THURSDAY, SEPTEMBER 28, 1905.

A TREATISE ON PLAGUE.

Treatise on Plague. By Dr. W. J. Simpson. Pp. xxiv+466. (Cambridge: University Press, 1905.) Price 16*s*. net.

THIS volume deals with the historical, epidemiological, clinical, therapeutic, and preventive aspects of plague, and it marks a distinct and important addition to what has hitherto been written about the subject. It gives a careful and well arranged summary of many writings, ancient and modern, which deal with oriental plague. Many of the ancient writers, some interesting and basing their statements on carefully observed facts, others less interesting and largely fanciful, are here succinctly placed side by side, and the advances or the reverse evolved out of them for subsequent generations are described in chronological order. What the reader of this volume will at once perceive as a marked difference from other works on plague is the recognition of the important bearing of the discovery of the *Bacillus pestis* as the real cause of the disease, and its influence on our knowledge of the manner of spread of the disease and its prevention. In these respects Dr. Simpson, as an epidemiologist of recognised standing, and by his practical knowledge of the bacteriological aspect, is in a distinctly more favourable position than previous writers on plague.

The subject-matter is dealt with in four parts in twenty-one chapters. Part i. gives an account of the history and distribution of plague from the earliest recorded times down to the end of the nineteenth century—chapter i.—and comprises accounts of plague in Syria, Arabia, Mesopotamia and Persia, Egypt, Lybia, Constantinople, and the west of Europe, including Germany, Italy, and England during the sixteenth and seventeenth centuries. The references to the various writers are everywhere carefully given, and include writers like Procopias of Cesarea, Evagrius of Antioch, Gregory Bishop of Tours, Paulus Diaconus, A. v. Kremer, Nicophorus Gregoras, Guy de Chauliac, Ed. Maunde Thompson, Patrick Russell, and Dr. C. Creighton's "History of Epidemics in Britain." This chapter i. contains in thirty-nine pages a review of a vast amount of interesting literature not readily accessible to the ordinary student.

Chapter ii. deals separately with plague in India, which at the present time is of special interest to English readers. Before the seventeenth century, since when more or less accurate records are available, "the history of plague in India is veiled in obscurity. That plague did prevail in India in or before the eleventh or twelfth century is certain, for in some of the Puranas which are at least 800 years old there are references to the disease and instructions to the Hindus as to the precautions to be taken in the event of its appearance. One of these is that whenever a mortality among the rats of a house is observed the inhabitants are to leave" (p. 40). There is evidence of extensive pestilences in India in the fourteenth, fifteenth, and sixteenth centuries. At the beginning of the seventeenth century plague broke out in the Punjab and spread over different parts of India, the outbreaks in Surat, Bombay, and Bijapur towards the last part of the seventeenth century having been of a particularly virulent character.

"Nothing more is heard of the disease (p. 46) on the western side of India until 1836, when the Pali plague broke out in Marwar in Rajputana and lasted until 1838 (Dr. Forbes)," and according to the same authority this epidemic was brought from Asia Minor and Mesopotamia. Next comes the consideration of Garwhal and Kumaon (both at the southern slopes of the Himalayas), which are held by all authorities to be an endemic centre; "fortunately this centre is comparatively an inactive one as regards its powers of diffusion." Simpson, therefore, does not countenance (see also later) the somewhat sensational suggestion by Hankin that the epidemic in Bombay in 1896 and since was due to importation by fakeers from Garwhal. Chapter iii. deals in an exhaustive manner with the present pandemic, which is traced from Yunnan by the trade routes into different parts of China, and finally, in 1894, into Canton and Hong Kong. The outbreak and course of the epidemic into these two places are described from personal inquiries, as also the manner and extent to which these localities became centres of distribution of the plague to Bombay in 1896. The course and nature of the epidemic in Bombay Presidency, its extension into other presidencies and other countries, are illustrated by carefully executed maps.

Part ii. deals with the epidemiology of plague. Having briefly discussed the discovery of the *Bacillus pestis* by Yersin and Kitasato as the real cause of the disease, the author gives an account of the morphological and cultural characters of the microbe, of its vitality under various adverse conditions (heat, cold, drying on various substances) as asserted by various observers, and finally of its general effect and its pathogenicity after inoculation into rodents (chapter iv.).

In chapter v. the relationship of epizootics to plague is fully described. That rats and mice are susceptible to natural infection has been observed and mentioned by many writers, ancient and modern (Book of Samuel, vi., Bhajawata Purana, Nicophorus Gregoras, Lodge, Forbes, and many others). Dr. Hunter, of Hong Kong, and the author himself have published charts (reproduced) which give a comprehensive account of the parallelism of the human plague and rat mortality. While it is universally admitted as proved that in some epidemics the mortality of rats from plague coincides with the appearance of plague in the human being—either preceding it, synchronous with it, or following it—there is, on the other hand, good evidence (collected by the Indian Plague Commission, and discussed by Dr. Bruce Low in his Reports and Papers on bubonic plague, 1902) to show that epidemic outbreaks of plague in the human subject are not necessarily connected with plague in the rat. This is a point which ought not to be lightly passed over; it is unfortunate

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that in recent years it has been assumed by some epidemiologists that the essential factor in the appearance and spread of plague is the rat, whereas there exists good evidence that plague was introduced into, and broke out in, a locality in which neither antecedently nor concurrently any such epizootic was noticed—to mention, amongst others, the outbreak of plague in Oporto, and in Glasgow, 1900. No one questions the fact that plague has occurred on board ships in which plague rats had been found, nor that such rats on landing may carry and spread the disease amongst rats on shore, which themselves become a focus for plague amongst human beings; but it would be a serious omission on the part of sanitary officers were they to assume that this is the only, or even the chief, mode of importing the disease oversea or from one locality to another.

Chapter vi. deals with the different views regarding the etiology of pandemics and epidemics of plague, views which, with few exceptions, fall within periods antecedent to the discovery of the *Bacillus pestis,* and attributed a primary causality to influences which we now know to be accessory, though important, circumstances in the dissemination and spread of the disease, as, for instance, famine, scarcity, insanitary disposal of the dead, and others.

The known variations in diffusive powers of epidemics and the effect of seasonal influences are considered in chapter vii., and are illustrated by charts and diagrams, without, however, bringing us nearer to an explanation of the fact that seasonal influences play an important part, unless we accept as seriously meant the statement by Gottschlich, according to whom the seasonal periodicity of plague in Egypt is to be explained by the seasonal breeding period of the rat (p. 158).

The variation in virulence of plague epidemics is dealt with in chapter viii., and is illustrated by an account of various epidemics which have occurred in Astrakhan and Vetlianka, 1877–8; Avignon, 1348; Kathiawar, 1820; Pali, 1836; Marseilles, 1720; Egypt, 1834, and others. From these the author concludes that not only do epidemics amongst themselves show great variations in virulence, but that an at first mild epidemic is succeeded by one of great virulence in the same or subsequent years, and further that the various types may be running concurrently in the same locality and at the same time, *e.g.* at Kathiawar, Pali, Marseilles, Russia, and other places. The often observed fact that glandular swellings without fever may precede or follow plague prevalence is dwelt upon, without offering for it a satisfactory explanation, beyond the suggestion that variation of virulence may be due to change in virulence of the *Bacillus pestis* with change in the surrounding physical conditions, or to differences in susceptibility of those attacked, such as are brought about by scarcity and famine, poverty, insanitary dwellings, &c.

The conditions which foster endemicity and epidemicity are considered in chapter ix. The influence of the various at present existing endemic centres on dissemination of plague to exotic countries, the different conditions (poverty, misery, deficient food, overcrowding, insanitary dwellings) under which the various peoples have lived and still live, as, for instance, in the Himalayas, in Bombay, Canton, Hong Kong, Cape Town, and others, play an important part in predisposing to plague, "and it is in a population living under these social and local conditions that plague usually commits its greatest ravages" (p. 193).

The modes of dissemination from one locality into another and within an infected locality are described in chapters x. and xi. respectively. As to the first, illustrations are given that plague travels by the most frequented trade routes, that persons sick with or incubating plague carry infection, so also infected clothes and personal effects; that infection conveyed to a new centre (infected cargoes and infected rats) may affect rats before human beings; that owing to panic caused by plague breaking out in a given locality, open and secret flight of inhabitants are instrumental in the dissemination of the disease. In the dissemination of plague within an infected locality, importance is attached in the first place to the high infectivity of the pneumonic form of plague, as contrasted with simple bubonic plague, which is not directly infectious. Next stands the infectivity of the septicæmic form, in which the excretions contain the *Bacillus pestis,* wherefore clothes and rats play an important *rôle.* In the conveyance of plague from the rat to man, the part that insects—fleas, lice, bugs, ants—play is brought into prominence. In support of this theory, no valid experimental evidence is brought forward; what there is mentioned is more of the nature of strong belief. It is to be regretted that such prominence is given to this mode of dissemination, seeing that beyond the theoretical possibility, namely, that a blood-sucking insect of a plague-infected animal the blood of which, presumably, contains the *Bacillus pestis* might be the means of causing by its bite cutaneous inoculation of a new individual, including the human, there is not sufficient evidence that such has actually been observed either naturally or experimentally. All the direct evidence at present available is of a negative character. The numerous modes of conveyance of plague from man to man, from rat to rat, from rat to man and *vice versâ,* which have actually been observed both under natural as also under laboratory conditions (chapter xiii.) are quite sufficient to account for all the facts without ascribing to the flea any other than a very restricted and accidental *rôle,* if any.

Part iii. deals with plague in the individual. The morbid anatomy and pathology, including histology and distribution of the *B. pestis* in the different tissues, are described in chapter xii., as also the details of several autopsies of typical plague cases; whereas chapter xiii. gives an extensive description of the various channels by which an individual may receive the infection—the skin, and hence directly into the lymphatics; the skin, and hence directly into the bloodvessels; the mucous membranes, particularly of the fauces; the respiratory tract. The author accepts the three-fold grouping of plague infection made by the Indian Plague Commission according to the duration of the incubation period in well ascertained cases.

The clinical symptoms, temperature charts, and some excellent photograms of the various forms of buboes in the living, the clinical history, treatment, and *post mortem* appearances of several specially selected cases are treated in a very readable manner in chapter xiv. While chapter xv. deals with the diagnosis and prognosis both from a clinical and bacteriological point, chapter xvi. is specially devoted to treatment, dealing with the methods used in the past, before the intimate nature of plague had been recognised, and in the present day, when Yersin's serum is extensively employed, giving statistical tables of the results of the use of this serum in Bombay, Karad, Karachi, Oporto, Natal, Hong Kong, and Brisbane, as also of Lustig's serum (p. 325), of that of Bondi and Terni, and of Kitasato.

This chapter concludes with a general account of prophylactic measures to be employed in an infected house, and of the injection of Haffkine's prophylactic into persons who have been exposed or are likely to be exposed to infection. Of the value of this prophylactic Dr. Simpson has no doubt, and recommends its immediate application.

Part iv. deals with measures for prevention and suppression of plague, those that were employed before the discovery of the *Bacillus pestis* (chapter xvii.), as also those at present in use (chapter xviii.). Amongst the former the measures used by the Venetians in 1348—in advance of all other countries and nations—deserve special notice, inasmuch as those measures were the first of a rational and organised nature, and practically are fundamental for all subsequent improvement and enlargements—lazaretto system of isolation, quarantine of men, merchandise, articles, and objects of various kinds. Amongst the existing measures are those agreed upon by the different Governments at the Venice Convention of 1897, and at the Paris Convention of 1903. Amongst the latter the importance of the destruction of rats is receiving a prominent place. While the use of fumigation of ships by means of the Clayton process, described in detail (pp. 359-365), unquestionably deserves the first place, undue prominence is given by the author to the Danysz bacillus (capable of causing acute fatal disease in rodents) as a means of rat destruction in localities other than ships. Owing to this prominence, the use of this microbe seems liable to lead to considerable disappointment; while the results of distributing with the food either cultures of this microbe or animals infected with it in the laboratory has been fairly satisfactory in some localities in destroying rats, in other localities it has been unsatisfactory. In some of the warehouses in the London Docks we distributed several dozens of cultures prepared by, and bought directly of, Dr. Danysz, as also a number of subcultures mixed with various foodstuffs, and a number of rodents (guinea-pigs, mice, and rats) dead after injection with virulent culture of the microbe; but while all these materials had been taken away by the rats of the warehouse, there was not a single dead rat found in consequence, nor was there afterwards any diminution of their number noticeable. Such unsatisfactory results have been observed also in other localities; it appears that the result depends not only on the virulence of the cultures (difficult to control), but also, and in a marked degree, on the species of rat. Moreover, recent observations show that even rats of the same species, but derived from different localities, are not susceptible to the Danysz virus in the same manner and to the same extent. The use, therefore, of the Danysz bacillus in one form or another can at best be considered only as a half-measure. It is precisely against half-measures, so frequently and so readily resorted to by indolent corporations and powers that be, that the author justly raises his voice in no uncertain manner (chapters xviii. and xix.), and we cannot help regretting that such prominence should have been given to a method falling far short of the drastic measures required to ensure the safe destruction of this dangerous vermin.

Chapter xx. is entirely devoted to a description of the nature, use, and results of preventive inoculation with Haffkine's plague prophylactic. The volume finishes with a reprint of the results of the International Sanitary Convention of Paris of 1903 *re* plague and cholera.

From the foregoing summary it will be seen that Dr. Simpson's "Treatise on Plague," dealing as it does with the disease from every aspect, is worthy to take a place in the foremost rank of the literature of the subject, and we have no doubt that it is destined to become an important and valuable aid to the student, the medical officer of health, to the epidemiologist, the sanitarian, and last, but not least, to the administrator. E. KLEIN.

ASTRONOMICAL STEREOGRAMS.

Our Stellar Universe. A Road-Book to the Stars. By Thomas Edward Heath. Pp. 75. (London: King, Sell and Olding, Ltd., 1905.) Price 5*s.* net.

Our Stellar Universe. (*Six Stereograms of Sun and Stars.*) By Thomas E. Heath. (London: King, Sell and Olding, Ltd., n.d.) Price 3*s.* net.

IN the first of these two volumes Mr. Heath has collected and amplified several articles which previously appeared in *Knowledge*, and in which he made a satisfactory attempt to bring home to the understanding of "the man in the street" the knowledge so far available as the result of the determinations of stellar parallaxes. It is, truly, as the subtitle indicates, a "road-book" in which the contours, or perhaps one should say the depths, as well as the directions, are plainly shown.

The text is really a simple, detailed description of the eight figures contained in the volume, all of which have been especially prepared by the author himself. Fig. 1 shows the sun and his attendant planets drawn to scale. In Fig. 2 the relative distances of all stars known to be within sixty light-years of our system are shown by placing the objects on a background formed by a map of the home counties, taking Greenwich as the point of departure, the "sun-powers" of the various stars being represented by a system of symbols. Fig. 3 similarly treats all those stars within 480 light-years, a map of N.W. Europe constituting the background. The scale employed for the stellar distances is an interesting one, which takes as its unit the distance of a star situated at one light-year from the solar system. Mr. Heath fortuitously discovered that by calling this unit one mile the sun's distance is almost exactly represented by one inch.

Figs. 4 and 5, of which detachable duplicates are given in the book, present really beautiful pictures when used with a stereoscope, the star images standing out in numerous planes, some quite near to the eye, others apparently infinitely remote. The conception of the three-dimension character of space is most vividly impressed by these charts, the first of which represents the stars as viewed from a plane situated 500 light-years from the sun by eyes 107 light-years apart, the second a similar view at a distance of 100 light-years as seen by eyes 26 light-years apart.

The sun-powers of various stars are more especially dealt with in Figs. 6 and 7 and the accompanying text, whilst Fig. 8 represents a view of the known universe as it would appear to an external observer looking in the direction of R.A. 6h.

All the data (*e.g.* parallaxes, spectral types, sun-powers) used in constructing the various diagrams and discussed in the text, are given in tables which form an interesting and useful appendix to the volume. Avowedly written in a popular form, the book contains much that will not appeal to the astronomer, *e.g.* the reference to the Dogger Bank incident on p. 17, but should prove of interest and assistance to the amateur tourist in space by visualising the real interpretation of stellar parallaxes.

In the second of these two volumes Mr. Heath gives us a series of six stereoscopic charts of the sun and stars of which the parallax has been determined, similar to those mentioned above. The scale of the charts here given is one-fifth of that he employed for his large stereoscope, and in all of them the spectator's eyes are supposed to be 26 light-years apart, each drawing being made at any angular distance of 90 degrees from the four adjacent to it. Each view is accompanied by a table similar to those mentioned above.

The idea of representing stars in this stereographic manner is very ingenious, and this book, too, will certainly interest many astronomical readers.

PHYSICAL CHANGES IN IRON AND STEEL.

The Crystallisation of Iron and Steel. An Introduction to the Study of Metallography. By Dr. J. W. Mellor. Pp. x+144. (London: Longmans, Green and Co., 1905.) Price 5*s.* net.

