corpuscles a thousand or more times smaller, all ordinary chemistry is built up on the conception of atoms introduced by John Dalton just a hundred years ago. The consolidation of this theory has proceeded as a consequence of the discoveries begun in 1872 by Wislicenus, developed by van 't Hoff and Le Bel in 1874, and confirmed by an army of other workers down to the present day. We now not only suppose it probable that atoms are placed within a molecule in definite positions relatively to one another, but in a great many cases their order and arrangement in space can be positively traced.

Suppose all these great laws and principles never to have been discovered—science and its applications would not exist, and the world would have remained in about the same condition as it was in two hundred years ago. Railways, electric light and traction, telegraphs, dyes, explosives, antiseptics, anæsthetics and many other drugs, metals such as sodium, aluminium, magnesium, tantalum, and even modern steel would be unknown.

But these things are merely the results of the recognition, development, and application of the principles already indicated as fundamental, and the immediate corollaries from them. And so it seems that there are two fields for research which are equally necessary to civilisation and progress. In the one the worker watches the operations of nature and puts questions in the form of experiments solely with the desire to find out her ways; in the other attention is given only to those laws, facts, and phenomena which can be made serviceable to man. There is much more public anxiety in regard to the latter, and considering how entirely ignorant are most people about the principles of physical and natural science this is not greatly to be wondered at.

Some people are under the impression that there is an art of scientific discovery which can be communicated from one person to another. That is not my belief. I think the history of scientific discovery shows that each successful pioneer has invented methods for himself, or has at least known how to select from the tools ready to his hand. And with regard to personal qualifications, I do not think it possible to create that combination of mental powers which is called insight. Hence I have very grave doubts about the advisability of spending time and energy in trying to evoke and cultivate the capacity for research in all students in colleges and universities. If this were possible we ought to see greater results in those cases in which it has already been tried. The judicious teacher will, of course, be careful to avoid any appearance of indifference toward ardour and enthusiasm whenever they appear, and he should ever be on the look-out for indications of the kind of capacity which alone repays cultivation, and give it all the encouragement in his power. But the clamour which has of late been raised as to the supposed desirability of extending instruction in the principles and methods of research, down to the very beginners, indicates, to my mind, a lack of judgment on the part of some of the agitators. It seems to be forgotten that in every branch of experimental science, and especially of applied science, there is a great deal to learn, and it is necessary that at the end of his career as a student a young man should be able to *do* things practically and usefully. The theory of music and the laws of harmony are very desirable for the musician, but if he is to be a performer he must devote the greater part of his time to practice on his instrument, whether piano or violin. The case of the student of science is analogous, and if he does not devote a good deal of time to learning the technique of his business he will not be ready for research or anything else. At the present time too many students who can write at length on theoretical questions of a most recondite character, and who boast that they have been engaged in research under eminent teachers, are yet incapable of choosing a subject for themselves or of handling successfully a subject found for them by their teachers or someone else.

With the object of testing the influence exercised by methods of education in science on the development of the faculty of research, I have lately had the curiosity to compare the results indicated by the lists of Doctors of Science of the University of London. Up to 1886 this degree was awarded on the results of a very severe examination. From 1887 onwards it has been obtainable only on the production of a thesis supposed to embody the ideas and the work of the candidate on some subject selected by himself. The examiners are at liberty to impose an examination with the object of assuring themselves of the candidate's knowledge of his subject, but as a matter of practice the examination has been reduced to a mere formality. It was expected that this change of system would be followed by indications of much greater fertility in the fields of research. Owing to the completeness with which chemical literature is indexed, I have been able to make a comparison between the number and character of original papers published by the chemists in these two lists within the ten years following graduation in each case. I have not been able to make so strict a comparison among the physicists owing to the distribution of their work through so many media of publication, but I have been led by a careful survey to the same conclusions as in the case of the chemists. In both classes, the *Examinees* and the *Researchers*, if they may be so distinguished, there are cases in which the doctor, after taking his degree, has done no original work—or at any rate none that was fit for publication—and his name does not appear in the literature of his science. On the other hand both lists contain famous names. I will only mention in passing that the names of Larmor and Lodge appear among the examined. On the whole, I see no indications that the procedure by thesis has had any effect whatever on the character of the graduates. If anything, the list of examined is of somewhat higher quality than the list of graduates by dissertation, for there are nine out of fifty-four who have become Fellows of the Royal Society, while among the others there are only eight out of fifty-nine who can write themselves F.R.S.

