THURSDAY, MAY 18, 1916.

MIMICS READY-MADE.

Mimicry in Butterflies. By Prof. R. C. Punnett. Pp. vi + 188 + xvi plates. (Cambridge: At the University Press, 1915.) Price 15*s.* net.

THE scope and general arrangement of this work are indicated in the following list of its eleven chapters: (i.) A short introduction on teleological interpretations—theological and otherwise; (ii.) A historical account of Batesian and Müllerian mimicry; (iii.) Old-world mimics, with a very poor reproduction on p. 19 of Dr. Eltringham's illustrations of the fore-feet of butterflies; (iv.) New-world mimics; (v.) Criticisms of "the five conditions which Wallace regarded as constant for all cases of mimetic resemblance"; (vi.) "Mimicry rings," a discussion on the origin of mimetic resemblances and initial steps; (vii. and viii.) On *Papilio polytes*—the Mendelian relationship between its female forms and their origin; (ix.) The enemies of butterflies; (x.) Mimicry and variation; (xi.) Conclusion, summed up in the last words—"The facts, so far as we at present know them, tell definitely against the views generally held as to the part played by natural selection in the process of evolution"—viz., against the theory that adaptations are built up by the gradual accumulation of small variations.

The last chapter is followed by two appendices, the first containing a table by Mr. H. T. J. Norton giving the means for "estimating the change brought about through selection with regard to a given hereditary factor in a population of mixed nature mating at random"; the second explaining the differences between the three sections of Papilio, and giving a list of Papilionine models and mimics quoted in the text.

The principal feature of the book is its illustration by means of twelve excellent coloured and four uncoloured plates. There are unfortunately a good many errors and much want of judgment in arrangement and in some of the examples selected.

In so complicated a subject as mimicry it is a great help to the reader to adopt some uniform system in the arrangement of models and mimics, and for many years it has been a usual custom when the figures are side by side to place the mimic to the right; when they are one above the other, to give it the lower place. The present work adopts no system at all. Sometimes, as in plate vii., the mimics are to the right; sometimes, as in viii. and xv., they are to the left; and so with upper and lower.

There are also unfortunate errors in the naming. Fig. 3 on plate i. is certainly not *Danais septentrionis*, but a Radena, probably *R. vulgaris*. The former butterfly is nearly represented by the closely allied *D. petiverana*, shown on plate vi., fig. 1. A still more serious mistake occurs on this last plate, where the names of figs. 2 and 3 are transposed in the description and in the text, so that a Danaine model is made to bear the name of the Papilionine mimic of another model, and *vice versâ*. Apart from this, the model shown in fig. 2, if only one was to be figured or mentioned in the text, is not well chosen, and it is natural that the author should, on pp. 29, 30, criticise his own selection. *Amauris echeria* and *albimaculata* are the well-known models of the *brasidas* form of *Pap. leonidas* in the south and south-east parts of its range. The same Danaines are also deprived of their true place as the models of *Pap. echerioides*, being ousted by *Am. psyttalea* in the table on p. 159.

The descriptive title of plate xii., "South American Butterflies," is unfortunately chosen, for the lowest of the four figures is a moth, and the word "Butterflies" in conspicuous capitals immediately beneath the figure quite overshadows the diminutive "(Heterocera)" at the side. Plate xv., "illustrating the closely parallel series of patterns occurring in the two distinct groups Heliconinæ and Ithomiinæ," is unfortunate, both in the names and in one of the genera selected—Mechanitis. If a single Ithomiine genus was to be shown with Heliconius, it should have been Melinæa, the undoubted primary models of the Heliconines and almost certainly of the species of Mechanitis as well. The resemblances shown on plate xv. are, in fact, the secondary or incidental resemblances between species that mimic the same models—not themselves illustrated. As regards the names, it is perhaps too much to expect a writer whose main interest is bionomic and evolutionary to follow all the ups and downs of synonymy. But the examples are not numerous, and it is easy to get assistance from friends devoted to the study of systematics. Furthermore, most of the examples on plate xv. had already been figured and named in the excellent, although uncoloured, plates xxx.–xxxiii. of J. C. Moulton's paper in Trans. Ent. Soc., 1908. Of the five species of Heliconius figured on plate xv., fig. 1, *mirus* is regarded as a form of *novatus*; fig. 2, *telchinia*, of *ismenius*; fig. 3, *eucrate* has been long known as *narcaea narcaea*; fig. 5, "*splendens*," a name unknown in the genus (*splendida*, Weym., does not resemble the figure), is *aristiona bicolorata*. Fig. 10, *Mechanitis "methona"* is doubtless intended to be *M. deceptus*, the true co-mimic of the accompanying Heliconius (fig. 5); but a butterfly from a different association and from farther north, *M. messenoides*, has apparently been figured—either this or a form transitional between it and *deceptus*. "*Methona*" is a third rendering of Hewitson's *mothone*, Salvin having introduced a second rendering, "*methone*"; but the butterfly originally named by Hewitson is a Melinæa, and not a Mechanitis at all.

Plate xvi. and the corresponding parts of the text suffer from the omission of a third North American Danaine from Arizona, *D. strigosa*, and the corresponding Limenitis, *L. obsoleta* (*hulsti*), which, although an excellent mimic,

retains more of the pattern of the non-mimetic species than its two mimetic relatives, *L. archippus* and *L. floridensis* (*eros*). The structural features, worked out by Dr. Eltringham, also confirm the conclusions derived from pattern, and should have been taken into account in any useful discussion of North American mimicry.

Criticisms suggested by the illustrations have occupied nearly the whole of the available space, and it is impossible to write on the present occasion of the numerous errors contained in the text or to discuss the various arguments advanced by the writer. One general criticism may, however, be made. If we desire, as the author desires, by the study of mimicry to throw light on the course of evolution in general, we must at any rate glance at mimicry between insects of different orders as well as the likeness between butterfly patterns; for a hypothesis which attempts to explain the latter but cannot explain the former is not only of limited interest, but also unlikely to provide a true interpretation in its own province. E. B. P.

THE GROWTH OF THE MIND.

(1) *Child Training: a System of Education for the Child under the School Age.* By V. M. Hillyer. Pp. xxxix + 299. (London: Duckworth and Co., 1915.) Price 5*s.* net.

(2) *The Foundations of Normal and Abnormal Psychology.* By Dr. B. Sidis. Pp. 416. (London: Duckworth and Co., 1915.) Price 7*s.* 6*d.* net.

(1) TO stimulate educational ideas is a most valuable social service, but the necessity of using the method of trial and error in the application of this or that principle to the teaching process may come hard on the child, who must submit to be a *corpus vile* for experimentation. The co-operation of teachers and psychologists has produced many futile and even mischievous "theories of education," and the younger the subject the more dangerous is their practical incidence. But this co-operation has recently begun to justify itself. Teachers with insight, especially in America, have been applying certain approved results of psychology, and their success has been considerable. It is interesting to note that several old-world methods are still found to be among the best; for instance, the two main principles of savage education, imitation and "helping" the parents, and the classical and mediæval insistence upon drill, are proved foundations of training, especially in the case of the very young. A system like that of Mr. V. M. Hillyer is practical in the best sense, and soundly based on psychological fact. "It aims to avoid the faults so common in child training—sentimentality, effeminacy, emotionalism, mysticism, licence under the guise of freedom, exaggeration of the unimportant or trivial, the attaching of imaginary value to the symbolic." "The formation of *habits*, physical, mental, and moral," by direct drill is the keynote of the system. Mental training, for example, depends on the formation of "brain paths" by repetition, and on their increase in number by increasing associations.

The author well remarks: "It is a commonplace in education to say that the forming of character is the chief aim, that it is not so much what is learned, as the character produced, but character is nothing more than the sum total of habits—good or bad," and these are not only moral, but physical and mental. "Habits are formed by repetition, and in no other way than by repetition." It is very sensible to say, "the involuntary habits we can form by making the right *setting* for the child. His playmates, nurses, and, not least, his parents, will be his involuntary copies, models, and habit-formers. The voluntary habits we can form only by *practising* the child; they cannot be formed by *telling* him." Muscle-memory must be exercised, and reaction must be encouraged; on these lines concentration and speed may be developed. It is perhaps claiming too much to say: "If you stimulate and exercise the brain cells properly you can develop almost any habits, abilities, tastes, faculties you may wish." With young children there is a danger from excessive drill, which may induce fatigue, misconstrued so often by the inexperienced teacher, and from excessive habituation, which confines the child in a rut from which he may never escape. In this case his work lacks both individuality and finish.

If carried out with sympathy and intelligence, Mr. Hillyer's system is excellent. Not the least of its positive features is the drill in *social* habits.

(2) Dr. Boris Sidis makes a timely protest against "practical pseudo-psychology," and those psychologists "who claim that they have some great psychological truths to reveal to business men, manufacturers, and working men." He also presses the current objection to the use of physical terms and metaphors in the illustration of psychical phenomena, *e.g.*, when Kovalevsky expresses mental activity in terms of mechanical energy, "the writer might as well attempt to change inches into pounds. He who undertakes the examination and study of mental phenomena must bear in mind the simple and important, but frequently forgotten truth, that facts of consciousness are not of a physical, mechanical character."

A disciple of William James, the author attacks the so-called "new psychology" in its attempt to make psychology a physical science. But his very lengthy argumentation on the scope and function of the science of mind is extremely nebulous, and consists more of illustrative phrases than of illustrative facts. For example, the axiom that "psychological facts cannot be reached by any of the sense organs" is discussed and illustrated in about fifty pages without any new light being thrown on the thesis. "Nothing," says Dr. Sidis, "gives me more pleasure than to find myself in accord with the great American psychologist and philosopher (James)." This is in reference to his own theory of "reserve energy."

Another theory of the author, that of "moment consciousness," may be described, in view of its

lengthy presentation, as, in James's phrase, "the elaboration of the obvious." The author says of Freud: "Of course, the claims of that school to originality and to the apparent unveiling of the causation of psychoneurosis are entirely unjustified." But he does not attempt except by repetition of phrase to disprove the conception, *e.g.*, of *das Unbewusste* as suppressed unconscious sex-complexes.

A. E. CRAWLEY.

AN INDIAN BIRD CALENDAR.

A Bird Calendar for Northern India. By Douglas Dewar. Pp. 211. (London: W. Thacker and Co., 1916.) Price 6*s*.

MR. DEWAR is well known to the Anglo-Indian public, and to a good many people over here, as the writer of a number of popular books, which, with a lively and trenchant style, combine a great deal of original observation and a very iconoclastic tendency towards the tenets of biological orthodoxy. The present book shows that he is well capable of handling his favourite subject in quite a different way; controversial matters are left on one side, and the style, though eminently readable and full of descriptions which bring the natural surroundings of the birds vividly before the mind's eye, is much more matter-of-fact as a rule than in the author's previous writings.

There is, indeed, so much to record in Indian bird-life from month to month, that to do it the justice that Mr. Dewar does leaves very little room for anything but the statement of ornithological events. It need scarcely be said that Anglo-Indian naturalists will appreciate a book like this, which, in a compact and handy form, puts before them the leading events of the ornithological year in northern India—the courtship, breeding, and plumage changes of the various species, and the arrival and departure of the numerous migrants; not only of visitors from the colder climates from the north, but of birds which move about locally in India, from the hills to the plains, and from one province to another, a limited form of migration which has been far less studied than the more sensational movements familiar in temperate climates. This will, however, no doubt in time be found to throw much light on the larger and, to most people, more familiar migrations; and for this reason, if for no other, the book deserves careful study by ornithologists not directly concerned with the Indian fauna.

The birds of India, and of the North-west Provinces especially, are indeed particularly well suited as a study to those ornithologists who aim at knowledge more scientific than can possibly be attained by a study of European, or, indeed, Palæarctic, birds only. The study is not too discouraging, for many of the birds are the same, though as a rule these naturally are mostly winter migrants; and numerous species exist belonging to European groups, though very distinct from our forms.

These, again, are differently distributed proportionally; Mr. Dewar has, for instance, several species of familiar cuckoos, kingfishers, and starlings—mynahs in Hindustani—to tell us about, as opposed to the single species of these families which we have in England, while of the thrushes and finches, such abundant birds over here, there is little for him to say. Notable, too, is the abundance and variety of the birds of prey and waterfowl, now so rare, comparatively, both in individuals and species, over most of Europe and especially in Britain; their continued abundance in India, even in the cultivated portions, showing that it is the aggressiveness of the European towards wild life, rather than the exigencies of cultivation, that has reduced them here. F. F.

OUR BOOKSHELF.

Engineering Geology. By Profs. H. Ries and T. L. Watson. Second edition, enlarged. Pp. xxvii+722. (New York: J. Wiley and Sons, Inc., 1915.) Price 17*s*. net.