THAT the students of the problems of metallography, particularly in the present unsettled state of affairs, should have for guides only those who have done some considerable amount of active work in the science will be readily acknowledged. A certain amount of familiarity with the metals themselves, their history and behaviour, is also necessary before the subject can be made to live. Reading through the present work convinces one that it is written by an onlooker, and the illustrations entirely support this view of the text. The presentation is without bias, and each theory and method is described and examined as clearly and fairly as the author's evident lack of practical acquaintance with the subject as a whole will permit. For anyone wishing to get an idea of what has been done and desiring a general survey of the scope of metallography, its theoretical aspect, and the problems it endeavours to solve, the book will serve fairly well. For the worker actually in the field, striving to progress in the science, to apply it to his own practical work with metals, and perhaps to endeavour by its aid to solve some of the difficulties that are ever confronting the metallurgist, it cannot honestly be recommended, as to such it will give but little light.

A few examples of the kind of thing encountered may be given. On p. 12, the recalescence curve of steel is shown as rising from 680° C. to about 810° C., whereas the real rise is only a few degrees; p. 14, "Ac2 is higher than Ar2"; p. 49, "excess of ferrite renders the steel ductile and tenacious," whereas pure iron has a tenacity of about 20 tons and pure pearlite of over 50 tons per square inch; p. 50, "2 per cent. carbon alloys are called cast iron" is quite wrong, for tons of steel are made with more than 2 per cent. carbon. Malleability is the essential point here. P. 52, discussing the influences which affect the physical properties, the author omits mechanical treatment—hot or cold work. "Heat white cast iron it forms grey cast iron" is quite misleading. P. 74, ii., is erroneous, and p. 76 is not in accord with the facts, as the writer has many times proved even in ordinary works practice, so there is only left the ingenuity of the explanation and the fact that it leads the reader astray. P. 81, "tenacity is lowered by silicon." Are the researches of Hadfield, Arnold, and Baker not sufficient to the contrary? Their results are not disputed. On p. 88, cleavage fragments are laboriously dealt with as crystallites. The reader is told they are perfect replicas of the larger crystal, and calcite is the example chosen! Sorby's samples are said to be 1 square cm. by 2 mm. thick. The originals are in front of the writer, and their surface area is more than 1 square inch. It may be of little importance, but the statement should either be near the truth or be omitted. P. 106, "the *cheapest* microscope, 16*l.* or upwards," and "it is necessary to have a brilliant light arc lamp, &c.," must discourage many isolated students, whereas much excellent work has been done and is being done with a batswing or a similar burner and a Beck's Star set at about 7*l.* P. 107, "microphotography."

A glossary gives the "nomenclature of metallography," and the present reviewer would like to study the faces of his colleagues of the Iron and Steel Institute's Committee on "The Nomenclature of Metallography" when they find that it is not based on the final report, but on the crude original put out expressly for discussion and amendment. The arduous session's work that followed was evidently in vain so far as the author and his readers are concerned. The illustrations are taken from well-known workers, but at least the approximate magnifications should be given. Other points, owing to their importance, would require to be traversed in detail, but enough has been said to help those interested to judge whether the book would suit their purpose or not.

A. McWILLIAM.

OUR BOOK SHELF.

Latins et Anglo-Saxons, Races supérieures et Races inférieures. By Prof. N. Colajanni. Translation by Julien Dubois. Pp. xx+432. (Paris: F. Alcan, 1905.) Price 9 francs.

SIGNOR COLAJANNI, a Socialist deputy and professor of statistics, is a convinced opponent of the doctrine of Anglo-Saxon superiority. The questions which he proposes to himself are, in brief:—(*a*) the meaning of the terms race and nation; (*b*) the existence of distinctive racial qualities; (*c*) the transmission of acquired qualities; (*d*) the equivalence of decadence in the nation and senescence in the individual. He concludes (*a*) that we have no data by which to determine the specific racial attributes of Sergi's European types; (*b*) that the terms superior and inferior, save as an expression of their relative positions at a given moment, have no meaning when applied to nations; (*c*) that acquired qualities are transmitted, especially when segregation favours fixation of the type; and (*d*) that decadence is relative, by comparison with the progress of other nations; nations may, phœnix-like, rise from their ashes and attain a second time to greatness.

Although Signor Colajanni's main arguments are derived from the English and Romance-speaking peoples of the present day, he does not hesitate to invoke the facts of ancient history and the non-European races, and his task is, in fact, one which demands the amplest equipment of historical, sociological, and economic knowledge, combined with an impeccable method and an unerring judgment. Let us illustrate his fitness for his task. A large part of the first half of this work is taken up with the proof of the first and second conclusions cited above; but his method consists largely in putting side by side two or more quotations, *primâ facie* contradictory, and drawing from them the conclusion that both or all are erroneous. He overlooks the fact that criteria are apt to differ; one author may assert the superiority of a race, another its inferiority; unless the standard is the same, the views are not even shown to be contradictory. Even were it otherwise, it is evident that of two contradictory assertions *both* are not necessarily wrong.

The statistical methods of the work are not above criticism; on p. 354 we have $110/3=22$; on the following page there is a comparison of the material progress of France and England since 1840; for France the savings banks are included; the deposits show an increase of 2200 per cent. Signor Colajanni has no hesitation in taking this as an index number, but he does not add to the English table any corresponding figure for our savings banks; even, therefore, were it legitimate to take the mean of ten index numbers, regardless of their relative importance, as a fair statement of the changes. his method is ludicrously fallacious.

Signor Colajanni's knowledge of England is probably limited; we learn (p. 279) that our distinguishing traits are rudeness, lack of sociability, and pitilessness, and that these are due to fagging at school. Our lack of generosity and sweetness (*douceur*) are due (p. 124) to our games and violent exercise—football, of course, and perhaps lawn tennis, or, at an earlier age, battledore and shuttlecock. Of Signor Colajanni's logic we may judge when we read (p. 174 *et seq.*) of Anglo-Saxon decadence as visible in U.S.A., and later (p. 302) that only one-fourth of its citizens are Anglo-Saxons.

Signor Colajanni's book, though inaccurate, is not without its good points, but it leaves little permanent impression. The translator has little knowledge of English and German to judge by the strange words that often meet the eye.

N. W. T.

Machine Construction and Drawing. By Frank Castle, M.I.M.E. Pp. viii+275. (London: Macmillan and Co., Ltd.) Price 4*s*. 6*d*.

IN the study of machine construction and drawing the assistance to be derived from books can never be more than of secondary importance. The acquirement of a thorough knowledge of the subject depends principally upon the opportunities which a student may have of coming into daily contact in the workshop with varied examples of good engineering practice, and the use which he makes of these opportunities. Assuming that a youth is fortunately circumstanced, he will be busy at suitable moments compiling a book of miscellaneous notes, containing, amongst other things, many fully-dimensioned sketches taken from machine details lying around him. Along with this work, and very appropriately in the drawing class, he will make working drawings to scale of some of the things sketched in his notebook, and additional examples for sketching and drawing will be provided in the class.

The student will also consult text-books for further information, and the book under review will be found very suitable indeed for the purpose. The author first describes the necessary drawing instruments, and explains their use. He then sets out in detail, with proportional dimensions, various forms of common fastenings, such as rivets, bolts, keys, &c. Then come chapters containing examples of mill work, followed by others dealing with steam-engine details. The final chapter gives a short account of the physical properties of materials used in construction. Sets of useful exercises occur at intervals, and a few calculations of strengths are given; but the latter are wisely kept in strict subordination.

The drawings which abound throughout the work represent good practice, are fully dimensioned, very clearly printed, and will be appreciated by teachers and students alike.

While not free from minor defects, the book can be cordially recommended for use in drawing classes, and to young engineers who are seeking after knowledge on which to base subsequent work in machine design.

Graphs for Beginners. By W. Jamieson, A.M.I.E.E. Pp. 64. (London: Blackie and Son, 1905.) Price 1*s*. 6*d*.

IN order to teach and illustrate the subject, the author in this small volume makes use of a number of interesting graphs relating mainly to technical and commercial subjects, many of them discontinuous, algebraical curves being given only a secondary place, though the logarithmic or compound interest law is dealt with. The significance of the slope at any point of a graph is enforced by simple and effective examples. The treatment is suggestive and interesting, and the author is justified in hoping that the book will tend to cultivate the observation and stimulate the reasoning powers of the young readers.

LETTERS TO THE EDITOR.

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

The Preservation of Native Plants and Animals.

FROM London papers recently to hand, I see that at the ornithological congress, on the motion of the Hon. W. Rothschild, a resolution was forwarded to the Premier of New Zealand in regard to the importance of taking steps to preserve and protect the birds on the Auckland and Campbell Islands.

It may be of interest to ornithologists in Great Britain to hear that our local scientific societies had already, in May, memorialised the Government to the same effect; indeed, we asked that protection should be afforded, not only to the birds, but also to the flora.

We have likewise forwarded a similar resolution to the State Government of Tasmania in respect of the penguins on the Macquarie Islands.

The resolution, therefore, of the ornithological congress should strengthen the hands of our local institutes, which bodies are keenly alive to the importance of preserving, as far as possible, the fauna and flora of New Zealand.

The Government, too, has hitherto met our requests in a prompt and generous manner. A couple of years ago, for example, the Otago Institute pointed out to the Minister for Lands that sheep were destroying the alpine flora of the Southern Alps, especially in the region around Mount Cook; the Government at once proclaimed the area as a "reserve," and the sheep were banished.

In fact, the Government is remarkably ready to afford any protection that is possible; and the recent proclamation of the whole of the S.W. portion of the South Island—including the Great Lakes, a vast mountainous, forest-clad area, and the famous fjords—as a "national park," and the prohibition of the use of guns and dogs herein, has already had its effect in the increase in number of some of our rare birds.

You will see, therefore, that we out here, equally with naturalists at home, have at heart the interests of our native plants and animals. W. B. BENHAM.

Otago University Museum, Dunedin, N.Z., August 21.

The Omission of Titles of Addresses on Scientific Subjects.

I VENTURE to ask the attention of "whom it may concern" to the practice in vogue in Great Britain of publishing presidential addresses of scientific societies and of sections of the British Association without any mention of the titles of those addresses. Take, for example, a case quite at random, but just at hand. NATURE of August 17, beginning on p. 368, contains the inaugural address of the president of the British Association with the heading "Part I." On p. 372 of the same number is another presidential address without a title. On p. 378 a third address has no general head, but it has the distinct advantage of four subheads that enable the reader to select at a glance what he wants, and to pass over other matters if he so chooses.

Unfortunately these are not exceptional cases. I have in my library scores of these addresses in the form of separates without a word on the title-page to indicate how they are to be classified in a library. The presidential addresses published in the reports of the British Association are conspicuous examples of this kind of publication. I have taken the trouble to look through these reports from the beginning of the association in 1831 down to 1892, and out of all the addresses of the presidents of the association published in these sixty-one years there are only five that have titles or subtitles. These are the addresses given in 1831, 1839, 1854, 1880, and 1885.

It is easy to see how this absence of title came about originally, but, as seen from this respectful distance, the history of it is nothing to the point. What this busy world wants is help to get at what we are interested in with the least possible waste of time.

This hot haste may seem unbecoming to men of science, or perhaps it may appear that we Americans are in too big a hurry—that we are too much impressed with the motto "time is dollars." But we are not spending all our time chasing the dollar; there are many other nimble things that we are trying to keep up with, and one of them is the progress of science in Europe, along the lines in which we are especially interested.

If a member of so young and giddy a nation might venture to make a suggestion to older and wiser people, it would be in favour of requesting or requiring the presidents of the various scientific organisations and sections of the British Association to provide headings for their addresses so that those of us who have not the time to read all these good things may be able at a glance to pick out what we want especially to see. As matters now stand we are compelled, as a rule, to do one of two things—either to let them all go unread—to our great regret and loss—or to wade through pages upon pages of matter which, however valuable it may be, is out of our line and of no especial interest to us. Such titles, headings or subheads as are here suggested would avoid these difficulties. It would not cost much; it would not take much time, and it would save much of ours and some of your own. We appeal to you for sympathy and help.

JOHN C. BRANNER.

Stanford University, California, September 7.

Protective Coloration of the Inside of the Mouth in Nestling Birds.

THE habit shown by many helpless nestlings, of gaping widely when the nest is approached, is usually explained by supposing that the birds are appealing for food. This explanation has always seemed to me inadequate, for nestlings that gape usually have the inside of the mouth brightly coloured, and in some cases marked with conspicuous spots. Moreover, newly hatched nestlings among the Passeres gape if the fingers are snapped just above them, or if the branch bearing the nest is shaken. It seems a fair inference, therefore, that the act of gaping is often, if not usually, an expression of alarm.

In order to test the effect of the widely opened and brightly coloured mouth, I have several times asked young children to touch the edge of the nest or place a finger in the mouth of one of the birds, and from their hesitation or even refusal to obey I am convinced that the conspicuous coloration, by centering attention upon the gaping mouth, tends to protect the nestling from molestation. Mr. W. P. Pycraft thinks that the bright colours and spots are "guide-marks" to facilitate the proper placing of the food in the mouth by the parents. But persons who rear nestlings find no difficulty in feeding them so long as they gape freely, without troubling themselves about placing the food in any particular region of the mouth. W. RUSKIN BUTTERFIELD.

4 Stanhope Place, St. Leonard's-on-Sea.

Helmert's Formula for Gravity.

ON p. 79 of Everett's valuable "Illustrations of the C.G.S. System of Units with Tables of Physical Constants" (London: Macmillan and Co., Ltd., 1902) the following lines occur:—

"In a Report now printing, which will contain a very full list of results, Helmert adopts, as the most accurate general formula for g reduced to sea level,

$$g=980.617\ (1-0{\cdot}002644 \cos 2\phi+0{\cdot}000007 \cos^2 2\phi).$$

. . . . This may be accepted as the best general formula yet put forward."

The formula alluded to was given first by Helmert in his paper "Der normale Theil der Schwerkraft in Meeresniveau" (*Sitzungsberichte der k. Preussischen Akademie der Wissenschaften zu Berlin*, 1901, xiv., pp. 332–336), but with a different coefficient, namely,

$$g=980{\cdot}632\ (1-0{\cdot}002644 \cos 2\phi+0.000007 \cos^2 2\phi),$$

and it is not reproduced in the report mentioned in the above quotation from Everett, but in a subsequent one (*Comptes rendus des Séances de l'Association Géodésique Internationale*, Copenhagen, 1903, ii., p. 42, Berlin, 1905).

OTTAVIO ZANOTTI BIANCO.

Turin, Via della Rocca 28, September 8.

THE FAYUM.[1]

THE palæontological treasures yielded by the Fayum have made that Egyptian province no less famous among geologists and zoologists than are the "bad lands" of the United States territories, the Sevalik Hills, or Pikermi. The discoveries by Messrs. Beadnell and Andrews of extinct mammals, the study of which serves to clear up the whole question of the ancestry of that strangely specialised group the Proboscidea, are not of less significance than those which enabled Marsh and Huxley to demonstrate how the equally aberrant type of Equidæ originated.

We are glad to learn from the introduction to the present volume that the whole mass of palæontological material which has been obtained by the Egyptian Government has now been handed over to the authorities of the British Museum for the purposes of study and description. While the type-specimens will, we understand, be eventually deposited in the museum at Cairo, a good representative series of duplicates will be retained in this country.

Preliminary notices by Dr. Andrews and Mr. Beadnell himself concerning the osteology of some of these curious extinct forms of mammalian life have already appeared, but for the full details we must await the promised publications to be issued by the trustees of the British Museum. In the meanwhile, we welcome the volume before us, which gives a very clear and suggestive account of the general features of the district in which these splendid discoveries have been made.

The Fayum is a circular depression in the Libyan Desert, having an area of more than 3000 square miles, and is situated to the west of the Nile, some distance south of the latitude of Cairo. The lowest part of the district is occupied by the lake known as the Birket el Qurun, which has an area of between 80 and 90 square miles; but this area appears to be continually diminishing owing to evaporation. On the south-east side of the lake lies a tract of cultivated land, covered with alluvium similar to that of the Nile Valley, and having an area of about 700 square miles. The cultivated area is directly connected with the Nile Valley by a depression through which runs a natural canal—the Bahr Yusef—which conveys water to the Fayum and irrigates the whole of the district.

The remaining area of the Fayum is practically desert, the most interesting part of this desert area being two deep dry depressions in the south-west known as the Wadi Rayan and the Wadi Muêla. These depressions have attracted a considerable amount of attention from engineers in recent years, as being possibly capable of conversion into reservoirs for the purposes of irrigation.

Until the year 1898, when the examination was commenced by the Geological Survey of Egypt, little was known concerning the geology of this district. It was crossed in 1879 by Dr. Schweinfurth, who discovered bones of the extinct cetacean Zeuglodon, and this seems to have been the first indication of the existence of vertebrate fossils in the district. Soon after the commencement of the survey by Mr. Beadnell, under the direction of Captain Lyons, the remains of fish and crocodiles were found to occur in the beds of the Middle Eocene, which had yielded the fossils found by Schweinfurth. A few fragments of bone were also found in the Upper Eocene strata, but it was not until 1901, when Dr. Andrews, of the British Museum, had joined Mr. Beadnell for the purpose of collecting recent North African mammals, that the outcrop of strata was crossed upon which a considerable number of mammalian and reptilian remains lay exposed, many in an excellent state of preservation. Energetic efforts on the part of the authorities of the British Museum and the Egyptian Government have resulted in the rich harvest of palæontological treasures now awaiting description, some of which are familiar to all visitors of the Natural History Museum at South Kensington. The study of these extinct types of mammals and reptiles, in addition to affording much new light on the evolution of living forms, cannot fail to increase greatly our knowledge of the successive stages by which the present distribution of these forms of life has been reached.