In the latter list there may be one or two who may achieve this distinction hereafter, but there are no indications that in the long run the amount and quality of the contributions made to science by the graduates who are supposed to have been trained to research will surpass those of the men who had to face the ordeal of examination.

Does this not seem to justify my original contention that the researcher is born, not a product of educational manufacture, and that his disposition to research will survive all sorts of adverse conditions, including those which are by some people supposed to be inherent in examination?

I feel convinced that most of the great discoveries of the future will be made, as in the past, by the inspired amateur, working usually alone and often on apparently insignificant beginnings, and with results which may not at first receive any attention from the world.

It is, however, necessary in these days to provide for some form of cooperation in research, partly for the reason that the cost of some kinds of investigation is quite beyond the means of most private persons, and partly because of the unfortunate separation which still prevails, chiefly in this country, between science and industry.

First, then, science may justly look for assistance from the State. In England this is given in a grudging way. Parliament allots 4000*l*. to the whole range of the physical and natural sciences. The fund is administered by the Royal Society, and the biggest slices out of it are taken in the form of contributions to the expenses of expeditions. Then there is the National Physical Laboratory, with an expenditure of about 25,000*l*. a year, of which 7000*l*. comes from the Treasury. This seems to be all that comes directly from the national purse; but science is endowed to a certain extent by her friends. This assistance is represented by the equipment of certain schools and colleges by the Guilds of London, and by the small research funds of the Chemical Society and the British Association.

Something more systematic is, however, wanted, and I feel strongly that some of the rather large funds given in the form of scholarships to young students could be more advantageously used if applied to the maintenance of proved investigators to make them independent of the necessity to earn a living by teaching or other professional work. I recognise, however, the difficulties which would attend any such scheme. In the first place, discoveries cannot be made to order. An able, industrious, and conscientious man might work for many years without producing definite results, and a few cases of that kind would destroy or shake public confidence. It would also be necessary to provide incomes large enough to retain the services of the most able men available.

With regard to the application of science to industry, I think our manufacturers have made some progress during the last thirty years. But they still suffer from delusions. The mistake most commonly made arises out of a misapprehension of the methods, powers, and promises of science. It still seems to be too often supposed that a scientific man, called into hurried consultation, can at once overcome a difficulty in a manufacturing process or can devise an improvement which, if adopted, would represent many thousands of pounds profit to someone. If this were so scientific men would be better off than they usually are. What is wanted is a general recognition of the principle that improvements can be expected only as the result of the use of scientific methods, which are simply the methods of reason applied to the materials provided by experience.

What every manufacturer wants is to begin with a scientific education, if not for himself then for his sons or successors, so that those who are at the head of affairs may understand fully the problems before them and in what direction to look for help towards improvement. Failing this he will be dependent on the services of paid assistants, and those services cannot be expected to produce the desired results unless they are paid for on a liberal scale. In this country there has not hitherto been sufficient attraction to draw into the field of technology a due share of the best brains of the nation. The prospect of ultimately reaching a salary of two or three hundred a year at the utmost is not sufficient to induce a young man of first-rate ability to spend several years of his life and a thousand pounds or so of capital in scientific and technical studies; and so the supply of the highest class of scientific assistance is at present far from what it ought to be.

But suppose conditions to improve, a question arises as to the best way of turning such assistance to account.

A suggestion has lately been made that a new society should be formed, to be constituted of trade committees associated with experts in various divisions of science, to carry on experiments confidentially in the interests of the manufacturers who become members of the society. It seems to me that any suggestion is better than none if it results in the closer association of industry and science: but I think this particular proposal would not be found to work in practice. The requirements of different industries are too numerous and complicated to be met by an arrangement so simple, for each committee would find itself occupied with so many different problems that nothing would be accomplished, unless, indeed, the staff were very large. In my judgment each manufacturer must endeavour to work out his own salvation. Moreover, the experience of the German manufacturer, and to some extent also of the American, shows that it can be done effectively. The most famous example known to me is the case of the great Badische colour works at Ludwigshafen, on the Rhine. There is a factory which employs some 5000 men, and which pays, and has always paid, 25 to 30 per cent. or more on its ordinary capital. The great feature of its organisation is to be seen in the direct association of manufacture with research conducted by a staff of highly skilled scientific men.