THE issue of a second edition less than eighteen months after the first would seem to indicate that this book is meeting with a favourable reception. The new volume is larger than the earlier by some 50 pages, the addition consisting of an eighteenth and concluding chapter on historical geology. Since the authors attempt to deal, in this limited space, with the nature and use of fossils, the classification of geological time, the characters and distribution in North America of the several systems, and their economic products, the treatment is necessarily very brief and the descriptions meagre. Nevertheless, the addition of the chapter is a decided improvement, inasmuch as it provides, in what might be the only geological text-book of an engineering student, some information, at least, as to the principles, methods, and outstanding facts of stratigraphy.

The first seventeen chapters remain practically as in the original edition. They deal in order with rock-forming minerals and rocks, rock-structures and metamorphism, rock-weathering and soil formation, the accumulation movements and effects of overground and underground waters, and with the principal geological materials used by the civil engineer or sought by the mining engineer. In view of the importance, to these engineers, of a thorough grasp of the meaning, methods of construction, and utility of geological maps and sections, the treatment of this part of the subject seems inadequate. In future editions it might be expanded with advantage.

The list of references to literature at the end of each chapter has been brought up to date, and will prove helpful when further information on special subjects is desired.

The book is probably the best available exposition of geology from the engineering point of view. C. G. C.

Electrical Apparatus-making for Beginners. By A. V. Ballhatchet. Pp. 164. (London: P. Marshall and Co., n.d.) Price 2*s*. net.

THE author has provided, at a moderate price, a very useful little book, which should do much to encourage the beginner to construct simple electrical apparatus with which to make a number of instructive experiments. The book is illustrated with a number of photographs of the apparatus described, which the author has himself constructed. In addition, there are good working drawings and diagrams of connections where these are helpful. The real utility and educational value of work of this kind to the beginner cannot be insisted upon too often. He has read of and perhaps seen professionally made apparatus, and he naturally supposes that nothing within his constructive power can be any good, and more especially is this the case if he is not already fairly accomplished in the use of tools. While his earlier efforts may not be much use to anybody else they are of immense value to him—that is, if he has any perseverance. He may gradually come to learn that rough-looking apparatus may really work up to a point well, and so begin to acquire that confidence in himself which is essential when, at a later stage, he has original ideas. He may then either make preliminary rough experiments to see if, with better work, they promise to succeed, or if he has become a good manipulator he may have discovered that he can carry out his own ideas quickly and with sufficiently good work in the essential parts to get better results than he could hope for if he depended entirely upon others to put his ideas into form. C. V. B.

Guida allo Studio della Storia delle Matematiche. By Prof. Gino Loria. Pp. xvi+228. (Milano: Ulrico Hoepli, 1916.) Lire 3.

THE plan of this work is rather unusual, but quite good. The first part gives, among other things, references to first-rate works on history and historical method in general (*e.g.* Bernheim, Lavisse et Rambaud, Merz), besides works on the history of mathematics in particular. We also find here summaries of the contents of the more important journals dealing with mathematical history. The second part is more specialised; there are sections on manuscripts, biographies, editions of collected works, mathematical correspondence, bibliography, catalogues, and so on. There is a name-index for each part separately. The amount of information given is really remarkable, and it is well up to date; the author, too, has not shrunk from the disagreeable duty of pointing out works (such as those of Montucla, and even of M. Cantor) which must be used with caution.

There are a good many misprints, especially in English names and words (Raleigh, for instance, *passim*); we even find our familiar friend Bernouilli (p. 166); but few, if any, are serious, and the wonder is that they are not more numerous than they are.

G. B. M.

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.*]

A Suggestion with regard to Genera Splitting.

INDIVIDUAL systematic botanists and zoologists differ much in the principles which guide them with regard to the "splitting," or "lumping," of genera. Much can be said on both sides. The splitting into smaller genera of a genus overloaded with species should help to show the more intimate relationships of the species to each other. On the other hand, if the new genera have names unlike the original genus, the kinship of all the species originally included in the one genus is, to the casual observer, more or less masked. When a genus is very small in species a better grasp of their relationship with each other is probably gained by retaining them all under one generic name, even though morphological characters may well warrant placing each species in a distinct genus. In botany in Australia several hundred species are included in the genera Eucalyptus and Acacia. Unquestionably a better grasp of the kinship of the individual species is obtained by leaving all in the two genera named rather than in instituting new genera for various groups, but it is equally certain that some day a "splitting" systematist will erect new genera, which will not, I believe, help us in "memorising" the groups as wholes.

Some time ago, in discussing this question with my friend, Mr. G. M. Matthews, whose valuable work on the "Birds of Australia" is now in the press, I suggested that the letters of the Greek alphabet should be used, when genera splitting is decided on, as a prefix to the original generic name, thereby showing the common relationship of all the species to each other. May I make this suggestion here in your columns, and add, further, that the relationship would be still more clearly shown if the Greek symbol were used rather than a "translation" into English? The original genus (*i.e.* the "split" part, containing the original type species) would be best represented as α, though difficulty would arise in thus altering the original generic name; so, unless zoologists and botanists could come to some international agreement on the matter, it would probably be necessary to use no prefix in this portion of the "split," but add (*S.S.*=*sensu stricto*) to the simple generic name. The "splits" could then be β, γ, etc. To take the genus Eucalyptus, for example, we should have α-Eucalyptus, or Eucalyptus (*S.S.*), β-Eucalyptus, γ-Eucalyptus, etc. Such a method of splitting would be convenient and handy, would still show the broader relationships of the species, and would not interfere with those systematists who disapprove of splitting, since these need only drop the prefix. J. BURTON CLELAND.

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The Place of Science in Education.

THE question as to whether modern education should be classical and literary, or scientific, is one which apparently, in certain high quarters, is still controverted. This matter, once said John Stuart Mill, is very much like a dispute "whether a tailor should make coats or trousers." Replying in the philosopher's own words, "Why not both? Can anything deserve the name of a good education which does not include literature and science too? If there were no

more to be said than that science teaches us to think and literary education to express our thoughts, do we not require both?" Most reasonable people would probably be prepared to concede the soundness of Mill's opinion. Is not therefore the educational system of a country which concerns itself in no way as to the status of science altogether imperfect and lopsided? The educational value of science was excellently assessed nearly half a century ago by the distinguished author of the words above quoted, in the following terms (*vide* Rectorial Address, St. Andrews University, 1867):—

"But it is time to speak of the uses of Scientific Instruction: or rather its indispensable necessity, for it is recommended by every consideration which pleads for any high order of intellectual education at all.

"The most obvious part of the value of scientific instruction, the mere information that it gives, speaks for itself. We are born into a world which we have not made—a world whose phenomena take place according to fixed laws, of which we do not bring any knowledge into the world with us. In such a world we are appointed to live, and in it all our work is to be done. Our whole working power depends on knowing the laws of the world—in other words, the properties of the things we have to work with, and to work among, and to work upon. . . .

"It is surely no small part of education to put us in intelligent possession of the most important and most universally interesting facts of the universe, so that the world which surrounds us may not be a sealed book to us, uninteresting because unintelligible. This, however, is but the simplest and most obvious part of the utility of science, and the part which, if neglected in youth, may be the most easily made up for afterwards. It is more important to understand the value of scientific instruction as a training and disciplining process, to fit the intellect for the proper work of a human being."

Since Mill's day there have been many realisations and warnings that those in charge of the country's affairs were not maintaining its position in the international scale of scientific efficiency, the probable contingent future effects being at the same time pointed out. The Government have no doubt always listened respectfully to the representations, emanating from conviction, that have from time to time been made to them, but, having no thoroughly intelligent apprehension, the central fact remains—they have done nothing. The country, in a matter vital to its welfare, has been allowed to fall back while parliamentary gentlemen have occupied themselves, and the minds of the majority of their fellow-countrymen, with domestic questions of only accessory, not essential, importance.

How can matters be remedied? In what possible way can progress in the future be ensured? Experience does not readily incline one to the belief that any number of memorials, deputations, or advisory boards will be able adequately to effect the greatly desired result. Would it not be an excellent thing and solve many difficulties were there a body of scientific opinion in the House of Commons? An old teaching of Bagehot's was that any notion, or creed, which could get a decent number of English members to stand up for it, might be a false, and, indeed, pernicious, opinion, but it was felt by nearly all Englishmen to be at all events possible—an opinion within the intellectual sphere, and to be reckoned with. And it was an immense achievement. This, of course, means that scientific men would require to stand as candidates for election to Parliament. The assertion that in general their very specialised scientific training would disqualify them from being useful participators in the ordinary business of the Legislature appears quite unfounded.

To the writer the foregoing suggests itself as one likely solution of our difficulty. The country, in an educational sense, appears to have got somewhat out of adjustment with external national requirement. Equilibrium with environment is, perhaps, not always easy of maintenance, but it is worth continually striving after, so far as is humanly possible; for, without this, insidiously begin the multifarious processes of destruction compassing an end which it is never possible precisely to define. D. BALSILLIE.

St. Andrews, April 30.

A Mysterious Meteorite.

THE photograph here reproduced is of a meteoritic stone which was recently obtained by Mr. A. S. Kennard from a curio-dealer in Beckenham, Kent. All that could be discovered of its history was that it had

been purchased at the sale of the effects of a local auctioneer named Harris. Hitherto also all efforts definitely to fix the locality given on the label have failed. Any help in the solution of the mystery will be welcomed by me. G. T. PRIOR.

Natural History Museum, South Kensington.

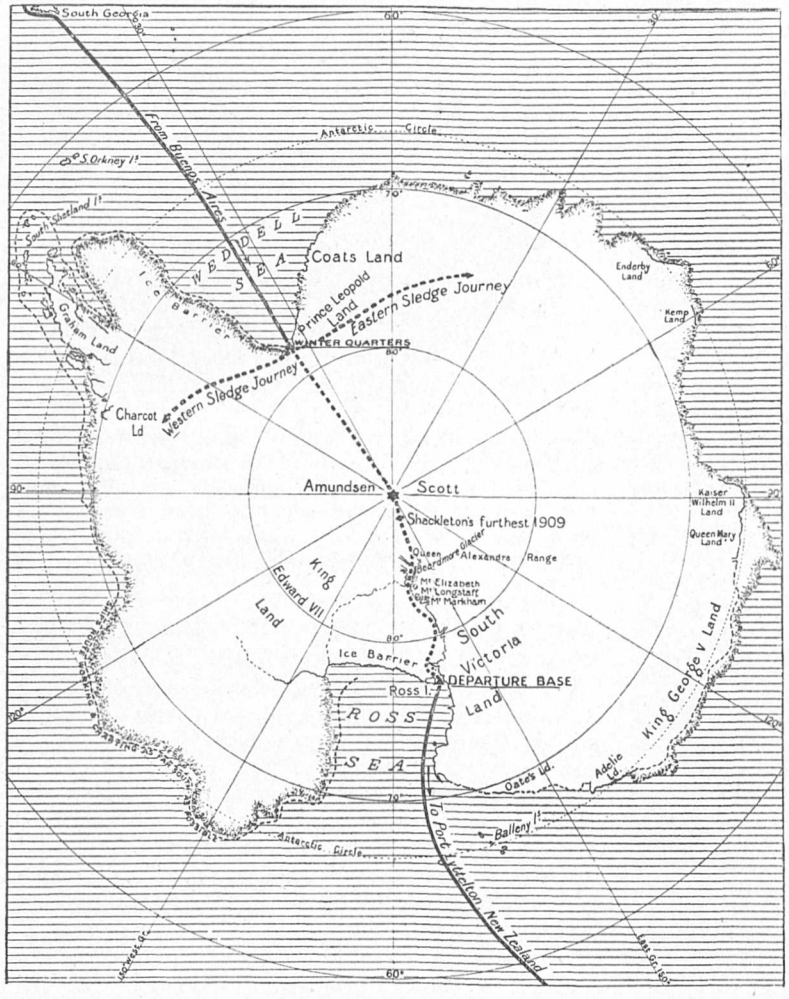
THE RELIEF OF THE SHACKLETON ANTARCTIC EXPEDITION.

AS the middle of May has been reached without news of the *Endurance*, action for the relief of Sir Ernest Shackleton's expedition has to be taken on the expectation that there will be no further news this season. It is possible that the *Endurance*, damaged and short of coal, may still be slowly working her way northward, and that any day we may hear of her return to South Georgia with perhaps the whole of the expedition on board. But such a solution of the difficulty must be regarded as highly improbable, and the relief expedition must be prepared with the information already available.

The more detailed news received from the *Aurora* encourages the hope that she can be refitted in New Zealand and entrusted with the relief work necessary on the Australasian side of the Antarctic. If so, the problem there is comparatively simple. The main anxiety in regard to that section of the expedition is due to the fact that when the *Aurora* was blown out to sea there had been no news of the depôt-laying parties for two months. Three sledge parties had started at the end of January, 1915, from the *Discovery* Hut at the southern end of Macmurdo Sound. Some depôts were successfully laid on the Ice Barrier.