FIG. 1.—North side of the Birket el Qurun, looking West. From "The Topography and Geology of the Fayum Province of Egypt," by H. J. L. Beadnell.

The series of strata which have yielded the interesting vertebrate faunas is clearly described by Mr. Beadnell in the work before us. The beds are admirably exhibited in a number of fine escarpments. At the base are found Middle Eocene (Parisian) strata with an aggregate thickness of about 1300 feet. Nummulites and mollusca abound in these beds, which in their lower part contain Zeuglodon and fish remains, and in their higher portion the older of the two vertebrate faunas. The Upper Eocene (Bartonian) which overlie these have a thickness of 830 feet, and, with some remains of mollusca, yield the abundant remains of the second vertebrate fauna. No Miocene strata have been found in the Fayum, but about 100 feet of fluvio-marine beds, intercalated with contemporaneous (interbedded) sheets of basalt, and containing silicified trees, are referred to the

[1] "The Topography and Geology of the Fayum Province of Egypt." By H. J. L. Beadnell, F.G.S., F.R.G.S. Quarto. Pp. 101. Plates 24. (Cairo: National Printing Department, 1905.)

Oligocene (Tongrian). The youngest beds in the area are gravel terraces, lacustrine clays, deposited on the bed of the ever-diminishing lake, sands blown from the desert, and alluvial deposits.

Mr. Beadnell adduces evidence in favour of the view that the bodies of the animals the skeletons of which are found entombed in the strata of the Fayum were brought down from the African interior by a great stream which flowed in a north-westerly direction, passing through the ancient lake occupying the site of the Baharia Oasis. At that period the shore-line would be near the Fayum, and the Nile would flow into the sea near the same point.

In historical times, as is well known, a large part of the Fayum was occupied by the ancient Lake Moeris. By successive reclamations of the alluvial lands, this lake has probably been reduced to less than one-eighth of its original area, and now constitutes the comparatively insignificant Birket el Qurun.

The work before us appears in the same excellent form as the other memoirs of the Geological Survey of Egypt, issued under the direction of Captain Lyons. There are sixteen plates reproduced from photographs, which give a good idea of the scenery of this wonderful district. We give reductions of two of the plates. In addition to these, there are two geological maps and six sheets of longitudinal sections. There are also woodcuts in the letterpress. The printing of the text of the work and the execution of the illustrations are highly creditable to the Survey Department at Cairo.

J. W. J.

FIG. 2.—Bahr Yusuf at Lahun before entering the Fayum. From "The Topography and Geology of the Fayum Province of Egypt," by H. J. L. Beadnell.

THE ROYAL PHOTOGRAPHIC SOCIETY'S EXHIBITION.

THE fiftieth annual exhibition of the Royal Photographic Society is now open. There is a distinct and regrettable falling off in the number of exhibits in the section devoted to scientific and technical photography, but this is in a measure compensated for by the presence of the loan collection of British photographs of a similar kind that was sent to the St. Louis Exhibition last year, though among the latter there are many examples that have been shown in the society's previous exhibitions.

Of the new work, the natural history section is by far the best represented. Miss Turner's set of photographs of the "great crested grebe," and a series of twenty-two lantern slides of butterflies by Dr. D. H. Hutchinson, have been awarded medals. The lantern slides are by the Sanger-Shepherd three-colour process, and illustrate the usefulness of this method for recording rare varieties. In some of the slides the colours are notably excellent, perhaps as perfect as any mechanical colour process will ever produce. Some of the photographs of "nesting swans" by Mr. Douglas English must have been taken at considerable risk, for in two or three of them the bird is shown flying at the photographer in anger. Another example (No. 237) will be found in the west room among the pictorial photographs, and close by (No. 216) is a very fine photograph of sea-gulls, the foremost of which are in the act of alighting on the water. Of other photographs that record slower movements, the chief are a series of seven by Mr. W. Farren of the "skin moult of the caterpillar of the privet hawk-moth," a series of eight photomicrographs (×30) by Mrs. Kate J. Pigg showing the germination of a grass seed, and two photographs of the same oak, the one taken more than fifty years before the other, by Mr. J. B. Hilditch. The earlier photograph of the oak was exhibited at the first exhibition of the Royal Photographic Society (then the Photographic Society of London), and is at least as good a piece of work as the later, the main difference from a technical point of view being that the exposure necessary for the first was three thousand times as long as that given for the second. There are many other photographs of living things, but the bee photographs of Mr. Oliver G. Pike deserve special notice. The difficulty was to get light enough without causing the bees to stop their work, and Mr. Pike has succeeded.

Of other work in the technical section there are photomicrographs showing the structure of various metals and alloys by Mr. E. F. Law, some interesting wave photographs by Dr. Vaughan Cornish, and a number of radiographs by Dr. Thurstan Holland which well illustrate the possibilities of modern methods. The only "natural colour" photograph that we discovered, other than the transparencies by the Sanger-Shepherd method, is a three-carbon print by Mr. Brewerton. We think he has sent as good examples in previous years, but whether or not, what we want to show the capabilities of three-colour work are the finished print, produced without handwork, by the side of the object or painting that it represents. Some commercial work is excellent, but its measure of perfection is due to retouching.

The loan collection from the St. Louis Exhibition will doubtless prove more interesting to many than the new work, because of its greater variety. Some of these exhibits are of historic interest, such as Sir William Abney's photograph of the spectrum in the infra-red, and General Waterhouse's examples of photomechanical work. There are a very great many photomicrographs of etched metals and alloys, some astronomical and spectrum photographs, and Mr. Edgar Senior's photomicrographs of sections of photographic films, including those of colour photographs by Lippmann's process which demonstrate that the silver deposit is in layers.

In the trade section there are many interesting exhibits. Doubtless the greatest novelty is the demonstration of the three-colour process called "pinatype," which is claimed to be the amateur's method of colour printing on paper. Three prints in chromated gelatin are made from the ordinary three transparencies, and these are each caused to absorb its proper colour by soaking it in the proper dye solution. The prepared paper that is to bear the print is squeegeed on to each of these coloured "print plates" in turn, and duly absorbs the colour. Thus the three colours are absorbed into a single film. The examples we saw were of various degrees of merit.

PROF. LEO ERRERA.

LEO ERRERA, professor of botany in the University of Brussels and member of the Royal Academy of Belgium, whose death on August 1 has already been announced, was born in 1858. He merited preeminently the title of professor, for not only was he gifted as few men are gifted with the faculty of giving a clear and precise explanation of complicated problems, and of impressing upon the minds of his hearers his conclusions, which were well reasoned and supported by facts and conceptions, but he was also one of those teachers who recognised that it is not possible to improvise a lecture, however simple or commonplace, without bestowing upon it lengthy and conscientious preparation. In addition to the critical judgment which characterised his teaching, he always kept it abreast of scientific knowledge; each year, even in the case of his elementary courses, his lectures were looked through, revised, and brought up to date so as to include the latest results in the subject.

Prof. Errera was one of the first teachers in Belgium who had the courage to declare that practical work should take precedence of theoretical studies, which alone had formed the ordinary courses up to that time. He was convinced that a student should only accept as true what he had verified for himself, and that it is not sufficient to know scientific results without becoming acquainted with the methods employed. With this object he established in 1884, when he was appointed professor in the university, the laboratory for vegetable anatomy and physiology which became later the Botanical Institute.

He was wonderfully assisted by the remarkable facility with which he assimilated all current literature. He read Danish and Swedish without any difficulty, and at the congresses in which he took part, whether English, German or Dutch, he invariably excited admiration by his correct and expressive rendering of foreign languages. It was not surprising that at the International Botanical Congress held at Vienna last June he was nominated president for the next congress, to be held at Brussels in 1910.

The worries of teaching did not cause Errera to forget that it is the duty of every scientific man to contribute to the increase of that knowledge which has been handed down to him. His energy was especially productive along four lines of research.

When Darwin had attracted attention to the importance of cross-fertilisation among plants and to the part played by insects in the transfer of pollen, Errera as early as 1878, recognising the full import of this discovery immediately set to work to study with his keen experimental insight the genera Penstemon and Primula, and *Geranium phaeum*.

Later, while he was working in De Bary's laboratory at Strasbourg, he discovered in certain fungal cells a substance then unknown which gave all the reactions of glycogen. This is a body allied to starch that was conclusively shown by the great Claude Bernard to be of great importance in animal physiology. By degrees Errera recognised glycogen in all the groups of fungi, and was able to assign to it the same function, *i.e.* that of reserve carbohydrate, as it has in animals. His first researches on this subject were published in 1884, and constituted his thesis for admission into the University of Brussels.

Prof. Errera initiated a series of papers on the *rôle* of alkaloids in plants. The origin and *rôle* of these poisons in plant economy formed, and still forms, the subject of discussion. The papers of Errera and his pupils tend to prove that alkaloids are decomposition products of nutrition, but that they may be utilised by plants as a defence against herbivorous animals.

He was one of those who realised the importance which attaches to molecular forces in the structure of living beings and in all the obscure phenomena of nutrition. Basing his investigations primarily on the important works of the physician Joseph Plateau, the illustrious professor of the University of Ghent, Errera showed that cellular membranes behave in the same way as if they obeyed the laws which regulate the reaction of liquid films such as are produced in blowing soap-bubbles. His first communication on this subject dates from 1886.

But not content to lead the way in the domains of science which we have outlined and to direct the work of his students therein, he also pursued many investigations in very diverse subjects. He did much to improve the methods of microscopical technique; he simplified greatly the microchemical examination of certain substances; he published ingenious theories on the mechanism of sleep, and contributed lectures on widely different subjects varying from pedagogy to natural philosophy; and all his publications were marked by a clearness and purity of style that are not surpassed in the writings of any other man of science.

JEAN MASSART.

NOTES.

MR. G. B. BUCKTON, F.R.S., author of several monographs on entomological and other subjects, died on September 26, at eighty-eight years of age.

WE regret to see the report that Sir William Wharton, who was prevented by illness from leaving Cape Town with other members of the British Association last week, is suffering from enteric fever complicated by pneumonia. His condition on Monday showed a slight improvement.

AN earthquake shock was felt in Stirling, Dollar, and Alloa shortly before midnight on Thursday, September 21. The shock travelled in a similar direction to that of July 23, namely, to the south-east, but it was of slightly longer duration and more violent in character. In Stirling pictures and crockery were shaken and articles of furniture moved, and a sound like thunder was heard. At Corton railway signal-cabin all the bells were set ringing. At Bridge of Allan the shock was felt very decidedly. In Bannockburn and in the neighbouring villages the impression was of a serious explosion. Comrie was only slightly affected: a low rumbling sound was heard, but no damage was done.

AN electrical exhibition on a large scale was opened at Olympia, Kensington, on September 25 by the Lord Mayor of London. The exhibition is under the auspices of the National Electrical Manufacturers' Association (Incorporated), and is intended to demonstrate the powers and uses of electricity in domestic, manufacturing, and commercial directions. Among the special exhibitors are the General Post Office and the Marconi Company. The Institution of Electrical Engineers is taking an interest in the exhibition on the educational side; and a series of popular scientific lectures and demonstrations has been arranged upon wireless telegraphy, electric motor developments, domestic lighting, telegraphy, telephones, and other subjects.

IN NATURE of July 13 (p. 244) there appeared a letter by Mr. Rotch, director of the Blue Hill Meteorological Observatory, U.S.A., describing the Franco-American expedition for the exploration of the atmosphere in the tropics which was sailing on M. Teisserenc de Bort's steam yacht *Otaria*. During a two months' cruise, the scientific members of the expedition, Messrs. Maurice, of Trappes Observatory, and Clayton, of Blue Hill, executed thirty-two soundings with balloons and kites, and made observations on two tropical peaks, all between latitudes 9° and 37° N. and longitudes 16° and 31° W. A southerly or south-westerly return trade was found at a height of about two miles in the tropics and an easterly wind in the equatorial regions, confirming the generally accepted theory of atmospheric circulation. While the detailed observations are to be published in a special volume by Messrs. Teisserenc de Bort and Rotch, the general results of the investigation will, it is hoped, be embodied in an article which will appear in the columns of NATURE.

THE first congress of the International Surgical Society was held from September 18–22 at the Palais des Académies in Brussels under the patronage of King Leopold. A correspondent of the *Times* says that more than two hundred delegates attended, representing the following countries:—Great Britain, France, Germany, Austria-Hungary, the United States, Belgium, Holland, Switzerland, Japan, Russia, Spain, Portugal, Sweden, Norway, Italy, Denmark, Greece, Finland, Rumania, Servia, and Egypt. The subjects discussed were of a purely technical order, and papers were read on the latest development of surgical science. An interesting feature of the congress was an exhibition of the latest surgical appliances. The delegates received a cordial welcome from the Government and municipal authorities and from their local colleagues. The last meeting of the congress was held on Saturday, September 23. During the session a congratulatory telegram was sent in the name of the society to Lord Lister on the great progress of surgery directly resulting from his antiseptic discoveries. It was resolved that the second congress should also be held in Brussels in 1908. Prof. V. Czerny, professor of surgery in the University of Heidelberg, was appointed president, and the various national committees were also nominated.

THE *Victorian Naturalist* announces the death of Mr. H. T. Tisdall, formerly president of the Field Naturalists' Club of Victoria, and an active botanical teacher and investigator. In September, 1883, he contributed his first paper to the club, the title being "A Botanical Excursion in North Gippsland." Having to a great extent exhausted the phanerogams of the district, he was induced by Baron von Mueller to turn his attention to the cryptogams, with the result that he became an authority on fungi, and at the meeting of the club in February, 1885, contributed a paper entitled "The Fungi of Mt. Baw Baw," in which he described some twelve species of the genus Agaricus. In November of the same year he contributed a further paper on the fungi of North Gippsland, in which he made some important remarks regarding the fungus then known as *Mylitta australis*, "Native Bread." During the interval of nearly twenty-one years between his first and last papers, he contributed numerous papers to the meetings of the club, all relating more or less to botany, either as bearing on a particular branch or descriptive of trips or excursions in search of specimens. In addition to his knowledge of Victorian phanerogamic and cryptogamic plants, Mr. Tisdall was, at the time of his death, an authority on marine algæ. He contributed an article on the flora of Walhalla to the mining department's report on that goldfield (1902), as also some useful papers to the meetings of the Australasian Association for the Advancement of Science, which included a list of the marine algæ of Victoria.

IN *l'Anthropologie* (xvi., No. 3) M. Boule gives a more detailed account of the machine-made eoliths referred to in his paper in the *Comptes rendus*, translated in NATURE of August 31 (p. 438). From the descriptions and illustrations, it appears that among the specimens collected

FIG. 1.

FIG. 2.

by M. Boule in a few minutes from the great pile of refuse flints are all the forms regarded as characteristic of eoliths. In particular, we find the bulb of percussion present in more than one example; one of these, shown in Fig. 1, is remarkable for what would, in an artificial

FIG. 3.

flint, be called "beauty of work" on one of the edges (Fig. 2); others, of which Fig. 3 is a good example, show the notch, which, like the bulb of percussion, is commonly regarded as a criterion of human workmanship. From the researches of M. Boule, it seems that the eolith should no longer be cited in proof of human antiquity greater than can be assumed on other grounds. Eolithic forms may be due to human agency, but independent proof of the contemporary existence of man in the area in question is henceforth indispensable.

THE latest issue (vol. viii., part i.) of the *Transactions of the Norfolk and Norwich Naturalists' Society* contains a number of interesting papers, mostly dealing with the natural history and antiquities of the county. The papers on local biology include one on the water-beetles of the "Broads" by Mr. F. B. Browne, another on the hydrachnids of the same district by Mr. C. D. Soar, notes on the Yarmouth herring-fishery of last year by Mr. T. J. Wigg, lists of Norfolk lichens and liverworts by the Rev. E. N. Bloomfield, and an account of the rotifers of the county by the Rev. R. Freeman.

WE have received from Dr. E. M. Goeldi, director of the museum at Parà, a budget of separate copies of papers by himself, published, with the exception of one, in the *Comptes rendus* of the sixth zoological congress held at Berne last summer. The one exception is from the *Ibis* for April, and deals with the habits of a Brazilian tyrant-bird (*Myiopatis semifusca*); this species, in place of being insectivorous, feeding on the fruits of a parasitic plant and disseminating the seeds, thus causing harm to arboriculture. The other papers relate to rare animals from Amazonia, the yellow-fever mosquito (*Stegomyia fasciata*), and the habits of ants of the genus Atta.

WE have received two new parts of the reports of the scientific results of the voyage of the *Belgica*, 1897–9, issued at Antwerp, in one of which Prof. H. Leboucq discusses the development of the flippers of Antarctic seals from the point of view of the evolution of the pinnipeds in general, while in the second Mesdames Bommer and Rousseau describe the funguses collected during the cruise, all of which, with the exception of a single Antarctic specimen, were obtained from Tierra del Fuego. Judging from the collection, the fungus-fauna of the latter area appears to be a rich one of which but little is at present known. Prof. Leboucq's article is the first of a series on the "organogenie" of the seals. In the case of both memoirs we may direct attention to the difficulty they present to recorders of biological literature, or, for that matter, to anyone who desires to quote from them. They are respectively headed "Zoologie" and "Botanique," but, despite the fact that they are not the first issues of those two series, each is separately paged, and neither bears any volume number. Consequently the whole title has to be quoted for reference purposes.