In England arrangements so complete are unknown, and the number of highly qualified chemists and physicists employed in works is very small. I say nothing about engineers, with whom I am not so well acquainted, but the greater number of the chemists are merely testers doing routine work, and because such men, receiving the wages of a clerk, have not been able to advance the industries with which they are connected, their employers have in too many cases in the past come to the conclusion that science is of no use. In the meantime many things have happened. The neglect of organic chemistry in England forty years ago led to the complete removal of the coal-tar dye industry to Germany, where since that time has sprung up the equally important manufacture of synthetic drugs. The saccharin, the antipyrin, the artificial perfumes consumed in England are not made here, and it now looks as if the fixation of atmospheric nitrogen in the form of nitrate, so important from the agricultural and industrial points of view, was going to be taken possession of by Germany and America acting together, England being left out.

Such things have been said over and over again for the last thirty years or more, and I am not aware that such statements have been shown to be fundamentally mistaken, nor has there ever been any public excuse or explanation of the indifference so commonly displayed.

The link between science and industry must be established by the masters of industry themselves. I do not believe in the efficacy of much of the technical instruction which is talked about, and I fear that much money is being wasted in the attempt to imitate industrial operations in schools and colleges. What is wanted is the highest and most complete kind of instruction in pure science, following a good general education conducted on such lines that the fittest only are passed forward to the university or scientific school. Young people educated in this way form the material which should be utilised by the manufacturer. But he must not expect that a man so prepared is going to earn his salary the first year or two. He has got to learn his business, and must have facilities for doing this, or such talent as he has cannot be turned to account, and this can only be done by taking him into the works. This is a subject on which a great deal might and should be said, but such a discussion is not suited to the present occasion.

In conclusion, I may perhaps be allowed to give a few minutes to a glance at the future—not that I can pretend to descry very much.

We must remember that there is no finality in physical science. The farther we go the wider does the horizon before us become, but every discovery of a new fact or principle gives us a new instrument to help on to higher things. Hence we may reasonably suppose that, wonderful as the past has been, the future will be more wonderful still.

Here I will venture to draw a distinction between invention and discovery, and to invention there is probably no limit. It may be said to consist in making new combinations and permutations in the elements of knowledge already acquired. Among the inventions which have affected the condition of mankind, those which are concerned in locomotion stand first. It may truly be said that life is lengthened, not only by years, but by opportunities, and from this point of view quick travelling, provided by steam and electricity, is a great advantage. It would be unwise to utter any predictions as to what may hereafter be done with big ships and aëroplanes, only the old-fashioned type of nervous system—already shrinking from the increased noise and bustle of the town—shudders at the thought that neither distant valley nor mountain top, from the tropic to the pole, can now be expected to provide an asylum where peace secure from intrusion is to be found.

In Samuel Butler's "Erewhon," a remarkable book published about forty years ago, a country was pictured in which moral delinquency was treated with sympathy and condolence, while bodily disease of all kinds was held to be a crime, and was punished by fine or imprisonment. I suppose it will take a good many generations to reach that condition of enlightenment, but the time cannot be far off when the propagation of infectious disease will in all civilised countries be abolished.

The habitability of the planet Mars has of late been a subject of much revived discussion. The possibility or probability of the existence of intelligent beings in other parts of the universe, long a subject of debate, is a question of profound interest, but whether communication with them from the earth can ever be established, who can tell?