Antarctic exploration — Shackleton Expedition

By March 11 these depôt parties had been reorganised by Captain Macintosh, who went south again to continue this work. The *Aurora*, after great difficulties, took up winter quarters opposite the 1910 hut at Cape Evans. After a stay there of nearly two months she was carried out to sea on May 6 and drifted, imprisoned in the ice, all through that winter and the succeeding summer. She was only released on March 10, 1916, when, even if she had been undamaged and had had adequate stores, it would have been too late to return to Macmurdo Sound that season. The *Aurora* had no news from Captain Macintosh between March 11 and May 6, but there seems no serious cause for anxiety. He would probably have spent the rest of March and the early part of April depôt-laying, and the bad weather at the end of April may explain his failure to communicate from Hut Point to Cape Evans. The men left ashore on Macmurdo Sound have the choice of three huts, and have ample stores for the two winters which they have had to spend there; and there would be plenty also for Sir Ernest Shackleton's party if it has succeeded in its journey across the Pole.



Proposed routes of the Shackleton expedition.

All that is necessary on the Ross Sea side is the dispatch of a ship from New Zealand in November or December to pick up the men left ashore at Macmurdo Sound and find what news there may be of the transcontinental party. As to the success of this relief expedition there need be no doubt, for no attempt to reach Macmurdo Sound has yet failed.

Regarding the opposite side of Antarctica, in the Weddell Sea area, there can be no such confidence, for the normal ice conditions there appear to be as unfavourable as those in the Ross Sea are favourable. The plans for search in the Weddell Sea must recognise at least three distinct possibilities.

(1) Sir Ernest Shackleton may have succeeded in establishing a land base where he hoped to winter, and thence started overland to the Ross Sea, while two sledge parties may have explored westward to the base of Graham Land peninsula and eastward to the south of Coats Land. The *Endurance* may have failed to return either in consequence of waiting for one of the two sledge parties, or by the packed condition of the ice in the Weddell Sea.

(2) The landing may have been effected so late, or so much further north than was intended, as to leave no chance of success for the transpolar sledge journey. Sir Ernest Shackleton, with his usual capacity for the quick realisation of facts, may have decided to devote all the resources of the expedition to research in the vast unknown area beside the Weddell Sea. In that case all the three sledge parties should have returned to the winter quarters, though any one of the three may have failed to get back, and thus have delayed the return of the *Endurance*.

(3) It would, however, appear quite possible, since the Weddell Sea has been so seldom found to be navigable, that the *Endurance*, in the effort to force her way to the land, may, like the *Belgica*, have been caught in the ice, and the whole expedition may be still on board drifting in the floes.

It is obvious that it is impossible to decide between these three possibilities with the information at present available, though from the news received as to the conditions of the ice in the Weddell Sea during the last two seasons it is highly probable that Sir Ernest Shackleton may not have been able to effect his desired landing. He may have been forced to land on north-eastern Coats Land. The *Endurance* may then have been car-

ried away from the winter quarters, and the relief expedition ought to be able to search independently for the ice-bound *Endurance* and for the party or parties left on shore. There would obviously be a much better chance of success if two vessels could be employed—one to search the coast-lands, and the other to scour the sea along the probable lines of drift of the Weddell Sea pack. From the observations of the *Scotia* in the Weddell Sea the prevalent wind direction there appears to be from the east, so that some belt of "land water" may be fairly persistent off Coats Land and the drift of the ice may be westward; but knowledge of meteorology in the Weddell Sea is so scanty that forecasts as to the usual drift of the ice would command but little confidence and may be falsified by an unusual season. The commander of the relief expedition should be at liberty to select his own route.

Sir Ernest Shackleton has met with very bad luck from the weather. His proposed transcontinental sledge journey was a daring and difficult undertaking. He had, however, considered all its possibilities, and it promised a fair chance of success; but his plans may have been deranged at the outset by the exceptionally unfavourable season. The ice conditions in the Weddell Sea may have prevented his starting forth on his great adventure. No time must be lost in organising the expedition to take him the help which he and his colleagues may sorely need. In addition to the return of the *Aurora* to Macmurdo Sound, two vessels, if possible, should be sent to the Weddell Sea, for the area that will have to be searched is vast, the clues are uncertain, and the season is short.

THE APPLICATION OF MATHEMATICS TO EPIDEMIOLOGY.

IT may seem remarkable that serious attempts to elucidate the mysteries of epidemic disease with the help of mathematical methods should only have been made within the last sixty years, and, even when made, should have been confined to the efforts of a very small number of students. In the seventeenth and early eighteenth centuries, the school of which Borelli was the most famous exponent endeavoured to bring much less promising medical fields under mathematical cultivation, while Sydenham's exposition of the principia of epidemiology would, one might have thought, have suggested to the founders of our modern calculus of probabilities that here was indeed an opportunity for them. No doubt, however, the explanation is to be found in the absence of statistical data, without which mathematical mills are forced to stand idle. It is of interest to recall the fact that the solution of a problem which took its rise in the failure to publish certain detailed statistics reveals a method which might have been generalised. We allude to Daniel Bernoulli's work on smallpox.[1]

His solution was as follows:—

If x denote the age in years, ξ the number who survive at that age out of a given number born, s the number of these survivors who have not had smallpox, and if in a year smallpox attacks 1 out of every n who have not had the disease, while 1 out of every m attacked dies, then the number attacked in element of time dx is sdx/n and we have:—

$$-ds = \frac{sdx}{n} - \frac{s}{\xi}\left(d\xi + \frac{sdx}{mn}\right) \text{ or } \frac{sd\xi - \xi ds}{s^2} = \frac{\xi dx}{ns} - \frac{dx}{mn}.$$

Substituting q for ξ/s, we have $dq = \frac{mq-1}{mn}dx$, so that $n \log (mq-1) = x + \text{constant}$, and ultimately, since when $x=0$, $s=\xi$,

$$s = \frac{m.\xi}{(m-1)e^{\frac{x}{n}} + 1}.$$

This investigation contains the germ of a method which, as Sir Ronald Ross has brilliantly demonstrated, might be applied to the study of the succession of cases in an epidemic. Nobody, however, took the hint, and the real history of mathematical epidemiology begins with Farr, whose work on these lines has been made familiar to the present generation by Dr. John Brownlee. Modern researches fall into one of two classes. On one hand, those directly or indirectly inspired by the epoch-making discoveries of Prof. Karl Pearson in the theory of mathematical statistics; on the other, the independent investigations of Sir Ronald Ross.

Prof. Pearson's development of a family of frequency curves, including the Gauss-Laplace or normal curve as a particular case and capable of describing effectively distributions very far indeed from normal, enabled statisticians to deal with a wide range of frequency systems, and it naturally occurred to some to use this method in the study of epidemics. Frequency curves have been fitted by Brownlee,[2] Greenwood,[3] and other medical statisticians to different epidemics, the most extensive work in this direction having been that of Brownlee. Much of this work was descriptive; that is to say, the object was in the first place to graduate the statistics, and, if possible, to classify epidemics on the basis of the type of curve found. So far as graduation is concerned, the results have been fairly satisfactory, but it proved to be impossible to effect any useful classification, the only result that emerged being that Pearson's Type IV curve was more commonly encountered than any other. The more fundamental problem of epidemiology, viz., that of discovering the law of which the epidemic, whether viewed in its temporal or spatial relations, is an expression, could scarcely be solved in this way. Brownlee, however, was by no means content with the mere graduation of statistics. Following Farr, he surmised, for reasons explained in his papers, that the theoretical curve of an epidemic in time or space should be normal, and that any practical departure from normality should be susceptible of an explanation capable of expression in terms of a function of the

[1] See Todhunter's "History of the Theory of Probability," p. 225.

[2] Proc. Roy. Soc. Edin., 1906, xxvi., 484; *ibid.*, 1911, xxxi., 262.

[3] *Journ. Hygiene*, 1911, xi., 96; Proc. 17th Inter. Congress Med., 1913, Sect. 18.

normal function. By supposing that a constant of the theoretical normal curve, viz., its standard deviation, was itself a variable, and assuming for the latter a convenient form, he succeeded in obtaining a curve which effectively described certain symmetrical epidemics.

Brownlee did not, however, obtain any function which satisfactorily accounted for the marked asymmetry which characterises many epidemics. It is an interesting illustration of the way in which apparently disparate problems are interconnected that his work owes much to the remarkable memoir of Pearson and Blakeman on random migration, a memoir inspired by the problem of mosquito distribution suggested to Prof. Pearson by Sir Ronald Ross. These researches, then, which began in the *a posteriori* study of statistics and were continued on the *a priori* assumption of a normal function being at the root of the problem, have carried us some way, but have not so far provided us with a satisfactory mathematical law of epidemics. Sir Ronald Ross, whose interest in the subject dates from so long ago as 1899, and whose latest contribution has just been published, followed a different path. Avoiding any presuppositions as to the form which the law should assume, he looked at the problem as one of *transfer*, viz., of mutual interchange between groups of affected and unaffected individuals, an interchange complicated by the subjection of each group to certain rates of natality, mortality, emigration, and immigration. Being at first specially concerned with the case of malaria, he formulated the problem in the second edition of his treatise on the prevention of malaria (pp. 651–686) in a system of difference equations, the solution of which should provide the required law. A summary of this work appeared in NATURE of October 5, 1911, under the title "Some Quantitative Studies in Epidemiology." In the paper before us,[4] these ideas have been extended and clothed in a more convenient mathematical form.

Sir Ronald Ross's method may be illustrated by summarising the simplest of his cases. If P be the whole population, x the ratio of affected to all members, v and V measures of the variation due to mortality, natality, immigration, and emigration of non-affected and affected persons respectively, and if the proportion affected in time dt be $h \,.\, dt \,.\, P$ where h is a constant, then we have the following system of equations:—

$$dP/dt = vP - (v - V)xP$$
$$dxP/dt = hP(1 - x) + (V - N - r)xP$$
$$dxP/dt = xdP/dt + Pdx/dt.$$

Eliminating dxP/dt and dP/dt, we have:—

$$dx/dt = h - (h + v - V + N + r)x + (v - V)x^2.$$

If, now, $v = V$, the equivariant case, the last equation can be written

$$dx/dt = K(L - x)$$

where $K = h + N + r$ and $L = h/K$.

Now put $y = L - x$ and we have $dy/y = -Kdt$.

So that if y_0 is the value of y at the beginning,

$$y = y_0 e^{-Kt} \text{ and } x = L - (L - x_0)e^{-Kt},$$

which gives the proportion of the total population affected at time t, this proportion being x_0 when $t = 0$.

Sir Ronald Ross proceeds to investigate the properties of this curve; he then takes the case of v not equal to V, which is dealt with on similar lines, and ultimately considers the curve arising in the simplest case of departure from the assumption that h is constant. The latter results are, no doubt, still somewhat remote from the conditions obtaining in practice, but they suffice to illustrate the genesis of an asymmetrical curve, and incidentally show that a form regarded by Brownlee as inconsistent with an hypothesis of constant infectivity and the termination of an epidemic by the exhaustion of susceptible persons may not be so.

The advantage of Sir Ronald Ross's method, apart from its simplicity and elegance—advantages which are, however, no mean matters—lies in its generality, so that it may be possible to include the case hypothesised by Brownlee as a particular example, precisely as Prof. Pearson's system of skew frequency curves included the normal curve as a special case. It is, of course, too early to speak with confidence. As restrictions are relaxed, the analysis will inevitably become more intricate, and, having evolved an *a priori* law, one must devise, usually by the method of moments, a way of applying the law to statistical data. This is work for the future, and all epidemiologists will await with interest the promised second part of Sir Ronald Ross's paper. No sensible man doubts the importance of such investigations as these; it is high time that epidemiology was extricated from its present humiliating position as the plaything of bacteriologists and public health officials, or as, at the best, a field for the display of antiquarian research. The work of Sir Ronald Ross, of Dr. Brownlee, and of a few others should at least elevate epidemiology to the rank of a distinct science.

M. GREENWOOD, JR.

PROF. EMILE JUNGFLEISCH.

PROF. EMILE JUNGFLEISCH, whose death occurred on April 24, at the age of seventy-seven, was born in Paris in 1839. He devoted himself to chemistry and pharmacy, and at an early age joined the Paris Chemical Society. In 1863 he was appointed dispenser to the hospital of La Pitié, and in 1869 qualified as pharmacist and member (agrégé) of the School of Pharmacy. In the same year he became assistant (préparateur) to Berthelot, who had recently been appointed to the new chair of organic chemistry of the School of Pharmacy, and on Berthelot's retirement in 1876 was made his successor. In 1890 Prof. Jungfleisch was nominated professor of chemistry of the Conservatoire des Arts et Métiers, and in 1908, again in succession to Berthelot, was appointed to the chair of chemistry

[4] "An Application of the Theory of Probabilities to the Study of *a priori* Pathometry." By Lieut.-Col. Sir Ronald Ross. Proc. Roy. Soc., A, 1916, xcii., 204.

at the Collège de France. In the following year he was elected a member of the Paris Academy of Sciences, where he took the place vacated by M. Ditte.