ACCORDING to the report for the year ending in May last, the Rhodesia Scientific Association, now in the seventh year of its existence, continues to make satisfactory progress, both as regards the length of its roll of members and in the work accomplished. With the report we have received a copy of the fourth volume (1903–4) of the association's Proceedings, which contains a number of papers dealing with the biology and antiquities of the country, together with one on its soils. The latter do not appear to be so promising as might have been hoped, most of them possessing only a moderate degree of fertility, and none exhibiting that redundant growing capacity we are accustomed to associate with virgin lands. Perhaps the most generally interesting paper is one on a new gladiolus which grows in the spray of the Victoria Falls, and has therefore been called the "Maid of the Mist." Four bulbs were sent to England, where by aid of constant syringing they were induced to bloom in a hothouse, when it was found that the petals are so arranged as to form a kind of penthouse for the protection of the central organs from the constant shower-bath existing in the "rain-forest."

AN important issue of the *Palaeontologia Indica* (*Mem. Geol. Survey of India*) is devoted to the description of some recently discovered vegetable and vertebrate remains from the permo-Carboniferous strata of the Vihi Valley, fifteen miles to the south-east of the city of Srinagar, Kashmir. The remains in question were discovered by Noetling in beds apparently underlying the marine Kuling series (Permian) of the Kashmir Valley; and as they include a member of the "glossopteris flora" of the Lower Gondwana system of peninsular India, their discovery serves to confirm the reference of these deposits to the Upper Palæozoic. The plant remains, which are described by Mr. A. C. Seward, include only one generically determinable type, namely, Gangamopteris, from the base of the lower Gondwanas of the peninsula. The vertebrates, for the identification of which Dr. A. S. Woodward is responsible, include a couple of species of the palæoniscid ganoid genus Amblypterus, nearly allied to Lower Permian from Rhenish Prussia, and fragments of a labyrinthodont amphibian apparently referable to Archegosaurus, a genus known elsewhere only from the last mentioned and equivalent formations. No reference is made to the labyrinthodont from the Lower Gondwanas of the peninsula described as Gondwanosaurus, but originally referred to Archegosaurus.

IN the third part of his contribution to the study of the mischievous insects commonly known as leaf-hoppers and their enemies, published at Honolulu as part iii. of the first Bulletin of the Experiment Station of the Hawaiian Sugar-Planters' Association, Mr. R. C. L. Perkins furnishes some very interesting information with regard to the life-history of the parasitic Stylopidæ (Strepsiptera). It appears that although the majority of those degraded beetles infest bees and wasps, a certain number of species are parasitic on leaf-hoppers and other Homoptera, and it is the latter that form the subject of the communication before us. Although death usually follows some time after being "stylopised," many leaf-hoppers are able to procreate their kind after being badly affected by the parasites, especially if by females. The male stylopids, on account of the larger size of the puparia, are, however, much more speedily fatal to the leaf-hoppers, the hole left in the bodies of the latter by the escaping insect being relatively large. Moreover, a fungus immediately makes its appearance, with fatal effect, in the tube; and in artificially infecting leaf-hoppers with stylopids it is considered of the highest importance that the fungus should also be introduced.

THE report on economic zoology contributed by Prof. Theobald, of Wye Agricultural College, to the college journal for the year 1904–5 deals chiefly with the insect pests of field and garden crops, and on this important subject gives a great deal of useful information. During the year Prof. Theobald dealt with about 1200 communications, and his report contains descriptions of the most troublesome pests brought to his notice. Among the pests of fruit trees, the apple aphides *Aphis pomi*, *A. sorbi*, and *A. fitchii* were much the most destructive. Prof. Theobald points out that these forms have been wrongly described as a single species, *A. mali*, by previous English writers. The aphides do great damage to young shoots, leaves, and blossoms, but it is apparently hopeless to attempt to get rid of them by spraying in the usual way in spring. The only practical remedy, especially where the first two species are concerned, is to spray in autumn, and a heavy paraffin emulsion is recommended, as injury to the leaves is not a serious matter at this season. The work is troublesome but effectual. In many cases it may be possible to collect and burn affected leaves in autumn, and this is recommended. Prunings should also be burnt before March. In the same report Prof. Theobald mentions a case in which honey-comb was destroyed by the maggots of the window fly (*Rhyphus fenestralis*). The window fly is a very common insect, but has never before been reported as an enemy of the bee, and the case is mentioned as showing how a harmless insect may suddenly change its habits and become a pest.

Two recent botanical parts, Nos. 9 and 11, of vol. xii. of the *Proceedings of the American Academy of Arts and Sciences* deal with systematic work. In the one number Mr. B. L. Robertson collates some American Eupatorieæ, and Mr. J. M. Greenman presents a list of new flowering plants from Mexico and the south-western United States. In addition to the new species, Mr. Greenman proposes two new genera, Lozanella, near to Trema, of the order Ulmaceæ, and Mimophytum, a borraginaceous genus allied to Omphalodes and Cynoglossum. The other part contains the sixth and last of the preliminary diagnoses by Prof. R. Thaxter on new species of Laboulbeniaceæ, a specialised group of minute ascomycetous fungi which live parasitically on insects.

SEVERAL points of interest are noted in a phytogeographical sketch by Dr. L. Cockayne of the vegetation of the two Open Bay islands, which lie close to the shore of South Westland, a county in the southern island of New Zealand. Characteristic liane formations occur on both islands; on the larger northerly island the dominant liane is a screw-pine, *Freycinetia Banksii*, and in some parts, *Muehlenbeckia adpressa*, of the order Polyonaceæ, is associated with it or takes its place; on the smaller island the Freycinetia is absent, and the Muehlenbeckia forms pure scrub or grows with a large-leaved variety of *Veronica elliptica*. The account appears in the *Transactions of the New Zealand Institute* (vol. xxxvii.), as also a list of newly-recorded habitats for New Zealand plants by the same writer. The identification of a Carex from Chatham Island, as a variety otherwise only recorded from Patagonia, adds another to the list of plants which connects the floras of New Zealand and South America.

AT the age of four score years, Dr. v. Neumayer has the satisfaction of issuing the third edition of his "Anleitung zu wissenschaftlichen Beobachtungen auf Reisen." It is appearing in parts (Jaennecke, Hanover) at a price of 36 marks, and will comprise two volumes, the first dealing with geography and inanimate nature, the second with plants, animals, and man. More than thirty experts are collaborating under Dr. v. Neumayer's editorship, so that each subject will be treated by an expert. The first two parts have already appeared, and contain articles on geographical observations, directions for somatological observations, an anthropological questionnaire, which seems to be identical with that issued by the Berlin Museum for Africa, and, finally, the commencement of an excellent article by Dr. v. Luschan on field work in archæology. No provision seems to be made for an article on a traveller's outfit or general hints; but it would not materially increase the size of the book to do so, and probably its general usefulness would be much increased by the addition. The last edition appeared in 1888, and in many branches of knowledge the advance since that date has been immense. It is therefore a matter for congratulation that Dr. v. Neumayer has been able to supervise the re-issue and gather around him so many able coadjutors.

A COMMISSION has been appointed by the Lieutenant-Governor of the Transvaal to consider the question of the safety of persons travelling in shafts. It will inquire into the structure, material, preservation, and examination of winding ropes and the adaptability of safety catches.

MESSRS. PERCIVAL, MARSHALL AND CO. have published a useful little guide to standard screw threads and twist drills by Mr. George Gentry. Tables are given of the Whitworth standard thread, the British Association standard, bicycle screw threads, the V standard thread, the United States standard thread, the international metric standard thread, watch and clock screws, and twist drills. The guide, which is published at 6*d*. net, is specially designed to meet the needs of the model engineer, and shows in a striking manner the necessity for the general adoption of standard threads as advocated in an article recently published in NATURE (August 31).

THE current issue of the *Bulletin de la Société d'Encouragement* contains an important memoir by a Swedish engineer, Mr. Hjalmar Braune, on the influence of nitrogen on iron and steel. That metalloid exerts an influence more harmful even than that of phosphorus, and appears to be the chief cause of the fragility of mild steel. Its presence in iron is not due to the direct combination of the metal with the nitrogen of the air; the intervention of basic slag is necessary. Metal made by the Thomas and Gilchrist process contains more nitrogen than steel made by the acid process, and this explains the inferiority generally ascribed to the former material.

THE annual report on the mineral resources of the United States for 1903 has been issued under the able editorship of Dr. David T. Day. It forms a bulky volume of 1204 pages, and contains, in addition to statistics of production, a large amount of descriptive and technical matter. In 1903, for the fourth time, the total value of the United States mineral production exceeded 200,000,000*l*., iron and coal being the most important of the mineral products. The United States in 1903 were the greatest producers of iron, coal, copper, lead, petroleum, and salt in the world. Tin, it is interesting to note, has been found in commercial quantities in South Carolina, and the mines were actively worked in 1903. The manufacture of arsenious acid, a new industry in the United States, is carried on at Everett, Washington. The production of gypsum continues to show a remarkable increase, owing, doubtless, to the use of plaster of Paris in large modern buildings. There was, too, a notable increase in the production of the ores of nickel, cobalt, chromium, tungsten, molybdenum, vanadium, titanium, and uranium owing to their use for steel-hardening purposes. A great advance in the lapidary industry is also reported. The fact that larger establishments have been formed, which are able to purchase the rough diamonds in greater quantities, has placed the American diamond-cutters in a position equal to that held by those of Amsterdam, Antwerp, and Paris. The cutting of American gems has also assumed large proportions, notably in the cases of the beryls and amethysts of North Carolina and Connecticut, and of the turquoises, sapphires, tourmalines, chrysoprases, and garnets of other States.

THE Department of Agriculture and Technical Instruction for Ireland is publishing a series of Bulletins upon experimental science, and No. 4 of this series, relating to "Voltaic Electricity," has just been issued. It has been prepared by Mr. James Comerton, and is a useful little pamphlet of thirty pages with numerous illustrations. The author states in the introduction that the experiments described are merely intended to introduce the student to the more systematic study of electrical measurements. When the student has worked through the forty-three experiments described in this pamphlet, it is hoped that he will have a fair general working knowledge of voltaic electricity—its generation, measurements, and the purposes to which it can be applied. Primary cells, resistances, galvanometers, and voltameters are illustrated, and their use is described in these pages. The handbook should prove a useful addition to the literature of elementary electrical measurements.

THE principal centres of the calcium carbide industry in France are in the Alps and Pyrenees. At present, according to a writer in the *Journal of the Society of Arts*, there are eleven manufactories capable of producing 40,000 tons of calcium carbide annually. The total output sold during 1904 may be estimated at 18,000 tons. The average yield of gas per unit of weight of carbide is about 40 gallons per pound. The cost price per ton of calcium carbide in Europe was estimated by Prof. Lefevre, of the École des Sciences, Nantes, in 1897, at from 8*l*. to 10*l*. M. Pictet, however, in the same year, thought that the product might be made at the cost of a little more than 3*l*., by the use of a new furnace. Theoretically, said Prof. Lefevre, one pound of calcium carbide ought to produce, by its action upon water, about seven ounces of acetylene. It has been stated by one of the most important of the French firms, speaking of the production of 1904, that this was disposed of at 8*l*. per ton, the standard accepted and declared being about 40 gallons of gas per pound. The product at the factory realises 8*l*. per ton, and the rate for the retail dealer is 14*l*. These figures demonstrate the advances made in manufacturing since the publication of Prof. Lefevre's treatise in 1897.

PROF. D'ARSONVAL describes in the Bulletin of the French Physical Society a new and simple form of apparatus manufactured by the Société Française de l'Acétylène dissous, which serves for the generation and automatic compression of oxygen. The gas is generated by the combustion within the compression cylinder of a combustible substance mixed with potassium chlorate, the heat produced being sufficient to liberate the whole of the oxygen from the chlorate. The largest form of apparatus, the industrial type, gives a production of about 60 cubic feet of oxygen per hour. A new form of oxyacetylene burner is also described by means of which a very intense light is produced by allowing the jet to impinge upon a suitable mixture of the rare earths; lime and magnesia are useless for the purpose, as they are rapidly fused and channelled by the intense heat of the oxyacetylene flame.

DURING the past few years doubts have been expressed by several investigators, notably by Fitzgerald, Kahlenberg, Quincke, and Traube, of the correctness of Van 't Hoff's hypothesis that the osmotic pressure of solutions is purely a kinetic phenomenon due to the impact of the molecules of the solute against a membrane impermeable to them. This hypothesis has been so fertile of results and is so intimately associated with the progress of modern chemistry that any arguments of a subversive tendency have, generally speaking, received little attention. In a recent number of the *Atti dei Lincei* (vol. xiv., ii., p. 5) Prof. A. Battelli and A. Stefanini have brought forward, however, a number of facts which, if subsequently verified, are likely to prove insuperable objections to its validity. A necessary consequence of Van 't Hoff's hypothesis is that isosmotic solutions should, under similar conditions, be equimolecular; but it is stated that several cases have been observed in which solutions possessing very different molecular concentrations are in osmotic equilibrium. The characteristic of these solutions is that they have equal surface tensions, and it is contended that osmotic pressure is essentially a capillary phenomenon. Osmosis would then be a tendency to equalise the surface tensions of the liquids on the two sides of the membrane. The further developments of the authors' experiments will be watched with interest.

AN interesting lecture device for illustrating the superposition of simple harmonic motions of different periods has been submitted to us by Mr. W. C. Baker, of the School of Mining, Queen's University, Kingston, Ontario. A horizontal bar (about 4 cm. deep and 15 cm. long) carries a pointer about 50 cm. long rigidly attached to it. This system, which must be as light as possible, is suspended by two hinges which permit it to oscillate freely about a horizontal axis. To the underside of the bar are attached two pendulums (100 cm. and 75 cm. long) the bobs of which are of equal mass, say 250 grams each. If the pendulums be displaced together through an arc of, say, 15° and then released, the pointer will be set vibrating through an arc which will vary from a maximum when the pendulums are in phase with one another to very approximately zero when they are in opposition, thus illustrating the formation of beats. There is, of course, no obvious relation between the amplitude of the motion of the pointer and that of the pendulums; the oscillations of the latter give rise to periodic forces upon the horizontal bar, and the pointer indicates the resulting motion. We may point out that a somewhat analogous device was shown by Lord Rayleigh during a recent course of lectures at the Royal Institution.

Le Radium for August contains various articles and reviews on all the branches of radio-activity, together with a summary of current researches in this subject.

THE *Revue Scientifique* (September 9) contains an interesting summary on trypanosomes and trypanosomiasis by Dr. Brumpt. In addition to the ordinary pathogenic forms, the trypanosomes of birds, reptiles, and fishes receive notice.

ACCORDING to *La Nature* (September 16), the ravages of the phylloxera in northern Spain are very serious, many of the older vineyards being almost destroyed; and it is becoming a question whether it will not be necessary to substitute cereals and fruit for the vine in the affected districts.

THE *Bulletin of the Johns Hopkins Hospital* for September (xvi., No. 174) contains an interesting historical article on Cotton Mather's rules of health by Prof. William Thayer, together with papers of medical interest. Cotton Mather was a divine who was born in Boston in 1663, a learned man with a remarkable literary style, and his rules are often very quaint.

IN the August number of the *Journal of the Royal Microscopical Society*, Mr. Conrady writes on the application of the undulatory theory to optical problems, and notes are contributed by Mr. Nelson on the presence of a flagellum at each end of the tubercle bacillus, by Lord Rayleigh on an optical paradox, and by Dr. Lazarus Barlow on a new form of hot stage. The usual summary of current researches concludes this excellent quarterly.

MESSRS. CHARLES GRIFFIN AND CO., LTD., have published a sixth edition of Mr. Andrew Jamieson's "Elementary Manual of Magnetism and Electricity." Several additions have been made in this new edition.

A KEY to the exercises in the second part of Mr. Pendlebury's "New School Arithmetic" has been prepared by the author and published by Messrs. George Bell and Sons. The price of the "Key" is 8s. 6*d*. net.

MESSRS. SMITH, ELDER AND CO. have published a sixth edition of Marshall and Hurst's "Junior Course of Practical Zoology." The new edition has been revised throughout by Dr. F. W. Gamble, who has also added short accounts of Monocystis, Coccidium, and Obelia.

THE following popular science lectures will be given at the Royal Victoria Hall, Waterloo Bridge Road, S.E., during next month:—October 3, "A Journey of Surprises: through Yunnan to Tonquin," Mrs. Archibald Little; October 10, "Smokeless Explosives," Mr. J. S. S. Brame; October 17, "The Plants of Other Days: what their Fruits and Seeds were Like," Mr. H. E. H. Smedley; October 24, "My Cruise Around Spain and Portugal," Mr. F. W. Gill.