But as to discovery in physical science, as already said, the horizon widens as we go on; but it seems not improbable that there is a limit set, though as yet very far off, by the capacity of the human intellect. Nature's ways used to be thought simple, but now we know that she is not only mysterious, but complex. However, there is every reason to expect that great strides are possible, even in the immediate future. The sort of problems which remain to be solved are represented by such questions as the following:—What is the cause and nature of gravitation and other sorts of attraction? What is the difference between positive and negative electricity, and what is the relation of electricity to matter? What is the nature of chemical affinity, and is it really electrical? What is the constitution of the elements, and is the transmutation of metals a dream or a physical possibility?

The penetration into final causes seems as we proceed to be further and further out of our reach. The problems of life and mind are, up to the present, inaccessible to man in his present state, and, notwithstanding the hopes and beliefs of some physiologists, it is safe to say that they will remain so for a long time to come, if not always.

And even in regard to common matter and the physical forces, all we know about them is derived from the perception of phenomena through the agency of our senses. Now the senses, sight, hearing, and the rest, have been evolved, not to provide the means of surveying nature, but for the protection and advantage of the body to which they belong. It is possible, therefore, that the human view of phenomena is only a partial and imperfect view; at any rate, the world which is open to the sense perception of a man must be very different from that which is perceived by many animals with their highly specialised senses, such as the scent of the dog, the sight of the carrier pigeon, and perhaps other senses for which we have no name.

"In its ultimate nature," said Herbert Spencer, "matter is as absolutely incomprehensible as Space and Time. Whatever supposition we frame leaves us nothing but a choice between opposite absurdities."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Vice-Chancellor has published to the Senate certain letters from the clerk to the Drapers' Company in which it is announced that the company is prepared to erect a physiological laboratory at Cambridge at a cost not exceeding 22,000*l.*, and to make a further grant of 1000*l.* for the equipment of it upon the following conditions:—(1) that the site be given by the University and approved by the company; (2) that the architect be appointed and the plans approved by the company; (3) that the University undertake adequately to maintain the laboratory when erected, and to provide the salaries of teachers and demonstrators. A Grace will be proposed at the next Congregation gratefully accepting the offer of the Worshipful Company of Drapers, and a syndicate will be appointed to discuss details with the company.

Mr. R. S. Goodchild has been reappointed assistant secretary to the Appointments Board for three years.

GLASGOW.—On Wednesday, October 26, the services of Prof. William Jack, who lately resigned the chair of mathematics in the University of Glasgow after a tenure of thirty years, were suitably recognised at an interesting and largely attended ceremony in the Bute Hall. Sir Henry Craik, M.P. for the University, presented to the Vice-Chancellor, Sir Donald MacAlister, K.C.B., a fine portrait of the professor, painted by Sir James Guthrie, president of the Royal Scottish Academy, which had been subscribed for as a gift to the Court by a large number of colleagues, students, and friends in all parts of the world. In addition, a sum of 300*l.* was provided for the foundation of a William Jack prize, to be awarded at intervals of three or four years to the author of the best dissertation on a mathematical subject submitted during the period in question for the degree of Doctor of Science in the University. A present of plate bearing a commemorative inscription was made at the same time to Prof. Jack. The latter, in an interesting speech of reminiscence, recalled the notable teachers and students with whom he had been associated during the half-century of his connection with Glasgow. His successor, Prof. Gibson, explained the value of the new prize as a stimulus to post-graduate study and research. The Vice-Chancellor, on behalf of the Senate and Court, acknowledged its debt to Prof. Jack, not only for what he had done, and done well, but for what he had been—the trusted friend and guide as well as the instructor of his students, the loyal comrade and peacemaker among his fellow-workers.

MR. S. BRIERLEY, formerly head of the Textile School, Stroud, has been appointed head of the textile department of the Huddersfield Technical College.

DR. J. A. EWING, C.B., F.R.S., Director of Naval Education to the Admiralty, will distribute the prizes at the Merchant Venturers' Technical College, Bristol, on Thursday, December 15.

MR. J. G. STEWART, of Edinburgh, has been appointed by the Essex Education Committee principal of the County Laboratory at Chelmsford. One of the chief duties of the office is to teach scientific farming to the agriculturists of Essex and Herts.