His numerous contributions to organic chemistry include the study of the chlorine and nitro-derivatives of benzene and aniline, of which he prepared a large number; but, not content with the mere preparation of new compounds, he sought to discover the relation existing between their physical properties and constitution. He succeeded in showing that there exists a definite relation between the number of substituting atoms and their melting points, boiling points, density, and molecular weight. These results served to some extent as the basis of Kekulé's theory.

Another series of memoirs was devoted to the examination of substances exhibiting molecular asymmetry, and Jungfleisch was able to show that the different forms of tartaric acid discovered by Pasteur, when heated with water, are transformed into one another, yielding an equilibrium mixture varying with the conditions of the experiment. For these researches he was awarded, in 1872, the Jecker prize of the Academy of Sciences. Up to this time no compound possessing molecular asymmetry had been prepared artificially, and it appeared that the intervention of a vital force, as Pasteur held, was necessary to produce it. Perkin and Duppa had succeeded in converting natural succinic acid into racemic acid. Jungfleisch completed the synthesis by converting ethylene, according to the method of Maxwell Simpson, into succinic acid. He also showed that camphoric acid exists in four isomeric forms, the so-called dextro- and lævo-camphoric and *iso*-camphoric acids which he isolated. Following up a similar line of research, he succeeded in resolving inactive malic and lactic acids into their active forms.

Among his other numerous memoirs may be mentioned his work on acetylene chlorides, a new method of reduction of organic compounds by tin salts, a research on derivatives of thymol, on lævulose, which he prepared in the crystalline state, on inulin, chloral hydrate, phenylphosphoric ether, etc.

Jungfleisch collaborated with Berthelot in the study of the partition coefficient of a substance in presence of several solvents; he assisted Lecoq de Boisbaudran in isolating gallium in quantity, and applied similar methods to the preparation of indium.

One of his latest contributions to chemistry was the study of gutta-percha, which resulted in the valuable discovery that the leaves of the plant can be used as a source of the material more economically and less destructively than the stem.

Of his literary contributions to the science mention should be made of the *Journal de Pharmacie et de Chimie*, to which he contributed for twenty-two years a review of foreign researches and publications, and successive editions of his well-known "Traité de Chimie Organique."

J. B. C.

NOTES.

THE Government has appointed a Committee to recommend the steps to be taken for the relief of Sir Ernest Shackleton's Antarctic Expedition. The chairman is Admiral Sir Lewis Beaumont, G.C.B.; the other members are the hydrographer of the Navy, Major Leonard Darwin (representing the Royal Geographical Society), Sir Douglas Mawson, Dr. W. S. Bruce (who has intimate personal knowledge of the Weddell Sea area), and representatives of the Treasury, Board of Trade, and of Sir Ernest Shackleton. The Committee has already begun its meetings.

UNIVERSAL sympathy will be felt with Sir William Crookes, who has suffered the heaviest of all bereavements by the death of his wife on May 10. Lady Crookes, whose maiden name was Ellen Humphrey, was born on January 31, 1836, and was therefore in her eighty-first year. She was married to Sir William on April 10, 1856, and from the earliest times took the liveliest interest in his scientific work, helping him, amongst other things, in delicate chemical weighings and the working out of the calculations connected therewith. Her devotion to, and interest in, his work formed a great incentive, and in no small degree contributed to his successful efforts in research. Theirs was the first private house in England in which electric light was introduced, and Lady Crookes helped her husband greatly in carrying out the installation and designing the ornamental work. She was a familiar and ever-welcome figure at scientific gatherings, to which she frequently accompanied her husband, and was able to be present with him at the reception given after his election as president of the Royal Society in the year 1913. Sir William and Lady Crookes celebrated their golden wedding in 1906, when they were able to welcome a large number of their friends and acquaintances, and were also the recipients of letters and telegrams of congratulation from all parts of the world. Lady Crookes was spared to celebrate quietly with her husband last month the almost unique event of a diamond wedding, but she was then in failing health, and passed away peacefully on May 10. Several sons and a daughter survive her.

THE first meeting of the Standing Committee on Metallurgy appointed by the Advisory Council for Scientific and Industrial Research was held on Monday, May 8, at the offices of the Board of Education. The committee consists as to one-half of members nominated by the professional societies concerned, the other half being appointed direct by the Advisory Council, and it has been constituted with a view to the representation of both the scientific and the industrial sides of the industries. It consists of the following members:—Prof. J. O. Arnold, Mr. Arthur Balfour, Prof. H. C. H. Carpenter, Dr. C. H. Desch, Sir Robert Hadfield, Mr. F. W. Harbord, Mr. J. Rossiter Hoyle, Prof. Huntington, Mr. W. Murray Morrison, Sir Gerard Muntz, Bt., Mr. G. Ritchie, Dr. J. E. Stead, Mr. H. L. Sulman, and Mr. F. Tomlinson. Sir Gerard Muntz is the chairman of the full committee and of the Non-ferrous Sub-Committee, and Sir Robert Hadfield is the chairman of the Ferrous Sub-Committee. The committee was welcomed by Sir William M'Cormick, administrative chairman of the Advisory Council, and Dr. Heath, administrative secretary to the Council. Sir A. Selby-Bigge also attended, and gave an account of the genesis of the movement, and emphasised the importance which the Government attaches to the establishment of close relations between education, research, and industry. The committee then proceeded to consider various matters of fundamental importance

in regard to policy and procedure. Afterwards the two sub-committees met and formulated their lines of policy, after which they passed to the consideration of various applications for financial aid in connection with contemplated researches of industrial importance. Grants in aid have already been made by the Advisory Council towards the cost of carrying out certain metallurgical researches.

PROF. HENRI LECOMTE, Prof. Edmond Perrier, and Prof. Pier' Andrea Saccardo have been elected foreign members of the Linnean Society.

DR. R. HAMLYN-HARRIS, director of the Queensland Museum, has been elected president of the Royal Society of Queensland for the year 1916–17.

THE Bakerian Lecture of the Royal Society will be delivered on Thursday next, May 25, by Prof. C. G. Barkla, on "X-rays and the Theory of Radiation."

THE twenty-first annual congress of the South-Eastern Union of Scientific Societies will be held at Tunbridge Wells on May 24–27. The retiring president is Dr. J. S. Haldane, and the president-elect the Rev. T. R. R. Stebbing.

WE regret to announce the death of Prof. H. C. Jones, professor of physical chemistry in Johns Hopkins University, and author of many books and papers on inorganic and physical chemistry.

AN extraordinary general meeting of the Chemical Society was held at Burlington House on May 11, to consider the question of the removal of the names of nine alien enemies from the list of honorary and foreign members of the society. No decision was reached, and the meeting was adjourned.

DURING recent excavations in Kent's Cavern, Torquay, the proprietor, Mr. W. F. Powe, has obtained a molar tooth of a nearly adult mammoth (*Elephas primigenius*). In the Pleistocene hyæna dens as a rule the remains only of young individuals of the mammoth occur, the smaller animals having been the more easy prey. The accumulated bones and teeth in Kent's Cavern were introduced at different times, both by hyænas and by man.

DR. C. A. CATLIN, who died recently at Providence, Rhode Island, had been chemist to the Rumford Works in that city for forty years, and was widely known as the inventor of various chemical processes and applications, many of which relate to the manufacture of phosphates for dietetic purposes. He was born at Burlington, Vermont, in 1849, and graduated in 1872 at the University of Vermont, which conferred on him in 1913 the honorary degree of Sc.D.

DR. C. A. DAVIS, one of the foremost American authorities on peat, died last month in Washington at the age of sixty-four. After graduating at Bowdoin College, Maine, in 1886, he spent several years as a teacher of science in various schools and universities. Since 1907 he had been employed by the U.S. Government as a peat expert, in connection first with the Geological Survey and afterwards with the Bureau of Mines. He was editor of the Journal of the American Peat Society, and author of "Peat in Michigan" and "The Use of Peat for Fuel."

THE control of the Imperial Institute will, by the new Act which has recently passed through both Houses of Parliament (see NATURE, April 27, p. 184), rest with the Colonial Office. By the establishment of an Executive Council a board of management will be created, which, subject to the control of the Colonial Office, will be responsible for the operations of the institute. The relationship between the Colonial Office and the institute will thus be analogous to that between the Colonial Office and a Crown Colony. Matters of important policy will have first to receive the sanction of the Colonial Office, but, subject to this, the Executive Council will possess a general executive authority.

IT has long been known that cats may be carriers of diphtheria and transmit the disease to human beings. A notable instance of this is recorded in the *National Medical Journal*. An outbreak of diphtheria occurred in an orphanage, and of seventy-one cases sixty-nine occurred on the boys' side. Sanitary defects and contamination of water and food were eliminated. Attention was then directed to the cats in the establishment, and on bacteriological examination it was found that four cats on the boys' side harboured the diphtheria bacillus, but the animals on the girls' side were free from infection. The cats were destroyed, and after this only ten more cases of diphtheria occurred, and these within a few days, showing that infection had taken place before the destruction of the cats. No further cases developed.

A NOTE in the *Times* of May 11 states that at the monthly meeting of the Central Executive Committee of the Employers' Parliamentary Association a resolution was passed urging the necessity (1) of increasing the number of chemists trained in research work, and (2) of making special effort to enlist the co-operation of manufacturers who hitherto have been lamentably apathetic in regard to scientific industrial research and training. The resolution was brought forward in connection with the consideration of the report of the sub-committee of the Advisory Committee to the Board of Trade on Commercial Intelligence, with respect to the measures for securing after the war the position of certain branches of British industry.

THE fourteenth annual session of the South African Association for the Advancement of Science will be held at Maritzburg on July 3–8 inclusive, under the presidency of Prof. L. Crawford, professor of mathematics, South African College, Cape Town. The sections, with their presidents, will be as follows:—A (Astronomy, Mathematics, Physics, Meteorology, Geodesy, Surveying, Engineering, Architecture, and Irrigation), Prof. J. Orr; B (Chemistry, Geology, Metallurgy, Mineralogy, and Geography), Prof. J. A. Wilkinson; C (Bacteriology, Botany, Zoology, Agriculture, Forestry, Physiology, Hygiene, and Sanitary Science), Mr. I. B. Pole Evans; D (Anthropology, Ethnology, Education, History, Mental Science, Philology, Political Economy, Sociology, and Statistics), Mr. M. S. Evans.

THE Illuminating Engineering Society, in common with other scientific and technical institutions, has been considering the encouragement of researches of special utility at the present time, and at the annual meeting, at which Prof. Silvanus P. Thompson presided, a report on the subject was presented by the Committee on Research. A number of problems are mentioned which will receive attention, in order of urgency, at the hands of the committee. Among these are included researches on the qualities of glassware required for illuminating purposes, the study of lighting appliances (globes, shades, reflectors, etc.), and the investigation of the conditions of illumination required for various industrial processes. Attention is also directed to the need for a series of standard colours of specified tint and reflecting value, the standardisation of so-called "artificial daylight," and

the prescription of a standard method of testing the permanence of colours, all of which are of considerable interest in relation to the dyeing and colouring trades. The list includes thirty distinct sections, and it is evident that the study of all these subjects would provide work for many years to come.

FLINT implements of the Neolithic type are fairly common in the Gold Coast Colony, but up to the present examples of the Palæolithic age have been wanting. In 1914 some rough quartzite stones of Palæolithic character were picked up on the coast at Accra. Mr. F. W. Migeod, in *Man* for April, announces the discovery of a rude implement in North Ashanti. It was found in a road cutting not far from the surface. The material seems to be a kind of chert, and Mr. Migeod is not disposed to attribute any great antiquity to it. He suggests that it was chipped experimentally, and was used for some temporary purpose. This supposition is confirmed by the character of the material, which is of a soft nature, and the implement would scarcely stand much rough use without losing its edge. Even if this specimen proves to be comparatively modern, it is still interesting as marking the survival of the Palæolithic type of implement in the Neolithic period.

DR. J. H. ASHWORTH contributes a brief note on the hibernation of flies to the *Scottish Naturalist* for April, describing the results of an inspection of a house in Edinburgh during February last, certain rooms of which, facing south, were harbouring swarms of flies. These had evidently been hibernating behind pictures and furniture during the winter, and had been roused into activity with the return of sustained sunshine. Though still lethargic, they had crawled from their hiding-places, where many were still found, to bask in the sun streaming through the windows. In all, five species were found, mostly females; but neither house-flies nor bluebottles were met with among them. An examination of the spermathecæ revealed living spermatozoa, showing that impregnation must have taken place during the autumn, when apparently the males for the most part die.

