THURSDAY, JUNE 25, 1903.

SCIENCE AND THE NAVY.

II.

IN a former article[1] we referred at some length to the new Navy scheme, pointing out that in our opinion the scientific education of naval officers, and therefore the whole naval service of the country, must be vastly improved by its provisions. Since this article appeared there have been debates in both Houses of Parliament, including a most important one on May 9, in which Lord Selborne in an admirable speech gave some new information concerning the proposed scheme of education, and on the 15th inst. a circular letter was issued relating to the selection, training, and advancement of navigating officers. There has also been much discussion in the public Press; in this, as was to have been expected, scientific questions have been only lightly touched; and when the engineer question has been broached, its relation to the Admiralty practice regarding the other officers who must possess high technical knowledge has not, in our opinion, been pointed out.

But when we pass from the criticism of the new arrangements to the first steps actually taken to give effect to them, the opinion is quite general that the Admiralty is to be entirely congratulated. Prof. Ewing, who may be looked upon as the creator of the admirable engineering school at Cambridge, thereby showing that his powers of administration and organisation are on a par with his scientific acquirements, has been selected to fill the post of Director-General of Naval Instruction; his duty, we take it, will, to a large extent, be to do for the *personnel* what the Director of Naval Construction does for the *matériel* of the fleet.

We may be convinced not only that with such a strong man as this at the helm the complete scientific instruction of officers will be insisted upon, but that practical laboratory instruction of the juniors in mathematics and pure science will be secured.

Indeed, we may go further, and say that they have already been secured in most admirable fashion, for Lord Selborne, in the speech to which we have already referred, spoke as follows:—

"Without pledging myself to exact detail, I will give a general sketch of the kind of education that will be given. It includes not only that special education for which the school will exist, but that general education which every officer and gentleman ought to have. History, geography, physical geography, English and French will be taught. I do not say that other modern languages will not be taught. Mathematics, algebra, arithmetic, trigonometry, mechanics, physics, laboratory work, seamanship, drill and engineering will be taught. There will be laboratories and workshops in which the boys will be accustomed to the use of tools from the very commencement. There will be vessels of all sorts for use and demonstration, from a launch to a battleship, and generally an effort will be made, while not neglecting the general education of the boys, to start them from the moment of their entering the college on the education of a naval officer."

[1] Vol. lxvii. p. 289.

When we compare this programme with the one hour a fortnight in physics in the *Britannia*, and no laboratory within sight, students of science well recognise that naval education for the future will be conducted on business principles, and we may again express our regret that such a system, *mutatis mutandis*, is still a thing to hope for in some dim distant future in the case of the Army.

In our former article we pointed out how the subject of navigation suffered generally from the absence of a school afloat for practical work similar to those provided long ago for gunnery and torpedo work. Not only is this defect in the system to disappear in the case of the junior officers, but as stated in the circular letter to which we have referred, the regulations for the instruction of navigating officers have been revised so that a definite course of practical training may be given them in a navigation school ship which is about to be established at Portsmouth, with a suitable staff of instructors. The course of instruction while they are attached to the school ship will last for ninety working days, part of the time being spent at sea in the ship and the remainder on shore. While going through the course they will live on the school ship.

After the candidates have qualified in the school they will serve for a short period in the large ships of the Mediterranean, Home and Channel fleets, so as to obtain experience under the navigating officers in the work of a fleet in regard to navigating duties.

It would be difficult to overestimate the importance of these new departures, about which very little has been said in the various discussions of the new scheme, although, in our opinion, they are precisely those by which the greatest benefit to the service will be secured in the future.

Leaving on one side the objections to the new scheme which have been based on prejudice or a complete ignorance of the changes in any naval service which the progress of science has rendered inevitable, we may say that the question of the possible interchangeability of the officers at some distant date has attracted most attention in relation to the new training of the Engineers. On this point opinion has rapidly grown in favour of the new scheme, since inquiry has shown what a large common basis of pure science underlies the proper performance of any one of the specialised duties. The objections, in short, have been held by advocates of technical education in its worst sense, that is, the rule-of-thumb carrying out of practical processes without any inkling of the scientific principles involved.

We indicated in our last article that, although the new scheme provides for a system of interchangeability when once it is in full working order, the present practice is vastly different, and as we consider this interchangeability of paramount importance from the point of view of utilising to the utmost the results of the complete scientific instruction of our naval officers to be provided in future, it is important to return to this subject in somewhat fuller detail to show the important bearing of another part of the new circular.

We may begin by saying that our present naval officers, so far as their *scientific* training goes, may

be divided into two categories, well trained and less trained; these are the equivalents of the "specialised" and "not specialised" of the Admiralty memorandum setting forth the scheme.

The well trained or specialised officers have to deal with (1) navigation (but so far without a navigating school), (2) gunnery with a gunnery school, and (3) torpedoes with a torpedo school. We may say that the lieutenants performing these specialised duties comprise roughly about one-third of the total numbers. They get special allowances for their special duties.

But it must at once be stated that there are many duties on board ship for the proper performance of which special training, not of a scientific character in the ordinary acceptation of the word, is equally required, and, of course, these duties have to be provided for. They are carried on by the "unspecialised" lieutenants, who are roughly twice as numerous as those who have received a full scientific training. These are employed as watch keepers and in connection with general ship duties. They are "deck officers" as opposed to the scientific officers. The less scientifically trained or deck officer gets little or no allowance; on the other hand he is expected to spend money in painting ship. We see then that under the present system the officers performing each particular piece of work, whether scientific or merely professional, are for the most part in water-tight compartments; there are differences in the amount of special instruction they receive, the kind of work they do, and the allowances they get.

It was pointed out in the previous article that according to the present practice the less scientifically trained officers get the lion's share of promotions; that, in fact, the promotion has been in the inverse ratio of the scientific nature of the work done.

It has been urged in defence of this practice that scientific knowledge is of less value in the higher ranks than that which is derived from a complete mastery of all the details of a ship's general organisation, which can only be gained by the constant performance of the "deck duties" to which reference has been made. So that if we take the navigator, the most important scientific officer, on the one hand, and the first lieutenant, the most important deck officer, on the other, the thing works out in this way. The navigator, because his duties are so onerous and are never changed, knows nothing of deck duties. The first lieutenant, because his duties are never changed, is unlikely ever to become a competent navigator. The navigator, because he has not had an opportunity of learning deck duties, has his promotion retarded so that he can never get on the active list of admirals. The first lieutenant, because he is necessarily familiar with deck duties, is the first to be promoted, and is thus sure of employment on the active list of admirals.

The baneful effects of such a system as this, which are two-fold, were fully set out in our previous article. The Admiralty indicated its contempt for scientific as opposed to mere professional training, and the Admirals' list was swamped by men who knew little of navigation, although this, of course, finds one of its highest outcomes in handling ships in tactical exercises and in order of battle.

It was next shown that while, as determined by the scheme, the interchangeability of all officers, including the engineer officers, *must* be secured ten years hence, there were reasons why the interchangeability of at least some of the duties of the existing executive officers should be commenced at once. We rejoice to learn from the new circular that this also is to be done.

Lieutenants (N.) will in future be placed on exactly the same footing as regards executive command and ship's duty generally as gunnery and torpedo lieutenants, and are not to be excused from any ship's duties except those which interfere with the special duties pertaining to them. They will be appointed and succeed to the position of first lieutenant, if a vacancy occurs, in all ships where a commander is borne exactly in the same manner as any other specialist officer.

In rendering the special report on the qualifications of a navigating officer, a further clause is to be added, dealing with his capabilities as an executive officer.

Further, midshipmen who show special aptitude are, whenever possible when the ship is under way, to be taken off other duties, and to navigate the ship independently from the after bridge, fixing positions on the chart, and bringing the result of such work to the navigating officer.

Instead of one commissioned officer taking sights and working the reckoning daily, arrangements are to be made, when practicable, for one junior lieutenant or sub-lieutenant to be taken partially off watch-keeping so as to work with the navigating officer for ten working days under way.

The officer thus told off is to be on deck when coasting, making the land, going in and out of harbour, &c., and is to be in every way encouraged to get an insight into navigating duties. If at the end of the ten days the captain is satisfied with his work, he will be relieved and another officer is to be told off for this duty.

These important changes can be urged on two grounds. In the first place, there is the obvious benefit to the Service which will be secured when all captains and admirals are made equally acquainted with both their scientific and professional duties by interchanging them while they are lieutenants and commanders. In the second place, the preparation and simplification of the carrying out of the new scheme, by which another class of specialised officers, the engineers, will be introduced in the future, will be vastly facilitated by organising and testing the best way of interchanging duties on a small scale over a limited area.

We have referred chiefly to the navigator among the scientific officers, and no doubt the Admiralty has dealt with him first, because his duties are the most specialised; but if the interchange is advantageous in his case, the other specialists will follow, and, speaking only from the scientific side, knowing nothing of professional difficulties to be surmounted, it seems to us that such a preliminary experimental study of the

problem which awaits the Admiralty in the future, and which, if faced along the whole line, at the same time, may prove of Herculean proportions and be fraught with dangers of breakdowns, must commend itself as a scientific method. Our view of the wisdom of such an interchangeability among the present officers is strengthened by information which has been furnished us as to the procedure in the German Navy, which enables us to compare the two systems, and in our opinion fully justifies the policy of the new circular.

The distribution of duties amongst executive officers of the German Navy is as follows. As in the British Service every officer is educated in seamanship, navigation, gunnery and torpedo service. In the course of their service the various qualifications of the officers are carefully noted, and especially if they show superiority in any one of the above-mentioned branches. Ships in the German Navy are commissioned for two years. The list of officers for any given ship is made out by the Admiralty at Berlin. The next senior officer after the captain becomes the executive officer. After him the officer who is most proficient (according to the returns) in navigation and pilotage is appointed as navigating officer, without regard to seniority as lieutenant. He who is most proficient in gunnery is appointed "artillery officer," and so with the torpedo officer. Qualification regulates the selection of each officer for special duties, not his seniority as lieutenant. The specialisation of an officer for any particular duty only lasts for the two years' commission. In the next commission the navigating officer may be artillery or torpedo officer, or an ordinary watch keeper without special duty. It is *exceedingly rare* for an officer to be appointed for navigating duties *for more than two years*, as the Admiralty require every officer to go through a probation as navigator *in order to ensure that captains who are responsible for the navigation of the ship shall know their work in that respect*. An apparently weak point in this system is that for a time after the appointment of an officer to navigating duties ships are not so well navigated as they might be, since for the first few months of his time the navigator is really learning his work. Gunnery and torpedo work may be learnt in harbour, but navigating can *only* be learnt by actual practice and experience at sea. But, on the other hand, the strength of this system is that all officers have practical training at sea as navigators *with a captain who has gone completely through the navigating mill*, and knows how to detect any failure in the navigator which might endanger the ship. For squadrons an officer who has shown good ability as navigator in a single ship is selected as navigator.

On this system, whilst ability in any branch (N., G. or T.) is recognised, an officer is not unduly specialised to the detriment of his knowledge in other branches of his profession. In the British Navy the gunnery and torpedo officers are occupied with their special duties nearly the whole of their time as lieutenant, but they go to deck duties when promoted commander, although their knowledge of navigation and the handling of the larger ships is practically nil. But the navigator is occupied in special duties when promoted commander as well as during his service as lieutenant, *some fifteen years in all at least*, and is allowed no practice in other branches of a naval officer's profession, and because he has not been allowed to have any such practice, he is discharged to the coast guard, his naval career is broken, and the Service loses a man who has had the best possible training for leading ships into action.

Surely this comparison shows that the question of interchangeability has already been considered in the German Navy on the lines which we indicated as beneficial for our own; and in this we see an additional argument why the preliminary trial which we suggested on scientific grounds in our own Navy, and to which the Admiralty now stands committed, should at all events be welcomed as a first step to the wider interchangeability to which the Admiralty is certain to be forced in the future, for of the progress and need of science in the armed service of a nation there will be no end.

THE DISTRIBUTION OF DISEASES.

The Geography of Disease. (Cambridge Geographical Series.) By Frank G. Clemow, M.D. Edin., D.P.H. Camb. Pp. xiv + 624. (Cambridge: University Press, 1903.) Price 15*s.* 6*d.*

THE present writer had occasion recently to endeavour to ascertain, from the literature available in London, the distribution of a particular tropical disease. After spending several months on the work, the conclusion left on his mind was that the task was impossible in London alone, and that similar work in continental libraries would have to be undertaken before an accurate idea could be obtained. There is another method possible in the study of distribution, viz. personal investigation in various countries into the occurrence of a particular disease. The difficulties in the way of this method are perhaps not so great as one would think.

A notable instance of what we mean has lately been afforded by Hutchinson in his study of the "fish" ætiology of leprosy. Not content with accepting all evidence second-hand, he proceeded to South Africa and India and inquired critically into the statements which had been made against his view, with the result that many if not all of the "facts" (such as p. 229, "leprosy is found to be *common* in people whose religion and customs forbid them to touch fish") quoted as opposed to his views he was easily able to show were not facts at all, but mere hearsay evidence, which by constant repetition is at last generally believed. Many instances of this kind have come within the writer's own experience. Thus when first the mosquito malaria theory was definitely established on a basis of fact, it was asserted in print over and over again that no mosquitoes existed in such a place, but that malaria was rife there. As it was important to examine into these statements, the circumstances were carefully investigated in each particular instance, with the result that the "facts" vanished into thin air.

Another striking example is Manson's theory of

Filaria perstans as the causative agent of sleeping sickness (p. 408). This view had prevailed in the text-books for some time, but the Royal Society's commission has shown at once that the facts will not support this view. These then are instances where a personal acquaintance of even a few months' duration of the disease under consideration has considerably modified received opinions. But we cannot always hope to have critical inquiries of this kind by trained observers. We are, unfortunately, left with the second much inferior method, viz. the diligent searching out of all that has been written on the diseases in question, more especially in the latest periodical literature. Here we are immediately confronted with the difficulty of knowing what to believe amidst the mass of published articles, and when we see some of the sources from which the author has only too frequently quoted, we consider that he has not had a due appreciation of the extremely untrustworthy nature of much of his material.

With this qualification then, viz. a too ready willingness to admit the statements of uncritical writers, we can only find praise for the large mass of material condensed by the author. To hope to find any general explanation of the distribution of diseases is, we think, at present premature. We may point out finally some details of particular diseases where the information is inadequate or inaccurately set forth. On p. 237, the principal carrier of malaria is said to be *A. Claviger*. This is a curious statement, seeing that it does not occur in tropical Africa, India, Malaysia, &c. Possibly the author had Europe alone in his mind. Nor should we think that Grassi holds that any species of Culex can transmit malaria. The malaria of cattle is quite a different disease from that of man, and it is not accurate to use this term in reference to pyroplasma bovis (p. 243). Again, the malarial statistics of India have been, up to the present, so notoriously untrustworthy that we doubt much the value of quoting statements about "an increased production of the poison" in famine years (p. 248). Nor is it true that the Central Provinces are among the most malarious territorial divisions of India.

Turning now to that peculiar manifestation of malaria, blackwater fever (p. 44), we note the omission of Palestine as an important focus of this disease. So virulent is it there among the Jews that some villages have been deserted. On p. 51 the author writes, "whether hæmoglobinuric fever in man is due to the same organism as the red water fever of cattle is uncertain." In our opinion it is absolutely certain that it is not, for the simple reason that this organism (pyroplasma) of cattle has a characteristic and easily recognised appearance, and exists in abundance in the blood and organs, but has never been seen or described by anybody in the blood or organs of blackwater patients. The recent commission on malaria appointed by the Royal Society has likewise shown that in the Duars (India) it is as common as in tropical Africa. Nor do we consider that an abundance of observations has been published tending to disprove Koch's views of blackwater; on the contrary, the Royal Society's commission was of precisely the same view as Koch.

Sprue (p. 127) undoubtedly exists in India, as a typical case from there in a lady came recently within our knowledge. It is quite certain, however, that the ætiology and differentiation of hill-diarrhœas in India is completely obscure at present. We have already referred to the work of the sleeping sickness commission, but it seems probable that when its complete reports are published our knowledge of the distribution of Filaria will be considerably modified.

While we have pointed out in what respect we consider this book deficient, yet it must not be thought that we have not a full appreciation for the industry which it must have necessitated; and those students who wish to possess a well-arranged book of reference on the distribution of diseases ought to be exceedingly grateful to the author, but when consulting it they should remember that the subject is hardly yet capable of accurate treatment. J. W. W. S.

HYDRODYNAMICAL FIELDS OF FORCE.

Vorlesungen über hydrodynamische Fernkrafte nach C. A. Bjerknes' Theorie. Von V. Bjerknes. Band ii. Pp. xvi+316. (Leipzig: Johann Ambrosius Barth, 1902.) Price 10 marks, or 11.50 marks bound.

THE first volume of this book, which was reviewed in NATURE for November 3, 1900, is of a theoretical character, and deals with the stream lines in a perfect liquid considered especially with reference to the motions set up by moving solids and in particular pulsating, oscillating, or moving spheres. In it were obtained results now well known to students of hydrodynamics showing the existence of attractions and repulsions between the spheres, bearing a considerable analogy to the forces occurring in gravitation and other physical phenomena.

The interest of these results is greatly enhanced by the experiments described in the present volume. These experiments were commenced in the summer of 1875 by the late Prof. C. A. Bjerknes, who observed that if two spheres lighter than water (croquet-balls were used in the first instance) are allowed to fall into a tank of water from the same height, so as to set up vertical oscillations at the surface, they will approach each other if let fall simultaneously, and will recede from each other if let fall so that their oscillations are opposite in phase. From the fact that the volumes displaced by the spheres vary, the conditions are in many ways analogous to those produced in an infinite liquid by "pulsating" rather than oscillating spheres. From this beginning more elaborate experiments were devised. A sphere falling in liquid in the neighbourhood of a vertical wall in which its image could be seen by reflection was found to reproduce the attractions and repulsions indicated by theory for a pair of spheres moving symmetrically. The next experiments were conducted with spheres so fixed as to perform pendulum oscillations below the surface. The experiments were first performed at home, but from 1876 to 1880 Prof. Schiötz arranged for their continuation in

the Physical Laboratory of Christiania, and during the last two years Mr. S. Svendsen assisted in the work. About 1880, Prof. C. A. Bjerknes received from the Norwegian Government a private laboratory, where the experiments were arranged by the author with the assistance of Mr. J. L. Andersen. The result of these facilities was the construction of an elaborate instrument for measuring the attractions and repulsions of bodies pulsating in liquid. The generator consists of a system of pumps or drums operated on as bellows by cranks worked by a handle. These alternately force air in and out of the "pulsators," which may consist either of elastic balls, drums, or similar arrangements suspended in the water by a "pulsation balance," and the whole apparatus is now supplied by Ferdinand Ernecke, of Berlin. Another form of apparatus is described suitable for studying bodies oscillating in water without change of volume. Methods are also described of rendering the stream lines visible, and diagrams are shown illustrating the resemblance of these lines to magnetic lines of force.