MESSRS. PHILIP HARRIS AND CO., LTD., Birmingham, have just issued the third edition of their valuable catalogue of scientific instruments required in all departments of instruction or research in physics. The volume contains five hundred pages and is lavishly illustrated, a large number of the pictures representing new instruments or new methods of illustrating the principles of physical science. Many manuals and text-books of physics used in schools have been consulted, and novel forms of apparatus described in them are now made by Messrs. Harris, and appear in the present catalogue. The volume is well bound, and should be very useful for reference by teachers of physics in schools and colleges. No doubt it will find a permanent place on the bookshelves of many laboratories and lecture-rooms.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN OCTOBER:—

Oct.	1.	8h. 52m. Minimum of Algol (β Persei).
,,	4.	5h. 41m. ,, ,, ,,
,,	8.	9h. Mars in conjunction with Uranus (Mars 1° 48′ S.).
,,	11.	Saturn. Major axis of ring $=42''\cdot28$, Minor axis $=8''\cdot46$.
,,	14.	15h. Mars in conjunction with λ Sagittarii (mag. 2·9), Mars 0° 7′ N.
,,	15.	Venus. Illuminated portion of disc $=0\cdot868$, of Mars $=0\cdot861$.
,,	19–22.	Epoch of October meteoric shower (Radiant 92° + 15°).
,,	20.	6h. 51m. to 8h. 12m. Transit of Jupiter's Sat. III. (Ganymede).
,,	21.	10h. 35m. Minimum of Algol (β Persei).
,,	23.	18h. 24m. to 19h. 30m. Moon occults ρ Leonis (mag. 3·8).
,,	24.	7h. 23m. Minimum of Algol (β Persei).
,,	27.	10h. 15m. to 11h. 35m. Transit of Jupiter's Sat. III. (Ganymede).
,,	31.	Uranus in conjunction with ι Sagittarii (mag. 5·3).

NOVA AQUILÆ.—Further news concerning Nova Aquilæ No. 2 is published in No. 4047 of the *Astronomische Nachrichten*. It appears that Mrs. Fleming discovered the existence of the Nova whilst examining the Draper memorial photographs on August 31. A photograph of the spectrum, taken on August 18, shows the hydrogen lines $H\delta$, $H\gamma$, and $H\beta$ bright and broad, also faint traces of the bright bands at λ 4472 and λ 4646. On that date the magnitude of the Nova was about 6·5, on August 21 it was 7·5, whilst on August 26 it had fallen to 10.0. No trace of the Nova is visible on a plate taken on August 10, although stars of magnitude 9·5 are shown thereon. A plate taken with the Bruce telescope at Arequipa on August 15, with an exposure of four hours, contains images of sixteenth-magnitude stars, but not of any object which can be recognised as the Nova.

A chart of the region, published by Prof. Wolf, shows the position of the Nova in regard to the star B.D. $-4°.4663$, and further shows that the Nova occupies a position between two spaces which are void of stars down to the fifteenth magnitude.

EPHEMERIS OF THE VARIABLE ASTEROID (167) URDA.—In No. 4047 of the *Astronomische Nachrichten* Herr A. Berberich publishes an ephemeris for the asteroid Urda, which Dr. Palisa recently showed to be variable.

The following is an extract from this ephemeris, which was calculated from the elements published in the "Jahrbuch" and for 12h. M.T. Berlin:—

1905	α (h. m. s.)	δ (° ′)	log r	log Δ
Sept. 28 ...	22 13 18 ...	−10 48·5		
Oct. 2 ...	22 11 46 ...	−11 0·3 ...	0·4463 ...	0·2875
,, 6 ...	22 10 36 ...	−11 9·9		
,, 10 ...	22 9 49 ...	−11 17·2 ...	0·4467 ...	0·3044

Observations made on August 31 and September 5 gave corrections to the above of +4s. and $+0'\cdot8$.

The following figures indicate the changes of magnitude which were observed during the period July 30–September 5:—

Date	July 30	Aug. 31	Sept. 5
Magnitude	13·0 ...	11.0 ...	12·0

THE ULTRA-VIOLET CHROMOSPHERIC SPECTRUM.—At the total eclipse of 1900 M. H. Deslandres devoted his attention to two special researches, of which the first was to obtain the ultra-violet spectrum of the "reversing layer," and the second to obtain a great number of plates showing the bright lines, in order to detect the changes which might take place in the chromosphere in the interval between the second and third contacts.

In the first research he was successful, and obtained a duplicate series of plates showing the bright spectrum between λ 3000 and λ 5000. The first series was obtained with a prismatic camera of 1 metre focal length, the second with a camera of half this focal length. The prisms employed were of 60° angle, and were made of Iceland spar, whilst the objectives were made up of an achromatic combination of quartz and fluorspar.

The general results obtained from the reduction of one of the larger negatives, which was exposed for two seconds at second contact, are given in No. 9 (August 28) of the *Comptes rendus*, and deal only with the 157 lines photographed between λ 3400 and λ 3066. The chief characteristic of the spectrum in this region, as in the less refrangible region already known, is the predominance of "enhanced" titanium lines. In fact, M. Deslandres states that, considered as a whole, the spectrum is that of the titanium spark. Vanadium and chromium are represented by lines of less intensity, whilst the iron lines are extremely weak, the enhanced lines being considered in each case.

The coronal radiations are represented on two other negatives by well defined lines at $\lambda\lambda$ 3329.6, 3388.0, and 3447.7, the last having the greatest intensity. The same negatives, which were exposed for fifteen and thirty seconds respectively, show several prominences, and here, again, the spectrum of titanium predominates.

The "chronophotographe," an instrument for photographing from six to ten spectra per second at the two contacts, was less successful, the vibration produced by its manipulation spoiling the definition. M. Deslandres gives the details of the instrument, and points out its probable efficiency if suitably mounted.

THE FORMATION OF ICE AND THE GRAINED STRUCTURE OF GLACIERS.[1]

IN the following pages I have the honour to lay before the Royal Society the results of a lengthy research on the formation of ice and the grained structure of glaciers, which may serve as a complement to the previous investigations on the same subject published in the *Philosophical Transactions* and *Proceedings of the Royal Society* by Forbes, Tyndall and Huxley, Tyndall, Faraday, T. Graham, J. F. Main, J. C. McConnel, and D. A. Kidd, and elsewhere by Guyot, Agassiz, James Thomson, and Sir William Thomson (now Lord Kelvin), Hermann and Adolf Schlagintweit, Person, Leydolt, Rüdorff, Bertin, Grad, and A. Dupré, Moseley, A. Heim, J. T. Bottomley, K. R. Koch and Klocke, Forel, Ed. Hagenbach-Bischoff, E. von Drygalski, Mügge, H. Hess, and others.

(1) It will be convenient at the outset to define the precise meaning with which it is proposed to employ certain words, some of which are in vague popular use, while others are less familiar, or new.

By an *oily* liquid will be meant one which has surface tension in the common surface with other liquids with which it may be in contact. According to this definition a solution of any salt will, in comparison with pure water or a weaker salt solution, be called, in certain circumstances, an oily liquid.

An *emulsion* is a watery liquid containing suspended drops of oily liquid, or drops of any sort enclosed in an oily skin. These drops can coalesce into larger drops, or the oily skins can join on to one another, and form a continuous mass of bubbles, or foam. Thus *foam* consists of portions of watery liquid enclosed in, and separated from one another by adjacent partitions of oily liquid. Each space thus enclosed will be called a *foam-cell*, and the enclosing partition the foam-wall. If the foam-cells are very small, and the fluid foam-walls very thin (or invisible), the whole is then a *liquid jelly*. The jelly is stiff, the foam stiff or solid, when the walls or the contents of the foam-cells, or both, have become solid.

"*Nearly pure*" applied to water or ice will be used in the special sense of "containing only very small amounts of any salt." *Salt* itself is used throughout in the general chemical sense, that is, not restricted to sodium chloride.

(2) I have allowed pure water, and water containing dissolved salt, to freeze in the dark at various rates, and to melt away slowly in the dark, in open air, and in sunlight. The ice prisms employed were from 1 mm. to 1000 mm. thick, and as the thawing proceeded their various layers were systematically examined—sometimes for days together—with the naked eye, with the microscope, and with polarised light. The same appearances presented themselves in the same order as those which for thirty-seven years past I have investigated and described in solutions of silicic acid, glue, or other colloids, when these are evaporated to form gelatinous masses or thin films, and develop fissures. I have shown that thin viscous oily films of more concentrated solution exist in a less concentrated solution of the same substance, and form folds, straight and twisted tubes, cylinders or cones, spheres and bubbles, open and closed foam-cells with visible and invisible foam-walls. Thin solid films behave like films of very viscous liquid. Whether the oily films form tubes or bubbles and foam-cells joining on to one another depends on the viscosity of the oily liquid. The mutual inclination of the foam-walls, and their surface tensions, continually change as the concentration of the oily liquid changes, and in the case of invisible foam-walls may depend also on the thickness of the oily film. When the oily film is very thin, its surface tension diminishes with diminishing thickness of the film. Oily foam-walls that are formed against solid surfaces are normal to these surfaces. If three oily foam-walls meet in a common edge at equal angles of 120°, they have equal surface tensions.

The foam-cells of a liquid jelly immersed in water can increase or diminish in volume by the diffusion of water through the foam-wall inwards or outwards, *i.e.* the liquid jelly can *swell* or *shrink*. Two clots of liquid jelly can coalesce into one, which does not occur with clots of solid jelly, nor can these latter swell or shrink.

A liquid jelly becomes for the time being positively or negatively doubly refracting when the viscous walls, or the viscous contents of the foam-cells, are expanded or compressed. A jelly remains permanently doubly refracting when the walls or the contents of the foam-chambers solidify while in an expanded condition.

(3) Now, ice is a liquid jelly, with foam-walls of concentrated "oily" salt solution, which enclose foam-cells containing viscous, doubly refracting, pure or nearly pure water.

(4) The further the temperature falls below 0°, the greater is the viscosity of both liquids—in the walls and in the interior of the foam-cells—and the less the plasticity of the ice.

(5) At very low temperatures, the ice breaks with conchoidal fracture at the surface of the invisible spherical foam-walls, which as the whole cools have contracted differently from their contents.

(6) The "glacier grains" are foam-cells filled with pure or nearly pure ice, and separated from one another by visible or invisible walls of oily salt solution.

(7) The union of two pieces of ice under water ("regelation"), and the increase in size of the glacier grains as they approach the lower end of the glacier, correspond to the running together of two gelatinous clots (of silicic acid, or glue) containing liquid foam-cells and liquid cell-contents. At the same time the oily foam-walls between the glacier grains become thicker, and then get thinner again through the draining away of the liquid salt solution at the foot of the glacier.

(8) All water, even the purest, contains traces of salt. As the water cools, ice crystals and oily mother liquor separate at short intervals, or periodically. Under the influence of the surface tension, the oily salt solution forms invisible foam-walls, the surface-tension of which decreases as the thickness of the walls and the concentration of the salt solution diminish. Otherwise, as the cooling proceeds, the salt solution becomes continually more concentrated, and the wall thinner. Finally, the concentrated salt solution also freezes to ice and solid salt. The value of the surface tension determines the angles at which three walls meet in a common edge. If three foam-walls meet at equal angles of 120°, the three walls have equal surface tensions, whereas an inclination of 90° means that fluid foam-walls have been formed in contact with old and already solidified ones.

(9) When water containing air freezes, the air, like the salts dissolved in the water, separates out at short intervals, or periodically. The white places in ice, which are those containing these air bubbles, are also the richest in salt.

(10) As water containing salt, but free from air, cools, the periodical separation of ice and salt gives rise, alike in sea ice, in artificial ice, and in glacier ice, to layers of ice containing varying amounts of salt. By pressure or by absorption of radiation (sunlight, electric light, or daylight), the parts of the ice which are rich in salt melt sooner than pure ice.

(11) In sunlight or electric light furrows are formed at the places rich in salt on the surface of sea ice, artificial ice, and glacier ice. (Forel's stripes; Forbes's "dirt bands"; foam-walls of the great foam-cells of the Kjendal Glacier.)

(12) The salt solution formed in sea ice, artificial ice, or glacier ice, through pressure or sunshine, shows, by the hollows which it fills, the forms assumed under the influence of the surface tension by the boundary between the oily salt solution and the water, just before the freezing of the water. As the ice melts, it contracts. Thus in sea ice pressure or absorption of heat radiation causes the formation, in horizontal layers parallel to the frozen surface, of Tyndall's liquefaction figures, vacuous bubbles, ice flowers, and "fir trees" with branches meeting at 120° and 90°, just like those obtained when colloid solutions are evaporated to dryness, or when salt solutions are allowed to crystallise.

In the case of artificial ice which has been frozen in deep prismatic troughs, these liquefaction figures are formed in the diagonal and median planes of the ice block, which were the last parts to freeze, and where the mother liquor had accumulated.

[1] By Prof. G. Quincke, For.Mem.R.S. Paper received at the Royal Society on June 19.

(13) Sea ice and artificial ice break up in sunlight into little hexagonal prisms of clear ice. These suffer mutual displacement the less easily, the thinner are the fine foam-walls (which have now melted again, and which, when the freezing took place, were formed out of oily salt solution, normal to the surface), and the less salt the water contained before freezing.

The purer the water was, the larger are these hexagonal prisms or foam-cells.

(14) The capillary fissures in transparent glacier ice are these fine foam-walls of oily salt solution.

(15) When water containing little salt freezes in deep metal troughs surrounded with strongly cooled brine, the oily salt solution separates in thin layers normal to the surface, and forms bubbles, foam-cells clinging to one another, or—when the oily liquid at low temperatures is very viscous—folds or hollow pipes, which are filled with pure or nearly pure ice, or with air if such were present in the water. The artificial ice is seen to be traversed by many horizontal tubes, normal to the surface, which are specially numerous in the diagonal and median planes of the ice block, where the mother liquor had accumulated. The less salt is contained in the ice, the more transparent are these diagonal and median planes of the artificial ice block.

Illumination with sunlight or daylight causes the appearance of fresh tubes. The ice becomes more cloudy, and subsequently more transparent again.

(16) When water containing air freezes in deep metal troughs, the upper part of the ice block shows horizontal layers consisting alternately of transparent pure ice and of opaque salt-containing ice with numerous air bubbles. The more salt the water contains, the more numerous and the closer are the opaque layers. In sunlight these opaque layers melt more easily than the transparent ones, and furrows are formed on the surface of the opaque ice.

(17) If the ice is allowed to thaw again in a warm room, or is exposed to radiation (daylight), the parts rich in salt melt sooner than those which contain little salt. The tubes of oily salt solution bulge and coil up, and then break up with contraction of volume into spherical bubbles, which may be vacuous or filled with air. The foam-cells exhibit shapes like those of colloids and jellies as they swell or shrink, or those tree-like and branched formations which I have described in the case of the "liquid precipitates" of metallic silicates and cyanides. If the capillary fissures in this opaque ice are filled with very viscous salt solution, or if the oily salt solution forms no continuous foam-cells, it cannot run away. The ice remains white, as glacier ice actually does.

(18) When an ice block thaws under the long-continued action of daylight, there appear, in the diagonal and median planes of the block, bright bands and cloudy bands, which change their shape and position as the duration and intensity of the radiation alter. This is due to the formation of new foam-walls of oily salt solution and the disappearance of old ones. The angles between the foam-walls are also seen to change, which means that the surface tension of these walls is changing. Now as the amount of salt in the diagonal planes increases, and the absorbed radiation diminishes, towards the interior of the ice, and as further the surface tension and viscosity alter with changing concentration and temperature, it follows that the shapes assumed by the oily layers in the interior of the ice under the influence of the surface tension also undergo change.

(19) After thirty to thirty-six hours, the block of artificial ice had melted in the warm room to half its original height (1 metre), and at the foot and warmer places had given way in a pasty mass. In the upper portion, foam-walls had formed in the pure ice, inclined 120° to one another. In these, as in the median layer that had thawed away, melting salt solution ran down for hours. At the warmer places, and at the thin uppermost crust, glacier grains were formed. These were foam-cells, 5 mm. to 10 mm. wide, filled with doubly refracting ice, and separated from one another by singly refracting foam-walls of transparent salt solution. At the junctions of the foam-walls there often lay tetrahedra, bounded by spherical surfaces and filled with transparent liquid.

(20) In the diagonal and median planes of a block of artificial ice (1 metre high) containing a certain very small amount of salt, and exposed to a certain intensity of radiation, there can be formed horizontal closed tubes of pure or nearly pure ice, having rounded heads and sides bulging at places, and filled with liquid salt solution. They slowly swell, slowly break up into separate bubbles, and then slowly pass away. They are first formed low down, at places of high pressure, and afterwards higher up, at places of low pressure.

(21) When distilled water, free from air, was frozen in iron troughs, it was found at a certain temperature or with a certain concentration of the salt solution and the oily foam-wall that the walls and contents of the closed tubes in the lower part of the median plane were for some time coloured yellow. Subsequently this colour disappeared. It was not present when the water was frozen in brass troughs. I believe it was due to ferric oxide, which was differently soluble in the walls and in the liquid inside the foam-cells, and at a higher temperature became insoluble and sank to the bottom.

(22) The phenomena of melting ice depend both on the velocity of freezing and the velocity of thawing. The more rapidly the water freezes, the more numerous are the foam-walls, and the smaller the foam-cells.