MR. C. TATE REGAN, in his memoir on "Larval and Post-larval Fishes," published by the trustees of the British Museum as part of the official "Report on the Results of the British Antarctic (*Terra Nova*) Expedition, 1910," has accomplished a peculiarly difficult task with conspicuous success. A wide knowledge of ichthyology, and a capacity for laborious work, are apparent everywhere. But these pages owe their value not so much to the number of species which have been determined as to the insight displayed into puzzling ontogenetic changes, and the lucid interpretation he has given in regard to problems of geographical distribution, migration, and the evolution of curious structural peculiarities which disappear with larval life. Among the latter, perhaps the most extraordinary is that furnished by the post-larval stage of a Stylophthalmid, of which a figure is given. Herein the terminal portion of the gut hangs down from the body after the fashion of the rope trailed from a balloon. A special cartilaginous support is developed at the base of this trailing portion. The function of this remarkable development seems to be that of a balancer. This, however, is but one of many structural adaptations peculiar to larval life discussed by Mr. Regan in the course of his "Notes and Conclusions," wherein he summarises the results of his investigations.

A NEW part of the *Palaeontologia Indica* (new series, vol. vi., No. 1) is devoted to a description of additional Ordovician and Silurian fossils from the northern Shan States of Burma, by Dr. F. R. Cowper Reed, with twelve plates of beautiful drawings by Mr. T. A. Brock. Although many of the Ordovician species are new, they are clearly more closely related to the northern European than to the American forms. They are also sufficient to show that the rocks from which they were obtained may be assigned to the lower part of the Ordovician series. Among the Silurian fossils are many interesting Graptolites, which Miss G. L. Elles refers to well-known species of the European Llandovery horizon. A few Graptolites from one locality also seem to agree with those from the base of the Wenlock Shales. Various fossils prove that the Upper Silurian is represented in at least two stages corresponding with the European Wenlock and Lower Ludlow. There also seem to be some marine formations transitional to the Devonian, but more evidence is needed to determine their exact relationships.

A PAPER was read on April 18 before the Institution of Petroleum Technologists, by Mr. E. H. Cunningham Craig, upon the Kerogen-shales, or Scottish oil-shales, in which the author advances some novel theories upon the origin of these oil-shales. He points out that a marked characteristic of strata yielding oil by distillation is to be found in the small irregular yellow masses, which have been discovered in most of these deposits by microscopic examination. These were first held to be gelatinous algæ, and were afterwards described by Prof. E. C. Jeffery as spores of vascular cryptogams. The author has come to the conclusion that they are not vegetable fossils at all, but are small masses of inspissated petroleum. According to this view, the rocks that are now oil-shales were originally argillaceous beds sufficiently colloidal to be able to absorb the necessary quantity of inspissated petroleum from the porous petroliferous sandstones with which they were associated. Such action is only possible in anticlinal areas where the petroliferous rocks come to the surface and are subject to the influence of weathering. Thus the decrease in the yield of oil down the flanks of anticlines is successfully accounted for. The author suggests that his theory affords valuable information in selecting a site for boring for oil-shales.

WE have received from Dr. N. O. Holst a reprint of his articles on the Ice age in England from the *Geological Magazine*, September–November, 1915. It is an interesting summary of the conclusions of one who has had long and varied experience of the Glacial deposits of Scandinavia and other parts of northern Europe, besides those of the British Isles, and emphasises the differences of opinion that still exist among geologists who have deeply studied the evidence of Pleistocene glaciation in this part of the world. Dr. Holst agrees with those who maintain that there was only one continuous Glacial period, and thinks there is still no proof in northern Europe of the alternation of cold and warm episodes which have been recognised and named by Penck in the Alps. He regards the high-level gravels in the valley of the Thames at Swanscombe, Grays, Ilford, Erith, and Crayford as pre-Glacial, and points out "how one warmth-loving mollusc after the other disappears from the Thames valley in proportion as the inland ice approaches." The associated flint implements at Crayford are described as oldest Mousterian. The Arctic bed at Ponder's End follows, and the well-known Thames brick-earth is truly Glacial, "belonging to the period of the melting of the inland ice." After much discussion, Dr. Holst concludes that the Ice age persisted continuously from Mousterian times, though not from their first beginning, to the close of the Magdalenian

stage, and remarks that it can be followed among British deposits from the beginning to the end. We commend his work to the notice of those who are interested in Palæolithic man and the associated mammals.

THE annual volume of "Records of the Survey in India" (vol. vii.) for 1913–14 has recently been published, and is a summary of an immense amount of useful work carried out under the supervision of the Surveyor-General of India, Sir S. G. Burrard. Apart from the details of the trigonometrical and geodetic operations, one of the most interesting chapters deals with the exploration of the north-east frontier. This work was done by Capts. Bailey and Morshead in 1913, and by the Abor exploration party in 1911–12–13. Up to that time almost the sole authority for the Abor country was Kinthup, who explored the course of the Tsan-po through the Himalayan Range in 1880–83. Kinthup, who was sold into slavery by his master, a Chinese lama, had been widely discredited, but in this report Capt. G. F. T. Oakes, in a critical discussion of his work, proves its trustworthiness.

THE report on the state of ice in the Arctic Seas for 1915 has made its appearance (*Det Danske Meteorologiske Institut, Kjobenhavn*). There are charts for April, May, June, July, and August, with full explanations of the data gathered from all available sources. The publication is printed in Danish and English in parallel columns. Most interesting are the abnormal ice conditions that prevailed in Spitsbergen waters. As early as May there were symptoms of an unusually bad season. In June the pack extended far to the westward, and there was no approach to the fjords. In July the belt of pack narrowed a little, but even in August it was lying all along the west coast. More remarkable still was the extension of this belt of pack, throughout the summer, well to the north of Prince Charles Foreland—an occurrence altogether exceptional. It is suggested by Commander Speerschneider, the author of the report, that some of the Greenland ice had drifted eastward to Spitsbergen waters, and mixed with the ice that normally sweeps round South Cape from the Barents Sea. Certainly in 1907 Greenland pack reached to 8° E. in the latitude of Ice Fjord, Spitsbergen, which is within the limits of the space covered last year by the pack under discussion. This explanation would also account for the northward extension of the ice. Off the north coast of Iceland ice conditions were bad until the end of July, which is again an abnormal state of affairs.

A GOOD instance of the high appreciation by scientific Americans of the circulars issued from time to time by the Bureau of Standards at Washington is provided by the recent issue by the Bureau of a *third* edition of the circular on magnetic testing of materials. It covers fifty pages, and is issued at 15 cents a copy by the Government Printing Office at Washington. It deals with the methods of measurement in use at the Bureau, the results obtained with typical commercial magnetic materials, and gives a great deal of general information on magnetic subjects. Induction and hysteresis data for straight bars are obtained by the Burrows form of permeameter, in which the bar under test is combined by means of two soft iron yokes with an auxiliary bar to form the magnetic circuit. Core loss determinations are made according to the specifications of the American Society for Testing Materials on strips 5 by 25 cm., cut half along, half across, the direction of rolling. They are assembled in four equal bundles, and with four corner pieces constitute the magnetic circuit. The measurements are made by means of the ballistic galvanometer in each case. A number of hysteresis curves for typical materials and a table of magnetic susceptibilities of chemical elements and compounds are given.

IN two papers published in the Journal of the Society of Chemical Industry (vol. xxxv., No. 4) Mr. G. S. Robertson discusses the question of the availability of the phosphates in basic slags and mineral phosphates. The increasing demand for phosphatic fertilisers is leading to a search for substances previously considered of little value for this purpose. The value of 2 per cent. citric acid as a solvent for testing the availability of phosphates has been challenged for minerals and fluorspar slags. On account of the low solubility of these phosphatic materials in this solvent it has often been assumed that they are not so valuable as the high-grade basic slags; indeed, Wagner introduced this test to detect the adulteration of basic slag with rock phosphate. Mr. Robertson shows that a sufficient number of extractions dissolve out quite as much phosphoric acid from the minerals as from the slags. The fineness of grinding is also an important factor in the solubility of rock phosphates. Field results at various English centres and in the United States have shown the high value of rock phosphates, and the author concludes that the citric test is worthless as a measure of the relative values of phosphatic fertilisers.

IT has usually been assumed that the wear of coins in circulation is due entirely to abrasion. In a memorandum by Sir T. K. Rose, however, contributed to the forty-fifth annual report of the Deputy-Master of the Mint, attention is directed to the effect of grease, derived from the sweat of the fingers or from other sources, in accelerating the wear of coins. The fatty acids of the grease have a corrosive action upon the metal. Copper, in particular, even if present only in small quantity alloyed with gold or silver, is converted into an oleate, stearate, or other salt. Haagen Smit, of the Utrecht Mint, found by analysis that the dirt on a bronze coin contained 36 per cent. of copper in the form of pulverulent compounds of the fatty acids. When the coin is handled the dirt is in part detached, and the coin undergoes a rapid loss of weight. Gold or silver is not readily converted into salts, but the removal of the alloying copper leaves the less easily attacked metals in a spongy form which offers little resistance to abrasion. A surface layer of pure silver at first preserves coins from chemical attack, but this layer is soon removed by mechanical wear. In new coins the rapid loss of weight which occurs is doubtless due at first to abrasion, but when the rough edges have been removed chemical action may prove to be of the first importance in the succeeding deterioration.

IN vol. xv. (part i.) of the Transactions of the English Ceramic Society the feature of most scientific interest is a series of three "Studies on Flint and Quartz," by Dr. J. W. Mellor and two collaborators. The first paper describes the effects upon quartz and flint of heating these substances at temperatures obtained in pottery ovens. It has long been known that quartz on calcination or fusion shows a notable decrease in specific gravity—a change which is presumably attributable to the conversion of the quartz molecule to a lower degree of polymerisation. Flint, it is found, undergoes similarly an alteration of specific gravity when calcined, but much more rapidly than quartz. Between grey flint and black flint there is likewise a difference in the rapidity of transformation to the form of lower density, grey flint being changed somewhat more quickly than the black variety. The practical bearing on certain ceramic operations of these differences of behaviour is pointed out. In the second

paper there is an interesting account of the formation and distribution of boulder and chalky flints; and in the third the question of substituting other forms of silica for flint in pottery manufacture is discussed. A timely article upon the national importance of fuel economy is contributed by Prof. W. A. Bone.

SEVERAL numbers of the Technologic Papers issued by the United States Bureau of Standards have recently come to hand. Each deals with a special problem of analytical chemistry which has been investigated by the departmental chemists. In No. 64 a new method is given for the determination of barium carbonate in vulcanised-rubber articles, and it is shown that the process is sufficiently accurate for use in the somewhat difficult case where sulphates of lead and barium are present simultaneously with the barium carbonate. Paper No. 65 includes a scheme for the determination of oil and resin in varnishes; tested upon samples of known composition, the process has given fairly good results. A method for the detection of resin in driers is developed in No. 66. It appears to be trustworthy except when the proportion of resin is very small. Analytical chemists who may have to deal with gums will find in paper No. 67 a useful summary of the chemistry of gum arabic. The authors of the paper find that basic lead acetate gives the most characteristic reaction for this gum, whilst for its quantitative determination they have devised an improved process, depending upon the precipitation of the gum with an alcoholic solution of copper acetate. Paper No. 69 describes a critical study of the determination of carbon in steel by direct combustion in oxygen at temperatures higher than are ordinarily employed. Although the new method gives good results, the investigators consider that the experimental difficulties place it beyond the reach of most industrial and works laboratories.

THE following works are in preparation for appearance in Messrs. Longmans and Co.'s *Monographs on Biochemistry*:—"The Development and Present Condition of Biological Chemistry," Dr. F. Gowland Hopkins; "The Polysaccharides," A. R. Ling; "Colloids," W. B. Hardy; "Physical Methods used in Biological Chemistry," Dr. G. S. Walpole; "Protamines and Histones," Dr. A. Kossel; "Lecithin and Allied Substances," Dr. H. Maclean; "The Ornamental Plant Pigments," A. G. Perkin; "Chlorophyll and Hæmoglobin," H. J. Page; and "Organic Compounds of Arsenic and Antimony," Dr. G. T. Morgan.

MESSRS. MACMILLAN AND CO.'S list of forthcoming books includes the following:—"A Bibliography of British Ornithology, from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works," by W. H. Mullens and H. Kirke Swann, in six parts, the first of which will be issued at the beginning of June; "Discovery, or the Spirit and Service of Science," by Prof. R. A. Gregory, illustrated (The purpose of the work is to display the nobility of scientific endeavour, the meaning and value of scientific method, and the practical service of results obtained by research); "Theoretical Chemistry," by Prof. W. Nernst, new edition, revised by H. T. Tizard; "A Manual of Practical Physics," by H. E. Hadley; "Elements of Geometry," by S. Barnard and J. M. Child, parts v. and vi.; "Second Thoughts of an Economist," by the late Prof. W. Smart, with a biographical sketch by T. Jones; "The Military Map: Elements of Modern Topography (French School of War)"; "The Statesman's Year Book, 1916," edited by Dr. J. Scott Keltie, assisted by Dr. M. Epstein.