The description of the experiments occupies the second part of the book. The first part consists of a summary of the main results, both quantitative and qualitative, which were established in vol. i., treated by elementary methods only, and it serves the purpose of enabling the physicist to read the present volume without studying its more mathematical predecessor. For such a reader the third part will have considerable interest, for it deals with the analogy of hydrodynamical phenomena with those of electrostatics and magnetism. Prof. C. A. Bjerknes's original discussions of these analogies having been given at a transition period in the development of electrical science, the writer of the present volume has largely remodelled the arguments in order that they may be studied in the light of modern electrical views. Between hydrodynamical and electric or magnetic fields of force, a close analogy exists *except in regard to the sign of the force*. The stream lines due to spheres executing pulsations of the same phase are identical with the lines of force due to like charges, but the pulsating spheres attract one another while the electrified spheres repel one another. If the pulsations are of opposite phases, the stream lines are the same as the lines of force of oppositely charged bodies, but the force is repulsive instead of attractive. Owing to this difference, the hydrodynamical field is to be regarded as affording a representation rather than an explanation of electric and magnetic fields, and as Prof. V. Bjerknes points out, a negative representation is still a representation, and it may admit of all the uses of a positive one.

Prof. V. Bjerknes has uniformly adopted the Heaviside system of "rational" electrical units, and he points out the great simplifications that arise from the use of this system, expressing his regret that the existing units were adopted before the advantages of the rational system had been fully appreciated.

The book will be read with much interest by physicists, and the reproduction of some of the experiments in the lecture room suggests a useful aid to the teaching of electricity. G. H. BRYAN.

FARM ACCOUNTS.

The Farmer's Business Handbook. By I. P. Roberts. Rural Science Series. Pp. xiii+300. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 4*s.* 6*d.* net.

THIS volume of the Rural Science Series consists firstly of an elementary account of book-keeping suitable to a small farm, and secondly a discussion of such legal questions as leases, tenant right, highways, fences, mortgages, taxes, &c., with which an ordinary farmer is likely to become conversant in the course of his business. This latter portion of the book is naturally only applicable to the United States, and though succinctly and clearly written, can be of little service to the English reader. In the earlier section of the book a system of book-keeping is set out by which the farmer can ascertain not only his profit or loss as a whole, but the result of his operations on each field or in each section of his business. The usual method of double entry is employed, though only day book (for which the American equivalent is apparently "blotter") and ledger are kept. The explanations are clear and simple, and may be read with profit by students who are beginning formal book-keeping, and are getting confused over the problem of Dr. and Cr. But we are by no means convinced that the ordinary system of double entry is the best method of handling farm accounts; naturally it can be made to deal with them, and for the cash account nothing different is wanted, but it is an extremely cumbrous means of ascertaining the profit or loss on individual crops or classes of live stock. Farmers are often reproached, and justly enough, with not keeping proper accounts, but it is not quite so easy a matter as in a business where all the items are in sight. So many of the figures must be estimates depending upon the judgment of the farmer; first of all the annual stock-taking has to be a valuation, in which market fluctuations have, or have not, to be considered, according to the purpose of the account. For example, a man has a breeding flock the number of which remains constant; in ascertaining his profits upon sheep-breeding it is best to take the value of the flock as constant, but in ascertaining his financial position at a given moment, he must re-value the flock at current rates. Again, many operations upon a farm are performed as much for their contingent advantages as for immediate return; the dung and cultivations given to the root crop have their value throughout the rest of the rotation; cattle are fattened for the sake of the manure they produce.

To one point the author of this book very properly gives special prominence, the item of household expenses; the house rent, the milk, potatoes, &c., consumed, the labour spent, are very often not taken into account at all, and the farmer sometimes comes to the conclusion that his farm is not paying when he is really living beyond his income. On the whole we believe that the ideal system is to open a ledger account for all cash transactions and for the house, and to keep separate running or progress accounts against the main branches of his business, such as the dairy

herd, sheep, crops, the latter account being occasionally specialised for a few years in order to ascertain whether a particular crop or field is paying its way. But we commend to the teachers of book-keeping in such of our agricultural colleges as possess a farm the problem of devising with an open mind an improved system of farm accounts, which shall be simple, actual, and helpful.

OUR BOOK SHELF.

The Rôle of Diffusion and Osmotic Pressure in Plants. By B. E. Livingston. Pp. xiii+149. (The University of Chicago Press, 1903.)

BIOLOGISTS who attach importance to the bearing of physics on their science must be gratified with the increasing number of books now appearing on such subjects as are treated in the book before us.

Mr. Livingston's short book is clear and readable, and contains a simple and concise sketch of much of the physics of diffusion and solution. The matter is well put, and difficulties are avoided. But concise treatment has its disadvantages, and, in one or two places, a false conception might be obtained from the author's descriptions. Thus there are notable exceptions to the rule that the particles of substances are brought closer together during the change from the liquid to the solid state. And it is scarcely fair to assume that the greater closeness of the particles is the cause of the greater rigidity of solids.

The limited space available in the book has apparently led to the exclusion of matter which it would be essential for the biologist to be acquainted with, and he should supplement it with the study of some text-book of physical chemistry. With regard to recent work, it must be regarded as unfortunate that the writer leaves out all mention of Brown and Escombe's work on diffusion through perforated septa from the physical part of the book, while in part ii., on physiological considerations, this investigation receives a bare mention by name in a small footnote. One would have thought that these authors' results would have been fully discussed as having a most intimate connection with the subject, and as bringing a completely new light to bear on our ideas of the diffusion of gases and of dissolved substances in plants.

The chapter on the terminology applied to solutions of different concentrations is very lucid, and should prove most useful to biologists.

In part ii. an account of turgidity and of absorption and transmission of dissolved substances in plants is given. Much information is imparted in a small space considering how nebulous are our ideas on the actual part played by the vital osmotic membranes of plants.

In the reviewer's opinion, far too much weight is accorded to Westermeier's and Godlewski's hypothesis explaining the ascent of water in trees. These writers assumed that the elevating force is to be found in the exudation pressure of the cells of the wood, cortex, and medullary rays. The physical relations of these cells to the water capillaries of the plant render the idea that the cells at different levels act as relay pumps impossible.

The theory of a tensile transpiration current is alluded to, but unfortunately it is criticised in the light of Copeland's undoubtedly misleading experiment.

The later chapters of the book are devoted to the osmotic effects of the medium on plants, and summarise most interestingly the recent results of osmotic and chemical fertilisation. H. H. D.

Mechanical Refrigeration. By Hal Williams, A.M.I.Mech.E., A.M.I.E.E. Pp. xiii+406. (London: Whittaker and Co., 1903.) Price 10*s.* 6*d.*

THIS book, which is devoted mainly to practical study of mechanical refrigeration and cold storage, should have a wide circulation, dealing as it does with a growing industry of which the literature, so far as text-books are concerned, is remarkably scanty. It opens with two chapters on the theory of heat engines and refrigerating machines. The first of these might well have been omitted, as it merely contains a series of definitions which can only be intended for a trader who is totally ignorant of the elementary theory of heat, and are somewhat apt to convey a wrong impression. The second chapter, on thermodynamics, is carefully worked out, the section dealing with the heat change consequent on the performance of internal work by the fluid being particularly interesting. A chapter devoted to the history of the subject leads to a short study of the methods of preparing the modern refrigerants, liquid carbonic acid and ammonia, and a description of the more important type of refrigerating machinery. In the latter section the author has confined himself to an account of ammonia and carbonic acid plant, and in this, considering the dimensions of the work, he is undoubtedly justified. Fifty pages of the book deal with the auxiliary plant necessary in a cold storage works. Finally, insulation, ice making, the construction and arrangement of cold storage works, and the application of methods of refrigeration to commercial processes are fully dealt with. The author wisely omits all mention of liquid air and its problematical applications. The book is well illustrated by means of photographs and diagrams, and the text is clear and concise. M. W. T.

Die stammgeschichtliche Entstehung des Bienenstaates sowie Beiträge zur Lebensweise der solitären u. sozialen Bienen (Hummeln, Meliponinen, &c.). Herausgegeben von Dr. H. von Buttel-Reepen. Pp. xii+138. (Leipzig, 1903.) Price 2.40 marks.

THIS is a book that should not be overlooked by those who are interested in the many important questions that are opened up by the habits of social insects. The author points out that the highly developed organisation of the life of the hive-bee does not stand alone, but may be traced up from the commencement of mere association of solitary species, through the less organised communities of humble-bees, &c., to its perfection in the hive-bee. A great number of outlying questions respecting parasitic bees, wax-secretion, &c., are also more or less fully discussed. The author is very anxious to eliminate, so far as possible, the natural tendency to anthropomorphise the actions of bees to too large an extent, and appears to take the view that inherited tendencies have to a large extent rendered their actions subjective and automatic. The index is very full, and is preceded by a list of nearly 200 books and papers dealing with the subject, which cannot fail to be of great value to any serious student of bee-life.

The Mind of Man. By Gustav Spiller. Pp. xiv+552. (London: Swan Sonnenschein and Co., Ltd., 1902.)

MR. SPILLER suffers apparently from the constitutional defects of extreme prolixity, and a marked contempt for the views of psychologists who have the misfortune to prove themselves "unscientific" by disagreeing with himself. The reader who is ready to overlook these deficiencies will find much interesting discussion of the principal problems of psychology in his book, though scarcely, I think, any considerable fresh contributions to the science. The author's fundamental point of view may be indicated by his definition of

psychology as the study of the functional needs of the central nervous system. His book exhibits great psychological learning, but is marred, I believe, by an ineradicable inconsistency of principle. He does not seem to have definitely made up his mind whether the processes of mental life are truly teleological (as he verbally asserts) or purely mechanical (as he frequently implies). Thus he exalts the significance of habit, or, as he calls it, "organised reaction," and minimises that of pleasure, pain and volition in determining action to a degree which leaves it a mystery how a new purposive reaction ever gets established.

A. E. T.

Heredity and Social Progress. By Simon N. Patten, University of Pennsylvania. Pp. i+214. (New York: the Macmillan Company; London: Macmillan and Co., Ltd., 1903.) Price 5*s.* net.

Useful as analogy may be for purposes of illustration, it forms a precarious basis for scientific argument. Dr. Patten's book exemplifies the danger of attempting to formulate general laws on the strength of more or less superficial resemblances between phenomena belonging to diverse natural conditions. Such first-sight correspondences may legitimately be employed in the way of suggesting or indicating an underlying law, but in the absence of verification by comparison with all related facts, they are incapable of carrying an induction beyond its preliminary stages. These principles, which would seem to be sufficiently obvious, are practically ignored in the present work, which accordingly, in spite of some clever reasoning, is vitiated throughout by its faulty method. The author's premises being unsound from the outset, his arguments cease to be of interest except as exercises of logical ingenuity. A few examples will show the kind of biological doctrine to which Dr. Patten asks our assent. It is not such as to justify confidence in either his facts or his method. "The germ cell. . . has, therefore, the conditions of consciousness and more readily may be assumed to be the seat of consciousness than any other part of the body. In fact, by a process of exclusion it would seem to be the only possible seat of consciousness." "The nerve, in its effort to emit its sex products, presses against the skin and partially breaks through. The skin hardens over the injured part and the tooth results, which holds the nerve in." "The brain . . . is a sex organ that never attains its elementary functions." "The play of the emotions is sufficient to account for the reduction and disappearance of organs." It will be seen that the author is not to be taken seriously. His book is simply a monument of misapplied ingenuity.

The Educational Systems of Great Britain and Ireland. By Graham Balfour, M.A. Second edition. Pp. xxxi + 307. (Oxford: Clarendon Press, 1903.) Price 7*s.* 6*d.* net.

THE first edition of Mr. Balfour's book was published five years ago, and since that time events of the greatest importance have taken place in English and Irish education. The consequence is that the present issue differs in many respects from the previous one. To students of education the volume is already well known, at least by name, and in its enlarged form it should prove of great assistance to members of the new education authorities being formed in all parts of the country as a consequence of the passing of the Education Act, 1902.

The education of the British Isles is considered under the three headings—elementary, secondary, and higher, but, as Mr. Balfour says, this is likely to be increasingly difficult, as the three grades are becoming parts of that organic educational whole which it is essential to form in this country. There is one direction in which the value of the book might be much enhanced, and that is in showing what has been done in this country by private effort for higher education. No educationist has yet instituted an exhaustive comparison between the extent of private munificence in aid of higher education in this country and in the United States, though a beginning was made in NATURE (No. 1750). Such a comparison would do much to quicken public interest in higher education. The book may be recommended to all who wish to obtain an accurate and comprehensive idea of the present state of education in the British Isles.

A. T. S.

Alpine Flora. By D. J. Hoffman, translated by E. S. Barton. Pp. xii+112. (London: Longmans, Green and Co., 1903.) Price 7*s.* 6*d.* net.

IT is a notable fact that many travellers who have little or no knowledge of their native flowers often become keenly interested in the flora of the Alpine regions, and the reason is not far to seek, for the attraction lies in the richness of colour and lavish abundance which characterise the flowers growing on the mountains. There is therefore a demand for a book, with illustrations, preferably coloured, and written in fairly simple language, which will enable the amateur or novice to name his botanical specimens. Such is mainly the object of the present book, originally written in German and translated for the benefit of English travellers. It is naturally a difficult matter to decide which flowers to represent in a small book of moderate price, the limitations of which are imposed by the cost of production of coloured plates, and the selection is on the whole judicious. There are a few plants, such as *Hacquetia epipactis, Lilium carniolicum,* which are not found, or rarely so, in Switzerland and the Tyrol, which might have been excluded in favour of others of more common occurrence. The colour contrasts are good, excepting for a weakness in the tone of the pinks, and a similarity of blue in the gentians. Mrs. Gepp has introduced more precise terms in the English edition, which add to its scientific value, and yet should not offer any difficulty to the amateur, since a glossary is provided. The book may advantageously be used with Gremli's "Flora für die Schweiz," and will be a material help to those botanists who have not previously visited the European Alpine ranges.

Arnold's Country-Side Readers. Book i., pp. 144; price 10*d.* Book ii., pp. 176; price 1*s.* Book iii., pp. 214; price 1*s.* 2*d.* Book iv., pp. 236; price 1*s.* 4*d.* (London: Edward Arnold, n.d.)

Arnold's Seaside Reader. Pp. 264. (Same Publisher.) Price 1*s.* 6*d.*

THE title of the first four of these reading books for schools suggests that the reading lesson should be utilised to give the pupil some knowledge of the natural objects of the country at the same time that he is learning to read, and there is much to be said for such a plan. An examination of the contents of the volumes shows that much interesting information about common plants and animals is placed before the young learner; but there is so bewildering a medley of fairy tale with descriptive natural history that the boys and girls who are set to learn from the books will scarcely be able to decide where fancies end and facts begin. The same diversity of contents characterises the "Seaside Reader"; instructive lessons on fishes and other sea animals are interspersed with accounts of naval battles and biographical sketches of naval heroes. On the whole it would be wiser in such books to exclude the fairy tales and historical chapters; there is romance enough about natural science without other aid being necessary. The books are well printed and attractively illustrated.

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.]*

Fœtal or New-born Giraffes Wanted.

WILL you give me the opportunity of making a request through your columns to museum curators and African sportsmen? I am especially anxious to obtain for study, preserved in spirit or dry, the head (*not* the prepared skull) of a new-born giraffe or of a late fœtal individual in which the boney ossicusps of the horns are already formed. I should be able to return the specimen after examination to the owner if desired. I should be glad to examine several such heads were it possible to procure them. All expenses of transport would be paid by me. I venture to ask those who can help me to communicate with me without delay.

E. RAY LANKESTER.

Natural History Museum, Cromwell Road, London, June 23.

Seismometry and Gêite.

BEFORE making a few comments on Prof. Milne's second letter under the above title (NATURE, June 12, p. 127), I should like to express my warm appreciation of his devotion to seismological research, and the great impetus it has given to observational work. In pure seismology—apart from applications of elastic solids to earth problems—Prof. Milne's reading is doubtless more extensive than mine, but if he is correct in regarding my first letter as containing nothing new to seismologists, they must, as a class, be singularly prone to a policy of *meliora scio deteriora sequor*. Novelty in results is, of course, much a matter of opinion. When Prof. Milne says, however, that there is no occasion for my warning as to Young's modulus, I must in reply give a quotation from his first letter, relating to the material of his hypothetical core, "it follows that the density . . . is 5·96, or approximately 6. *The* elastic modulus for a core of this density which conveys vibrations with a speed of at least 9·5km. per second is 451×10^{10} C.G.S., or roughly speaking, a little more than twice the Young's modulus for Bessemer steel." The italics are mine. If "the modulus" is not Young's modulus, E, a comparison between it and the E for steel is misleading, because a comparison of numerical results naturally implies that they refer to the same physical quantity. On this view the statement is doubly misleading, because there are *two* wave moduli, viz. $m+n$ and n. If, as one would infer from Prof. Milne's second letter, "the" modulus was intended for the wave modulus $m+n$, the futility of the comparison becomes obvious when we remember that on the ordinary theory $(m+n)/E$ may have any value between 1 and ∞, according to the value of Poisson's ratio. As a matter of fact, "the" modulus must, I think, have been intended at the time for Young's, though this must have escaped Prof. Milne's memory. If it were meant for $m+n$, we should have $(451\div5·96)^{\frac{1}{2}}$ "at least" 9·5, whereas it is really only 8·7. If, however, we multiply 451×10^{10} by 6/5—which would be correct if 451×10^{10} were a Young's modulus in a material where Poisson's ratio had the uniconstant value 0·25—and substitute this, we deduce a wave velocity of 9·53km. per second.