IT is announced in *Science* that Mr. J. D. Rockefeller has recently offered to give to Western Reserve University for further endowment of its medical department the sum of 50,000*l.*, provided 150,000*l.* additional is raised. Toward this 200,000*l.* fund Mr. H. M. Hanna, of Cleveland, has given 50,000*l.* The trustees of the University have indicated their intention to undertake to secure the 100,000*l.* needed to complete the fund. Yale University is to receive the residue of the estate of the late Mr. S. H. Lyman on the death of the testator's brother, with the exception of 5000*l.* The value of the bequest is not known, but the estate is said to be large.

IN NATURE of October 13 a letter appeared from Mr. E. G. Reiss, honorary secretary of the Apprenticeship and Skilled Employment Association, directing attention to the fact that a number of laboratory monitors in secondary schools, who, having reached the age of sixteen years, were no longer eligible for employment by the London County Council, wanted situations. Mr. Reiss writes to say that he has succeeded in placing in various suitable posts all the boys referred to, and points out that a number of girls who have been employed in a similar capacity also want suitable employment. As yet Mr. Reiss has been unable to discover posts for these girls, and would be glad of any suggestions as to openings for them. They are about seventeen years of age. The address of the association is 36 Denison House, 296 Vauxhall Bridge Road, London, S.W.

THE Yarrow Educational Fund of the Institution of Civil Engineers was established to afford assistance to young men who desire to become engineers, who have given proof of their capacity to profit by specialised education and training, but who lack sufficient means to obtain it. Grants varying between 50*l.* and 100*l.* per annum, for a period not exceeding three years, may be made in the discretion of the committee. Applicants for such grants must be of British birth, not more than twenty-one years of age, and must be prepared to qualify for attachment as students of the Institution of Civil Engineers. Several vacancies for scholarships under the fund will occur in March, 1911, and the council of the institution are prepared to receive and consider applications therefor.

Applications should be addressed to the secretary of the Institution of Civil Engineers, Great George Street, Westminster, S.W. Further particulars may be obtained on application to the secretary of the institution.

IN the technical schools of this country the library is usually a comparatively unimportant factor in the intellectual work done by the institution in question. This is perhaps partly due to the insistent and ever-growing claims of the laboratories and workshops for apparatus, plant, &c. As a result of this and other causes, the higher work of many technical institutions is seriously hampered by the inadequate provision of scientific and technical literature, works of reference, and the journals of the learned societies. Not only is there a deficiency in the supply of books and journals open to the student, but in some cases the libraries themselves are small, badly lit, noisy, and crowded. This militates against fostering those habits of study which are essential to the progress of the student, especially as in some cases the technical student is unable to secure a quiet working place in his or her own home. The magnificent new library at the Battersea Polytechnic, recently presented by the munificence of Mr. Edwin Tate, and opened on October 21 by the Archbishop of Canterbury, is excellently adapted for study and reading by those attending classes at the polytechnic. The library is 70 feet long and 30 feet wide, and is erected at the south-western corner of the polytechnic, and can be approached both from the main corridor and the present reading-room. At the western end of the library is a wide bay containing a beautiful stained-glass window. The book-cases project at right angles to the wall, forming bays to seat readers, and the gallery runs round three sides of the library. The total book accommodation is 18,000 volumes. The whole of the fittings and panelling are of oak, the floor being of teak. As the building stands close to the road there are double casements, the inner ones being filled with ornamental lead glazing. As regards lighting, there is a separate window to each bay. Speaking generally, the library is planned on lines similar to those on which all modern university libraries are being developed, the books, for instance, being accessible at once to all students. The cataloguing is by card. Efforts are being made to obtain funds in order to increase very largely the technical and scientific portions of the library. It may be mentioned that the library is of considerable use, not only to students of the polytechnic, but also to certain local firms. Some little time ago a circular was sent from the polytechnic to the local chemical firms inviting them to utilise, if they wished, the works of reference and technical journals in the library.