OUR ASTRONOMICAL COLUMN.

STEREOSCOPIC SPECTROHELIOGRAMS.—A remarkable pair of photographs of hydrogen (H_α) flocculi, showing a stereoscopic effect, have been forwarded to us by Prof. Hale. They were taken with a new grating spectroheliograph, used in conjunction with the 60-ft. tower telescope at Mt. Wilson, and exhibit the flocculi surrounding a large spot-group near the sun's west limb on August 7, 1915. The time interval between the two exposures was seven minutes, giving a separation of the two images due to the sun's rotation somewhat greater than Helmholtz's estimate of 1′ for the minimum angular separation of two objects just sufficing for stereoscopic vision. The photographs show the structure of the flocculi in a way which at once recalls Langley's well-known representation of the minute details of the photosphere about a spot; and a long, dark flocculus, which afterwards appeared as a prominence on the west limb, is distinctly seen in relief. Photographs of this kind must necessarily be affected by changes in the actual details in the interval between the exposures, and by distortion arising from drift of the solar image, or from irregular motion of the spectroheliograph, during exposure; but Prof. Hale believes that with due precautions the stereograms will assist in clearing up some of the questions referring to relative levels. A check on the reality of the stereoscopic relief has been obtained by taking photographs of a globe having a roughened surface, turned through angles corresponding with the intervals between the solar photographs.

A VARIATION IN THE SOLAR ROTATION.—In the programme of spectroscopic work at the Ottawa Observatory a considerable place is devoted to the investigation of the solar rotation. In the most recent publication Mr. H. H. Plaskett gives an account of a special inquiry regarding its variability in time (*Astrophysical Journal*, vol. xliii., No. 2). In order to regularise the personal equation and avoid bias all measurement was postponed until the desired series of spectra had been secured; the plates were then mixed, divided into two bundles, and measured with two quite different types of machines. The displacements of eight lines, including three of telluric origin, to serve as a check on possible instrumental displacements, were measured. Three possible modes of variation were looked for: (1) diurnal; (2) short period; and (3) secular changes. The evidence indicates that daily variations, if existent, do not reach 0·1 km.; variations of the second and third types are revealed in a cyclic change of 0·15 km. with a period of about a month, and a diminution of rotational velocity amounting to 0·04 km. since 1913. The research is a typical example of the thoroughness already traditional at Ottawa.

THE GREAT MERIDIAN CIRCLE OF THE PARIS OBSERVATORY.—The annual reports of the Paris Observatory for the last two years contain some interesting facts concerning the working of this instrument. After accidental damages the indications of the repaired level were discordant, so that throughout the past twelve months the determinations of inclination of the axis have been entirely made by nadir observations, employing the suspended mercury bath devised by M. Hamy. Another modification of procedure concerns the collimation error. It was found that when the usual daily determinations were employed the resulting clock rates showed variations greater than could be expected. Consequently use is now made of a weighted mean value of the collimation error determined by observations of circumpolar stars at upper and lower culminations.

THE "SUMMER TIME" BILL.

THE main provisions of the "Summer Time" Bill, which was introduced in the House of Commons on May 9 by the Home Secretary, Mr. Herbert Samuel, and was read a second time in the House of Lords on May 16, are as follows:—

(1) During a prescribed period the local time in Great Britain is to be one hour in advance of Greenwich mean time.

(2) The prescribed period this year is from two o'clock in the morning Greenwich mean time on Sunday, the twenty-first day of May, until two o'clock in the morning Greenwich mean time on Sunday, the first day of October, and during the continuance of the present war the Act can be declared by Order in Council to be in force for any prescribed period.

(3) During the prescribed period any expression of time in any Act of Parliament, Order in Council, order, regulation, rule, or by-law, or in any deed, time-table, notice, advertisement, or other document, is to mean "Summer Time."

(4) The Act is to apply to Ireland as to Great Britain, with the substitution, however, of references to Dublin mean time for references to Greenwich mean time.

(5) Greenwich mean time is to be maintained as hitherto, for purposes of astronomy or navigation.

No particular time is prescribed for meteorologists, who are left to decide for themselves whether to record their observations at the same hour G.M.T. throughout the year, or to adopt the Summer Time for five months and G.M.T. for the remainder. A like difficulty arises with self-registering meteorological instruments, which are used to record continuously day and night. Either the instruments are to be an hour wrong in the summer, or meteorologists are to use a time-system different from that of the general public. For example, the five thousand voluntary observers connected with the British Rainfall Organisation record their readings at 9 a.m., which is to be 10 a.m. Summer Time. Dr. H. R. Mill, director of the Organisation, has had to announce to his observers that the readings should be taken, if possible, at 9 a.m. G.M.T., as hitherto, or a note should be made on each page of the observation book if the readings are taken at 9 a.m. Summer Time. Anyone who is concerned with the preservation of records for long series of years must contemplate with blank dismay the dual system about to be introduced.

Lighting-up times, as was stated in last week's NATURE, depend upon local times of sunset, and are therefore based upon Greenwich mean time, with differences for latitude and longitude. The *Law Journal* points out that since sunrise and sunset always mean in law the exact moment at which the sun rises or sets at any particular place, the obligation to light up vehicles an hour after sunset—an interval which is reduced to half an hour during the war—is not affected by the Summer Time Bill. The law will thus maintain local time for many of the statutes in which time is mentioned, and this, for nearly all places in Great Britain and Ireland, will be later than Greenwich time, not an hour earlier, as the Summer Time Bill prescribes. As the tides, sunrise and sunset, lunar phases, and like occurrences belong to navigation and astronomy, they will continue to be tabulated in advance in Greenwich time; but all public clocks are to show mid-European time.

The economic and social advantages claimed for this introduction of confusion into an orderly system of time-reckoning remain to be seen; but whatever they are there can be no question that the scheme of a fluctuating time-standard has no natural basis. It is the duty of a scientific journal to point out the objections to the scheme, even though it stands alone, and, in the opinion of the public, may represent what is contemptuously termed scientific theory as something apart from the practical needs of life. The difficulties are not appreciated by our legislators, and few writers in the public Press have shown any intelligent understanding of them, while scientific interests have been completely disregarded. The only satisfaction to be derived from this childish method of promoting the increased use of daylight is that the measure is limited to the period of the war.

PURIFICATION OF COAL-GAS.

PROF. FRANK CLOWES read a paper before the Society of Chemical Industry on May 1 dealing with the past and present of the sulphur impurity in coal-gas. He recalled that the higher temperature carbonisation arising from the displacement of iron by fireclay retorts had resulted in an increased amount of sulphur coming into the gas, not only in the form of hydrogen sulphide, but more noticeably as sulphur compounds of an organic nature. Purification by iron oxide is sufficient to remove sulphuretted hydrogen, but the removal of these organic compounds is much more difficult. "Sulphided lime," prepared by passing coal-gas containing hydrogen sulphide, but free from carbon dioxide, over freshly slaked lime, was in common use for the purpose, but its action was so uncertain that a Board of Trade Committee which inquired into the subject came to the conclusion that any statutory requirement that the sulphur impurities should be removed to such an extent as to demand the use of lime ought to be discontinued. The detrimental physiological effect and very slight, or non-existent, disinfectant value of the sulphurous products of combustion of coal-gas were, however, plainly indicated by Dr. Haldane, and experimental results were also brought forward which proved that these sulphurous products caused leather to rot and ultimately to crumble, and that some fabrics were similarly affected.

Dr. C. Carpenter and his collaborators have advanced matters by working out on the large scale a practical method of removing carbon bisulphide by passing the gas at a temperature of about 450° C.[1] (the author gives the temperature 450° F., presumably a misprint) over fireclay surfaces impregnated with reduced nickel. The hydrogen sulphide formed is removed by subsequent exposure of the coal-gas to iron oxide, and the carbon deposited on the fireclay-nickel surface is burned off; the sulphur of the coal-gas is so reduced to about 8 grains per 100 cubic feet.

A similar process is in the hands of an investigator in France, and it appears that the immediate possibility of distributing a much purer gas supply is presented to the gas industry.

PREHISTORIC ART.

A MELANCHOLY interest attaches to a paper entitled "Nouvelles découvertes à Laugerie Basse: Rabots, os utilisés, œuvres d'art," by Capt. Bourlon, published in the last issue of *L'Anthropologie* (vol. xvii., Nos. 1–2, for January-April), because the gallant officer was killed at the opening of the war. The paper has now been edited by M. l'Abbé Breuil. These new discoveries in this famous cave are of remarkable interest, including a fine collection of flint implements, among which the rabots, or scrapers, are of exceptional interest. We have also fine examples of work in bone, including many heads of animals engraved on this material. The engravings on stone, besides those of the normal type, display some curious variants. Of these the most remarkable are a splen-

[1] Trans. Inst. Gas Eng., 1914, p. 213.

did picture of a red bear, stags, bison, and a figure of a bird with a long, slightly curved beak, with a protuberance on the throat, which may make it possible to identify the species.

This type of prehistoric art is also illustrated in a novel way in a paper in the same issue of *L'Anthropologie* by M. E. F. Gautier, entitled "Nouvelles Stations de Gravures rupestres Nord-Africaines," which describes a series of rock sculpturings at a place to the north of Figuig, on the Algerian-Moroccan frontier. These include elephants, lions, an animal possibly a giraffe, and ostriches. The author remarks that eminent geologists, on the analogy of the prehistoric drawings in the French caves, are disposed to assign the North African specimens to the Quaternian age. But he warns us that the collection of examples was made in the course of a rapid tour, and that it is still far from complete. Much further exploration is required before any definite conclusion regarding this type of prehistoric art and the ethnology of the artists can be formulated.

SCIENCE AND CLASSICS IN MODERN EDUCATION.[1]

THE resolution I have the honour to move seems to need but few words to commend it to a meeting of scientific men. But we have to bear in mind that it is not scientific men that have to be convinced, and it becomes necessary therefore to state clearly what it is that we desire, and why we desire it.

I propose to begin, however, by stating what it is that we do not desire, my reasons for so doing being that our aims have been grossly misrepresented in the past, as they will no doubt continue to be misrepresented in the future. Thus, in expressing the opinion that science ought to oust the study of Greek and Latin from the prominent position which these subjects hold in the educational course of our schools, we have been accused of wishing to kill all learning but our own. The accusation is baseless. We have never expressed any such desire. No one of us would be so foolish as to wish that the classics should not continue to be a serious branch of study. We do not contest that an intimate knowledge of Greek and Latin may help towards the attainment of literary and oratorical style, or that it may even add to the amenities of conversational intercourse. We admire—some of us from a long distance—the favoured few who are possessed of those advantages. But it is the many we have to consider in the matter of general education, and we ask ourselves—looking over the circle of our acquaintances at those who have had the inestimable privilege of having Greek and Latin swished into them from their earliest years—whether in the great majority there is any sign that there was ever much penetration beyond the skin, and whether the educational benefits which the—for the most part long-forgotten—acquisition of these languages has bestowed are really worth the enormous amount of time and trouble expended upon them. This is, of course, an entirely different question from what I may perhaps be permitted even by our opponents to call the *scientific* study of classical languages and literature, which is on an altogether different footing, and cannot be promoted by forcing Greek and Latin on every schoolboy, whether he has aptitude for it or not, to the exclusion of subjects the knowledge of which would at least be of some benefit to him in after life.

We must all admit that there is not time for any adequate study of both the classics and the natural sciences in the general educational curriculum; surely, therefore, it is scarcely fitting to omit subjects which in any conceivable circumstance of life may prove of some value in order to retain those which can only be valuable in professions which demand a certain standard of literary attainment. But I am not prepared to concede that knowledge of the classics is necessary for the production of the best English. I refer to this point particularly because the claim has been recently made by one of the champions of the present system of education that without such knowledge we are unable adequately to express our ideas in our own language. The absurdity of this contention is obvious at a time when we are commemorating the tercentenary of the author whose immortal works were written under all the disadvantages of the possession of "small Latin and less Greek." Perhaps it is unfair to bring in evidence so transcendant a genius as Shakespeare; he, one feels, even with a complete classical education, would still have succeeded in bewitching the world with his wonderful imaginings and in inspiring his characters with the attributes and sentiments which his puny fellow-mortals have marvelled at for three hundred years, and will doubtless continue to admire as long as our world continues. Nevertheless, if Shakespeare had gone through a course of Eton and Oxford the language those sentiments are clothed in would certainly have been different, and I imagine that not even the most pro-classical of our opponents but is thankful that he escaped.