Prof. Milne seems to have misunderstood my treatment of the two wave velocities in the *Phil. Mag.* (March, 1897, p. 199), and as it bears directly on the question at issue, I should like to make it clear. In previous papers I had advanced a variety of considerations pointing to the conclusion that, whilst all applications of elastic equations to the earth are more or less speculative, the mathematical and physical difficulties are enormously reduced when we suppose that the deep-seated material—about which we have no direct information—is nearly incompressible, *i.e.* has a Poisson's ratio approaching 0·5. Such a hypothesis, for one thing, rendered it unnecessary to assign to the rigidity and Young's modulus values largely in excess of anything yet encountered at the earth's surface. There remained, however, the fact of the high velocities observed in the more rapid earthquake waves, which had been generally supposed to imply enormously large Young's moduli, such, for instance, as the value 45×10^{11} given by Prof. Milne. The problem stood as follows:—

In an infinite isotropic elastic medium there are necessarily *two* wave velocities. If we know them both we can deduce all the elastic properties of the medium, provided we know the density; if we do not know the density, we can still deduce Poisson's ratio. If the medium is not infinite, but is bounded by a plane surface, then, as shown by Lord Rayleigh, there is a special type of surface wave the velocity of which, especially when the material is nearly incompressible, approaches closely to that of the slower or rigidity body wave natural to the material. If the bounding surface be not plane, but spherical or spheroidal, there is doubtless a wave answering to the Rayleigh wave, which within moderate distances of its origin may be expected very closely to resemble the Rayleigh wave in type, when the depth to which it penetrates and the wave-length are both very small compared to the central radius. If the medium have a Poisson's ratio of 0·25, the velocities of the two body waves must be in the ratio of $\sqrt{3}$(or 1·73) : 1.

In the earth there seems distinct evidence of only two types of waves. For the more rapid, supposing them to travel straight through, Prof. Milne himself would apparently take 10km. as the most probable value at depths below the immediate heterogeneous crust. It was important for my object not to understate this velocity, and I took the somewhat higher figure of 12·5km. The second type—which Prof. Milne terms the "large" waves—travel much slower. If they go straight through, their velocity is *less*, of course, than if they travel along the surface. On the former hypothesis, Prof. Milne might make them a trifle slower than the value I took, viz. 2·5km. per second. If, instead of 12·5 and 2·5, we took 10 and 2, we should obtain, of course, the same value of Poisson's ratio as before, 0·48 approximately, with a value for E somewhat *less* even than the very moderate value (about 10×10^{11} C.G.S.) obtained in my paper. If we took 10 and 2·5, or even 10 and 3, for the two velocities, we should get 0·47 and 0·45 for the values of Poisson's ratio.

The uncertainty as to whether the "large" waves were body waves or surface waves—or, as I thought more likely, a combination of the two—was not overlooked, as Prof. Milne's letter might suggest, but was dwelt on at some length in the paper. If they are *entirely* surface waves, the heterogeneous nature of the earth's crust, and the irregularities of mountain and ocean, are such as to introduce extreme uncertainty into any mathematical calculations. In this event it is doubtful whether any conclusion can be drawn either for or against the hypothesis of great incompressibility in the core; its explanation of the high velocity in the faster waves would, however, be unaffected.

The discussion of magnetograph results by Prof. Milne in the B.A. Reports for 1898 and 1899 (1888 is surely a misprint) was familiar to me as a contributor of data, but it did not seem to render my letter unnecessary. I suspect, however, that I partly misunderstood Prof. Milne's letter on this part of the subject, as I did not fully realise that he did not recognise the distinction between anomalous and merely high values of the horizontal force H. The fact that H is nearly twice as large at Batavia or Bombay as at Kew is natural, owing to their proximity to the magnetic equator. Whether the values at these stations are higher or lower than one would expect from their geographical position cannot be said with certainty until the completion of magnetic surveys. What my letter suggested was the advantage for critical purposes of records at a station where there is known to be a true *large* magnetic anomaly—*e.g.* in N.E. Ireland or the Scottish Highlands. Variations in the value of g are, relatively considered, trifling compared to those in H, and the larger gravitational anomalies present systematic features to which there seems no parallel in magnetics (*c.f.* Bourgeois' discussion of g in the "Rapports présentés au Congrès International de Physique," Tome iii., Paris, 1900). Apart from the question of the unit, I am a little puzzled by Prof. Milne's gravitational data for Kew, and I should warn him that there, as at some other stations, the agreement between different observers at different times has not been such as to warrant much reliance in any one observer's value for $g-\gamma$ (*i.e.* gravity observed less calculated). C. CHREE.

Phenomena of Vision.

YOUR correspondent, Mr. W. Betz, refers in his letter of May 7 to the fact that an object just screened from direct vision by the nose (or by any other obstruction) becomes visible if we rotate the eye in a direction away from the object. This is a well-known phenomenon, and a very interesting one on account of the curious facts with regard to vision that can be deduced from it; but it is not in any way due to spherical aberration. It is rather a perspective effect, being caused simply by the shifting of the point of sight, which, being situated near the crystalline lens, moves laterally as the eye is rotated about its centre. There are several ways of demonstrating the movement of the point of sight, but the experiment described by Mr. Betz is perhaps the most convincing.

An interesting corollary of this experiment is the generally unfamiliar fact that we employ two points of sight simultaneously in the act of vision, though we may use one eye alone. Speaking generally, the eye wanders over any object we may be examining with slight pauses at each point of interest. Only at each pause do we really see, and our final mental impression of the whole object may be described as a mentally combined image of a series of "snap-shots." The retinal image produced at each "snap-shot" is a perspective view with the node of the crystalline lens as the station point. The final mental picture is, however, a view with the centre of the eyeball (or its centre of rotation) as a station point. This latter view is smaller than the other, by reason of the fact that the centre of rotation is some little way behind the crystalline lens, hence the apparent size of an object varies as we study it. The general effect is further complicated by the lateral movement of the crystalline lens, which causes each momentary snapshot to be taken from a different station point; also the final impression is more or less influenced by the impression gained during the last fixed glance. Therefore we may conclude, with a considerable amount of reason, that we do not see objects exactly as they are. Really we only see a combination of a number of views taken from different points, and to arrive at a true understanding of what we see we must employ our capacity of reasoning. The extraordinary complexity of our mental visual conception is often deceptive, though unconsciously so to many people who have no idea of the peculiarities of vision.

The various effects of the employment of the two station points are not likely to be appreciated unless looked for, but once you realise the fact, evidence is easily collected. One of the most striking effects is the apparent movement of fixed points. In the experiment described by Mr. Betz the object point seems to play hide and seek with you, popping out from behind the screen when you look in another direction, and dodging back again when you try to look straight at it. It seems to move with the eye, but this effect is due mainly to the presence of the screen, for under other conditions it will generally be found that the apparent movement is opposite to that of the eye. The following experiment illustrates both the illusion of movement and also the dependence of apparent size upon the direction of vision.

Place two objects at different distances from the eye and subtending a moderate angle at the eye so that both can be seen when one is directly looked at. Look fixedly at one object and estimate the distance between the two. Then traverse the eye slowly on to the other object, and the distance between them most distinctly alters, the effect being apparently due to a shifting of one or both of the objects. You will find it somewhat puzzling to account for all the various effects of movement that can be detected under different conditions, but if you take all factors into consideration, you will, I think, eventually find that the shifting of the station point is primarily responsible for all the effects produced, other than those due to spherical aberration.

C. WELBORNE PIPER.

May 15.

MR. PIPER'S explanation of the curious phenomenon pointed out by Mr. Betz is presumably correct; that there are two station points used in vision can, however, scarcely be demonstrated. The positions of the nodal points of the eye are shifted during accommodation for near vision, and perhaps this displacement is what Mr. Piper refers to. In general it is difficult to observe the apparent motions of objects which Mr. Piper mentions, and it is still more difficult to trace such motions to the optical properties of the eye, since we are here dealing, not with optical images which can be directly examined, but with mental impressions. Thus König pointed out (*Wied. Ann.*, xxviii. pp. 367–368, 1886; "Gesammelte Abhandlungen zur physiologischen Optik," xiii. p. 58, Leipzig) that patients, on first being provided with strong divergent spectacles, complain that, on moving their eyes without turning their heads, stationary objects appear to move. After a time this apparent motion ceases to be observed, or, indeed, to be observable, but on removing the spectacles stationary objects appear to move in a sense opposite to that previously observed with the spectacles. In this case a readjustment of judgment respecting visual impressions has been effected; the result shows to what a great extent judgment enters into the act of vision.

EDWIN EDSER.

June 13.

School Geometry Reform.

IN the unsigned review of Prof. Barrell's "Elementary Geometry" appearing in the issue of June 18, the following sentence occurs:—"A feature to be noticed is that the author gives three meanings of a plane angle, in the last of which the angle is regarded as the plane space swept out by a line of indefinite length (one way) turning about one end." It is unsafe to say that such a definition is wrong, but it is certainly most undesirable in a school book. The apprehension of the true nature of an angle is one of the greatest difficulties that the beginner has to encounter, and the way is not smoothed by the introduction of the idea of an infinitely extended space. It is true, as Mr. Russell points out ("Principles of Mathematics," p. 416), that the definition can be made logically satisfactory if the axiom of the whole, being greater than its part, be rejected; but this is an intolerable objection. The best course for an educational book is that adopted by Ronché and De Comberousse ("Traité de Geometrie," 1891, p. 5), who say:—"La considération de deux droites qui se rencontrent conduit à une idée nouvelle, qui est celle d'*inclinaison* mutuelle ou d'*angle*, et qui, comme l'idée de longueur, ne saurait être définie, c'est-à-dire ramenée à une idée plus simple."

R. W. H. T. HUDSON.

June 22.

RECENT EXCAVATIONS AT NIPPUR.

IT was in 1884, at a meeting of the American Oriental Society, that the first plans of an expedition to Southern Babylonia were projected, and from that year dates the beginning of the systematic scientific work which is being carried on by the Americans at the mounds of Nuffar, the ancient Nippur, with all possible thoroughness. Since the year 1888, there have been four expeditions sent out to excavate this ancient site, and there is still much to be done there. The first resulted in the discovery of a Parthian palace, and many "finds" from systematic diggings in the Temple of Bel, the cuneiform tablets alone numbering two thousand; but ill-luck overtook the members of the party, and, owing to trouble with the Arabs, the camp was burnt and they themselves were robbed. However, the next year, on reopening the works, there was no opposition, and the labours of the expedition were rewarded with eight thousand tablets of the second and third millennium B.C., and in the third campaign many pre-Sargonic ruins were discovered, besides more than twenty thousand tablets. The last expedition, which came to an end in 1900, was the most successful of all; the Parthian palace was completely explored, and, what was more important, the great library of the Temple of Bel was located, and twenty-three thousand clay tablets were excavated therefrom, thus bringing the total number found up to more than fifty thousand.

Looking at the results of the four expeditions, we are struck with the careful way in which all operations have been conducted, especially towards the end of the period. The mounds were carefully surveyed, and even a relief map of them was made in plaster, the buildings which were discovered were accurately mapped, numerous photographs were taken of the various phases of the diggings, and as time went on those in command became even more methodical in their diggings. The manner in which the excavations were carried on merits the highest praise.

The "section" of the shafts dug through the mounds, as figured by Prof. Hilprecht in his latest work, "Explorations in Bible Lands" (p. 549), shows, as is common in ancient mounds, that the city was occupied from a very early period, and that from time to time new builders superimposed their pavements and dwellings upon those of an earlier period, so that the mounds are made up of successive layers, each marking an earlier building as the shafts sink lower. The diggers first cut through soil containing Sassanian and early Arabic remains. Then came the great Parthian fortress of the second or third century B.C. Next were found in six successive strata the pavements of buildings of (*a*) Ashurbanipal, who restored the great *ziggurat*, or temple-tower (*c.* 668-626 B.C.); (*b*) Kadashman-turgu (*c.* 1350 B.C.); (*c*) Ur-ninib (*c.* 2500 B.C.); (*d*) Ur-gur (*c.* 2700 B.C.); (*e*) Lugal-surzu (*c.* 3500 B.C.); (*f*) Sargon and Naram-Sin (*c.* 3750 B.C.). Below these, and beneath the level of the surrounding plain, a vaulted drain came to light, of a period distinctly before Sargon, and in the heart of the mound, on a slightly higher level, was a pre-Sargonic *ziggurat*. Straight down through these layers, from almost the top to the very water-level, a Parthian well had been sunk, a total distance of about seventy feet in depth. The mound of Nippur is therefore similar to Hissarlik and Tel-el-Hesy in the superimposition of cities.

The larger of the two Parthian buildings was a palace and fortress occupying what had been the centre part of the old Babylonian temple, and was an almost rectangular building surrounded by an enormous double wall, five hundred and sixty feet long on its south-eastern front. From the discovery of great masses of water-jars piled together in the southern part, as well as various fire-places and other kitchen arrangements close to them, it is clear that these were the servants' quarters, storehouses and bakeries. In the centre of the whole building rose the citadel, built over the ancient *ziggurat*, and it was through this that the only well of the whole building had been dug, evidently with the idea of the garrison holding out against a long protracted siege.

The smaller Parthian palace, west of the Chebar, which has been completely excavated, was a square building, measuring each side about 170 feet. It apparently had but one entrance, which was situated in the centre of the north-west façade. The walls varied in thickness from three to eight and a half feet, and the material used in the construction was brick, baked and unbaked. The roof, as the pieces of charred wood discovered in the ruins plainly show, was of palm logs, matting and earth. Prof. Hilprecht divides the building into two almost equal parts, the one for public functions and the other for the family life.

But important as these two buildings were, their interest cannot compare with the discoveries of earlier Babylonian ruins. Of these the huge *ziggurat*, or tower of the Temple of Bel, stands out pre-eminent, a huge brick building, the origin of which dates back to pre-Sargonic times, and shows in its various strata traces of the handiwork of the many kings who restored and added to it. According to Prof. Hilprecht, the Temple of Bel (called Ekur in the cuneiform inscriptions) was divided into two principal buildings, the *ziggurat* or great tower, and the "House of Bel." The whole was surrounded by the great wall called *Imgur-Marduk*. It is to this temple that the energies of the excavators have been principally directed, and from it have come the majority of the tablets found. The temple in Babylonia was not only a place wherein the gods might be worshipped, but was also a college at which priests were trained, and for this a reference library was essential. Consequently, it is not going too far to say that probably every important temple in Assyria and Babylonia had its own library of clay tablets. An excellent idea of what the temple rooms looked like may be gained from the photograph in Prof. Hilprecht's book, "Explorations in Bible Lands," p. 509.

In the remains of this Babylonian city many discoveries were made which add considerably to our knowledge of the daily life of the inhabitants. One of the most remarkable things found was a baking furnace made of brick, dating back to the third millennium B.C., composed of a series of seven (originally nine) parallel arches over a fire-box which ran lengthwise through the whole kiln. It was, in fact, very similar to the military field-ovens in use at the present day. Still earlier is the specimen of the elliptical arch which Haynes discovered, which Prof. Hilprecht assigns to the fifth millennium B.C. This is undoubtedly the first Babylonian arch known, and will go far to prove the much-disputed question of the origin of the arch.

Up to the present comparatively few of the tablets discovered in the ruins have been published, so that it is impossible to speak of the possibilities of the great temple library. We may notice, however, an important clay map of Nippur, photographed in Prof. Hilprecht's book (p. 518), which gives the environments of that ancient city as they were about two thousand five hundred years ago. Interesting, also, are the "practice" tablets, written by the pupils in the schools during their study of the Babylonian language. Indeed, it is to this class of tablet that we owe much of our knowledge of the classical works in cuneiform, for many similar are preserved in the British Museum which are inscribed with excerpts from the Creation legends, syllabaries, and incantations.

Much remains to be done at Nippur, and it is to be hoped that the Americans will continue and complete the great work they have begun. There is little doubt that when the mounds of Assyria and Babylonia have yielded up their hoards of cuneiform tablets stored up in the palace and temple libraries, our knowledge of those countries will equal, if not surpass, what we know of the archæology of Greece and Rome.

MATHEMATICAL REFORM AT CAMBRIDGE.

THE syndicate appointed in December, 1902, to consider what changes, if any, should be made in the regulations affecting the mathematical portions of the pass examinations of the University of Cambridge has recently presented a report which has just been adopted by the Senate, and will profoundly and beneficially affect the teaching of the subject in our public schools and throughout the country.

Recognising the widespread desire for reform, noting the changes that have already been made in the schedules of important examining bodies, and having examined the recommendations of various committees, the syndicate is convinced that changes are desirable, and that a "modification of the requirements of

examinations is a necessary preliminary to any substantial improvement in teaching."

The syndicate has, therefore, made recommendations affecting the subject-matter of the Previous Examination. The alterations will begin to operate in the Lent term of 1904, and will finally supersede the present regulations after October, 1905. The principal changes may be summarised as follows :—

(1) In demonstrative geometry, Euclid's Elements shall be optional as a text-book, and the sequence of Euclid shall not be enforced. The examiners will accept any proof of a proposition which they are satisfied forms part of a systematic treatment of the subject.

(2) Practical geometry is to be introduced, along with deductive geometry, and questions will be set requiring careful draughtsmanship and the use of efficient drawing instruments.

(3) In arithmetic, the use of algebraical symbols and processes will be permitted.

(4) In algebra, graphs and squared paper work will be introduced; and a knowledge will be required of fractional indices and the use of four figure tables of logarithms.

The scope of the subject-matter in geometry is set out in two schedules. The first gives a list of constructions in practical geometry. We venture to take exception to one detail in this list, that of requiring a construction for drawing a common tangent to two circles. Why insist on first finding the points of contact? This may have been necessary under Euclid's postulates, but it should now be discarded; it is not practical geometry.

The second schedule indicates the amount of book work necessary in preparing for the Previous Examination. The propositions enumerated are nearly all contained in the Elements, but a judicious amount of pruning has been effected in the latter. Hypothetical constructions are permitted. The theory of incommensurables is not required.

The increase of freedom now being given to teachers should lead to further developments in the reform as experience is gained. It will be one great advantage to have the several branches of the subject brought into closer association and reacting on one another.

Geometry will be made generally interesting and will at last have a chance of being taught in a manner suited to boys. In looking out for suitable numerical examples in geometry, we predict that a good teacher will not fail to make use of functions of angles. Probably three figure tables of chords, sines, cosines and tangents will be sufficient, reading to tenths of a degree, and occupying a very modest space. A boy's interest will be stimulated when he discovers the latent power residing in these innocent looking tables. And in checking his graphical results, he may be led on to the numerical solution of right-angled triangles before he has heard of trigonometry, and will never afterwards be repelled by the symbols sin., cos., tan.

The employment of logarithms is most important. Their use illustrates the significance of fractional indices. And here again the interest of a boy must surely be aroused when he finds himself in possession of a new, unforeseen, and most valuable means of calculation.