AT the meeting of the Education Committee of the London County Council on October 26 the question of the senior scholarships awarded by the council was under discussion. It was eventually decided to increase the number of these scholarships in 1912. Just as it was necessary to increase the number of intermediate scholarships in 1910 when the first batch of junior scholars attained the age of sixteen, so it will be necessary to increase the number of senior scholarships in 1912 when the same candidates reach the age of eighteen. The number of senior scholarships available for competition at present is 50; in 1912 it will be 100. The standard required for the award of these senior county scholarships is, however, not to be lowered in any way. It is estimated that the annual cost of awarding 100 of these scholarships will be 20,000*l*. In the award of senior county scholarships the council has regard, in the first instance, to the past achievements of the candidates and to the reports of the teachers under whom they have worked and of other responsible persons acquainted with the candidates, and such reports must have reference to the character and qualifications of the applicants as well as their scholastic attainments. The scholarships consist of a maintenance grant not exceeding 90*l*. a year. This amount is in each case determined after consideration of the requirements and the financial circumstances of the candidate. Senior county scholarships are, as a rule, tenable for a length of time necessary for a student to take an honours degree in the subject selected, provided that this period is not more than four years When the scholarship has been held for four years the council may, in a limited number of cases, continue the scholarship for a fifth year if satisfied that there are exceptional circumstances which render such further continuance desirable. At present the income of the parents or guardians of a scholarship holder must not exceed 400*l*. a year. A proposal to abolish this limit was referred back to the higher education sub-committee for further consideration.

SOCIETIES AND ACADEMIES.

LONDON.

Institution of Mining and Metallurgy, October 19.—Mr. Edgar Taylor, president, in the chair.—A. J. **Bensusan**: Notes on passagem mine and works.—R. H. **Kendall**: Treatment of refractory low-grade gold ores at the Ouro Preto Gold Mine, Brazil. These two papers, which were discussed conjointly, both deal with the same mines from slightly different points of view, so that one may be taken as the complement of the other. The ore treated is composed of quartz, tourmaline, arsenical and iron pyrites, with some bismuth, and the method of high concentration had to be adopted in view of the difficulties and losses encountered with amalgamation in the presence of arsenical pyrites and bismuth. The ore from the mine passes through grizzlies and rock-breakers to two series of Californian stamps, eighty head in all, and thence over blankets. The material remaining on the blankets is piped to *passadores* for daily concentration, and the concentrate passes through a second *passador* and thence to *bateas*, whence the gold dust is recovered, and the tailings return to the *passador*, and thence with the first *passador* tailings to the concentrates cyanide plant. The pulp from the mortar boxes passes over Frue vanners, whence the rich concentrates pass to the cyanide plant, and the tailings pass through spitzkasten and thence through the sands and slimes cyanide plants respectively. The papers describe the various processes and the plant in considerable detail, and give statistics as to costs, time of operations, and results.—J. Egerton **Wood**: A method of collecting gold from pannings. A short note dealing with a simple means of collecting and preserving gold values obtained in the field until such time as they can be be cupelled in the laboratory.

PARIS.