I am content, however, to leave Shakespeare on his pinnacle—unattained and unattainable—and to recall the name of one John Bunyan. Has anyone amongst the polished eighteenth-century essayists written in a clearer style than this Bedfordshire tinker's son, whose literary studies were mainly confined to the Bible? Or, to take an instance from our own times, was there ever a finer political speaker than John Bright, "the great tribune," whose utterances, couched in simple, vigorous English, were wont to pass straight from his own heart to that of his audience? And is there not another writer and speaker of whom we are many of us proud to have been the disciples, and whose spirit we may well imagine to be with us this afternoon, who, without the advantage of a classical upbringing, was pre-eminent amongst nineteenth-century authors for his faultless diction and for the direct and terse enunciation of his ideas; needless to say, I refer to Thomas Henry Huxley.

We have further been accused of desiring, in our enthusiasm for science, to oust such subjects as modern history, and geography, and the study of the English language and literature from the educational curriculum. No accusation can be more unfair. We recognise that these subjects must for us form a fundamental part of all education. They *have* been ousted from the present scheme because their immediate relation to the classical languages and literature was remote, and the amount of knowledge of Greek and Latin which has been required in competitive examinations has needed all the time at the schoolmaster's disposal. We believe, however, that there will, if the greater part of that time can be recovered, be opportunity afforded for the acquisition of such knowledge of the subjects in question as will help to fit our boys and girls to become worthy citizens of this great island-empire.

But in order that there shall be a reasonable chance of our being able to maintain our place in the world it is above all necessary that we should move with the times. We are a long way from the eighteenth century—when a sound education in classics was recognised as the be-all and end-all of a boy's upbring-

[1] Remarks made by Sir Edward Schäfer, F.R.S., in proposing the first resolution at the meeting on the Neglect of Science held at Burlington House on May 3 (see NATURE, May 11, p. 230).

Classical education

ing. Science was then in its infancy. Throughout the nineteenth century it was advancing by leaps and bounds. In this twentieth century we meet it at every turn; there is no getting out of its path. That this is truly the age of science we have no lack of evidence in the present war, but the statement is no less true and is even more important in its application to the occupations of peace. And if we wish to live up to our age we must do what in us lies to promote the progress of science. The mere diffusion of scientific knowledge throughout the community will be directly beneficial; but, besides this, certain important consequences must follow such diffusion. Not the least of these is the capability of appreciating the fact that it is necessary for our prosperity—nay, for the continuance of our very existence—that in every possible way knowledge of science should be advanced. Let us make no mistake on this point. The nation which recognises this necessity will succeed, the nation which refuses to recognise it will fail.

We make no claim to have eminent representatives of science in the Cabinet. We believe in the cobbler sticking to his last. The qualities for which politicians are chosen are rarely found in men who devote their lives to the pursuit of science. But we think that even Cabinet Ministers should know something about the world they live in and the bodies they inhabit. Surprise has been expressed at the singular ignorance displayed by distinguished statesmen of simple facts in chemistry and physiology, familiar to the most junior student. This ought not, however, to be surprising. What chance have they had to acquire any knowledge on these subjects? Usually none at all. We meet with the same kind of ignorance in such a generally well-informed quarter as the editorial column of a newspaper; nor can this be otherwise considering that the journalist has as a rule the same kind of education as the politician—an education in which science has occupied no part. Neither is able to distinguish between a real and *soi-disant* authority on a scientific subject, and for this reason we frequently find the utterances of a quack quoted as of equal value with those of a master in science. And if men like these—men who have had the highest educational advantages which our schools and universities can afford—are so deficient in knowledge of things around them: things which really matter, and which affect the well-being and prosperity of the whole community: what can be expected from the ruck of their fellow-graduates who have taken—or perhaps been excused—the ordinary degree at our universities, and who have acquired in that laborious process little but a smattering of certain ancient languages, which they very soon contrive to get rid of? Or, if anything remains, it is of no possible use to them in the practical avocations—agricultural, commercial, or manufacturing—which will occupy so much of their subsequent attention. Whereas, had the time which most of them have thus wasted in classical studies been devoted to the acquisition of a basal knowledge of the physical and biological sciences, it may confidently be affirmed that the living interest which these subjects afford would lead to a desire for the extension of such knowledge, and that its possession could not but prove of definite advantage in their future career.

It is, however, constantly alleged by our pro-classical friends that whatever may be said for the teaching of science on utilitarian grounds the study of the classics has shown itself by long experience to have such inestimable advantages as an educational asset in the formation of character that it is not possible for any other branch of knowledge to take its place in the curricula of our schools and universities. This allegation must, in the absence of specific proofs, be met by us with the most absolute denial. The evidence we possess is indeed altogether on the opposite side. Of all the public services the one which is pre-eminent for the high character and efficiency of its officers is by universal consent the Royal Navy. And this is also distinguished from the rest by the fact that from the very first the training given is mainly a training in scientific methods, whilst the very subjects which are alleged by so many instructors of youth to be essential to a scheme of general education are rigorously excluded. We have here, in fact, an experiment in education which has been conducted on a large enough scale for us to draw definite conclusions from it, and I venture to say, without fear of contradiction, that the results are altogether in favour of the proposal to substitute science for classics in the schools and universities of this country.

Lastly, let us look for a moment at the sentimental side. More than one recent writer has argued as a proof of the efficiency of the existing system that if it is productive of no other benefit, the experience of the present war has shown that it has at least taught our boys how to die. The obvious answer to this appeal to sentiment is that the lesson has been just as well learned by those who have not passed under the classical yoke. Men of all classes of the community have done their duty equally bravely and unflinchingly. The courage and self-sacrifice which have been so abundantly displayed in our fighting Services and their auxiliaries cannot therefore be looked upon as the result of this or that system of education, but must be regarded as part of the common heritage of our race, of which we may all be justly proud. There is, besides, one thing which is of equal, or even greater importance than the knowledge of how to die, and that is the knowledge of how to live. Nevertheless, we are content to be ignorant of everything that pertains to our bodily life; ignorant of the functions of our organs, of their maintenance in health, of the evils which follow the abuse of those functions, of the relation of our bodies to their environment, of everything which tends to develop a healthy mind in a healthy body. True, many of us muddle through somehow in spite of this ignorance, but far too many suffer severely on account of it, and one of the benefits which will accrue from a diffused knowledge of science will be apparent in an enhanced interest in all questions affecting the health of the individual and the community. An educational curriculum which offers nothing beyond a little Greek and Latin must, by its very nature, produce an unfertile soil, permanently incapable of encouraging the growth of such knowledge as is of real value in the battle of life.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An exhibition of 50*l.* a year, tenable for two years, is offered each year by the governing body of Emmanuel College to a research student commencing residence at Cambridge as a member of Emmanuel College in October. Applications, accompanied by two certificates of good character, should be sent to the Master of Emmanuel not later than September 24.

LONDON.—The report of the Vice-Chancellor on the work of the University during the year 1915–16 gives many interesting particulars as to the war work accomplished by the University. The total number of commissions granted to cadets and ex-cadets of the University Contingent of the Officers Training Corps since the outbreak of the war is 2031, and of com-

missions granted to other graduates and students is 273. Honours and distinctions conferred include one Companionship of the Bath, one Victoria Cross, thirty Military Crosses, and seventy-eight Mentions in Despatches. Eighty-nine members of the contingent have fallen in the war. Returns received already from schools and institutions of the University show that upwards of 600 members of the staffs, and more than 6000 of their present and former students, have gone to the war. During the year the number of these who have given their lives has been 226. A large number of professors, demonstrators, and others, both teachers and students, are engaged in assisting the national authorities as chemists, physicists, engineers, and otherwise.

OXFORD.—The statute providing that original experimental investigation shall be a necessary condition for obtaining a class in the honour school of chemistry passed Convocation on May 16 without a division. This marks an important new departure in the regulation of chemical work at Oxford. It is hoped in many quarters that the principle thus established may be widely extended, so as to affect other scientific subjects besides chemistry.

The Halley Lecture for 1916 will be delivered in the Hall of Queen's College at 8.30 p.m. on Saturday, May 20, by Dr. G. W. Walker, late fellow of Trinity College, Cambridge. His subject is "The Measurement of Earthquakes."

SHEFFIELD.—Under the will of the late Mr. W. Edgar Allen, for many years chairman of Messrs. Edgar Allen and Company, Ltd., Imperial Steel Works, Sheffield, the sum of 32,000*l.* has just been paid to the University. Mr. Edgar Allen left estate of the gross value of 271,068*l.*, of which the net personalty was sworn at 251,792*l.* Among the numerous legacies for Sheffield institutions was the whole of his books for the University library, of which Mr. Allen was the donor. He also appointed the University one of the residuary legatees. Two-fifths of the residue of the property was to go to the University of Sheffield, one-fifth to Dr. Barnardo's Homes for general purposes, one-fifth to the Church Army for general purposes, and one-fifth to the Salvation Army for general purposes.

The 32,000*l.* mentioned is part of the residue of the estate, though when the distribution is completed the University will most likely receive further substantial proof of the late Mr. Allen's thoughtful generosity. The sum of 5000*l.* is intended by the will for the Applied Science Department of the University, and the balance is to go to University scholarships, half of the sum to be reserved for the sons of workingmen.

Sir Joseph Jonas, chairman of the Applied Science Committee, who has been a generous supporter of the University from the time of its inception, was a close friend of the late Mr. Allen, and he agreed to give 5000*l.* to the Applied Science Department, and this, with the sum left by Mr. Allen—10,000*l.* in all—will be devoted to the provision of materials-testing laboratories for the department, to be known respectively as "The Edgar Allen Physical Testing Laboratory" and "The Jonas Mechanical Testing Laboratory." In regard to any further amount which may still be received under Mr. Allen's will, this sum will be set aside for the provision of further scholarships.

SUMMER evening classes began at the Manchester Municipal School of Technology on May 15. From the prospectus, a copy of which has been received, we find that classes at low fees have been arranged in numerous branches of mechanical, electrical, municipal, and sanitary engineering, chemical technology, mining, the textile industries, and in some departments of pure science. That Manchester students are willing to devote themselves to evening study during the summer months is a satisfactory indication of their earnest intention to qualify themselves to take a worthy part in the international industrial competition of the future.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 11.—Sir J. J. Thomson, president, in the chair.—Major P. A. **Macmahon**: Seventh memoir on the partition of numbers. A detailed study of the enumeration of the partitions of multipartite numbers. Whereas a unipartite number m enumerates objects of the same species, a multipartite number m_1, m_2, m_3... may be regarded as numbering objects which involve similarities. The problem is the partition of a multipartite, or dividing up into sets of objects a given assemblage of objects, the division being subject to various governing conditions. The author showed long ago that the solution is implicitly contained in the algebra of symmetric functions. The difficulty has been in the evaluation of numerical coefficients which arise in the development of the symmetric function which presents itself as the solution for a particularly specified problem of partition. The discovery of the paper is principally that there exists a set of symmetric functions, Q_1, Q_2, ... Q_i..., such that the effect of any one of the operations upon the product $Q_1^{k_1}, Q_2^{k_2}, \ldots Q_i^{k_i} \ldots$ is merely to multiply it by an easily ascertainable integer, combined with the circumstance that the symmetric function operand can be expanded in terms of such products. The result is that laws are obtained. It is established that under any given conditions enumeration in regard to a unipartite number m_s is given by the expression $\lambda a_s + \mu b_s + \nu c_s \ldots$ wherein λ, μ, ν, ... are constants. Then the enumeration in regard to a multipartite number $m_1, m_2, \ldots m_s$ is given by

$$\lambda a_1 a_2 \ldots a_s + \mu b_1 b_2 \ldots b_s + \nu c_1 c_2 \ldots c_s + \ldots\ldots$$

It is therefore only necessary to obtain the unipartite solution in the form above given, when the multipartite solution at once follows. The set of functions Q can be modified to meet any specified conditions of partition. The complete solution of the problem of multipartite partition has thus been reached.—Lord **Rayleigh**: Legendre's function $P_n(\theta)$ when n is great and θ has any value. As is well known, an approximate formula for Legendre's function $P_n(\theta)$, when n is very large, was given by Laplace. The subject has been treated with great generality by Hobson, who has developed the complete series proceeding by descending powers of n, not only for P_n, but also for the "associated functions." The generality arrived at by Hobson requires the use of advanced mathematical methods. A simpler derivation, sufficient for practical purposes and more within the reach of physicists with a smaller mathematical equipment, may be useful. It had, indeed, been worked out independently. The series, of which Laplace's expression constitutes the first term, is arithmetically useful only when $n\theta$ is at least moderately large. On the other hand, when θ is small, P_n tends to identify itself with the Bessel's function, $J_0(n\theta)$, as was first remarked by Mehler. A further development of this approximation is here proposed. Finally, a comparison of the results of the two methods of approximation with the numbers calculated by A. Lodge for $n=20$ is exhibited.—Prof. A. **Dendy**: The occurrence of gelatinous spicules and their mode of origin in a new genus of siliceous sponges.