The introduction of graphs is of great value. The fundamental idea of the representation of position and change of position by means of rectangular coordinates is thus acquired early and in an agreeable manner. Some teachers find that it is quite possible to go on without much delay to easy illustrations of the calculus.

Looking ahead to possible developments, the graphical use of polar coordinates to mark position and change of position, by the plotting of lengths and angles, might serve as an introduction to the study of vectors, a subject of first importance, and at present so woefully neglected.

We regard this reform at Cambridge as an important step in the movement now in progress throughout the country, and we hope to see it carried much farther before crystallisation takes place.

THE UNIVERSITY OF LONDON.

THE presentation for degrees of the University of London, which is to take place in the Albert Hall as we go to press, under the presidency of the Chancellor, Lord Rosebery, is noteworthy in several respects. For the first time in the history of the university, honorary degrees are to be conferred, the recipients being their Royal Highnesses the Prince and Princess of Wales, Lord Kelvin, and Lord Lister. The Prince is to receive the honorary degree of Doctor of Laws, the Princess that of Doctor of Music, and Lord Kelvin and Lord Lister that of Doctor of Science. Ordinary degrees are also to be conferred on 414 persons who have obtained them during the past year. Moreover, the occasion is remarkable as being the first gathering of representatives of all the different institutions and groups of persons connected with the university.

The reconstituted university has opened up new avenues of work in connection with schools, with university extension, with the colleges, medical schools, and polytechnics; students are entering both for the ordinary matriculation examination and for post-graduate study and research in unexpected numbers. The educational forces of London have, in fact, been organised by the university, and public interest is being shown in the work. But, as Sir Arthur Rücker, the principal, has pointed out, while there are many grounds for hope, and while the university is doing its best to make itself worthy of public support, it can never fulfil its duties without the supply of funds from public or private sources on a very large scale. We trust that one result of the brilliant ceremony on Wednesday evening will be an increase of the endowment of the university sufficient to secure the full development of the scheme which has already produced such satisfactory results.

NOTES.

FOR the first time for about forty years the Royal Society of Edinburgh, on the evening of June 6, held a conversazione. Lord and Lady Kelvin and Sir William Turner received the guests. There were many interesting exhibits from several departments of the Universities of Edinburgh, Glasgow, and St. Andrews, from the Geological Survey of Scotland, the Scottish Antarctic Expedition, &c. Prof. McIntosh, of St. Andrews, sent over a large collection of pearl shells and animals, living and dead, and great interest was taken in Prof. Ewart's exhibition of hybrid ponies. Some of the lantern exhibits were particularly attractive, notably the projection on the screen of tanks of living worms, crustacea, &c., and a fine selection of slides made from Piazzi Smyth's "cloud" negatives. Among the inventions and novelties exhibited, Dr. Halm's instruments for mechanically correcting stellar observations and for solving Kepler's problem in any given case, and Dr. Hugh Marshall's petrol incandescence lamp are worthy of mention.

CAPTAIN AMMUNDSEN'S Magnetic North Pole Expedition left Christiania on June 16 on board the ship *Gjoa*.

WE regret to announce the death, on June 10, of Prof. Luigi Cremona, director of the engineering school of the University of Rome.

THE summer meeting of the Institution of Naval Architects was opened at Belfast on Tuesday, and Lord Glasgow delivered his presidential address.

THE retirement of Sir James Hector, K.C.M.G., from the directorship of the Geological Survey of New Zealand and of the Colonial Observatory is announced by the *Victorian Naturalist*.

MR. MARCONI'S manager at Glace Bay, Nova Scotia, states that the company is transmitting daily wireless messages from Table Head to Poldhu, but the replies are being cabled pending the installation of machinery at Cornwall.

THE *Times* announces that Commander Don Julian Irizar, Naval Attaché to the Argentine Legation in London, has been appointed to command the vessel *Uruguay*, which will be sent by the Argentine Government in October to the Antarctic regions in search of Dr. Otto Nordenskjöld's South Polar expedition, which was joined at Buenos Ayres in 1901 by an officer of the Argentine Navy.

A GRANT of 5000 dollars, and travelling expenses to the amount of 1500 dollars, has been made to Prof. Arthur Gamgee by the Carnegie Institution for the preparation of a report on the physiology of nutrition, the object being to enable him to secure information which may lead to the organisation in the laboratories of various countries of cooperative research in the important problem of human nutrition, &c.

PROF. STEINMANN, of Freiburg, and two of his fellow-geologists of the same University, have arranged an expedition to the Central Andes of Bolivia. The party will start in August for Buenos Ayres, whence the route to be taken is *viâ* Jujuy, Tarija, Sucre, to Cochabamba. After a prolonged stay in the mountains the explorers will probably work their way to Antofagasta *viâ* La Paz. The outfit is of the most modern description, and Dr. Hoek, who is a member of the expedition, is one of the most capable German mountaineers.

THE International Fire Prevention Congress convened by the British Fire Prevention Committee will be opened at Earl's Court on Monday, July 6, by the Lord Mayor of London, who will be accompanied by the Burgomaster of Brussels. The general and sectional discussions will be held on the forenoons of July 7, 8, and 9. The testing operations and inspections are fixed for the afternoons of these days.

THE Royal Statistical Society announces the next competition for the Howard medal (1903–1904). The essays must be sent in on or before June 30, 1904. In addition to the medal, a grant of 20*l*. will be awarded to the writer who may be the successful competitor. The subject is "The Effect, as Shown by Statistics, of British Statutory Regulations, Directed to the Improvement of the Hygienic Conditions of Industrial Occupations." Full particulars may be obtained at the office of the Society, 9 Adelphi Terrace, Strand.

THE concluding meeting of the thirty-eighth session of the Aëronautical Society of Great Britain will be held on the Sussex Downs this afternoon. On this occasion will take place the international kite competition (wind and weather permitting) for the silver medal of the Society, in accordance with the rules and regulations drawn up by the council of the Society and the jury of the competition. Amongst those who have consented to act on the jury are Dr. W. N. Shaw, F.R.S., Prof. C. V. Boys, F.R.S., Mr. E. P. Frost, Sir Hiram Maxim, Dr. H. R. Mill, Mr. E. A. Reeves, and Mr. Eric Stuart Bruce.

WE learn from the *Lancet* that Dr. Loudon, of St. Petersburg, has published some interesting observations relative to the action of the Becquerel rays on the nervous system and on the eye. He found that when a box containing bromide of radium was placed in a cage in which mice were kept the animals became paralysed and comatose, and died in five days. He also found that persons who are either totally blind, or have only the feeblest possible perception of light, are peculiarly sensitive to the Becquerel rays, and are able to form visual conceptions of the contour of objects the shadows of which are shown on a screen by means of the rays.

THE following note referring to observations of sunrise at Stonehenge on Sunday appeared in Monday's *Times*:—For the first time for nearly ten years visitors to Stonehenge yesterday morning saw the sun rise over the altar-stone. There was an almost cloudless sky, and at forty-three minutes past three the sun appeared above the horizon and rose in a direct line over the altar-stone. It was a magnificent sight, and after a moment's silence the crowd gave a mighty cheer. There were some hundreds of people present, many of them having travelled in previous years many miles during the night preceding the longest day in the hope of seeing the sight which was seen under such favourable conditions yesterday morning.

SLIGHT earthquake shocks were felt in North Wales and Anglesey on the morning of June 19. Mr. Fred. C. Carey, of the County School, Bethesda, writes to us that the first shock was felt by him in the county school at 10.8 a.m. precisely, when a distant rumbling noise, lasting about a minute, was heard, and the whole building shook. Slighter tremors followed at 10.12·5, 10.16, 10.19·5, 10.27, and 11.11·5. At Carnarvon the buildings trembled violently. At Bangor the shocks were felt at about the same time. The bells rang at the railway station. The post office at Llanrug was much shaken. The shocks were general throughout Carnarvonshire, and were felt as far as the southern part of the Isle of Man. The vibration appeared to travel in a north-westerly direction. In Anglesey the shock was comparatively slight.

IN connection with the meeting of the International Meteorological Committee at Southport during the British Association week in September next, it is proposed to make arrangements for an exhibition of meteorological appliances and other objects of meteorological interest. Upon the initiative of the Meteorological Council, with the cooperation of the Royal Meteorological Society and the Scottish Meteorological Society, a committee has been formed to carry out this proposal. It is proposed to group the exhibits into four classes:—(*A*) meteorological statistics; (*B*) weather telegraphy; (*C*) atmospheric physics, including (*a*) meteorological photography; (*b*) instruments and instrumental records; (*c*) high level stations, balloons and kites, observations and records; (*d*) experimental illustrations; (*D*) the relation of meteorology to other branches of physics.

THE weekly weather report issued by the Meteorological Office for the week ended June 20 shows that over the southern part of England the rainfall was three times as much as the mean, while in the east of England it was more than seven times as great. Further, that the rain-

fall since the beginning of the year is in excess of the average in all districts, varying from more than 10 inches in the north of Scotland to 0·9 inch in the north-east of England. During the first three weeks of this month the amount measured near London was upwards of 6 inches; the Greenwich records for the last 60 years show that the heaviest previous fall in June was 5·80 inches, in the year 1860. At Malin Head the fall in the same three weeks was only 0·05 inch, and at Holyhead only 0·4 inch. But on June 22 an area of low barometric pressure reached our western coasts and occasioned heavy rain, amounting to an inch and three quarters at Valencia in the forty-eight hours ending 8h. a.m. on June 24.

THE cleanliness of electric lighting has always been urged as one of the great claims in its favour, and it has been justly pointed out that the saving effected in redecoration partly balances its extra cost. Although this is true, electric light cannot be regarded as perfectly clean; it has long been noticed that there is a marked tendency for dust to accumulate on electric light fittings and wires, and on the walls and ceilings in their immediate neighbourhood. This is partly, no doubt, due to the air currents produced by the local heating, but it is also partly an electrical phenomenon. The dust particles floating in the air are presumably at air potential, and are consequently attracted to the conductors on the non-earthed side of an earthed system; they either stick to these permanently, or remain on them until charged, when they are projected on to and stick to the walls. The defect has naturally become more marked with the increased use of 200-volt systems. If switches are always put, as they should be, in the non-earthed wire, the deposition of dust will only occur during the time the lamps are alight, and will be minimised. Mr. D. S. Munro, writing in the *Electrical Review*, points out that a still further improvement can be effected by using concentric flexible conductors instead of the ordinary twisted cord, the outer conductor being connected to the earthed side of the system.

DR. EDINGTON read a paper at the recent meeting of the South African Science Association upon the occurrence of an epidemic among domesticated animals in Mauritius, in which trypanosomata were found in the blood. It attacked cattle, mules, horses, and donkeys, among which it caused an alarming mortality, and seemed to be allied either to nagana or to surra.

THE commemoration day proceedings of the Livingstone College were held at Leyton on June 10. The College trains missionaries in the elements of medicine and surgery. The Bishop of St. Albans, who presided, stated that there could be little doubt that the average life of a man abroad was considerably extended when due care was taken to observe the rules of health. He referred to the importance of training women as medical missionaries for work in India, and to the moral effect exerted upon native races by curing their bodily ailments.

THE annual return showing the number of experiments performed on living animals in the United Kingdom during 1902 has been issued as a Parliamentary paper (186). In England and Scotland the number of licensees was 319, of whom 112 performed no experiments. The total number of experiments performed by these was 14,906, of which 2130 were carried out under anæsthetics, and the remainder, 12,776, were of the nature of hypodermic inoculations. The inspector, in his report, directs attention to the large number of experiments performed for the preparation of remedies and on behalf of various public authorities. Five licensees alone performed 3857 inoculation experiments for testing anti-toxins, and fifteen licensees 3997 inoculations for public bodies for the purpose of testing milk for tuberculosis, for the examination of sewage and of air, and the like. As regards Ireland, 13 licences were in existence during the year, and 65 experiments were performed under them.

WE have received from the director of the Survey Department, Cairo, a report on the meteorological observations made at the Abbassia Observatory during the year 1900, together with mean values for Alexandria for the previous ten years: also monthly results for Port Said, Assiut and Omdurman for part of the year 1900. The report is a very valuable contribution to Egyptian climatology, and bears evidence of every care having been taken in the selection of trustworthy instruments and in the reduction of the observations. The observatory is now well supplied with automatically registering instruments of the best patterns, including Dines's anemometer, Callendar's electric recorders for dry- and wet-bulb platinum wire thermometers, Campbell-Stokes's sunshine recorder, and Milne's seismometer. For Abbassia hourly observations are given, and the results, with daily and annual variations and other data, are shown in clearly drawn diagrams, both for this station and for Alexandria. From the latter ten-year series we note that the mean of the highest temperatures recorded in each month was 36°·6 C. in May, and of the lowest maxima 21°·6 in January; the mean of the highest minima was 22°·7 in August, and of the lowest 7°·0 in January. The extreme values were 40° and 5°·4. The mean annual rainfall is only 0·53 inches; most of this falls between November and January. No measurable quantity falls in June, July and August, and only three-tenths of an inch, on the average, in September.

IN our recent notice of Messrs. Burroughs Wellcome and Co.'s "tabloid" preparations for photographers, we remarked that, among a very large assortment of reagents and mixtures, mercuric chloride and ferrous oxalate appeared to have been overlooked. The firm informs us that the mercuric iodide and sodium sulphite intensifier is so efficient that it does not consider the issue of mercuric chloride tabloids as desirable. We would point out that intensification is the only process subjected to such a limitation, and that, although the iodide of mercury method is easily applied and the tabloids are excellent for the purpose, there is no method of intensification that is so simple in its chemical and physical effects, and so trustworthy as to the amount of change produced and the permanency of the resulting negative, as the use of mercuric chloride followed by ferrous oxalate. The same advantages that we have indicated in connection with photographic "tabloids" apply also to the same firm's "'soloid' microscopic stains." A dozen or more varieties are already issued, the most recent addition being Leishman's modification of Romanowsky's stain for blood films. Microscopists will appreciate not only the convenience of being able to prepare staining solutions without having to weigh the solid substances, but also the fact that these preparations are made from materials specially selected for the purpose.

IN *Science* for May 29, Mr. C. A. Chant discusses certain questions connected with theories of colour vision, and in particular a view put forward by Dr. Kirschmann according to which colour sensation may not be due to the effect of rays of one particular wave-length, but rather to the superposition of rays of different lengths the *combination* of which produces the effect of colour. That the theory in question is a possible one arises from the fact that "nobody

has seen light of one wave-length," and even in the narrowest band obtainable by a pure spectrum, differences of frequency amounting to many millions of wave-lengths may occur. Mr. Chant, on the other hand, refers to the experiments of Rowland, Michelson and Morley, Perot and Fabry in obtaining interference effects with very long differences of path (other experiments in this direction were recently noted in NATURE), and to the fact that not only was there no sign of the colour disappearing when the light approached perfect homogeneity, but the intensity of the sensation was slightly increased.

THE article on the infection-power of ascospores in the Erysipheæ is continued in the *Journal of Botany* (June) by Mr. E. S. Salmon. The ascospores of *Erysiphe graminis* growing on barley were found to be capable of infecting two allied species, but failed when sown on four other species of Hordeum, as well as on wheat, oats and rye. This establishes the existence of biologic forms in the ascospore stage similar to those known for the conidial stage. In the case of the form under investigation, the same species of Hordeum are proof against infection whether by ascospores or conidia.

THE announcement was recently made of the discovery of a new source of indiarubber, the peculiarity being that the latex, which has been found to yield a good marketable caoutchouc, is obtained from the underground portion of the tree, a Landolphia. The genus is confined to Africa, more especially to the tropical regions, and is characterised by the presence of latex in the stem, but the latex only furnishes caoutchouc in a few species. Of these the three best known, *Landolphia Kirkii*, *L. owariensis*, and *L. florida*, are lianes climbing by means of tendrils. Recently the new species *Landolphia Thalloni* has been exploited in the French Congo; the aërial portions of this species persist only for one or two seasons, and the latex is stored in the rhizome.

THE whole of vol. lxxiv. part ii. of the *Zeitschrift für wissenschaftliche Zoologie* is occupied by the first instalment of a dissertation, by Prof. A. Schuberg, on the nature of intercellular tissue. Among other results, it is demonstrated that the tissue between the cells of the epidermis is readily distinguishable from the corresponding structure in the true skin.

IN the April number of the *American Naturalist*, Prof. W. Patten describes certain fragmentary remains which, in his opinion, justify the conclusion that the primitive fish-like creature Trematapis (previously known only by the dorsal shield) was furnished with a pair of oar-like swimming appendages attached to the head, and resembling those of Pterichthys and Bothriolepis. If this be so, it is probable that similar appendages likewise existed in Pteraspis, Cyathaspis, and Polyaspis.

IN an article entitled "The Ways of Nature," published in the June number of the *Century Magazine*, Mr. J. Burroughs discourses in a popular style on the question whether the lower animals really possess self-consciousness. Probably, he argues, they think without knowing that they think, and thus the faculty in question is restricted to man. Later on reference is made to incidents quoted in well-known works which seem to show that animals are really possessed of reasoning powers, but it is pointed out that since these incidents were, in most cases, at any rate, not recorded by trained scientific observers, their value must be largely discounted.

IN the report of the Marlborough College Natural History Society for 1902, the secretary states that, notwithstanding the season having been unfavourable for field-work, there are no reasons to be dissatisfied with the results of the year. The collections which have been most largely increased are those of the various groups of insects, especially Diptera. The members, it is stated, have been urged to specialise their studies, as it is considered that by this method the best results are ensured for future years. Whether this is really so there may, however, be two opinions.

ACCORDING to the annual report of the Cambridge Museums and Lecture Rooms Syndicate for the past year, considerable progress has been made in transferring the collections of the Woodwardian Museum to the Sedgwick Memorial Museum in Downing Street, where the geological lectures have been delivered. Amongst the more important additions to the University collections, special attention is directed to a valuable series of human skulls obtained from various sources, also to the skeleton of a humpback whale, presented by Mr. Rothschild, and to specimens of the whale-headed stork (*Balaeniceps rex*), the gift of Sir Reginald Wingate. During the twelvemonth the Zoological Museum has likewise been enriched by the gift, from Prof. Newton, of several collections of birds and eggs of exceptional value.

M. É. RECLUS has reprinted his interesting little book "Les Primitifs," which was originally published in 1885. The book is well known to English readers under the title "Primitive Folk: Studies in Comparative Ethnology" (The Contemporary Science Series); it deals with the Eskimo, Apaches, and various tribes of southern India. Nothing new has been added to the original edition.