(23) Very dilute solutions of different salts, when slowly frozen under similar conditions, give oily layers of varying viscosity and surface tension, or spheres, bubbles, tubes, and foam-walls of varying form. I have shown this with freshly boiled water containing 0·000003 per cent. of NaCl, or equivalent quantities of KCl, K_2CO_3, Na_2SO_4, $CaCl_2$, $MgCl_2$, $Al_2(SO_4)_3$. The water was frozen in prismatic troughs of brass or tin.

(24) During the freezing of water containing 0·0015 per cent. of Na_2SO_4, and also containing air, the air separated at the same time as the mother liquor. The bounding surface between air and almost solidified, very viscous liquid, tends to become as small as possible, and rolls up together to form hollow cylinders, the radii of which are the smaller the more quickly the ice has frozen. The water freezes the more slowly the further it is from the strongly cooled (below 0°) side of the trough. The thin layers forming the walls of the tubes are normal to the solid surface of the side of the trough, or of the transparent mantle of ice which encloses the mother liquor. They frequently form cylindrical or conical tubes, 6 mm. to 12 mm. long, with a whitish skin, and filled with air. Their axes are normal to the surface, and their pointed ends are directed towards the outer side of the ice mantle. At the base of the tubes, which may be 0·5 mm. to 2 mm. wide, there hangs a whitish hollow sphere inside the mother liquor.

(25) On slowly freezing water containing from 0·00014 per cent. to 0·0014 per cent. of Na_2SO_4, or 0·003 per cent. of NaCl, it happens at times that the mother liquor, which is surrounded by a transparent mantle of ice, contains numerous flat crystalline plates of pure ice. These, by their shape, position, and inclination to one another, clearly show that they have been formed from thin oily foam-walls of pure water, which, as the cooling proceeded, have separated from the watery salt solution, and then solidified.

(26) When a test tube, containing boiling distilled water, is plunged into liquid air, the water freezes very quickly to a milky-white mass of ice, with fissures normal to the surface of the glass. If the test-tube with the white ice—the whole being now cooled down to −190°—is plunged into distilled water, it becomes coated on the outside with a thin crust of ice, which can be detached with a knife, and examined in a watch-glass under the polarising microscope. It consists of small glacier grains or foam-cells (0·1 mm. to 0·2 mm. in diameter) the flat walls of which are normal to the cylindrical surface, and are inclined to one another at angles of 120°, 110°, and so on. The interior of each foam-cell contains a crystal of ice, which in the different cells is differently orientated. When the ice in the test-tube is crushed with a steel point, it exhibits a fibrous fracture, with fine fibres normal to the cylindrical surface. Occasionally in the cross-section are seen concentric cylinders composed alternately of transparent and of white ice. The latent heat of the slowly freezing water diminishes the loss of heat, and the velocity of cooling changes. The ice in the transparent layers was frozen

slowly, that in the opaque ones quickly. As this ice thaws in a watch-glass under the polarising microscope, the lumps of quickly frozen white ice exhibit immense numbers of strings—arranged radially alongside one another—of spheres and lenticular masses, 0·01 mm. to 0·02 mm. in thickness, consisting of very nearly pure water. In each sphere there was a vacuous bubble 0·0006 mm. in diameter.

(27) Slowly frozen water showed, on thawing, similar strings of (liquid) spheres and lenticular masses (of larger size, viz. 0·04 mm. to 0·12 mm. diameter), normal to the surface of the block of ice. These spheres and lens-shaped masses had been formed out of solid or hollow cylinders, or long thin cones with local swellings or bulgings. Frequently lens-shaped masses bounded by two spherical surfaces lay in a thin, flat, spiral or warped foam-wall.

(28) The fibres and cylindrical or conical tubes, like the tubes filled with air, were formed out of thin layers of very viscous, oily liquid, which, as the cooling proceeded, separated out, normal to the surface, and under the influence of the surface tension rolled up, being unable, by reason of excessive viscosity, to form spheres or bubbles.

(29) When the thawing has gone on for a long time, fewer foam-walls and larger foam-cells, or glacier grains, appear in the lumps of ice. The strings of liquid spheres, normal to the surface, show an increase in the size of the spheres, caused by the coalescence of the small spheres in the doubly refracting mass of ice into larger ones. An increased amount of salt in the ice assists this coalescence. The tubes or strings of spheres could often be followed continuously through several glacier grains. The partition walls of the glacier grains, when illuminated, often show hundreds of small lens-shaped masses of the same or gradually diminishing size.

(30) By repeated fractional freezing and melting of the ice crystals formed, continually purer and purer ice is obtained, with increasingly large foam-cells or glacier grains. I have, however, not yet succeeded, even by repeated slow freezing, in obtaining ice free from foam-walls or from glacier grains.

(31) A block of transparent ice was cut through, as described by Bottomley, with a loaded wire loop. The loop was of steel wire, or of platinum wire previously heated to redness, and carried 2 kilograms or more. In no case was the plane of section transparent, but always opaque from the presence of solidified foam bubbles of oily salt solution, possessing refracting power different from that of their surroundings.

(32) Each separate glacier grain in artificial ice contains a differently orientated crystal of ice, the optic axis of which is very seldom normal to the surface of the ice. When in natural sea ice the optic axes of the separate crystals in the different grains are found to be normal or parallel to the free surface of the water, the separation of orientated crystals of ice may have been started by the contact-action of ice crystals or snow flakes falling on the surface of the super-cooled water, and swimming thereon in a horizontal position.

(33) The more slowly artificial ice has frozen, and the less salt it contains, the more transparent, rigid, and difficult to cut with a knife it is.

(34) Every block of artificial ice cleaves, on pressure with a steel point, along the diagonal and median planes, in which, as the ice crystals separated out on freezing, the mother liquor became more concentrated through holding the traces of salt dissolved in a continually diminishing volume of liquid.

(35) The planes of easiest cleavage in natural ice crystals (laminated structure, displacement without bending) are due to invisible layers of liquid salt solution which are embedded in the crystals, normal to the optic axis, or often in other positions.

(36) Ice crystals at temperatures below 0° consist of doubly refracting viscous liquid, and are intermediate between the soft crystals of serum albumen and ordinary crystals of quartz, felspar, &c.

(37) At the edge of Tyndall's liquefaction figures, while they are in process of enlarging, or on the bursting of the foam-walls of artificial ice as it melts, one often sees periodic vortex movements. These arise from a periodic capillary spreading out ("Ausbreitung") of the salt solution of the foam-walls at the boundary between pure water and air or vacuum.

(38) Tyndall and Huxley observed in white glacier ice transparent lenticular masses bounded by spherical surfaces. These were foam bubbles of water free from air, which were enclosed in a thin skin of oily salt solution and had solidified while embedded in such a skin.

(39) The blue bands in glacier ice consist of pure ice, while the white bands are composed of ice containing salt and air bubbles. They are formed by the periodical action of solar radiation and by changing pressure, or by the slow descent of the portions rich in salt, or by the slow ascent of air bubbles in the viscous liquid of the glacier ice.

(40) The ice of the snow flakes which fall on the upper part of the glacier becomes fertilised with inorganic salts derived from disintegrated rocks, and is, as it were, hatched out by the sun's rays, forming "névé" or "firn" snow and glacier grains, or foam-cells filled with ice in the glacier proper. The glacier ice travels on, rolling (or "wallowing") slowly downwards as a living river of ice. Its skeleton of liquid salt solution changes the while, and forms new and larger foam-cells, which, at the lower end of the glacier, perish, disappear, and flow away as the water of the glacier stream.

THE BRITISH ASSOCIATION.

SECTION L.

EDUCATIONAL SCIENCE.

OPENING ADDRESS BY SIR RICHARD C. JEBB, LITT.D., D.C.L., M.P., PRESIDENT OF THE SECTION.

University Education and National Life.

EVERY country has educational problems of its own, intimately dependent on its social and economic conditions. The progressive study of education tends, indeed, towards a certain amount of general agreement on principles. But the crucial difficulties in framing and administering educational measures are very largely difficulties of detail; since an educational system, if it is to be workable, must be more or less accurately adjusted to all the complex circumstances of a given community. As one of those who are now visiting South Africa for the first time, I feel that what I bring with me from England is an interest in education, and some acquaintance with certain phases of it in the United Kingdom; but with regard to the inner nature of the educational questions which are now before this country, I am here to learn from those who can speak with knowledge. In this respect the British Association is doing for me very much what a famous bequest does for those young men whom it sends to Oxford; I am, in fact, a sort of Rhodes scholar from the other end—not subject, happily, to an age limit—who will find here a delightful and instructive opportunity of enlarging his outlook on the world, and more particularly on the field of education.

As usage prescribes that the work of this Section, as of others, should be opened by an Address from the Chair, I have ventured to take a subject suggested by one of the most striking phenomena of our time—the growing importance of that part which Universities seem destined to play in the life of nations.

Among the developments of British intellectual life which marked the Victorian age, none was more remarkable, and none is more important to-day, than the rapid extension of a demand for University education, and the great increase in the number of institutions which supply it. In the year 1832 Oxford and Cambridge were the only Universities south of the Tweed, and their position was then far from satisfactory. Their range of studies was too narrow; their social operation was too limited. Then, by successive reforms, the quality of their teaching was improved, and its scope greatly enlarged; their doors were opened to classes of the community against which they had formerly been closed. But meanwhile the growing desire for higher education—a result of the gradual improvement in elementary and secondary training—was creating new institutions of various kinds. The earliest of these arose while access to Oxford and Cambridge was still restricted. The University of Durham was established in 1833. In 1836 the University of London, as an examining and degree-giving body, received its first charter. A series of important Colleges, giving education of a University type, arose in the greater towns of England and Wales. The next step was the formation of federal Universities. The Victoria University, in which the Colleges of Manchester, Liverpool and Leeds were associated, received its charter in 1880. The Colleges of Aberystwyth, Bangor, and Cardiff were federated in the University of Wales, which dates from 1893. The latest development has been the institution of the great urban Universities. The foundation of the University of Birmingham hastened an event which other causes had already prepared. The federal Victoria University has been replaced by three independent Universities, those of Manchester, Liverpool and Leeds. Lastly, a charter has recently been granted to the University of Sheffield. Then the University of London has been re-constituted; it is no longer only an Examining Board; it is also a teaching University, comprising a number of recognised schools in and around London. Thus in England and Wales there are now no fewer than ten teaching Universities. Among the newer institutions there are some varieties of type. But, so far as the new Universities in great cities are concerned, it may be said that they are predominantly scientific, and also that they devote special attention to the needs of practical life, professional, industrial and commercial; while at the same time they desire to maintain a high standard of general education. It may be observed that in some points these Universities have taken hints from the four ancient Universities of Scotland—which themselves have lately undergone a process of temperate reform. The Scottish Universities are accessible to every class of the community; and the success with which they have helped to mould the intellectual life of a people traditionally zealous for education renders their example instructive for the younger institutions. With reference to the provision made by the newer Universities for studies bearing on practical life, it should be remarked that much has been done in the same direction by the two older Universities also. At Cambridge, for example, degrees can be taken in Economics and associated branches of Political Science; in Mechanism and Applied Mechanics; and in Agricultural Sciences. It certainly cannot now be said that the old Universities neglect studies which are of direct utility, though they rightly insist that the basis and method of such studies shall be liberal.

In looking back on the general course of this whole movement in England, we find that it has been steady, smooth, and fairly rapid. It has not been due to any spasmodic impulse or artificial propaganda, but has been the result of natural forces operating throughout the nation. Universities, and the training which they give, have come to count for more in our national life as a whole. It should be noted in passing that the missionary movement known as University Extension did not arise in the first instance from spontaneous academic action, but was a response to public appeals from without. It had its origin in memorials addressed to the University of Cambridge, in 1872, by various public bodies; and it was in compliance with those memorials that, in the winter of 1873, the first courses of Extension lectures were organised in the Midlands. Another fact of vital significance in the movement is that it has included ample provision for the higher education of women.

With reference to the present position and prospects of the higher education in South Africa, I tried, before leaving England, to acquaint myself with at least the outlines of the general situation; but it is only with great diffidence that I shall offer a few observations bearing on some of the broader aspects of the question. I trust to be heard with indulgence by those from whom I shall hope to learn more. At any rate, I can truly say that the question seems to me one of the deepest interest and of the gravest importance. Indeed, it does not require much insight or imagination to apprehend the greatness of the issues that are involved.

In the first place, it would be correct, if I am not mistaken, to say that in South Africa at large there is a genuine and a keen desire for efficient education of the highest type. A sound liberal education is desired for all who can profit by it, whatever their future callings are to be. But the practical and immediate need for the organising of the highest teaching is felt, I believe, more particularly in regard to three great professions—the profession of Engineering, in all its branches; the profession of Agriculture (including Forestry); and the profession of Education itself, on which the intellectual future of South Africa must so largely and directly depend. That the interest in the higher instruction is so real must be regarded as the best tribute to the efforts of those able and devoted men who, in various parts of this land, have laboured with dauntless perseverance for the improvement of primary and secondary education. Unstinted gratitude is due also to the University of the Cape of Good Hope. It is acknowledged on all hands that the University, as the chief guardian of learning in South Africa, has done admirable work in maintaining a high standard of general education. Certainly it cannot be regarded as any disparagement of that work if, as seems to be the case, a widespread desire exists that South Africa should possess an institution, or institutions, of University rank, which, besides examining, should also teach. That is a natural progress, which is illustrated by the recent re-constitution of the London University itself. I am not qualified, nor should I desire, to discuss the various difficulties of detail which surround the question of a teaching University. That question is, for South Africa, an eminently practical one; and doubtless it will be solved, possibly at no distant time, by those who are most competent to deal with it. I will only venture to say a few words on some of the more general aspects of the matter.

The primary needs of daily life in a new country make demands for certain forms of higher training—demands which may be unable to wait for the development of anything so complex and costly as a teaching University. It is necessary to provide a training for men who shall be able to supervise the building of houses, the making of roads, bridges, and railways, and to direct skilled labour in various useful arts and handicrafts. The first step in such a provision is to establish technical schools and institutes. Germany is, I suppose, the country where the educational possibilities of the technical school are realised in the amplest measure. In Germany the results of the highest education are systematically brought to bear on all the greater industries. But this highest education is not given only in completely equipped Universities which confer degrees. It is largely given in the institutions known as Technical High Schools. In these schools teaching of a University standard is given, by professors of University rank, in subjects such as Architecture, various branches of Engineering, Chemistry, and General Technical Science. There are, I think, some ten or eleven of these Technical High Schools in Germany. In these institutions the teaching of the special art or science, on its theoretical side, is carried, I believe, to a point as high as could be attained in a University; while on the practical side it is carried beyond the point which in a University would usually be possible. In England we have nothing, I believe, which properly corresponds to the German Technical High School; but we may expect to see some of the functions of such a school included among the functions of the new Universities in our great industrial and commercial towns.

Now Technical Schools or Institutes, which do not reach the level of a German Technical High School, may nevertheless be so planned as to be capable of being further developed as parts of a great teaching University. And the point which I now wish to note is this—that the higher education given in a Technical Institute, which is only such, will not be quite the same as that given in the corresponding department of a teaching University. University education, as such, when it is efficient, has certain characteristics which differentiate it from the training of a specialist, however high the level of the teaching in the special subject may be. Here, however, I pause for a moment to guard against a possible misconception. I am not suggesting that the specialist training given in a technical institute, though limited, is not an excellent thing in itself; or that, in certain conditions and circumstances, it is not desirable to have such a training, attested by a diploma or certificate, instead of aiming at a University standard and a University degree. Universities themselves recognise this fact. They reserve their degrees for those who have had a University training; but they also grant diplomas for proficiency in certain special branches of knowledge. Cambridge, for instance, gives a diploma in the Science and Practice of Agriculture; and the examinations for the diploma are open to persons who are not members of the University.

But the University training, whatever its subject, ought to give something which the purely specialist training does not give. What do we understand by a University education? What are its distinctive characteristics? The word *Universitas*, as you know, is merely a general term for a corporation, specially applied in the Middle Ages to a body of persons associated for purposes of study, who, by becoming a corporation, acquired certain immunities and privileges. Though a particular University might be strongest in a particular faculty, as Bologna was in Law and Paris in Theology, yet it is a traditional attribute of such a body that several different branches of higher study shall be represented in it. It is among the distinctive advantages of a University that it brings together in one place students—by whom I mean teachers as well as learners—of various subjects. By doing this the University tends to produce a general breadth of intellectual interests and sympathies; it enables the specialist to acquire some sense of the relations between his own pursuit and other pursuits; he is helped to perceive the largeness of knowledge. But, besides bringing together students of various subjects, it is the business of a University to see that each subject shall be studied in such a manner as to afford some general discipline of the mental faculties. In his book on "The Idea of a University" Newman says:—

"This process of training, by which the intellect, instead of being formed or sacrificed to some particular or accidental purpose, some specific trade or profession, or study or science, is disciplined for its own sake, for the perception of its own proper object, and for its own highest culture, is called Liberal Education; and though there is no one in whom it is carried as far as is conceivable, or whose intellect would be a pattern of what intellects should be made, yet there is scarcely anyone but may gain an idea of what real training is, and at least look towards it, and make its true scope and result, not something else, his standard of excellence; and numbers there are who may submit themselves to it and secure it to themselves in good measure. And to set forth the right standard, and to train according to it, and to help forward all students towards it according to their various capacities, this I conceive to be the business of a University."