Academy of Sciences, October 24.—M. Émile Picard in the chair.—A. **Haller**: Two active alcohols and a third ketone contained in spirit from cocoanut oil. The raw material used in the investigation was a bye-product in the purification of cocoanut oil. Apart from acids separated by alkalies, possibly arising from saponification of fatty bodies, methyl-heptyl-ketone, methyl-nonyl-ketone, and methyl-undecyl-ketone were isolated, as well as methyl-heptyl-carbinol and methyl-nonyl-carbinol. The two alcohols were dextrorotatory, the optical inverse of the alcohols isolated from oil of rue.—M. **d'Arsonval**: The second International Congress for the Suppression of Adulteration.—Henri **Douvillé**: How species have varied. As the result of a comparative study of the Lamellibranchs, the author is of opinion that the evolutionary changes have not been continuous, but have occurred in a series of abrupt steps separated by periods of stability.—MM. **Landouzy** and L. **Loederich**: Experimental study of heredity in tuberculosis. The experiments were made on guinea-pigs, dogs, and rabbits, and evidence was obtained of direct placental infection. In the cases where there was no direct infection the mortality was very high from causes other than tuberculosis.—F. **Robin**: The variation of resistance of steels to crushing as a function of the temperature. Relations between the static and dynamic properties of the steels. Data are given for copper, nickel steel, manganese steel, and three steels containing 0·07, 0·384, and 1·8 per cent. of carbon at temperatures ranging between $-185°$ and $1400°$ C.—Edouard **Salles**: The diffusion of gaseous ions. Experiments were carried out with air, carbon dioxide, nitrogen, and oxygen; measurements were carried out with air at two pressures, 758 mm. and 1028 mm., and with nitrogen at four, 760 mm., 1000 mm., 1120 mm., and 1302 mm.—J. **Duclaux**: Refrigerating mixtures. A lowering of temperature is produced when carbon bisulphide is mixed with acetone. A simple apparatus is described, utilising the regenerative principle, by means of which a volume of 20 c.c. can be continuously maintained at a temperature 70° below that of the room, with an expenditure of 100 c.c. of carbon bisulphide and 70 c.c. of acetone per hour.—Jean **Villey**: The measurement of very small displacements by means of the electrometer. A condenser formed of two parallel plates and charged to a suitable potential is applied to measure extremely small displacements of one of the plates. Using an electrometer giving a motion of 150 cm. per volt on a scale 350 cm. distant, with a condenser formed of circular plates 6·5 cm. radius and 158 μ apart, a displacement of the spot of 150 cm. on the scale is obtained when the condenser plate, charged to 176 volts, is moved 0·001 mm., or a magnification of 1,500,000. The sensibility exceeds that of the interference methods.—J. **Carvallo**: The electrical purification of liquid sulphur dioxide and its electrical conductivity. Liquid sulphur dioxide, already fairly pure, is further purified by the prolonged passage of a current at a high potential. The limiting values obtained for the conductivity do not follow Ohm's law, but laws which recall those governing the conductivity of gases.—Paul **Nicolardot** and Georges **Chertier**: The nitrous esters of cellulose. In an attempt to find the cause of the differences in the percentage of nitric nitrogen in guncotton when determined by the Schlœsing and Crum methods respectively, the author was led to examine the action of the nitrogen peroxides on cotton in presence of glacial acetic acid. The nitro-products thus obtained appear to contain nitrites, and do not yield their true percentage of nitrogen by the Crum method.—MM. **Magnan** and **Perrilliat**: An acephalous human monster.—Mme. V. **Henri-Cernovodeanu**, MM. Victor **Henri**, and V. **Baroni**: The action of the ultra-violet rays upon the tubercle bacillus and upon tuberculin. After a short exposure to the ultra-violet rays the tubercle bacilli are attenuated; after a more prolonged exposure they are destroyed. Tuberculin, after a very long exposure (five hours), gives no reaction with tuberculous guinea-pigs.—A. **Fernbach** and A. **Lanzenberg**: The action of nitrates in alcoholic fermentation. Nitrates are not prejudicial to the fermentation.—E. **Roubaud**: The influence of the physiological reactions of Glossina in the salivary development, and the virulence of the pathogenic trypanosomes.—Paul **Marchal**: Contribution to the biological study of Chermes.—M. **Fabre-Domergue**: The storage of oysters in filtered water. After remaining for eight days in filtered water oysters do not diminish in weight, and do not appear to be depreciated in any way.—Carl **Störmer**: The situation of the zone of maximum frequency of the aurora borealis according to the corpuscular theory.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 3.

ROYAL SOCIETY, at 4.30.—The Origin of the Hydrochloric Acid in the Gastric Tubules: Miss M. P. Fitzgerald.—(1) Trypanosome Diseases of Domestic Animals in Uganda. II. *Trypanosoma Brucei.* (Plimmer and Bradford); (2) Trypanosome Diseases of Domestic Animals in Uganda. III. *Trypanosoma vivax* (Ziemann): Colonel Sir D. Bruce, C.B., F.R.S., and others.—Further Results of the Experimental Treatment of Trypanosomiasis; being a Progress Report to a Committee of the Royal Society: H. G. Plimmer, F.R.S., Capt. W. B. Fry, and Lieut. H. S. Ranken.—On the Peculiar Morphology of a Trypanosome from a case of Sleeping Sickness and the possibility of its being a new Species: Dr. J. W. Stephens and Dr. H. B. Fantham.—Note upon the Examination of the Tissues of the Central Nervous System, with Negative Results, of a case of Human Trypanosomiasis, which apparently had been cured for years by Atoxyl Injections: Dr. F. W. Mott, F.R.S.—On a remarkable Pharetronid Sponge from Christmas Island: R. Kirkpatrick.