DR. FRANZ BOAS has published as *Bulletin* 27 of the publications of the Bureau of American Ethnology the Tsimshian texts he collected at the mouth of the Nass River in 1894 while he was engaged in researches under the auspices of the British Association Committee on the North-western Tribes of Canada. By far the greater number of these are myths of the tribes in which the miraculous is blended with the actual; it is not difficult to eliminate the former. The remainder gives a good insight into the everyday life of the people. The texts are printed as they were taken down by Dr. Boas from his informants, and a literal word for word translation is given, as well as a more free rendering. In addition to their linguistic value these texts afford the reader a good idea of the literary style and the sentence-building of the Tsimshian Indians without a previous knowledge of the language being necessary.

A REPORT on the Kangaroo Hills Mineral Field, by Mr. W. E. Cameron, has been issued by the Queensland Geological Survey. The district is one of altered sedimentary rocks and granite, in which tin, copper, and silver mining has been carried out. A report on Yorkey's Gold Field and the Marodian Gold and Copper Field in the district of Wide Bay, Queensland, has been prepared by Mr. L. C. Ball. Yorkey's Gold Field lies in an area of slates assigned with doubt to the Gympie (permo-Carboniferous) formation, with intrusive masses of granite and diorite, and the auriferous quartz reefs occur in or adjacent to the diorite. The other districts referred to are in the prospecting stages. A report on the west coast of the Cape York Peninsula and on some islands of the Gulf of Carpenteria has been drawn up by Mr. C. F. V. Jackson. Interesting particulars and photographic views are given of

this little known region, including notes on the mangrove trees and their influence on the coast line. The gold-field of Horn Island is described, the reefs occurring in porphyritic granite. The works are now abandoned, but apparently they were started before adequate investigations had been made, and even now it is doubtful whether the trials were exhaustive.

WE have received a copy of the illustrated catalogue of chemical apparatus and laboratory fittings supplied by Messrs. Max Kaehler and Martini, of Berlin, W. The catalogue runs to 500 pages, and will be sent post free to schools and colleges where there are chemical laboratories. The sole agent for the United Kingdom is Mr. S. Bornett, 62 King William Street, London, E.C.

PROF. WYNDHAM R. DUNSTAN, F.R.S., was recently appointed by the Board of Trade to be director of the Imperial Institute, and one of the results appears to be the publication, as a supplement to the *Board of Trade Journal*, of a "Bulletin of the Imperial Institute." The first issue of the bulletin contains much useful information as to the experiments and inquiries which have been carried out in the scientific and technical department of the Institute. Reports on the following investigations, amongst others, are included:—poisonous fodder plants and food grains; analyses and examinations of coal from Trinidad; kaolin from St. Vincent; tin ore from the Bautshi tin fields, Northern Nigeria; fibres from Sierra Leone and Brazil; and nuts from British Honduras and Portuguese East Africa. The second part of the bulletin consists of general notices prepared by the scientific department on a variety of questions, as different as the chemical analysis of gutta-percha as a guide to its cultivation and valuation, and cotton cultivation in Asia Minor. The work of the scientific and technical department is chiefly initiated by departments of the Governments of India and the Colonies. Arrangements have been also made by the Foreign Office whereby British Consuls may transmit for investigation such natural products of the countries in which they are appointed to reside as are likely to be of use to British manufacturers and merchants. Materials are first chemically investigated in the laboratories of the department, which includes a staff of skilled assistants, and are afterwards submitted to technical trials by experts, and finally are commercially valued. Manufacturers, and dealers in natural products, ought to be keenly alive to the advantages to be derived from work and inquiries of this character.

THE additions to the Zoological Society's Gardens during the past week include an Indian Elephant (*Elephas indicus*, ♀) from India, presented by the Maharaja of Benares; a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, presented by Mr. J. R. E. Stansfeld, D.S.O.; a Crested Porcupine (*Hystrix cristata*), a Black-backed Jackal (*Canis mesomelas*), a Puff Adder (*Bitis arietans*), a Cape Bucephalus (*Dispholidus typus*), a Smooth-bellied Snake (*Homalosoma lutrix*) from South Africa, presented by Mr. Barry McMillan; two Puff Adders (*Bitis arietans*) from South Africa, presented by Mr. A. W. Guthrie; two Black Lemurs (*Lemur macaco*) from Madagascar, a New Zealand Owl (*Ninox novae-seelandiae*), four Variegated Sheldrakes (*Tadorna variegata*) from New Zealand, five Nutmeg Fruit Pigeons (*Myristicivora bicolor*) from Moluccas, six Nicobar Pigeons (*Caloenas nicobarica*) from the Indian Archipelago, a Glossy Calornis (*Calornis chalybeus*), a Hamadryad (*Naia bungurus*) from India, seven Large Andaman Parrakeets (*Palaeornis magnirostris*), an Andaman Starling (*Poliopsar andamanensis*), six Andaman Teal (*Querquedula albigularis*) from the Andaman Islands, two Canadian Cranes (*Grus canadensis*), four Prickly Trionyx (*Trionyx spinifer*) from North America, four Ceylonese Terrapins (*Nicoria trijuga*) from Ceylon, two Adanson's Sternotheres (*Sternothoerus adansoni*) from West Africa, deposited; a Brush Turkey (*Talegalla lathami*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JULY:—

1. 10h. 40m. Minimum of Algol (β Persei).
5–6. Venus very near Regulus (α Leonis).
9. 8h. 4m. to 9h. 11m. Moon occults ρ′ Sagittarii (mag. 3·9).
" 15h. Venus at greatest elongation, 45° 30′ E.
15. Venus. Illuminated portion of disc = 0·459 of Mars = ●·873.
20. 13h. 56m. Moon in conjunction with Aldebaran (α Tauri).
21. 12h. 23m. Minimum of Algol (β Persei).
23. Mars 1½° N. of Spica (α Virginis).
24. 9h. 12m. Minimum of Algol (β Persei).
26. 8h. Moon in conjunction with Pallas. Pallas 0° 47′ N.
29. 20h. Saturn in opposition to the sun.
30. Uranus ½° N. of 51 Ophiuchi (mag. 4·9).

NEW COMET, 1903 *c*.—A Kiel Centralstelle telegram announces that M. Borelly, observing at Marseilles, discovered a new comet, 1903 *c*, on June 21. Its position for 11h. 36·5m. (M.T. Marseilles) on June 21 was

R.A. = 21h. 52m. 52s., Dec. = 8° 10′ south,

and its daily movements in R.A. and Declination are −28s. and +44′ respectively.

The telegram states that a nucleus and a tail have been observed, but it does not state the magnitude of the object.

A later telegram states that Herr Wirtz, Strasburg, observed this comet at 22h. 8·8m. (M.T. Strasburg) on June 22, and determined its position as follows:—

R.A. = 21h. 51m. 53·73s.
Dec. = 7° 17′ 11″ south.

PHOTOGRAPHIC OBSERVATIONS OF COMET 1902 III.—Prof. Sykora, of Jurjew, has communicated to No. 3871 of the *Astronomische Nachrichten* the results of the photographic observations of Comet 1902 iii. made by him during September and October of last year.

Reproductions of drawings made from the photographs show that on September 26 the comet possessed two tails of Bredichin's second and third types respectively, and the measurements showed that the longer tail was about 2° in length. On October 7 this length was increased to 3°, and the tail was more like Bredichin's first type, whilst the shorter third-type tail had decreased in length. On the photograph taken on October 9 this difference was further accentuated.

THE MIRROR OF THE CROSSLEY REFLECTOR.—Dr. G. Johnstone Stoney writes to correct a misapprehension referring to the mirror of the Crossley reflector in use at the Lick Observatory. The figuring of this mirror is usually attributed to the late Dr. Common, and has been ascribed to him in these columns (pp. 132, 162). It appears, however, from a correspondence between Mr. J. Gledhill and Prof. Campbell that Mr. Crossley's gift to the Lick Observatory included two mirrors, described as A and B, essentially of the same diameter and focal length. One of these, B, was refigured by Sir Howard Grubb, and was sent to America as it came from his workshop. "It is the B mirror," Prof. Campbell states, "which has been used in all the work with the Crossley Reflector at the Lick Observatory." Dr. Stoney adds:—"In any enumeration of noteworthy instruments made by Dr. Common, it would appear desirable to include the very remarkable flat mirrors of large size which he produced of late years, some of them for the cœlostats of the Joint Solar Eclipse Committee of the Royal and Royal Astronomical Societies. The production of

optically flat mirrors of such size and so great perfection was a very great achievement."

RADIANT POINTS OF JULY AND AUGUST METEORS.—A paper by Mr. Denning in No. 3874 of the *Astronomische Nachrichten* describes the meteor showers which occur about the same time of the year as the splendid Perseid shower, and it gives, in tabular form, the radiant points of more than one hundred showers that have been observed at Bristol, during 1876–1902, in the months of July and August, dividing the epochs of appearance into three periods, viz. July 6–16, July 20–August 16, and August 19–25. Many of the displays are feeble, and a prominent feature of these is that they appear for a long period from the same fixed radiant.

The Perseid swarm varies greatly in intensity; at some apparitions as many as 150 to 200 shooting stars are observed per hour, whereas at other appearances the hourly rate may decline to 20 or 30. From a careful survey of the records, Mr. Denning thinks that there is evidence of this shower having a periodicity of between 104 and 123 years. The maximum is now reached on the morning of August 12 or 13.

SUN-SPOTS AND TERRESTRIAL TEMPERATURE.—In discussing the statement recently made by M. C. Nordmann in its application to the temperatures observed at the Jacob camp (Guadeloupe), M. Alfred Angot finds that approximately the same law holds good, and may be represented by the formula

$$t = t_0 + ar,$$

where t is the actual temperature, r is Wolf's frequency number, and t_0 and a are constants for each station, a being a negative quantity. On calculating the temperatures for the Jacob station from this formula, first determining the constants for that place, it is found that they vary but slightly from the observed values, the mean variation being $\pm 0°{\cdot}06$ C., and M. Angot suggests that an analysis of the annual variations at a number of stations might reveal the presence of further periodical variations (*Comptes rendus*, No. 21).

THE SATELLITES OF SATURN.—*Bulletin* No. 34 of the Lick Observatory contains the results of a second series of observations of the satellites of Saturn made by Mr. W. J. Hussey of that observatory.

Mr. Hussey measured the position angles and distances of each satellite in respect to one of the others, and gives a table containing all the details of each observation; he concludes from estimations of their respective light values that Mimas is probably larger than Hyperion, and, from his measurements, that the generally accepted diameter of Titan is undoubtedly too large; 2500 miles is, according to him, a much nearer approximation to the true value than the values given in most text-books.

THE ROYAL SOCIETY CONVERSAZIONE.

MANY of the objects on view at the Royal Society conversazione on Friday last were shown at the gentlemen's conversazione held on May 15, and have already been described in these columns (p. 59). There was, however, a number of additional exhibits illustrating methods and results of recent work in many branches of science, and these are mentioned below.

The condensation of the radio-active emanations of radium and thorium by liquid air formed the subject of an exhibit by Prof. E. Rutherford, F.R.S., and Mr. F. Soddy. The radio-active emanations of thorium and radium appear to be the residues of the thorium atom and radium atom respectively after the heavy positively charged particles, known as the "α rays," have been projected. They have all the properties of inert gases of the argon family, and diffuse away from the radium and thorium compounds producing them. They can be condensed at the temperature of liquid air, and are again volatilised on raising the temperature. Their actual quantity is almost infinitesimally small, being quite invisible and unweighable, but their presence can be detected by their property of radio-activity.

A method for the rapid determination of the specific gravity of blood, taken from a single drop, was shown by Prof. W. J. Sollas, F.R.S. A fluid heavier than the blood (chloroform and benzole sp. gr. 1·07), and another lighter (benzole and chloroform sp. gr. 1·04), are introduced into a tube, the heavier first, so that the lighter, added subsequently, floats upon it. The two fluids mix by diffusion so as to produce a column in which the specific gravity varies continuously from a higher to a lower value upwards. A drop of blood obtained from a pin prick is then added, and sinks in the column until it reaches a level where the specific gravity is identical with its own. Two glass floats of known specific gravity are now introduced, one of higher and the other of lower specific gravity than the blood. The distances of these, when floating in the column, from the drop of blood are proportional to the difference in specific gravity.

Mr. J. Y. Buchanan, F.R.S., exhibited a copper sphere and brass tube in illustration of an effect produced by the momentary relief of great pressure. Experiments were made during the cruise of the *Challenger* and on board the *Princess Alice*. The copper sphere contained a glass spherical flask of about 1½ inches in diameter hermetically sealed, and the sea water had free access through the two holes at the poles. The brass tube contained a glass tube of 50 cubic centimetres in capacity, hermetically sealed, and the sea water had free access at both ends of the brass tube. The brass tube was sent to a depth of 3000 metres, and at some, probably less, depth the internal glass tube gave way to the pressure and collapsed suddenly. The enclosing brass tube was pinched up by the external pressure. The experiment shows that, in the time, it was easier to pinch the envelope of brass than to shove in the plugs of water at both ends. The copper sphere was sent first to 3000 metres, but was pulled up without showing any effect. It was then sent to 6000 metres, and the internal glass flask collapsed at some depth between 3000 and 6000 metres, and the creasing which is visible on the copper sphere was produced. These experiments, whether made with the copper ball or with the brass tube, furnish striking demonstrations of the importance of the element of *time* in all physical considerations.

Photographs of the paths of aërial gliders were shown by Prof. G. H. Bryan, F.R.S., and Mr. W. E. Williams. These photographs were taken by attaching a piece of magnesium wire to gliders of cardboard, and show the path taken during their descent through the air. By fixing a rotating wheel in front of the camera so as to give a series of exposures instead of a continuous exposure, dotted traces were obtained, the distance between the dots enabling the velocity at different points to be compared.

The solar disc in monochromatic (K) light was exhibited by the Solar Physics Observatory, South Kensington. The glass positive and negative shown was a specimen of one of the trial plates taken for adjustment of the new photo-spectroheliograph. Large belts of prominences could be seen stretching across the solar disc.

The Solar Physics Observatory also exhibited photographs of the spectrum of lightning. The spectra were secured by Dr. William J. S. Lockyer on the early morning of May 31. Small cameras were employed fitted with Thorpe's transparent gratings in front of the lenses.

A reproduction of the hydraulic organ of the ancients was shown by Mr. John W. Warman. This instrument, originally invented by Archimedes about 250 B.C., has furnished a problem for at least 600 years, and has been the subject of endless speculation. The only real difference between the hydraulic and the ordinary or "pneumatic" organ is that, in the former, the wind-pressure is derived from the weight of an annular mass of water, instead of from the loaded top of a folded air-bellows.

Mr. W. N. Shaw, F.R.S., had on view the July number of the Monthly Pilot Charts of the North Atlantic and Mediterranean, issued by the Meteorological Council. The chart was exhibited to show the modifications introduced since the commencement of the series in April, 1901.

Bactericidal emanations from radium were demonstrated by Mr. Henry Crookes, who also showed photographs of a box of instruments, (*a*) taken by ordinary Röntgen rays, (*b*) taken by radium emanations at a distance of eighteen inches.

Other subjects of exhibits belonging to the physical sciences were :—photographs illustrative of the Coronation Naval Review, 1902, Dr. W. J. S. Lockyer; the Cooper-Hewitt mercury vapour lamp of the British Westinghouse Electric and Manufacturing Company, Ltd., by Prof. Ernest Wilson; an automatic mercury vacuum pump, by Dr. S. R. Milner; (1) stereoscopic fluoroscope, (2) stereoscopic X-ray photographs, Mr. J. Mackenzie Davidson; detonation of small shells, Dr. O. J. Silberrad; (1) apparatus for obtaining monochromatic illumination with the microscope, (2) a new turbidimeter, for determining the turbidity of water, by Mr. Charles Baker; controlling and regulating spark discharges, experiments in illustration, by Mr. Alfred Williams.

Prof. E. B. Poulton, F.R.S., illustrated the protective resemblance of butterflies to dead leaves and fragments of dead leaves. A resemblance to entire dead leaves with midrib, traces of oblique veining, and often attacked by fungi, is found in many genera of tropical butterflies. Holes, when represented, appeared to have been gnawed by insects, &c. There are three stages in the representation of such holes :—(1) by opaque strongly reflecting "body colour"; (2) by transparent windows; (3) by actual apertures. In the Holarctic region, with its deciduous trees, a genus (Polygonia = Grapta) which is defended by the same kind of concealment resembles, not entire leaves, but weather-beaten and ragged fragments, and it is not a gnawed hole which is represented on the butterfly, but a curved crack due to chemical and mechanical changes in a dead leaf fragment.

The director, Royal Botanic Gardens, Kew, showed three interesting instances of plant adaptations, namely, (1) a sensitive orchid (*Masdevallia muscosa*) from New Grenada. The lip closes when an insect lights on it; the insect, in crawling out, is compelled to carry the pollen masses away with it. (2) A case of commensalism (*Dischidia rafflesiana*) from Java. Leaves become converted into bags which ants fill with soil; the plant sends roots into the "flower pots" thus formed. (3) A possible case of protective mimicry (*Mesembryanthemum Bolusii*) from South Africa. The fleshy leaves simulate the lichen-covered fragments of rock amongst which they grow.

An exhibit by Dr. D. H. Scott, F.R.S., and Prof. F. W. Oliver illustrated Lyginodendron and its seed Lagenostoma. Lyginodendron is a characteristic member of the Palæozoic group Cycadofilices, a group recognised as occupying an intermediate position between ferns and gymnosperms. Hitherto no certain knowledge of the reproductive organs of these plants has been available. A reinvestigation of the detached Coal-measure seeds belonging to Williamson's genus Lagenostoma has furnished evidence which leads to the conclusion that one of them (*Lagenostoma Lomaxi*) was borne by Lyginodendron.

Fossil vertebrata from the Fayûm, Egypt, were exhibited by the director, British Museum (Natural History). The most important of the specimens were portions of the skull of the remarkable horned mammal, Arsinoïtherium, from the Upper Eocene. Specimens of the upper and lower dentition of the primitive elephants Palæomastodon and Mæritherium were also exhibited; these showed that the teeth are comparatively simple, and that the premolars and molars are in use simultaneously as in the ordinary mammal. Remains of the elephant and antelopes associated with flint implements from the lake beds of the lake Birket-el-Kerun were also shown.