It may be granted that the function of a University, as Newman here describes it, is not always realised; Universities, like other human institutions, have their failures. But his words truly express the aim and tendency of the best University teaching. It belongs to the spirit of such teaching that it should nourish and sustain ideals; and a University can do nothing better for its sons than that; a vision of the ideal can guard monotony of work from becoming monotony of life. But there is yet another element of University training which must not be left out of account; it is, indeed, among the most vital of all. I mean that informal education which young men give to each other. Many of us, probably, in looking back on our undergraduate days, could say that the society of our contemporaries was not the least powerful of the educational influences which we experienced. The social life of the Colleges at Oxford and Cambridge is a most essential part of the training received there. In considering the questions of the higher education in South Africa it is well to remember that the social intercourse of young students, under conditions such as a great residential University might provide, is an instrument of education which nothing else can replace. And it might be added that such social intercourse is also an excellent thing for the teachers.

The highest education, when it bears its proper fruit, gives not knowledge only, but mental culture. A man may be learned, and yet deficient in culture; that fact is implied by the word "pedantry." "Culture," said Huxley, "certainly means something quite different from learning or technical skill. It implies the possession of an ideal, and the habit of critically estimating the value of things by a theoretic standard." "It is the love of knowledge," says Henry Sidgwick, "the ardour of scientific curiosity, driving us continually to absorb new facts and ideas, to make them our own, and fit them into the living and growing system of our thought; and the trained faculty of doing this, the alert and supple intelligence exercised and continually developed in doing this—it is in these that culture essentially lies." And if this is what culture really means, evidently it cannot be regarded as something superfine—as an intellectual luxury suited only for people who can lead lives of elegant leisure. Education consists in organising the resources of the human being; it seeks to give him powers which shall fit him for his social and physical world. One mark of an uneducated person is that he is embarrassed by any situation to which he is not accustomed. The educated person is able to deal with circumstances in which he has never been placed before; he is so, because he has acquired general conceptions; his imagination, his judgment, his powers of intelligent sympathy have been developed. The mental culture which includes such attributes is of inestimable value in the practical work of life, and especially in work of a pioneer kind. It is precisely in a country which presents new problems, where novel difficulties of all sorts have to be faced, where social and political questions assume complex forms for which experience furnishes no exact parallels, it is precisely there that the largest and best gifts which the higher education can confer are most urgently demanded.

But how is culture, as distinct from mere knowledge, to be attained? The question arises as soon as we turn from the machinery of the higher education to consider its essence, and the general aims which it has in view. Culture cannot be secured by planning courses of study, nor can it be adequately tested by the most ingenious system of examinations. But it would be generally allowed that a University training, if it is really successful, ought to result in giving culture, over and above such knowledge as the student may acquire in his particular branch or branches of study. We all know what Matthew Arnold did, a generation ago, to interpret and diffuse in England his conception of culture. The charm, the humour, and also the earnestness of the essays in which he pleaded that cause render them permanently attractive in themselves, while at the same time they have the historical interest of marking a phase in the progress of English thought and feeling about education. For, indeed, whatever may be the criticisms to which Arnold's treatment of the subject is open in detail, he truly indicated a great national defect; and by leading a multitude of educated persons to realise it, he helped to prepare the way for better things. Dealing with England as it was in the 'sixties, he complained that the bulk of the well-to-do classes were devoid of mental culture—crude in their perceptions, insensible to beauty, and complacently impenetrable to ideas. If, during the last thirty or forty years, there has been a marked improvement, the popular influence of Matthew Arnold's writings may fairly be numbered among the contributory causes, though other and much more potent causes have also been at work. When we examine Arnold's own conception of culture, as expressed in successive essays, we find that it goes through a process of evolution. At first he means by "culture" a knowledge and love of the best literature, ancient and modern, and the influence on mind and manners which flows thence. Then his conception of culture becomes enlarged; it is now no longer solely or mainly æsthetic, but also intellectual; it includes receptivity of new ideas; it is even the passion for "seeing things as they really are." But there is yet a further development. True culture, in his final view, is not only æsthetic and intellectual; it is also moral and spiritual; its aim is, in his phrase, "the harmonious expansion of all the powers which make the beauty and worth of human nature." But whether the scope which Arnold, at a particular moment, assigned to culture was narrower or wider, the instrument of culture with which he was chiefly concerned was always literature. Culture requires us, he said, to know ourselves and the world; and, as a means to this end, we must "know the best that has been thought and said in the world." By literature, then—as he once said in reply to Huxley—he did not mean merely *belles lettres*; he included the books which record the great results of science. But he insisted mainly on the best poetry and the highest eloquence. In comparing science and literature as general instruments of education, Arnold observed that the power of intellect and knowledge is not the only one that goes to the building-up of human life; there is also the power of conduct and the power of beauty. Literature, he said, serves to bring knowledge into relation with our sense for conduct and our sense for beauty. The greater and more fruitful is the progress of science, the greater is the need for humane letters, to establish and maintain a harmony between the new knowledge and those profound, unchanging instincts of our nature.

It is not surprising that, in the last third of the nineteenth century, Arnold's fascinating advocacy of literature, as the paramount agency of culture, should have incurred some criticism from the standpoint of science and of philosophy. The general drift of this criticism was that the claim which he made for literature, though just in many respects, was carried too far; and also that his conception of intellectual culture was inadequate. As a representative of such criticism, I would take the eminent philosopher whose own definition of culture has already been cited, Henry Sidgwick: for no one, I think, could put more incisively the particular point with which we are here concerned. "Matthew Arnold's method of seeking truth," says Sidgwick, "is a survival from a pre-scientific age. He is a man of letters pure and simple; and often seems quite serenely unconscious of the intellectual limitations of his type." The critic proceeds to enumerate some things which, as he affirms, are "quite alien to the habitual thought of a mere man of letters." They are such as these: "How the crude matter of common experience is reduced to the order and system which constitutes it an object of scientific knowledge; how the precisest possible conceptions are applied in the exact apprehension and analysis of facts, and how by facts thus established and analysed the conceptions in their turn are gradually rectified; how the laws of Nature are ascertained by the combined processes of induction and deduction, provisional assumption and careful verification; how a general hypothesis is used to guide inquiry, and, after due comparison with ascertained particulars, becomes an accepted theory; and how a theory, receiving further confirmation, takes its place finally as an organic part of a vast, living, ever-growing system of knowledge." Sidgwick's conclusion is as follows: "Intellectual culture, at the end of the nineteenth century, must include as its most essential element a scientific habit of mind; and a scientific habit of mind can only be acquired by the methodical study of some part at least of what the human race has come scientifically to know."

There is nothing in that statement to which exception need be taken by the firmest believer in the value of literary education. The more serious and methodical studies of literature demand, in some measure, a scientific habit of mind, in the largest sense of that expression; such a habit is necessary, for instance, in the study of history, in the scientific study of language, and in the "higher criticism." Nor, again, does anyone question that the studies of the natural sciences are instruments of intellectual culture of the highest order. The powers of observation and of reasoning are thereby disciplined in manifold ways; and the scientific habit of mind so formed is in itself an education. To define and describe the modes in which that discipline operates on the mind is a task for the man of science; it could not, of course, be attempted by anyone whose own training has been wholly literary. But there is one fact which may be noted by any intelligent observer. Many of our most eminent teachers of science, and more especially of science in its technical applications, insist on a demand which, in the province of science, is analogous to a demand made in the province of literary study by those who wish such study to be a true instrument of culture. As the latter desire that literature should be a means of educating the student's intelligence and sympathies, so the teachers of science, whether pure or applied, insist on the necessity of cultivating the scientific imagination, of developing a power of initiative in the learner, and of drawing out his inventive faculties. They urge that, in the interests of the technical industries themselves, the great need is for a training which shall be more than technical—which shall be thoroughly scientific. Wherever scientific and technical education attains its highest forms in institutions of University rank, the aim is not merely to form skilled craftsmen, but to produce men who can contribute to the advance of their respective sciences and arts, men who can originate and invent. There is a vast world-competition in scientific progress, on which industrial and commercial progress must ultimately depend; and it is of national importance for every country that it should have men who are not merely expert in things already known, but who can take their places in the forefront of the onward march.

But meanwhile the claims of literary culture, as part of the general higher education, must not be neglected or undervalued. It may be that, in the pre-scientific age, those claims were occasionally stated in a somewhat exaggerated or one-sided manner. But it remains as true as ever that literary studies form an indispensable element of a really liberal education. And the educational value of good literature is all the greater in our day, because the progress of knowledge more and more enforces early specialisation. Good literature tends to preserve the breadth and variety of intellectual interests. It also tends to cultivate the sympathies; it exerts a humanising influence by the clear and beautiful expression of noble thoughts and sentiments; by the contemplation of great actions and great characters; by following the varied development of human life, not only as an evolution governed by certain laws, but also as a drama full of interests which intimately concern us. Moreover, as has well been said, if literature be viewed as one of the fine arts, it is found to be the most altruistic of them all, since it can educate a sensibility for other forms of beauty besides its own. The genius of a Ruskin can quicken our feeling for masterpieces of architecture, sculpture, and painting. Even a very limited study of literature, if it be only of the right quality, may provide permanent springs of refreshment for those whose principal studies and occupations are other than literary. We may recall here some weighty words written by one of the very greatest of modern men of science. "If I had to live my life again," said Charles Darwin, "I would have made it a rule to read some poetry and listen to some music at least once every week. . . . The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature." The same lesson is enforced by John Stuart Mill, in that remarkable passage of his Autobiography where he describes how, while still a youth, he became aware of a serious defect, a great lacuna, in that severe intellectual training which, for him, had commenced in childhood. It was a training from which the influences of imaginative literature had been rigidly excluded. He turned to that literature for mental relief, and found what he wanted in the poetry of Wordsworth. "I had now learned by experience"—this is his comment—"that the passive susceptibilities needed to be cultivated as well as the active capacities, and required to be nourished and enriched as well as guided." Nor is it merely to the happiness and mental well-being of the individual that literature can minister. By rendering his intelligence more flexible, by deepening his humanity, by increasing his power of comprehending others, by fostering worthy ideals, it will add something to his capacity for cooperating with his fellows in every station of life and in every phase of action; it will make him a better citizen, and not only a more sympathetic but also a more efficient member of society.

One of the urgent problems of the higher education in our day is how to secure an adequate measure of literary culture to those students whose primary concern is with scientific and technical pursuits. Some of the younger English Universities, which give degrees in Science, contribute to this purpose by providing certain options in the Science curriculum; that is, a given number of scientific subjects being prescribed for study with a view to the degree of B.Sc., the candidate is allowed to substitute for one of these a subject taken from the Arts curriculum, such, for instance, as the Theory and Practice of Education. This is the case in the University of Wales and in the University of Birmingham; and there are indications, I believe, that this example will be followed elsewhere. Considering how hard and sustained is the work exacted from students of science, pure or applied, it seems important that the subjects from which they are to derive their literary culture should be presented to them, not in a dryasdust fashion, not chiefly as subjects of examination, but rather as sources of recreation and changes of mental activity. From this point of view, for British students of science the best literature of the English language offers unequalled advantages. It may be mentioned that the Board of Education in London is giving particular attention to the place which English literature should hold in the examination of students at the Training Colleges, and has under consideration carefully planned courses of study, in which portions of the best English writers of prose and of verse are prescribed to be read in connection with corresponding periods of English history, it being understood that the study of the literature shall be directed, not to philological or grammatical detail, but to the substance and meaning of the books, and to the leading characteristics of each writer's style. If, on the other hand, the student is to derive his literary culture, wholly or in part, from a foreign literature, ancient or modern, then it will be most desirable that, before leaving school, he should have surmounted the initial difficulties of grammar, and should have learned to read the foreign language with tolerable ease.

When we look at this problem—how to combine the scientific and the literary elements of culture—in the light of existing or prospective conditions in South Africa, it appears natural to suppose that, in a teaching University, the Faculty of Education would be that with which literary studies would be more particularly connected. And if students of practical sciences, such as Engineering and Agriculture, were brought together at the same centre where the Faculty of Education had its seat, then it should not be difficult, without unduly trenching on the time demanded by scientific or technical studies, to provide such students with facilities for some measure of good literary training.

A further subject is necessarily suggested by that with which we have been dealing—I mean the relation of University to Secondary Education; but on that I can only touch very briefly. Before University Education can be widely efficient, it is indispensable that Secondary Education should be fairly well developed and organised. Secondary Education should be intelligent—liberal in spirit—not too much trammelled by the somewhat mechanical uniformity apt to result from working for external examinations, but sufficiently elastic to allow for different aptitudes in the pupils, and to afford scope for the free initiative of able teachers. It is a gain for the continuity of education when a school-leaving examination can be accepted as giving admission to the University. Such an examination must be conducted under the authority of the University; but there is much to be said in favour of the view that, under proper safeguards, the school-teachers should have a part in the examination; always provided that the ultimate control, and the decision in all cases of doubt, shall rest with the University. A system of school-leaving examinations for this country was earnestly advocated, I believe, by Mr. P. A. Barnett, who has achieved such excellent work for the cause of education in Natal. To discuss the advantages or difficulties of such a proposal, as they at present affect South Africa, would demand knowledge which I do not possess; and I must content myself with the expression of a hope that in days to come—perhaps in a not distant future—it may be found practicable to form such a link between the highest education and the grade next below it.

But the limit of time proper for a Chairman's address has now almost been reached. I thank you sincerely for the kindness and patience with which you have heard me. In conclusion, I would only say how entirely I share a conviction which has been expressed by one to whose ability, to whose generous enthusiasm and unflagging efforts the cause of education in this country owes an incalculable debt—I refer to Mr. E. B. Sargant. Like him, I believe that the progress of education in all its grades, from the lowest to the highest, is the agency which, more surely than any other, will conduce to the prosperity and the unity of South Africa. For all workers in that great cause it must be an inspiring thought that they are engaged in promoting the most fundamental and the most far-reaching of national interests. They are endeavouring to secure that the men and women to whom the future of this country belongs shall be equal to their responsibilities and worthy of their inheritance. In that endeavour the sympathies which they carry with them are world-wide. As we come to see, more and more clearly, that the highest education is not only a national but an Imperial concern, there is a growing desire for interchange of counsels and for active cooperation between the educational institutions of the Colonies and those of the Mother Country. The development of education in South Africa will command keen attention, and will be followed by earnest good wishes, not only in England but throughout the British dominions. One of the ideas which are bound up with the history and the traditions of our English public schools and Universities is the idea of efficient work for the State. Those institutions have been largely moulded, from generation to generation, by the aim of ensuring a supply of men qualified to bear a worthy part, either in the government of the nation, or in professional activities which are indispensable to the national welfare. In our own time, and more especially within the last thirty years, one particular aspect of that idea is illustrated by the closer connections which have been formed between the Universities and the higher branches of the Civil Service. The conception of work for the commonweal is in its turn inseparable from loyalty to those ideals of character and conduct by which English life and public policy have been built up. It is by the long and gradual training which such ideals have given that our race has been fitted to grapple with responsibilities which have inevitably grown, both in extent and in complexity, far beyond anything of which our forefathers could have dreamed. That training tends also to national self-knowledge; it makes for a sober estimate of our national qualities and defects; it quickens a national sense of duty to our neighbour. The munificence of a far-sighted statesman has provided that selected youths, whose homes are in this land, and whose life-work may be here, shall go for a while to England, shall breathe the intellectual and social atmosphere of a great English University, and shall learn to judge for themselves of the sources from which the best English traditions have flowed. That is excellent. But it is also most desirable that those traditions should pass as living forces into the higher teaching of South Africa itself, and that their spirit should animate educational institutions the special forms of which have been moulded by local requirements. That, indeed, has been, and is, the fervent wish of men whose labours for South African education have already borne abundant fruit, and are destined to bear yet larger fruit in the future. May those labours prosper, and may that wish be fulfilled! The sooner will come the day when the inhabitants of this country, this country of vast and still indefinite possibilities, will be able to feel, in a sense higher and deeper than citizens of the Roman Empire could conceive, *Cuncti gens una sumus* ("We are all one people"). If the work which lies before us, in this Section of the British Association, should result in contributing anything towards the promotion of those great objects, by helping to elucidate the conditions of further progress, our deliberations will not have been held in vain.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Goldsmiths' College, New Cross, the gift of the Goldsmiths' Company to the University of London, will be opened to-morrow, September 29, by the Earl of Rosebery, K.G., K.T., F.R.S.

ON October 5 Prof. J. W. Judd, C.B., F.R.S., will distribute the medals, prizes, &c., gained by the students of the Royal College of Science. The distribution will take place in the lecture theatre of the Victoria and Albert Museum, South Kensington, at 4 p.m.

THE University of Wisconsin has established a course in chemical engineering. Besides the regular professorial instruction, arrangements have been made for occasional lectures by prominent engineers. The course, which covers four years, includes gas engineering and electrolytic work, as well as other branches of chemical practice.