LINNEAN SOCIETY, at 8.—Biscayan Plankton, Part XIII. The Siphonophora: H. B. Bigelow.—Plankton Fishing in Hebridean Seas: Prof. W. A. Herdman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—Presidential Address: Dr. G. H. Rodman.

MONDAY, NOVEMBER 7.

ARISTOTELIAN SOCIETY, at 8.—Self as Subject and Self as Person: S. Alexander.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—A Sixth Journey in Persia: Ancient Parthia, Nishapur, and Turshiz: Major Molesworth Sykes, C.M.G.

SOCIETY OF ENGINEERS, at 7.30.—Public Slaughter Houses: S. M. Dodington.

TUESDAY, NOVEMBER 8.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Recent Advances in, and the Present Status of Gas Lighting: F. W. Goodenough.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The London County Council Holborn to Strand Improvement, and Tramway Subway: G. W. Humphreys.

WEDNESDAY, NOVEMBER 9.

GEOLOGICAL SOCIETY, at 8.—The Rhætic and Contiguous Deposits of West, Mid, and Part of East Somerset: L. Richardson.—Jurassic Plants from the Marske Quarry: Rev. G. J. Lane.

THURSDAY, NOVEMBER 10.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Tidal Observations of the British Antarctic Expedition, 1907: Sir George Darwin, K.C.B., F.R.S.—Conduction of Heat through Rarefied Gases: F. Soddy, F.R.S., and A. J. Berry.—The Chemical Physics involved in the Precipitation of Free Carbon from the Alloys of the Iron Carbon System: W. H. Hatfield.—On the Determination of the Tension of a recently-formed Water surface: N. Bohr.

MATHEMATICAL SOCIETY, at 5.30.—Annual General Meeting.—The Relation of Mathematics to Experimental Science (Presidential Address): Sir W. D. Niven.—Properties of Logarithmico-exponential Functions: G. H. Hardy.—The Double Six of Lines: G. T. Bennett.—On Semi-integrals and Oscillating Successions of Functions: Dr. W. H. Young.—On the Existence of a Differential Coefficient: Dr. W. H. Young and Mrs. Young.—The Analytical Extension of Riemann's Zeta-function: F. Tavani.—The Geometrical Representation of non-real Points in space of Two and Three Dimensions: T. W. Chaundy.—The Extension of Tauber's Theorem: J. E. Littlewood.—A Note on the Property of being a Differential Coefficient: Dr. W. H. Young.—The Stability of Rotating Shafts: F. B. Pidduck.—A Class of Orthogonal Surfaces: J. E. Campbell.—On Non-integral Orders of Summability of Series and Integrals: J. W. Chapman.—Optical Geometry of Motion: A. A. Robb.—Lineo-linear Transformations, specially in Two Variables: Dr. A. R. Forsyth.—On the Conditions that a Trigonometrical Series should have the Fourier Form: Dr. W. H. Young.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Presentation of Scholarships and Premiums.—Inaugural Address of the President: S. Z. de Ferranti.

FRIDAY, NOVEMBER 11.

ROYAL ASTRONOMICAL SOCIETY, at 5.

MALACOLOGICAL SOCIETY, at 8.—On the names used by Bolten and Da Costa for genera of Venerdiæ: A. J. Jukes-Browne, F.R.S.—On New Melaniidæ from Goram and Kei Islands, Malay Archipelago: H. B. Preston.—On the Anatomy of the British Species of the Genus Psammobia: H. H. Bloomer.—Note on *Triton tesselatus*: Major A. J. Peile.

PHYSICAL SOCIETY, at 8.—On the supposed Propagation of Equatorial Magnetic Disturbances with Velocities of the Order of 100 miles per second: Dr. Chree, F.R.S.—On Cusped Waves of Light and the Theory of the Rainbow: Prof. W. B. Morton.—Exhibition of a Brightness Photometer: J. S. Dow.

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