A chart representing the first results of experiments on the migrations of plaice in the North Sea was shown by the Marine Biological Association. The distances travelled by some of the fishes have been very great, amounting in one case to 160 miles in six weeks. The Association also had on view a new British species of the Polychæte family Sabellaridæ, and living representatives of the Plymouth marine fauna.

The following were also among the objects on view :—mounted specimen of newly-born Indian elephant (*Elephas maximus*), born in the Zoological Society's Gardens, showing the hairy nature of the skin, as in the mammoth, by the director, British Museum (Natural History). A series of spear-heads, manufactured by the existing Aborigines of the north-west territories of Western Australia, by Dr. Henry Woodward, F.R.S. Remains of fossil mammals from an ossiferous cavern of Pliocene age at Doveholes, near Buxton, Derbyshire, by Prof. W. Boyd Dawkins, F.R.S. Colour photographs of living insects to illustrate protective coloration and resemblance, by Mr. F. Enock. (1) Tail feathers from a common male pheasant, illustrating sexual transformation of plumage; (2) a wild duck bred in captivity showing a converse change, by Mr. S. G. Shattock and Mr. C. G. Seligmann.

During the evening Prof. E. B. Poulton gave an account of the discoveries of Mr. Guy A. K. Marshall upon the wet season and dry season forms of Rhodesian butterflies. Mr. Marshall has proved, in three cases, by breeding the one from the other, that butterflies which are entirely different in colour, pattern, shape, relation of upper side to under side of wings, and even habits, and the selection of a certain type of country, are only the summer and winter forms of one species. The winter forms are always the better concealed in these cases, probably because the butterfly passes a much larger proportion of its life in a state of complete repose.

The Bioscope Company gave a lantern demonstration illustrating the scientific and educational applications of the bioscope.

THE ENGINEERING CONFERENCE.

LAST week the Institution of Civil Engineers held the bi-annual engineering conference for the present year, under the presidency of Mr. John Clarke Hawkshaw, president of the Institution.

The proceedings commenced on the evening of Tuesday, June 16, when Mr. W. H. Maw, past-president of the Institution of Mechanical Engineers, delivered the eleventh "James Forrest" lecture in the theatre of the Institution, his subject being "Some Unsolved Problems in Engineering." We published an abridgment of Mr. Maw's address last week (p. 163). On the following day, Wednesday, June 17, the chief business of the meeting commenced, and was continued over the Thursday and Friday following. The conference was divided into seven sections, the members of which met in various rooms near the Institution house in Great George Street. These sections were as follow :—Section i., railways, chairman, Sir Guilford Molesworth; section ii., harbours, docks and canals, chairman, Sir Leader Williams; section iii., machinery, chairman, Dr. Alex. B. W. Kennedy; section iv., mining and metallurgy, chairman, Mr. E. P. Martin; section v., shipbuilding, chairman, Sir John I. Thornycroft; section vi., waterworks, sewerage and gasworks, chairman, Sir Alexander Binnie; section vii., applications of electricity, chairman, Mr. Alexander Siemens.

Before proceeding to the various section rooms, members of the congress assembled in the theatre of the Institution of Mechanical Engineers to hear an introductory address from the president of the Institution of Civil Engineers, Mr. J. C. Hawkshaw. The address alluded to the work done at past conferences, and subsequently referred to the Engineering Standards Committee, which had been organised by the Institution in conjunction with various other technical bodies. The subject of the education and training of engineers was also touched upon, and in connection with the Admiralty scheme of training, the president pointed out that a similar plan of operations was devised by the Institution for the admission of students and associate members. Referring to the pollution of the town by smoke, the president said that "neglect to deal with it is yearly costing the growing population of London a large sum, and a Royal Commission had been appointed to inquire into the subject." The problems of locomotion and transport, timber supplies, and motor-car traffic were also dwelt upon briefly.

RAILWAYS.

The section devoted to railways met on the first and second days of the meeting, five papers being read in all. The first paper was on "The Assimilation of Railway Practice as Regards Loads on Bridges up to 200 feet Span," the subject being introduced by Mr. A. Ross. It was pointed out that it was undesirable to carry standardisation

to such an extent as might tend to arrest advancement in type or design, although it was of the utmost importance that uniformity should be arrived at with regard to the loads to which such structures might be subjected. In the discussion it was suggested that loads on bridges were nearing a limit, as electric traction would probably come into use, and this would do away with the need for the heavy steam locomotive.

In a contribution on "The Design of Permanent Way and Locomotives for High Speeds," by Mr. J. C. Inglis, it was pointed out that the increase in train mileage of British railways was mostly on long distance traffic, which meant heavy trains with heavy axle loads hauled at a relatively high speed. For express running, up to 60 miles an hour, no curves should be less than 40 chains radius. Heavy rails gave smoother running, and 90 to 100 lbs. per yard was often the practice. Four-coupled engines, with the front wheels coupled and a bogie under the foot-plate, formed an undesirable class of engine for high speed running, whilst engines with single drivers, and only one axle in front and one behind, were likewise unsatisfactory, and plunged considerably, even on good roads. Equalising levers had much to recommend them, and recent practice had been in the direction of raising the centre of gravity of the locomotive.

Mr. W. J. Cudworth read an interesting paper on "Automatic Signalling," giving particulars of applications that had been made on the London and South-Western Railway and on the North-Eastern Railway. Mr. Jacomb-Hood, in the discussion, said he was convinced that automatic signalling had a great future before it.

Lieut.-Colonel Yorke, R.E., introduced the subject of "The Organisation and Administration of an American Railway," which he dealt with in some detail. He advocated the separation of the traffic or commercial department from the operating or working department, as followed in America, although unusual in this country. The value of keeping accurate statistics was dwelt upon during the discussion.

"The Relative Advantages of Overhead, Deep-level, and Shallow Subway Lines for the Accommodation of Urban Railway Traffic" was the subject brought forward by Mr. S. B. Cottrell, who discussed the respective advantages and disadvantages of the different systems.

Harbours, Docks, and Canals.

This section met on the first and last days of the congress, Wednesday and Friday, and five papers were read in all. The first paper was on "Dredging in New South Wales," Mr. C. W. Harley being the author. He pointed out that rivers were the natural means for conveying produce, and the New South Wales Government had expended considerable sums on improving its navigation. Particulars of the extensive plant that was used for this purpose were given.

The second paper on the list was "Dredging, with Special Reference to Rotary Cutters," by Mr. J. H. Apjohn. The value of hydraulic dredgers, and the results achieved on the bar of the Mersey and other rivers, were first referred to. In dealing with rotary cutters, the author pointed out that the form of the blades and the angle at which they were set, whether they were straight or spiral, and the openings between them at the bottom, were the points to be determined. Different descriptions of material needed different forms of cutters. These two papers were discussed together, Sir Leader Williams, Prof. Vernon Harcourt, Mr. Wheeler, Mr. Matthews, and others speaking. The question of "Foreshore Protection and Travel of Beaches" was next taken, the subject being introduced by Mr. W. T. Douglass. This matter was discussed at a conference at Norwich, held last January, and the author dealt with the various points raised in connection with the subject, such as direction of current, depth of water, effect of flood tides on the travel of the beach, angle and length of groynes, &c. In the course of discussion, Mr. Matthews pointed out that often the value of land reclaimed was not equal to the cost of saving it.

The other papers read in this section were "The Modern Equipment of Docks, with Special Reference to Hydraulic and Electric Appliances," by Mr. Walter Pitt; and "Recent Improvements in Canal Engineering," by Mr. Gerald FitzGibbon.

Machinery.

In the machinery section sittings were held on the Wednesday and Thursday. The first subject was introduced by Mr. Archd. P. Head, and was on "The Speed of Overhead and other Cranes as a Factor in the Economic Handling of Material in Working." The author favoured continuous current for crane work at 220 to 500 volts. He preferred this to alternate current on account of the greater starting torque and acceleration which it gave; although alternating current motors were efficient at full loads, they could only have a strong starting torque at the expense of efficiency. Continuous current also admitted of easier regulation, was cheaper in wiring, and could be stored in batteries to equalise a variable load. Series-wound motors automatically ran faster with lighter loads, and should be used coupled permanently to the gear. They could withstand 100 per cent. overload for short periods, and higher overloads momentarily, without damage. Motors running continuously with clutch connections to the gearing should be shunt-wound. Quick stopping could be achieved by an electric brake working on the armature shaft, operated by a weight or spring, and taken off by a solenoid in series with the motor. A somewhat lively discussion followed the reading of Mr. Head's paper, Mr. Tannett Walker and Mr. Ellington advocating the use of hydraulic cranes, although the latter allowed that electricity was the best source of motive power for overhead travellers.

A valuable paper by Mr. H. J. Marshall, "Gauges and Standards as Affecting Shop and Manufactory Administration," followed. The subject is one which does not well lend itself to being abstracted in a few words, but Mr. Marshall's paper is the more valuable because it represents actual experience in large works.

Mr. H. A. Humphrey's paper on "Internal Combustion Engines for Driving Dynamos" was also one of considerable interest, and attracted a good many of the electrical engineers from section vii. The author dealt with the large gas-engines which have quite recently come into use, and the design of which, unfortunately, we largely owe to the Continent, where the application of blast furnace gas to internal combustion engines has given an impetus to this branch of industry. The author stated that there were about fifty firms manufacturing large gas engines of 200 horse-power and upwards. The engines completed or on order numbered 515, having an aggregate capacity of 328,065 horse-power; of these, 398 engines were for dynamos, and gave collectively 206,805 I.H.P. The gas producer and gas engine constituted the cheapest means of generating electric power, where coal was the basis of energy, and the gas engine had proved quite trustworthy for driving alternators in parallel. He considered that ultimately the gas engine would entirely take the place of steam plant in large central electric stations. A long discussion followed the reading of this paper, in which the views of the author were upheld by some speakers. Dr. Kennedy (who occupied the chair), however, said that before he advised the application of internal combustion engines for the generation of electrical energy he would like to feel more confidence, or have more experience on the subject. Mr. Crossley and Dr. Hopkinson, who both spoke, gave some remarkable figures, showing the advantage of gas engines over steam engines in regard to economy.

"The Use of Petrol Motors for Locomotion" was the subject introduced by M. E. Sauvage, the well-known French locomotive engineer, who gave in detail the points that should be observed in designing a successful petrol motor. In the discussion, Mr. Aspinall and other locomotive engineers pointed out that though the single unit vehicle had advantages, and appeared very attractive at first sight, practical considerations militated against it, and where, in the past, the system had been tried, it had been abandoned sooner or later.

The chief feature in this section was the last paper read, which was on "Apprenticeship in Engineering Education," by Prof. J. D. Cormack. The subject is too long and too important to treat in a brief report of this nature. Prof. Cormack merely set forth the chief aspects of the question, without pretending to arrive at any conclusion,

leaving the latter task to the speakers in the discussion; of these there were no less than twenty-five. They included Sir W. H. White, Prof Kennedy, Colonel Crompton, Captain Sankey, Profs. Ayrton, Burstall and Capper, the Hon. R. C. Parsons, and Messrs. D. Drummond, A. F. Yarrow, E. B. Ellington, Bertram Hopkinson and Mark Robinson. Most diverse opinions were expressed by the various speakers, but it may be said generally that some system in which a college course would alternate with practical experience, in periods of greater or less duration, received acceptation. Sir William White, in closing the discussion, gave a promise that the matter would be considered by the council of the Institution of Civil Engineers, which would take into consideration what had been said in the section, as well as the proceedings before the Institution of Mechanical Engineers and the Institution of Naval Architects, both of which had had presented to them papers on this subject by Prof. W. E. Dalby, who recently made a tour in America and on the Continent to study this question.

Mining and Metallurgy.

Seven papers were read in this section. The first taken was by Sir Thomas Wrightson, Bart., M.P., and Mr. John Morison, the subject being "Notes on Percussive Coal Cutters." Details of the machinery were given, the authors arriving at the conclusion that in America machine coal-cutting had been successful, but in this country, up to the present, almost the opposite experience had been the result of the adoption of machinery, the economy, except in speciai cases, being doubtful.

"Recent Improvements in Gold-mining Machinery on the Rand," by Mr. A. E. T. Lees, followed. He dealt with the labour difficulty and its effect on the introduction of labour-saving devices. Considerable progress has recently been made in surface works, as well as certain improvements in mining machinery generally.

Mr. J. H. Harrison read a paper on "Equalising the Temperature of the Blast for Blast-furnaces, and its Effect on the Melting Zone." He gave particulars of the practice followed in America for preventing "scaffolds."

"Notes on Steam-driven and Gas-driven Blowing Engines" were contributed by Mr. Tom Westgarth, who had no hesitation in saying that the gas engine generally was more suitable for blast-furnace work, provided always that the gas saved by the use of the gas engine could be readily employed.

The remaining three papers read in this section were:—"The Continuous Method of Open-hearth Steel-making," by Mr. B. Talbot; "Alloys of Iron, Nickel and Manganese," by Mr. R. A. Hadfield; and "The Dangerous Crystallisation of Mild Steel and Wrought Iron," by Prof. J. O. Arnold.

Shipbuilding.

Section v. had five papers before it. The first was by Mr. A. F. Yarrow on "The Comparative Merits of Drilling and Punching in Steel for Shipbuilding." The author gave particulars of the British Admiralty regulations, which require drilling in place of punching for light vessels. He had found by experience that this was a wise provision, although it had been objected to by some contractors. In the discussion which followed, it was allowed that a drilled hole was better than a punched hole for light vessels, such as torpedo craft. For merchant ships, however, the greater expense of the drilling might be objected to.

Mr. John List read a paper on "Screw Shafts," pointing out the severe effects set up in them by racing in light vessels. He referred to the growing use of nickel steel for propeller shafts.

Mr. A. E. Seaton also read a paper on "The Modern Express Steamer for Short Passages," whilst Prof. A. Rateau dealt with "Steam Turbines." Mr. H. H. West contributed a paper on "Harbour Dues and Charges."

Water-works, Sewerage and Gas-works.

Five papers also were read in this section. The first was by Mr. G. T. Beilby on "Smoke Abatement." The author looked forward to the spread of the internal combustion engine and electric transmission of power to produce a better state of the atmosphere in large towns. He also considered that the firing of steam-boilers with washed gas would prove advantageous.

The next paper read was by Dr. S. Rideal, and was on "Coal-gas Standards." The subject is not one that lends itself to compression. The same may be said of Prof. Percy F. Frankland's paper on "The Bacterial Treatment of Water and Sewage." The other papers read in this section were:—"Steam Turbine-driven Centrifugal Pumps for High Lifts," by Mr. C. W. Darley; and "The Raising of Water by Compressed Air," by Mr. Percy Griffith.

Applications of Electricity.

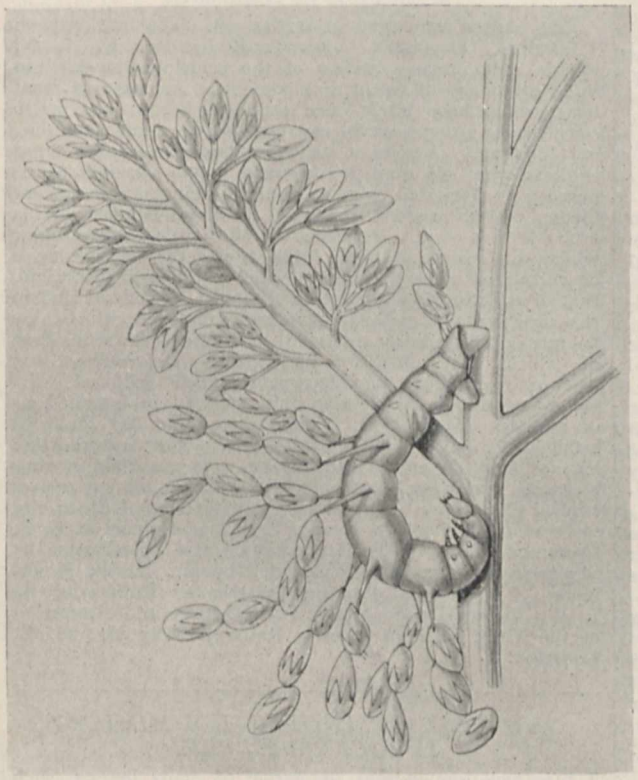
Five papers were read in section vii. The first was on "Wireless Telegraphy," introduced by Mr. E. A. N. Pochin, who gave a review of the principles involved in this subject and of recent developments. Among important facts which have lately been established are:—(1) up to considerable ranges earth-curvature is not a fatal obstacle, but hills may exercise a serious influence; (2) the ether exhibits what we may provisionally call a variable transparency to Hertzian waves, sunlight being an important factor. With regard to both these phenomena, it is probable that certain wave-lengths offer special advantages, whilst the second affords a faint clue to the relative share of earth and ether in transmission. Amongst problems, that of isolation is undoubtedly the most important, and in this direction two methods have been employed, which may be termed respectively syntonic and optical methods, both of which were described as regards performance and promise. During the discussion which followed, Mr. Gavey expressed the opinion that syntony in installations of wireless telegraphy of from 60 to 100 miles could be established, and maintained with certainty and regularity; but for long distances transmission was uncertain, owing to causes which were not apparent. The remaining papers read in this section were on the "Applications of Electricity to Driving Carriages in Towns," by Lieut.-Colonel R. E. B. Crompton, C.B.; "The Transmission and Distribution by Single-phase Alternating Current," by Mr. E. W. Monkhouse; "High-speed Electric Traction on Railways," by J. W. Jacomb-Hood; and "The Position and Protection of the Third Rail on Electric Railways," by Mr. W. E. Langdon.

NEW CASE OF PROTECTIVE MIMICRY IN A CATERPILLAR.

IT is well known that the larvæ of many insects, such as those of the case moths, clothes moths, caddis flies, tortoise beetles, and the masked bug, construct for themselves cases or artificial coverings either for protection or concealment, and a new and somewhat remarkable instance is described by Mr. R. Shelford, the curator of the Sarawak Museum, in the *Zoologist* for May. We are indebted to the publishers for the accompanying illustration of the caterpillar described.