CONSEQUENT upon the closing of Coopers Hill College, it has been decided that probationers for the Indian Forest Department will take their theoretical course at Oxford. The writer of an article in the *Indian Forester* (July) on the future training of the upper staff of the Indian Forest Department recognises several advantages in the change. But while approval is expressed with the nature of the theoretical course and the experience that will be gained at Oxford, it is pointed out that a practical course in India, as, for instance, at Dehra Dun, would afford greater scope and provide more useful training for the work that is required of Indian forest officers than sending candidates to study forestry practice on the Continent.

THE French and Prussian Governments have recently established a system under which a number of young masters in English secondary schools may be attached for a year to certain secondary schools in their respective countries. The authorities of the foreign Ministries of Public Instruction are most anxious to extend the scheme and to find similar opportunities in suitable English secondary schools for young graduates who will afterwards be employed in their State schools. In the opinion of the Board of Education, the proposal has much to recommend it, and, provided that proper care be exercised in the selection of the candidates and in the arrangements made for their work, it is thought that the presence of such teachers on the staff of a school would add materially to the effectiveness of the modern language teaching. Headmasters who are willing to cooperate and to employ such assistants are requested to communicate with the Director of Special Inquiries and Reports, Board of Education Library, St. Stephen's House, Cannon Row, Westminster, S.W.

THE following free public introductory lectures will be delivered at University College, London, during October. Sir William Ramsay, K.C.B., F.R.S., will lecture on some advances in chemistry; Prof. L. M. Brandin on 'la critique littéraire au xixe siècle"; Prof. L. W. Lyde on the teaching of geography to children; Prof. H. S. Foxwell on some aspects of competition in modern business; Prof. F. Mackarness on the origins of Roman Dutch law and its introduction into the British Empire; Prof. E. A. Gardner on architectural sculptures; and Sir John Macdonell on some present directions in legislation. In the department of chemistry of the college several courses of work have been arranged for the ensuing session, viz. Sir William Ramsay, K.C.B., F.R.S., will lecture on the inactive gases of the atmosphere, and on the physics and chemistry of colours; Mr. E. C. Baly will give a course of lectures on spectroscopy and spectrum photography; Mr. J. H. K. Inglis one on recent advances in inorganic chemistry; and Mr. N. T. M. Wilsmore one on electrochemistry. A laboratory course in experimental psychology, consisting of lectures and practical demonstrations, will be given by Mr. W. McDougall, and a course of about thirty lectures on advanced psychology will be delivered by Prof. G. Dawes Hicks. Six lectures, open to the public without payment or ticket, will be given during November by Mr. G. U. Yule on the vital statistics of England and Wales.

THE Marquis of Linlithgow, Secretary for Scotland and vice-president of the Committee of Council on Education in Scotland, is to open the Dunfermline College of Hygiene and Physical Training on Wednesday next, October 4. A correspondent writing to the *Times* says that the establishment of a college of hygiene may be described as an afterthought on the part of the Carnegie trust. When the palatial gymnasium and baths, given to his native city by Mr. Carnegie at a cost of about 40,000*l*., was approaching completion, it attracted the notice of the highest educational authorities in Scotland, who recognised the fitness of the building, with its splendid equipments, to supply what they considered a serious defect in the national provision for education, viz. the instruction of teachers in physical training. After careful consideration the Carnegie trustees, who have charge of the building, agreed to entertain the appeal of the experts to link the local benefaction, of which they are the administrators, with a national service which, while bringing additional distinction to the city, would ensure greater efficiency in the physical training supplied to the local schools. The lady superintendent of athletic instruction has been transformed into the principal of the physical training college, a residence for women students has been acquired, a medical officer has been appointed to devote his whole time to the work of the college, and a course of study has been marked out to extend over two years and to include hygiene, anatomy, physiology, educational and remedial gymnastics on the Swedish system, games, swimming, dancing, &c.

SIR DONALD CURRIE'S letter to the president of Queen's College, Belfast, offering a sum of money under certain conditions for the better equipment of the college was submitted at a private meeting of the executive committee of the college fund on September 22. It was unanimously resolved to convey to Sir Donald Currie the thanks of the committee for his proposal. It was also resolved that in view of the munificent offer of Sir Donald Currie, the committee earnestly appeal to all old students of the college and all who are interested in the promotion of education in Belfast and Ulster to assist in raising the required sum of 20,000*l*. before Christmas. The Rev. Dr. Hamilton, president of Queen's College, writing to the Belfast papers on September 23 in reference to Sir Donald Currie's offer of 20,000*l*., says that for some time Queen's College has been engaged in a strenuous effort to better its equipments, so as to bring them into line with the scientific and educational advances of our time and with its own growth and development in recent years. This enterprise was inaugurated four years ago, and, notwithstanding adverse circumstances, quickly attained a gratifying success. A sum of more than 30,000*l*. has been raised, by means of which most important additions have been made to the working power of the college. One laboratory has been built and equipped, and the foundation of a second will, it is hoped, be laid before many weeks have passed. If the college succeeds in satisfying the reasonable conditions which Sir Donald Currie lays down, the fund will be increased to 70,000*l*., and the college will be placed in a financial position such as it never before occupied.

AMONG the calendars and educational directories published during the past few days we notice those of the Northampton Institute at Clerkenwell, the Armstrong College at Newcastle-upon-Tyne, and the Plymouth Education Authority. At the Northampton Institute the following classes are worthy of mention, viz. the day and evening courses in mechanical and electrical engineering, in technical optics, and in horology. In addition to these there are evening courses in technical chemistry and in domestic economy. The Armstrong College was formerly known as the Durham College of Science. The college forms an important part of the University of the North of England, and the degrees of Durham in science and in letters, and its diplomas in engineering, are open to students of this Newcastle institution. It may be noticed that, in addition to the biological laboratories at the college, a marine biological laboratory has been opened at Cullercoats, and by the generosity of the Northumberland Sea Fisheries Committee is available for students. The agricultural department has been entrusted with the scientific direction of the farm acquired for the purpose of experiment and demonstration by the Northumberland County Council. The new calendar contains full information of all the courses of work arranged for the coming session. The Plymouth directory contains an excellent diagram showing in a graphic manner the arrangements made by the local education authority to coordinate the work in all Plymouth schools. The classes at the school of science and technology make it possible for any workman anxious to acquaint himself with the scientific principles of his calling to do so easily.

IN order to facilitate the adoption by secondary schools of systematic courses in geography, the Board of Education has issued a circular indicating in outline the points to which the attention of inspectors will be directed when inspecting classes in this subject. Each school desiring the approval of the Board for its course in geography should be prepared to submit a course providing, first, an outline scheme dealing with the great land and water areas in such a way that on completing the course the pupils shall have gone through the geography of the world; and, secondly, a suitably graded series of exercises connected with the subjects included in the course. The Board lays it down that the aim of the teaching should be to produce a vivid impression of connected facts through considerations, such as those of cause and effect, and the practical bearings of the facts selected. Referring to the exercises, the circular states that these may consist of (*a*) questions and answers designed to elicit, through causes and consequences, subject-matter for entry in the pupils' note-books; (*b*) notes and diagrams which should include worked-out problems together with original maps and plans; (*c*) mapping; and (*d*) field work, excursions, factory visits, &c. Suggestions for a four-year course in geography, together with an outline plan for preliminary instruction, are also given. The work suggested for the preliminary instruction as suitable for children from eight to twelve, and the statement of what these pupils should be expected to know before entering upon the four-years' course, presume a standard of attainment which the Board can scarcely expect to be realised at present. The knowledge of physiography, for instance, to be expected of these young people would be a credit to students several years older. As so few teachers of geography understand what is meant by the scientific study of their subject, it would have been an advantage if the instructions as to the practical work to be done could have been made more explicit. The circular refers to "worked-out problems," but it might with advantage have included a few typical examples of the problems required. The real difficulty will be to find teachers capable of acting in the spirit of the suggestions made by the Board; but it is something for them to have a method indicated which not only is sound in principle, but is being put into practice here and there. The circular is a decided step in advance, and brings nearer the time when scientific instruction in geography will be general in schools of all grades.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 8.—"The Pharmacology of Indaconitine and Bikhaconitine." By Dr. J. Theodore **Cash,** F.R.S., and Prof. Wyndham R. **Dunstan,** F.R.S.

The present paper deals with the physiological action of two new "aconitines," which have been isolated at the Imperial Institute from two varieties of Indian aconite. One is an alkaloid, which has been named indaconitine. It was found in the roots of the Indian aconite, called by Bruhl *Aconitum napellus*, var. *hians*, since identified by Stapf as a new species which has received the name of *Aconitum chasmanthum*. The other alkaloid has been named "bikhaconitine," being derived from one of the highly poisonous forms of aconite known in India under the vernacular name of "Bikh." This aconite was named by Bruhl *Aconitum ferox*, var. *spicatum*, but has been renamed *Aconitum spicatum* by Stapf, who regards it as a distinct species.

Results of experiments with these two substances are summarised as follows:—

The two aconitines, indaconitine and bikhaconitine, agree in their qualitative effects with the other alkaloids of this series, aconitine, japaconitine, and pseudaconitine, which have been dealt with in our previous papers.

The toxicity of indaconitine is less than that of bikhaconitine towards warm-blooded animals; in this respect the former stands very near to the aconitine of *A. napellus*, whilst the latter, being somewhat stronger than japaconitine, is to be referred to a position between this alkaloid and pseudaconitine from forms of *A. ferox*, which is much the most active of the series.

The depression of the respiratory function by indaconitine is less than that produced by bikhaconitine, and to this the greater toxicity of the latter is referable. Repeated doses of alkaloids administered at regular intervals and in similar fractional proportions of the lethal dose are followed by a more marked toxic effect when bikhaconitine is administered rather than indaconitine. Towards frogs the toxicity of the two alkaloids under discussion is practically equal; bikhaconitine is more active than indaconitine in reducing the respiratory activity. On the other hand, it is somewhat less active in abolishing the excitability of muscular and intramuscular motor nervous tissue (immersion experiments), and in reducing the ability of the muscle-nerve preparation poisoned *in situ* for the performance of work sufficient to cause fatigue. The local effect of the two aconitines when applied to the skin by inunction is equal and similar to that of the aconitines already considered.

Indaconitine and bikhaconitine may therefore be substituted for aconitine and pseudaconitine for internal use, indaconitine being administrable in the same dose as aconitine (from *A. napellus*) and bikhaconitine in proportion of 0·75 of the unit dose of the former, whilst for local application they may be used as constituents of ointments in similar proportions to aconitine.

Pseudaconine from Pseudaconitine and Bikhaconitine.

The action of these is, towards frogs, identical. Their toxicity appears to be practically equal and their effect generally similar to that of aconine (from aconitine). Their action is in the main curari-like in character.

"On the Physiological Activity of Substances Indirectly Related to Adrenalin." By H. D. **Dakin.** Communicated by Prof. E. H. Starling, F.R.S.

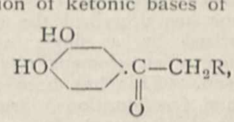
The following deductions are made provisionally, until further experimental evidence is available:—

(1) It appears that the catechol nucleus is essential for the production of physiologically active substances of the type of adrenalin.

(2) It is of importance that the hydrogen atoms of both hydroxyl groups in the catechol nucleus be unsubstituted.

(3) An alkyl group of low molecular weight (*e.g.* methyl, ethyl) attached to the nitrogen tends to produce a much more active substance than when an aromatic group is attached, whilst derivatives of piperidine, heptylamine, and benzylamine occupy an intermediate position.

(4) The reduction of ketonic bases of the type



where R is a simple aliphatic group, results in the production of bases with enormously increased physiological activity.

(5) In the substances examined there appears to be a connection between chemical instability and physiological activity, and *vice versâ*.

July 8.—"An Experimental Inquiry into the Nature of the Substance in Serum which influences Phagocytosis." By Dr. George **Dean.** Communicated by Prof. J. Rose Bradford, F.R.S.

The author's conclusions are as follows:—

(1) As has been shown by a number of workers, *e.g.* Denys, Metchnikoff, Savtschenko, Levaditi and others, there is produced in the blood serum of animals actively immunised by bacterial injections a specific immune substance which has among its properties that of preparing the microbe for phagocytosis.

(2) This immune substance is thermostable, resisting a temperature of 60° C. for several hours.

(3) In normal serum there is present a substance having a similar action and which also resists a temperature of 60° C. for hours, and may persist in the serum of the horse for years.

(4) The experiments recorded in this paper tend to confirm the idea that the substances are identical, *i.e.* that in normal serum there is present a small amount of the immune substance having the property of preparing the microbes for phagocytosis.

(5) Cocci fully occupied by the substance from heated immune serum when passed through fresh normal serum do not remove the substance from normal serum, whereas fresh cocci remove a large part of it.

(6) The converse of the above is also true, viz. that cocci fully occupied by the substance from normal serum do not remove the substance from immune serum, whereas fresh cocci do.

(7) The thermostable substance in normal serum is no doubt identical with the "fixateur" or "substance sensibilisatrice" of the French school and with Wright and Douglas's "opsonin."

Seeing that the terms "fixateur" and "substance sensibilisatrice" which have been employed by Metchnikoff's school to include the property of preparing the microbes for phagocytosis are used to designate a number of other properties of immune serum, it may be convenient to adopt Wright and Douglas's term of "opsonin" for the particular property in question. The only danger attached to such a course is that one might be led to regard the "opsonin" as actually a different substance, and not merely a property of immune serum.

PARIS.

Academy of Sciences, September 18.—M. Troost in the chair.—Preliminary note on the total eclipse of the sun of August 30 at Burgos: H. **Deslandres.** Details are given of the instruments set up and the observations attempted. Owing to clouds, the second and third contacts could not be observed. The corona was seen for a minute about the middle of totality. M. Fabry succeeded in making a photometric measurement of the total light of the corona, and an observation of the brightness of one of its points. M. Bernard also was successful in some photometric observations, and M. d'Azambuja in measurements of the heat spectrum of the corona. Details of the work will be published later.—Observation of the eclipse of August 30: H. **Andoyer.** The apparatus was installed at El-Arrouch, 32 kilometres from Philippeville, and the weather was very favourable. The object was to obtain as many direct photographs as possible. Forty-four were obtained, eleven during totality.—Observation of the solar eclipse of August 30 at Athens: D. **Eginitis.** The observations were made under good atmospheric conditions.—On the isolation of terbium: G. **Urbain.** In a preceding communication the author has described the separation of a rare earth characterised by a single absorption band $\lambda=488$, corresponding to an element named Zδ by M. Lecocq de Boisbaudran. This has been submitted to a long series of further fractionations, first as a double nitrate with nickel, and afterwards by precipitation with ammonia. The final product was 7 grams of an earth apparently homogeneous, for which the author proposes to reserve the name of terbium. The principal bands in the absorption spectrum are given, and the atomic weight, 159.2 (O=16).

NEW SOUTH WALES.

Linnean Society, July 26.—Mr. T. Steel, president, in the chair.—On dimorphism in the female of *Ischnura heterosticta*, Burm. (Neuroptera: Odonata): R. J. **Tillyard.** In February last, at Cook's River, about a dozen beautifully coloured examples of the pretty little dragon-fly, *Ischnura heterosticta*, Burm., which appeared to be males, were captured, together with half-a-dozen females of the ordinary dull blackish type. On examination it was found that, with the exception of three, all the supposed males were in reality a second form of female (form B) closely resembling the male. It is intermediate in shape between the male and the typical female (form A), the abdomen being thicker than in the male, but with the tip distinctly enlarged; while in colouring it almost exactly resembles the male, but bears not the slightest resemblance to the typical female. Both forms, however, possess the pale pterostigma on the forewing, whereas in the male this is black.—Notes on the older Tertiary foraminiferal rocks on the west coast of Santo, New Hebrides: F. **Chapman.** The examination of the oldest sedimentary rocks seen and collected by Mr. Mawson in the Island of Santo proves them to be of Miocene age (Aquitanian and Burdigalian). A point of particular interest brought out by the present investigations is the association of Lepidocyclina with the excentric forms of Miogypsina in the New Hebrides. From this it appears that faunas, distinct in the European area, were living together in the New Hebrides Miocene sea. A similar association of species occurs here as in the Miocene limestones of Christmas Island, and also of Madoura, and other parts of the Dutch East Indies, with which the New Hebrides marine area was most probably connected when these fossiliferous beach and shallow-water deposits were laid down.—On the occurrence of a bed of fossiliferous tuff and lavas between the Silurian and Middle Devonian at Cavan, Yass, N.S.W., similar in age and character to the Snowy River porphyries of Victoria: A. J. **Shearsby.**—The *rôle* of agglutination in immunity: R. Greig **Smith.** The research has shown that (1) normal typhoid bacteria are incapable of being absorbed by the leucocytes when these have been freed from adhering serum; (2) typhoid bacteria, when treated with active agglutinating serum which has been heated to destroy the opsonins, are agglutinated and are then englobed by the leucocytes; (3) typhoid bacteria which have been grown in agglutinating serum, heated or not heated, are also absorbed; (4) while active agglutinating serum prepares the microbes for inception by the phagocytes, the so-called chemical agglutinating substances do not possess this property; and (5) the *rôle* of agglutinin is, therefore, to coat the bacteria with a precipitate which is positively chemotactic towards the leucocytes; and thus, by facilitating the absorption of the microbes, agglutination plays an active part in immunity.

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