On May 16, 1900, a native collector brought in a quantity of a Spiræa-like plant, intended for the food of butterfly-caterpillars. It bore numerous pale green cymose inflorescences which were still in bud, and presently one of the branchlets was noticed to be moving. This proved to be due to the presence of a small Geometer caterpillar (only 9 millimetres in length) covered with buds from the inflorescence on which it was feeding. This "bore the following spine-like processes, a dorsal pair on the 4th segment, a dorso-lateral pair on segments 5, 6 and 7, a lateral pair on the 8th segment, and a short dorsal pair on the 11th; there were also some small tubercles in the positions shown in the accompanying sketch." To these spines strings of buds, connected by silk, were fastened in a similar manner, and when the green buds faded, or were removed, they were immediately replaced by fresh ones. "A bud would be shorn off with the mandibles, then held in the two front pairs of legs, and covered all over with silk issuing from the mouth of the larva; the larva then twisted round the anterior part of the body, and attached with silk the bud to one of the spinous processes, and another bud would then be attached to this, and so on, until a sufficiently long string (generally three or four buds) was made, when operations on another spine would be com-

menced." The larva fed on the buds of the inflorescence, scooping out the interior, and (when not hurried) using the empty shells in preference to whole buds for its covering. "When irritated, the larva curled up in the attitude represented in the sketch, and it remained in this position for fifteen or twenty minutes." At other times it would sway about, looking like a branchlet blown by the breeze. The larva spun up on May 28, forming a silk cocoon covered with green buds, but it was, unfortunately, destroyed by ants, and as no other specimen could be discovered, it is



supposed that, as is well known to be frequently the case with specially protected insects, the species must be very rare. The perfect insect is, of course, at present unknown.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Harkness geological scholarship has been awarded to Mr. R. H. Rastall, Christ's, and the Wiltshire prize in palæontology to A. Blackie, Peterhouse, and H. H. Hodgson, Trinity, equal.

The Museum of Zoology has received an important addition through the bequest of the late Mr. T. E. Buckley, of Trinity College. The collections include some 440 volumes of books, and about 400 birds.

In the natural sciences tripos, part i., thirty men and one woman gain first classes. In part ii. thirteen men and one woman appear in the first class.

The Raymond Horton-Smith prize for the best M.D. thesis of the year is awarded to the Hon. G. H. Scott, Trinity.

At St. John's College the Hockin prize for experimental physics is gained by Mr. J. H. Field, late Lieut. R.E. The Adams memorial prize in astronomy is awarded to Messrs. Gold and Phillips, equal. The Hutchinson studentship for research in botany goes to Mr. R. P. Gregory, University demonstrator.

DR. A. F. DIXON, professor of anatomy in University College, Cardiff, has been appointed to the chair of anatomy in Dublin University, lately held by Prof. Daniel Cunningham.

MR. J. STUART THOMSON, lecturer on biology at the Municipal Technical School, Plymouth, has been appointed to the post of assistant to the Government Marine Biologist at the Cape of Good Hope.

DR. K. J. P. ORTON, demonstrator in practical chemistry at St. Bartholomew's Hospital Medical School, has been appointed professor of chemistry at the University College of North Wales, Bangor, in succession to Dr. Dobbie.

THE Massachusetts Institute of Technology has established a laboratory of physical chemistry to be opened in September, which is to be devoted exclusively to research work. The laboratory is to be under the directorship of Prof. A. A. Noyes, with whom will be associated Profs. H. M. Goodwin and Willis R. Whitney. The researches will be carried on in large part by a staff of research assistants and associates working under their direction. Every facility will also be offered to advanced students who wish to carry on investigations in this branch of science.

AN appeal for funds to extend the department of experimental and applied science and natural sciences is being issued by the University of Dublin. It is pointed out that the University of Dublin must either obtain external aid to build and equip laboratories and lecture rooms for physical science, electrical and mechanical engineering, botany and zoology, or teach these subjects under grave disadvantage. A full report, drawn up by a committee appointed by the board of Trinity College to consider the present scientific requirements of the college, shows that a sum of 100,000*l.* is needed to provide for the requirements of the scientific schools of the University. Owing to the generosity of Lord Iveagh, however, the appeal is reduced to a request for an increased income of 2700*l.* The entire capital outlay, 34,000*l.*, is undertaken by Lord Iveagh if the necessary income for upkeep is forthcoming within the next three years.

FOR a long time past the Merchant Venturers' Technical College, Bristol, though a large building, has been inadequate to meet the demands of the increasingly large number of adult day and evening students. Negotiations have, however, just been concluded by which an additional building will become available for the purposes of the college in September next. It is hoped to make provision in this new building for an extensive boot and shoe shop, and for new shops for printers, painters, bookbinders, and plumbers. In order that the new workshops may be fitted up with the latest improvements, the teachers of the college are to visit workshops of the same kinds in other towns. It is hoped also that the local manufacturers interested in the trades in question will be willing to contribute funds or apparatus. The total floor space in the new building will be close upon 12,000 square feet. The space available for the mechanical and the electrical engineering laboratories will be more than doubled. The present small hydraulic laboratory will be replaced by one many times larger, and a new large physical laboratory will be provided. Arrangements are being made to provide as early as the manufacturers can make them a large experimental steam engine, with two additional dynamos and all necessary measuring apparatus, at a cost of about 2000*l.*

THREE months ago, on March 26 (vol. lxvii. p. 500), a note was given of the gifts to science and higher education announced in *Science* for the preceding quarter. Since then the following benefactions have been published in our contemporary:—Harvard University has received two anonymous gifts, respectively 2000*l.* and 10,000*l.*, for Emerson Hall, to be erected for the department of philosophy, for which the necessary 30,000*l.* required has now been obtained; a fund of 2100*l.* has been subscribed to establish a lectureship in memory of Edwin L. Godkin; 2000*l.* for the establishment of a scholarship and 1000*l.* for the Semitic Museum by the will of Jacob A. Hecht; Mrs. John Markoe has given 1000*l.* to establish a scholarship in memory of her son; and the Harvard Club of Chicago has given 1000*l.* to found a scholarship in memory of Dunlop Smith. Mrs. Anderson has given 200,000*l.* to Barnard

College, Columbia University, to purchase the three blocks of land adjoining Columbia College. Mr. Joseph Pullitzer has given 3000*l.* for scholarships to the university. From the will of Dr. Thomas W. Evans, the City of Philadelphia will receive about 800,000*l.* for the "Thomas W. Evans Museum and Institute Society." Mr. John D. Rockefeller has offered to duplicate money raised by Acadia College, in Wolfville, N. S., up to 20,000*l.* before January 1, 1908; he has also offered to pay two-thirds of the cost of a building for the University of Nebraska to be used for social and religious purposes, on condition that the remaining third of the 20,000*l.* be contributed within about a year, and to give Denison College, Newark, Ohio, 12,000*l.* if the institution will raise a like sum by January 1, 1904, for the construction of additional buildings. Chicago Yale alumni give 500*l.* a year for the establishment of four Yale scholarships. Dr. Elizabeth L. McMahon left 1600*l.* to found a scholarship in Vassar College for daughters of deceased physicians. Colby University, Maine, receives 1000*l.* by the will of the late Robert O. Fuller, of Cambridge, Mass. The will of Mrs. Susan Bevier gives 10,000*l.* to the Rochester Athenæum and Mechanics' Institute. Mrs. Helen F. Ackley has left to Wesleyan University a bequest of 400*l.*, the income from which is to be used for the benefit of one or more women students. Mr. Andrew Carnegie has given 50,000*l.* for an extension of the Mechanics and Tradesmen's Institute, New York City. Dr. D. K. Pearsons has given Winter Park, Florida, 10,000*l.*, and Kingfisher College, Oklahoma, 5000*l.* The late Ario Wentworth, of Salem, Mass., left 20,000*l.* to the Massachusetts Institute of Technology. Mrs. Vail, wife of Prof. Vail, has given Hobart College 1000*l.* The late Walter D. Pitkins has bequeathed 2000*l.* to Yale University. Mr. Francis L. Stetson, of New York, has given 5000*l.* to Williams College. Mr. Robert C. Billings has given the same sum to Wellesley College. Mr. Henry Denhart, of Washington, Ill., announces a further gift of 29,000*l.* to Carthage College. He offers 20,000*l.* for the endowment fund providing that the same amount be raised in the college territory, half of the expense of any new buildings erected up to 10,000*l.*, and 5000*l.* cash.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 28.—"On the Adaptation of the Pancreas to different Foodstuffs." Preliminary Communication. By F. A. **Bainbridge**, M.B., M.R.C.P. Communicated by Prof. E. H. Starling, F.R.S.

The author's observations have been made in the hope of determining, first, whether the composition of pancreatic juice (as regards its enzymes) varies in response to the stimulus of different foodstuffs, and, secondly, by what means this adaptation is carried out. The enzyme studied was lactase, which converts lactose into galactose and dextrose, and the degree of inversion produced by the enzyme was estimated by Pavy's method.

It was found that when dogs were fed on milk for two or three weeks, their pancreatic juice contained lactase, whereas the pancreatic juice of adult dogs not fed on milk contained no lactase. It seemed clear, therefore, that a definite foodstuff—lactose—caused the pancreas to secrete an enzyme capable of producing (in the lactose) digestive changes; in fact, the pancreatic juice varied in composition with different diets. It is believed by Pawloff and others that this adaptation is carried out entirely by a nervous mechanism, and that a given food reflexly excites the pancreas to secrete a juice specially adapted for the digestion of that particular foodstuff, and Weinland has adopted this view as regards the lactase of the pancreas.

However, Weinland's observation that lactose injected subcutaneously did not cause the formation of lactase by the pancreas suggested to the author that the intestinal mucous membrane must be concerned in the production of lactase, and that possibly the process was chemical rather than nervous. The author found that when an extract of the intestinal mucous membrane of a dog fed on milk was injected into a second biscuit-fed dog, the pancreatic juice of the latter contained lactase. On the other hand, when a watery extract of the intestinal mucous membrane of a *biscuit-fed* dog was injected intravenously into a second biscuit-fed dog, the pancreatic juice of the latter contained no lactase. These results suggest that, in consequence of the action of the intestinal mucous membrane on lactose, some substance is formed which passes by the blood-stream to the pancreas, where it stimulates the latter to manufacture a specific enzyme-lactase. If this proves to be the case, the whole process of adaptation must be chemical rather than nervous.

"Hydrolysis of Fats *in vitro* by means of Steapsin." By Dr. J. **Lewkowitsch** and Dr. J. J. R. **Macleod.**

Experiments which one of the authors (J. L.) had made with lipase prepared from pig's liver had not led to a higher hydrolysis of cotton-seed oil than 3 per cent. A fresh series of experiments was, therefore, commenced jointly by the authors with steapsin. Preparations of steapsin were obtained by mincing 200 grams of fresh pig's pancreas and triturating it in a mortar with twice the bulk of water. The preparations were not incubated at the body temperature, as previous experiments had proved that steatolytically active preparations had lost considerably in steatolytic power by being kept at 37° C.

The experiments were carried out by triturating in a mortar varying quantities of the steapsin preparations with cotton-seed oil until an emulsion was obtained. Unless the preparation and the oil form a thorough emulsion, no action of the ferment can be expected. If the emulsions are allowed to stand, hydrolysis commences after a few days, and reaches in the course of a few weeks a very considerable amount. Hydrolysis up to 86 per cent. was obtained after a lapse of a few months in the case of cotton-seed oil. Lard has not given so high a percentage of hydrolysis, although the opposite result would have been expected, inasmuch as the consistency of lard favours the state of emulsion.

Steapsin does not seem to produce the reversible action which other enzymes have been shown to exert. So far, small quantities of acid or alkali do not appear to influence the action of the ferment.

The foregoing experiments prove for the first time that it can be demonstrated by the usual quantitative methods of fat analysis that steapsin is a very powerful fat-splitting ferment.

June 11.—"The Measurement of Tissue Fluid in Man." Preliminary Note. By George **Oliver**, M.D., F.R.C.P. Communicated by Sir Lauder Brunton, F.R.S.

The object of this preliminary note is to indicate a method by which the tissue fluid in man may be measured, thus enabling the observer to ascertain the conditions under which it is effused and disposed of.

In the course of some observations made with the view of eliminating tissue fluid as a cause of variability in the samples of blood obtained for examination, the author found that the rolling of a tight rubber ring over the finger from the tip to beyond the interphalangeal joints will, as a rule, considerably raise the percentages of the blood corpuscles and of the hæmoglobin. The author could not arrive at any other conclusion than that the ring not merely empties the vessels, but likewise clears away any tissue fluid present in the skin and subcutaneous tissues. The needle, in puncturing the capillaries, liberates a certain portion of lymph from the areolar tissue which surrounds them, and this dilutes the blood. When, however, both fluids have been dispersed as much as possible by the compression of the firm rubber ring, a puncture made just before removing the ring yields blood *per se*; for the blood instantly returns to the vessels, whereas an appreciable interval must elapse before the lymph reappears, or is exuded afresh. The author therefore inferred that the reading of the difference in the percentage of the corpuscles, or of the hæmoglobin, before and after the use of the ring, provides a measure of the tissue-lymph, and makes the study of the circulation of it in man possible.

This simple method having furnished somewhat unexpected results, the author accepted them at first with reserve; and, for some time, the data were allowed to accumulate, until at last it was quite apparent that they invariably fell into the same order. Inasmuch as the method did not provide results which were exceptional or erratic, or contradictory and unaccountable, trust on it became gradually established by the mere repetition of the observations.

A number of observations have been made on normal subjects leading a quiescent life, with comparative rest of the muscles; and on persons subjected to varying degrees of exercise, and to different temperatures and altitudes. In this note the author limits himself, however, to a statement of results obtained in the former class of subjects only.

The numerous observations which this inquiry necessitated on the corpuscles, and on the hæmoglobin, were made by the hæmocytometer tubes and the hæmoglobinometer, which were described by the author before the Physiological Society some few years ago (see *Journal of Physiology*, Cambridge and London, vol. xix. p. 15), and the specific gravity of the blood was determined by Roy's method. The blood-pressures (arterial, capillary, and venous) were read by the hæmodynamometer (*ibid.*, vols. xxii., xxiii.), and Hill and Barnard's sphygmometer, and Prof. Gärtner's tonometer, were also occasionally used in determining the arterial pressure.

Some of the general conclusions afforded by the observations may be thus epitomised :—

(1) The amount of tissue fluid varies at different times in the course of the day, and each variation is of short duration.

(2) The ingestion of food produces a rapid flow of lymph into the tissue spaces, which in an hour after the meals acquires its maximum development, and then it slowly subsides, and only ceases to be apparent after the lapse of from 3 to 4 hours.

(3) The digestive curve of variation always follows the same general type; the rise being rapid, the acme short, and the subsidence gradual. The variations were observed to follow this well-defined order in all the healthy subjects so far submitted to observation. The curve of variation is, therefore, rhythmical—the wave abruptly rising to an acme and then somewhat slowly subsiding.

The following are two examples :—

Example 1.

	Corpuscles per cent.		Diff.	Per-centage of lymph.
Before the meal	99[1]	(4,950,000 per c.mm.)	200,000	4
(breakfast)	103	(5,150,000 ,,)		
1 hour after ...	91	(4,550,000 ,,)	750,000	15
	106	(5,300,000 ,,)		
2 hours after ...	94	(4,700,000 ,,)	550,000	11
	105	(5,250,000 ,,)		
3 hours after ...	96	(4,800,000 ,,)	400,000	8
	104	(5,200,000 ,,)		
4 hours after ...	98	(4,900,000 ,,)	150,000	3
	101	(5,050,000 ,,)		

Example 2.

	Corpuscles per cent.		Diff.	Per-centage of lymph.
Before the meal	99	(4,950,000 per c.mm.)	None	0
(dinner)	99	(4,950,000 ,,)		
1 hour after ...	91	(4,550,000 ,,)	850,000	17
	108	(5,400,000 ,,)		
2 hours after ...	94	(4,700,000 ,,)	600,000	12
	106	(5,300,000 ,,)		
3 hours after ...	104	(5,200,000 ,,)	None	0
	104	(5,200,000 ,,)		

(4) The amount of lymph is proportionate to the rise of the mean arterial and capillary pressures, and these pressures have been found to follow exactly the same prolonged rhythmical course after the ingestion of food as does the effusion of lymph.

The following example shows the agreement between the blood-pressures and the amount of lymph :—

	Percentage of lymph.	Mean arterial pressure.
Before the meal	None	100 c.mm. Hg.
½ hour after	10	110 ,,
1 hour after...	16	116 ,,
1½ hours after	8	108 ,,
2 hours after	5	105 ,,
3 hours after	None	100 ,,

[1] The figure on the first line represents the percentage of corpuscles before, and the figure on the second line that after, compression of the finger by the rubber ring.

The method devised for observing the capillary pressure is not quite so delicate for the smaller variations as could be wished, and the author hopes to improve it; but it is sufficiently definite to show that the capillary blood-pressure is raised throughout the digestive circulatory disturbance, and especially so at the acme of it, and falls again at the close of it. When the mean arterial pressure is 100 c.mm. Hg before a meal, as in the above example, the capillary blood-pressure will read 20 c.mm. Hg; and in an hour after the meal, when the arterial pressure rises to 115 c.mm. Hg, or so, the capillary pressure will rise to at least 30 c.mm. Hg. Though this is a large relative rise, the author's observations show that it is not less than this, and that it is often more.

Physical Society, June 12.—Dr. R. T. Glazebrook, F.R.S., president, in the chair.—Some experiments on shadows in an astigmatic beam of light, by Prof. S. P. **Thompson.** Two years ago Prof. Thompson showed before the Society some experiments on the shadows formed when a thin rod is placed in a beam of light which has passed through a tilted plano-convex lens. In those experiments the peculiar effects were chiefly due to the aberration known as coma. Following up his experiments, Prof. Thompson has investigated the shadows produced when a thin rod is placed in an astigmatic beam.—On a method of determining the viscosity of pitch-like solids, by Prof. F. T. **Trouton** and Mr. E. S. **Andrews.** The various methods which have been proposed for measuring viscosity meet with difficulties when it is attempted to apply them for the measurement of the viscosity of bodies such as pitch. To obviate some of these difficulties a method has been devised in which a constant torque is applied to a cylinder of the substance, and the relative rate of rotation of the ends is observed. From these and the dimensions of the cylinder, the viscosity can be calculated by means of a formula deduced in the paper.—The positive ionisation produced by hot platinum in air at low pressures, by Mr. O. W. **Richardson.** The experiments described in this paper were almost all made at temperatures so low that there was no appreciable negative ionisation. In examining the relation between the current from a positively charged hot platinum wire and the applied E.M.F. at low pressures, results were obtained which indicated that the value of the current fell off with time when the other conditions were kept constant. Further experiments showed that the current died away rapidly at first until it reached a steady value which only disappeared gradually.

Royal Astronomical Society, June 12.—Prof. H. H. Turner, F.R.S., president, in the chair.—The president announced the death of Dr. A. A. Common, and a vote of condolence with his relatives was put from the chair and passed by the meeting.—A letter (accompanying a paper on the present condition of the lunar theory) from Mr. **Nevill,** director of the Natal Observatory, was read, in which the writer stated that the reductions desired by Prof. Newcomb had already been made, and were awaiting publication at the Natal Observatory.—The secretary read a paper, by Prof. E. W. **Brown,** on the verification of the Newtonian law, which gave rise to a discussion in which Prof. Newcomb and others took part.—Mr. **Newall** exhibited and explained a series of slides from spectroheliographs of solar faculæ, &c., taken by a new method by Prof. G. E. Hale at the Yerkes Observatory, and Dr. Lockyer showed slides taken at South Kensington.—Mr. E. W. **Maunder** read a paper by himself and Mr. J. E. Evans on experiments as to the actuality of the "canals" observed on Mars. A drawing of the planet, showing no canals, had been placed before classes of boys at the Greenwich Hospital School, who were set to copy it. It was found that those closest to the original, and therefore able to see the actual detail, drew no canals, but those placed at a further distance made copies in which they delineated canals, in many cases almost exactly as they are represented in drawings by Schiaparelli and others. The author's conclusion was that the so-called "canals" were mainly the interpretation by the observer of faint markings just at the limit of visibility. It also appeared that observers were inclined to prolong into lines any projecting points on the edges of the Martian "seas," and also to draw hard lines at the boundaries of faint shades. Mr. Maunder was convinced that the boys employed in the

experiments were not biased by any knowledge of drawings of Mars showing "canals."—Dr. Johnstone **Stoney** read a paper on an examination of Mr. Whittaker's "undulatory explanation of gravity" from a physical standpoint.—Father **Cortie** read a paper on the spectrum of sun-spots in the region B to D.—Photographs of nebulæ in Auriga, by Dr. Max **Wolf** and Dr. Isaac **Roberts**, were shown on the screen.—A paper by Dr. **Lockyer** on a probable relationship between solar prominences and coronal streamers was taken as read, as well as a paper by Dr. A. W. **Roberts** on the relation between the light changes and orbital elements of close binary systems.—The president briefly noticed a paper by Mr. **Bellamy** on the positions of stars around Nova Geminorum, and also a paper of his own on the possible identity of the Nova with a small star that had been previously photographed by Mr. Parkhurst and Dr. Max Wolf. Prof. Turner concluded that this faint star was not precisely in the place of the Nova.

Zoological Society, May 26.—Mr. G. A. Boulenger, F.R.S., vice-president, in the chair.—Mr. G. A. **Boulenger**, F.R.S., read a paper on the collections of batrachians and reptiles made at Chapadá, Matto Grosso, during the Percy Sladen Expedition to Central Brazil. One species of reptile was described as new to science under the name of *Norops sladeniae*.—A second paper on the collections made at Matto Grosso was contributed by Mr. Edgar A. **Smith**. It contained an account of the shells of the family Bulimulidæ, which was referable to three species.—A communication from Mr. F. F. **Laidlaw** dealt with the collection of acotylean polyclads made by Mr. Cyril Crossland in Zanzibar in 1901–02. Specimens of nine species were contained in the collection, eight of which proved to be new.—Mr. W. **Bateson**, F.R.S., read a paper on the inheritance of colour in fancy rats and mice, in which he gave an account of the work already published relating to the subject, and communicated new observations. The author analysed the evidence at his disposal, showing how far it conformed to Mendel's principles of heredity, and stated the difficulties which were encountered in attempting to apply those principles to certain of the specific results already witnessed. It was hoped that the chief colour-types might be figured in order to promote uniformity of nomenclature.

Geological Society, May 27.—Mr. E. T. Newton, F.R.S., vice-president, in the chair.—An experiment in mountain-building, by the Right Hon. the Lord **Avebury**, P.C., F.R.S. Various observers have endeavoured to throw light on the origin of mountains by compressing pieces of cloth, &c. In these cases, however, the pressure was only in one direction. The author wished to obtain a method of producing compression in two directions at right angles to one another; and, accordingly, he had an apparatus constructed consisting of four beams of wood, which could be approximated by means of screws. In the space, 2 feet across and 9 inches in depth, were placed pieces of carpet-baize and layers of sand, each about 1½ inches deep. The beams were then caused to approach one another until the sand rose in the centre into contact with the glass cover, against which it was flattened out. Casts were made of the surfaces of the different baize-layers, and it was found that in the lower layers the ridges were narrower, shorter, more precipitous, and more broken up than in the higher layers. A second series of casts was exhibited, with the sand and baize having been arranged as before, but with the weight placed on one side. The ridges followed the edges, though not closely, leaving a central hollow. There was a difference between the higher and lower layers, similar to that seen in the first experiment.—The Toarcian of Bredon Hill (Worcestershire), and a comparison with deposits elsewhere, by Mr. S. S. **Buckman**.—Two Toarcian ammonites, by Mr. S. S. **Buckman**. Two ammonites, belonging to the family Hildoceratidæ, found by members of the Cotteswold Naturalists' Field Club, are described and named.

Linnean Society, June 4.—Mr. G. S. Saunders in the chair.—Mr. F. N. **Williams** showed a series of 100 drawings of British Compositæ, 20 being Hieracia, drawn in pen-and-ink by Mr. E. W. Hunnybun, of Huntingdon.—Mr. George **Massee** showed a remarkable felted lining of fungus mycelium of a Polyporus taken from the interior of the node of a bamboo; the specimen belonged to Sir D. Brandis.—Colonel George **Colomb** sent for exhibition a fragment of a branch of a thorn from Hyde Park. This branch shows the mischief done to thorns near London by the larvæ of what had been identified as belonging to the wood leopard moth, *Zeuzera Æsculi*, Linn. The house sparrow was stated to destroy numbers of the perfect insect on their emergence.—Sir Dietrich **Brandis**, K.C.I.E., F.R.S., showed herbarium and museum specimens, from Kew, of *Gelsemium elegans*, Benth., a plant possessing powerfully poisonous properties.—On the anatomy and development of *Comys infelix*, Embleton, a Hymenopterous parasite of *Lecanium hemisphericum*, by Miss Alice L. **Embleton**. The only paper already published on this subject is that by Bugnion on the anatomy, development and habits of an allied fly (*Encyrtus fuscicollis*) parasitic in a caterpillar; there are numerous omissions in the results he records. The present paper also leaves points unexplained, but the author has been able to add some valuable facts to the knowledge upon the subject, the insect on which she has worked being *Comys infelix*, a new species.—Notes on the transition of opposite leaves into the alternate arrangement: a new factor in morphologic observation, by Mr. Percy **Groom**. The author stated that his observations began on *Atriplex rosea*, and to make a graphic representation of results, he plotted the length of the internodes in a given manner, which produced a regular curve; when this principle was applied to Chenopodium and Salsola an entirely different result came out, and a zig-zag course was plotted, due to the long and short internodes alternating; at first he suspected this might be due to its nearness to salt water, but inland specimens told the same tale, and neither the influence of day and night nor of salinity could account for it. His belief was that the fusion of branch and stem was the true solution, for axillary branches are given off, but without visible traces of the fusion which does exist; in Salicornia, for instance, the leaves are fused up to the next node above. Observations have been made with a number of other plants as regards the arrangement of leaves and inflorescence.

PARIS.

Academy of Sciences, June 15.—M. Albert Gaudry in the chair.—On the conditions afforded for astronomical observations at the observatory of the Pic du Midi, by MM. B. **Baillaud** and H. **Bourget**. Preliminary experiments with three telescopes showed that this observatory forms an excellent station for astronomical observations.—On the existence of solar radiations capable of traversing metals, wood, &c., by M. R. **Blondlot**. The rays previously discovered by the author in the radiations from an incandescent mantle, and named by him the *n* rays, are now shown to be present in sunlight. Their property of increasing the luminosity of feebly phosphorescent substances was utilised as a means of detection.—On the problem of transformation in Taylor's series, by M. L. **Desaint**.—On the integrals of linear partial differential equations, by M. J. **Le Roux**.—On the barometric formula of Laplace, by M. L. **Maillard**.—On the diurnal period of the *aurora borealis*, by M. Charles **Nordmann**. The intensity of the aurora is regarded as due to two factors, the intensity of the solar Hertzian waves, and the degree of ionisation of the atmosphere. The ionisation being produced by the action of the violet and ultra-violet rays, and recombination occurring during the night, the conclusion is drawn that the diurnal period of the aurora ought to be characterised by a maximum in the early hours of the morning, and this is in agreement with the observed facts.—On the generalisation of a theorem of M. Boucherot, by M. R. **Swyngedauw**.—The wave-length of the *n* rays determined by diffraction, by M. G. **Sagnac**. The refractive index for quartz for the *n* rays, given by M. Blondlot as 2·942, is confirmed; the wave-length in air is about 0·2mm., or about four times the wave-length of the longest infra-red waves discovered by Rubens.—The classification of liquids and crystals from the magnetic point of view, by M. Georges **Meslin**.—The conditions which determine the sense and magnitude of electrification by contact, by M. Jean **Perrin**. The action of H and OH ions is very great in electrical osmosis, so much so that osmosis indicates their presence with a sensibility which

may even surpass that of coloured indicators.—On the prediction of barometric variations, by M. Gabriel **Guilbert.** It has been shown that the velocity of the wind does not always correspond with the barometric gradient. These cases are called abnormal, a normal wind being defined as one which is light for a gradient of 1mm. per geographical degree, moderate for 2mm., strong for 3mm., and violent for 4mm. The study of abnormal winds has led to deductions which may be utilised practically.—On a method of crystallising slightly soluble bodies, by M. A. **de Schulten.** Dilute sulphuric acid, added to a hot dilute solution of barium chloride at the rate of 0·1 mgr. per minute, gave after a month measurable crystals of barium sulphate. Crystals of anglesite and celestine can be obtained similarly, and the method has been successfully applied to the production of several other minerals.—On the substitution of paints having zinc for a basis in the place of lead paints, by M. J. L. **Breton.**—On the so-called colloidal silver, by M. **Hanriot.**—On the fusibilities of mixtures of sulphide of antimony and sulphide of silver, by M. H. **Pelabon.** The fusibility curve of a mixture of the sulphides of antimony and silver can be constructed completely; it presents two maxima corresponding to the existence of two definite combinations, $Sb_2S_3.Ag_2S$ and $Sb_2S_3.3Ag_2S$. It shows besides three minima corresponding to three different eutectic mixtures.—On the etherification of sulphuric acid, by M. A. **Villiers.** The limits observed in the case of some mixtures of alcohol with sulphuric acid of different strengths after standing twenty-five years at the ordinary temperature are practically identical with those attained by the same mixtures after 221 days at 44° C., or 154 hours at 100° C.—On some derivatives of aminopyromucic acid and furfuranamine, by M. R. **Marquis.**—The action of phosphorus trichloride upon glycerol, by M. P. **Carré.** PCl_3 acts upon glycerol in the same manner as with glycol. The compounds $P_2O_6(C_3H_5)_2$ and $P(OH).O_2C_3H_5Cl$ are immediately decomposed by water, giving $P_2(OH)_4.O_2.C_3H_5.OH$ and $P(OH)_2.O.C_3H_5(OH)Cl$, the calcium salts of which were isolated.—The action of hydrogen sulphide upon methyl-ethyl-ketone, by M. F. **Leteur.** The compound $(C_4H_8S)_3$ has been isolated, which can be regarded as a polymer of an unknown butanethione.—On two new hydrocarbons isomeric with camphelene and camphene, by MM. L. **Bouveault** and G. **Blanc.**—The synthesis of 2 : 2-dimethylglutaric acid, by M. E. E. **Blaise.**—On formic acid from the air, by M. H. **Henriet.** In a previous note the author has indicated the existence in the air of a nitrogen compound with an acid which appeared to be formic acid. The substance has now been isolated in larger quantity, and the identity of the acid with formic acid completely proved.—The distribution of some organic substances in the geranium, by MM. E. **Charabot** and G. **Lalone.** The terpene compounds of the geranium are almost entirely localised in the leaves.—Observations on phenylglycollic acid, by M. Œchsner **de Coninck.**—The action of iodine bromide on albumenoid materials and on the organic nitrogen bases, by M. A. **Mouneyrat.** Iodine bromide forms addition compounds with many substances containing nitrogen, and is not necessarily a test for the existence of the pyridine ring in the molecule.—On the presence of indoxyl in urines, by M. L. **Maillard.** A reply to a note on the same subject by M. J. Gnezda.—On some peculiarities observed in the renal tubes of *Barbus fluviatilis*, by M. J. **Audigé.**—On a criterion of irreducibility in statistical data, by MM. Charles **Henry** and Louis **Bastion.**—New expression of the law of electrical stimulation, by M. and Mme. L. **Lapicque.** The formula given by Weiss, $vt=a+bt$, where v is the voltage, t the time, and a and b constants, is found to be only roughly approximate; the experiments of the author require a term with an additional constant to be added to the formula of Weiss.—On some nuclear phenomena of secretion, by M. L. **Launoy.**—Cerebral inertia relating to the reading of printed letters, by MM. André **Broca** and D. **Sulzer.**—Observations on the treatment employed for the destruction of Pyralis of the vine, by M. Joseph **Perraud.**—New researches on the epiplasm of the Ascomycetes, by M. A. **Guilliermond.**—Researches on the nutrition of the tissues in galls, by M. C. **Houard.**—On the cave of Font-de-Gaume, and on the age of the cavern, by M. E. A. **Martel.**—On a living safety lamp, by M. Raphael **Dubois.**

DIARY OF SOCIETIES.

THURSDAY, JUNE 25.

UNIVERSITY COLLEGE MATHEMATICAL SOCIETY, at 5.30.—Some Present Aims and Prospects of Mathematical Research: E. T. Whittaker.

FRIDAY, JUNE 26

PHYSICAL SOCIETY, at 5. (University of London, South Kensington).—(1) Electrical Effects of Light upon Green Leaves; (2) Blaze-Currents, (*a*) of a Vegetable Tissue, (*b*) of an Animal Tissue; (3) Quantitative Estimation of Chloroform Vapour in Air by (*a*) Oil Absorption, (*b*) Densimetry: Dr. Waller.—The Temperature Limits of Nerve-Action in Cold-blooded and in Warm-blooded Animals: Dr. Alcock.—(1) On the Movement of Unionised Bodies in Solution in an Electric Field; (2) On the Passage of Nervous Impulses through the Central Nervous System: Dr. Hardy.

TUESDAY, JUNE 30.

SOCIETY FOR THE PROMOTION OF HELLENIC STUDIES, at 5.—Annual Meeting.

FARADAY SOCIETY (Rooms of the Chemical Society, Burlington House), at 8.—The Present Position of the Theory of Electrolysis: W. C. Dampier Whetham, F.R.S.—Chlorine Smelting, with Electrolysis: J. Swinburne.—Total and Free Energy of the Lead Accumulator: Dr. R. A. Lehfeldt.—Electrolytic Apparatus: Dr. F. Mollwo Perkin.

THURSDAY, JULY 2.

INSTITUTION OF MINING ENGINEERS, at 11 a.m.—Luxemburg and its Iron-ore Deposits: J. Walter Pearse.—The Lake Superior Iron-ore Region: Prof. Van Hise.—Mineral Resources of the State of Rio Grande do Sul, Brazil: H. Kilburn Scott.—Electric Coal-cutting: W. E. Walker.—Pneumatic and Electric Locomotives in and about Coal-mines: A. S. E. Ackermann.—Electrical Plant Failures, their Origin and Prevention: A. C. Cormack.—The Electrical Driving of Winding-gears: F. Hird.—Electric-power Distribution by Continuous Current for Mining and General Purposes in North Wales: T. P. Osborne Yale.

RÖNTGEN SOCIETY, at 8.30.—Annual General Meeting.

FRIDAY, JULY 3.

INSTITUTION OF MINING ENGINEERS, at 11.30 a.m.—Further Remarks on the Portuguese Manica Gold-field: A. R. Sawyer.—Coal-fields of the Farõe Islands: E. A. Greener.—Miners' Anæmia or Ankylostomiasis: Dr. J. S. Haldane.—Water-softening Plant: Vincent Corbett.—The Redevelopment of the Slate-trade in Ireland: O. H. Kinahan.—The Smelters of British Columbia: W. Denham Verschoyle.—The Commonsense Doctrine of Furnace-draught: H. W. Halbaum.—The Ventilation of Deep Mines: Arthur C. Murray.

CONTENTS.

	PAGE
Science and the Navy. II.	169
The Distribution of Diseases. By J. W. W. S.	171
Hydrodynamical Fields of Force. By Prof. G. H. Bryan, F.R.S.	172
Farm Accounts	173
Our Book Shelf:—	
Livingston: "The *Rôle* of Diffusion and Osmotic Pressure in Plants."—H. H. D.	174
Williams: "Mechanical Refrigeration."—M. W. T.	174
Buttel-Reepen: "Die stammgeschichtliche Entstehung des Bienenstaates sowie Beiträge zur Lebensweise der solitären u. sozialen Bienen (Hummeln, Meliponinen, &c.)"	174
Spiller: "The Mind of Man."—A. E. T.	174
Patten: "Heredity and Social Progress"	175
Balfour: "The Educational Systems of Great Britain and Ireland."—A. T. S.	175
Hoffman and Barton: "Alpine Flora"	175
"Arnold's Country-side Readers"; "Arnold's Sea-side Reader"	175
Letters to the Editor:—	
Fœtal or New-born Giraffes Wanted.—Prof. E. Ray Lankester, F.R.S.	176
Seismometry and Gëite.—Dr. C. Chree, F.R.S.	176
Phenomena of Vision.—C. Welborne Piper; Edwin Edser	177
School Geometry Reform—R. W. H. T. Hudson	177
Recent Excavations at Nippur	177
Mathematical Reform at Cambridge	178
The University of London	179
Notes	179
Our Astronomical Column:—	
Astronomical Occurrences in July	183
New Comet, 1903 *c*	183
Photographic Observations of Comet 1903 III.	183
The Mirror of the Crossley Reflector	183
Radiant Points of July and August Meteors	184
Sun-spots and Terrestrial Temperature	184
The Satellites of Saturn	184
The Royal Society Conversazione	184
The Engineering Conference	185
New Case of Protective Mimicry in a Caterpillar. (*Illustrated.*)	187
University and Educational Intelligence	188
Societies and Academies	189
Diary of Societies	192