Collosclerophora arenacea, n. gen., n. sp., a sand-sponge from Australia, contains an entirely new type of spicule, for which the name *collosclere* is proposed, and similar spicules are met with in another species from the Indian Ocean. The collosclere differs from all spicules previously known in the fact that it consists of a gelatinous material, contracting on the addition of alcohol and swelling up again on the addition of water. Evidence is brought forward to show that these spicules are composed of colloidal silica containing a higher percentage of water than the hydrated silica or opal of which ordinary siliceous spicules are composed. The collosclerés lie in vesicles in the mesoglœa, but these vesicles do not represent the mother-cells or scleroblasts by which they are secreted. On the contrary, the collosclere is an extra-cellular product, and first appears as a knob on the outer surface of the cell-membrane of a large spherical scleroblast. The collosclerés may be homologous with isochelæ, but the supposed intra-cellular origin of the chelate and other microsclerés must be re-investigated before this point can be established.—E. S. **Goodrich**: The classification of the Reptilia. The group Reptilia represents not a true monophyletic class, like the class Mammalia and the class Aves, but rather an assemblage or grade of Amniotes retaining a more primitive general structure. The Reptilia thus include a basal Protosaurian group of amphibian-like forms leading to a central point, from which diverge two main branches—the Sauropsidan branch leading to the birds, and the Theropsidan branch leading to the mammals. The modern classification of the reptiles, based chiefly on the structure of the skull, is in a very uncertain state. There is a great difference of opinion as to the relationship of the various orders. Certain specialisations in the skeleton of the hind foot and in the structure of the heart and great vessels (in living forms) are of great importance in classification, and deserve more weight than has hitherto been attributed to them. The development of a hook-shaped fifth metatarsal and of a metatarsal articulation, and the subdivision of the aortic trunk so as to form two systematic arches crossing at their base in such a way as to become separated by the interventricular septum, clearly distinguish the Sauropsidan from the Theropsidan line of evolution. The possession of these characters shows that all living Reptilia belong to the Sauropsidan group, while the structure of the foot enables us to determine the affinities of many incompletely known fossil genera, and to conclude that only certain extinct orders can belong to the Theropsidan branch.—Dr. R. **McCarrison**: The experimental production of congenital goitre.

Mathematical Society, May 11.—Sir Joseph Larmor, president, in the chair.—Prof. H. M. **Macdonald**: A note on electrostatic problems.—G. B. **Jeffery**: The relations between spherical, cylindrical, and spheroidal harmonics.—E. K. **Wakeford**: The double six.—J. G. **Leathem**: Theorems on conformal transformation.—G. H. **Hardy** and S. **Ramanujan**: A problem in the analytic theory of numbers.

EDINBURGH.

Royal Society, May 1.—Dr. J. Horne, president, in the chair.—Dr. H. **Rainy** and Miss C. M. **Hawick**: A clinical method for the estimation of sugars in the blood. The method was a modification of the method described by Bang, and had advantages over other methods on account of the small quantity of blood which was required and the comparatively short time in which the tests and measurements were made. The method was also equally applicable to the estimation of sugar in the urine. Experiments showed that the blood sugar rose very rapidly to its maximum, while in the kidneys the maximum was not reached until an hour later.—Dr. A. E. **Cameron**: The insect association of a local environmental complex in the district of Holmes Chapel, Cheshire. The districts with which the study is concerned were two fields, Glover's Meadow and the alluvial pasture situated in the farm land of the Holmes Chapel Agricultural College. In these fields the soils were respectively a reddish clay loam and a dark-coloured loam. The plant environment and its relation to the insects were fully considered; also the physical factors of the environment, such as water content, humidity, light, temperature, precipitation, wind, soil, exposure, slope, and the like. The index of an insect's habitat is where it breeds, and it is important to recognise endemic forms which are proper to an association and polydemic forms which are invaders. Detailed accounts were given of the various orders of insects found, such as Diptera, Coleoptera, Neuroptera, Apterygota, Hymenoptera, etc.; and the facts were brought together in a series of tables, showing the months of occurrence of the different species, their habits, and the plants with which they were associated. Another point of interest was the relation of the soil-inhabiting insects to the food habits of ground-feeding birds.

PARIS.

Academy of Sciences, May 1.—M. Camille Jordan in the chair.—G. **Lemoine**: The catalysis of hydrogen peroxide in heterogeneous medium. Second part: experiments with platinum. Experiments were carried out with distilled hydrogen peroxide containing 8·6 per cent. of the pure peroxide, in contact with platinum black and platinum sponge, both at a constant temperature. The results are given in graphical form. The velocity of decomposition increases with the weight of the catalyser and with the state of division of the platinum. Comparison of platinum black with the sponge, in approximately the same state of division, shows that the platinum black exerts a special catalytic action, much more energetic, and due to a distinct cause.—H. **Le Chatelier**: Science in its relations with the economic development of a country.—A. **Righi**: Experiments relating to the influence of the magnetic field on the charge of a conductor in rarefied air. Details of an experiment which, in the opinion of the author, renders necessary the hypothesis of magneto-ionisation, the action of the magnetic field favouring ionisation by shock.—E. **Kogbetliantz**: The Sturm-Liouville series simply capable of summation.—G. **Vacca**: The *Harmonicon coeleste* of François Viète.—G. **Bigourdan**: Remarks on the preceding note.—A. **Bilimovitch**: The trajectories of a non-holonomial system.—T. **Peczalski**: The determination of the law of integral radiation of a solid from the light yield.—E. **Moles**: The absolute density of gaseous hydrobromic acid. The gas was prepared by two independent methods, liquefied, and purified by fractional distillation. The figures obtained for a litre of the gas under normal conditions varied between 3·6439 and 3·6447 grams, with a mean of 3·6444 grams.—L. **Reutter**: The analysis of two resinous masses used by the Incas of South America for embalming their dead. These consisted mainly of Peru and Tolu balsams, with some volatile essences containing menthol.—P. de **Sousa**: Contribution to the petrographical study of the south-west of Angola.—V. **Raymond** and J. **Parisot**: The etiology, prophylaxy, and therapeutics of the affection called trench feet. This affection appears to be due to a pathological fungus, *Scopulariopsis Koningii*.

WASHINGTON, D.C.

National Academy of Sciences (Proceedings No. 4, vol. ii., April 15).—By the committee of the National Academy of Sciences appointed at the request of the President of the United States: Preliminary report upon the possibility of controlling the land slides adjacent to the Panama Canal.—H. **Shapley**: Discovery of eight variable stellar spectra. It appears safe to infer that all Cepheids (including the cluster-type), besides being variable in light and in velocity, vary periodically in spectral class.—G. M. **Green**: The linear dependence of functions of several variables, and certain completely integrable systems of partial differential equations. The theory of linear dependence is generalised to the case of n functions of several independent variables, and is applied to the study of an important class of systems of partial differential equations.—B. **Boss**: Systematic motion among stars of the helium type. There appears to be a strong tendency for the helium stars to move in their own plane, which should therefore be preserved, at least until the next step in the star's evolution. But there are likewise strong tendencies on the part of helium type stars to depart from the plane, so that the tendency for the stars to spread in every direction has its birth in the helium stage of evolution.—W. D. **Harkins**: The abundance of the elements in relation to the hydrogen-helium structure of the atoms. A spiral form of the periodic table is given. The elements are found to arrange themselves in three cycles containing respectively 4^2, 6^2, 8^2 elements, the last being incomplete. The even-numbered, or helium-system, elements are very much more abundant in nature than those of the odd-numbered, or lithium, system.—C. **Wissler**: The genetic relations of certain forms in American aboriginal art. The investigation reveals several good examples of the genesis of specific decorative designs growing out of attempts to embellish surfaces of fixed contour and to conceal unsightly lines.—C. E. **St. John**: The situation in regard to Rowland's preliminary table of solar spectrum wave-lengths. The general transformation from the system of Rowland wave-lengths to the international wave-lengths is a matter of the greatest difficulty, even though the relative wave-lengths in each system be free from error; and statistical comparison between different systems is a procedure fraught with the possibilities of introducing residuals that may be quite misleading.—E. P. **Hubble**: Changes in the form of the nebula N.G.C. 2261. The nebula appears to be turning about its own axis after the manner of a top, and there is some indication of a helical motion towards the nucleus. The observed shifts seem to be rather of mass than illumination, and are independent of the variability of the nucleus.—Ruth B. **Howland**: The effect of removal of the pronephros of the amphibian embryo. Removal of both pronephroi leads to œdema and death, though the presence of one is sufficient to keep the embryo healthy, bringing about an increase in size in the remaining organ.—R. **Ruedemann**: The presence of a median eye in trilobites. The question of the presence or absence in trilobites of the median eye is of considerable phylogenetic importance. The median eye appears in the majority of cases as a single tubercle, and there is evidence for the visual function of the tubercle.—W. J. V. **Osterhout**: The nature of mechanical stimulation. In this conception of mechanical stimulation the essential things are:—(1) Substances which are more or less completely prevented from reacting by semi-permeable surfaces; (2) a deformation of the protoplasm sufficient to produce in some of these surfaces a rupture which is not at once repaired; (3) a resulting reaction which produces the characteristic response to the stimulus.—R. E. **Clausen** and T. H. **Goodspeed**: Hereditary reaction-system relations: an extension of Mendelian concepts. The mechanical Mendelistic theory of Morgan is applied in the study of Nicotiana, and it is suggested that by the application of such conceptions to Œnothera the occurrence of mutants and their subsequent behaviour admit of logical interpretation.—A. B. **Coble**: Point sets and allied Cremona groups (part ii.). Theorems such as the following:—A pencil of plane cubic curves can be transformed by ternary Cremona transformation into only 960 projectively distinct pencils of cubics—are proved.—M. B. **Porter**: A theorem of Lucas. A simple proof is given for Lucas's theorem that the zeros of any polynomial $F'(z)$ lie inside any closed convex contour inside of which the zeros of $F(z)$ are, and the theorem is extended to give information concerning the distribution of zeros of the derivative of certain relational or transcendental functions.—E. J. **Wilczynski**: Interpretation of the simplest integral invariant of projective geometry.—W. E. **Castle**: Size inheritance in guinea-pig crosses. Preliminary studies published in 1909 showed that size and weight in rabbits do not follow the Mendelian rules of dominance and segregation as unit-characters. A large amount of material being now available upon guinea-pigs, attention is invited to the nature of the growth curves observed for the races crossed and to non-genetic, as well as genetic, factors affecting size. From these crosses there is no evidence showing either the existence of numerous multiple Mendelian factors, or of a few Mendelian factors, or of a single Mendelian factor affecting size.

BOOKS RECEIVED.

Subtropical Vegetable-Gardening. By P. H. Rolfs. Pp. xviii+309. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 6*s*. 6*d*. net.

The Mechanical Engineers' Pocket-Book. By W. Kent. 9th edition, revised, with the assistance of R. T. Kent. Pp. xliv+1526. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s*. net.

Theory and Applications of Finite Groups. By Profs. G. A. Miller, H. F. Blickfeldt, and L. E. Dickson. Pp. xvii+390. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 17*s*. net.

Modes of Research in Genetics. By Raymond Pearl. Pp. vii+182. (New York: The Macmillan Company; London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Chemists' Year Book, 1916. Edited by F. W. Atack. Vol. i., pp. 354. Vol ii., pp. 355 to 990. (London and Manchester: Sherratt and Hughes.) 10*s*. 6*d*. net.

Union of South Africa. Report of the South African Museum for the Year ended December 31, 1915. Pp. 12. (Cape Town: *Cape Times*, Ltd.)

Canada. Department of Mines. Geological Survey. Memoir 58, No. 48, Geological Series: Texada Island, B.C. By R. G. McConnell. Pp. v+112. Memoir 72, No. 60, Geological Series: The Artesian Wells of Montreal. By C. L. Cumming. Pp. v+153. Memoir 76, No. 62, Geological Series: Geology of Cranbrook Map-Area, B.C. By S. J. Schofield. Pp. vii+245. Museum Bulletin No. 22, Geological Series, No. 31: The Age of Killarney Granite. By W. H. Collins. Pp. 12. (Ottawa: Government Printing Bureau.)

British Mycological Society. Vol. v., part 2: Transactions for the Season 1915. (Worcester: Baylis and Son.) 10*s*. 6*d*.

The Drink Problem of To-day in its Medico-Sociological Aspects. Edited by Dr. T. N. Kelynack. Pp.

xii+318. (London: Methuen and Co., Ltd.) 7s. 6d. net.

The *Athenaeum* Subject Index to Periodicals, 1915. Anthropology and Folk-Lore. Pp. 32. (London: *Athenaeum* Office.) 1s. 6d. net.

Rapport Annuel sur l'Etat de l'Observatoire de Paris, 1914. By P. Baillaud. Pp. 38. 1915. By P. Baillaud. Pp. 28. (Paris: Imprimerie Nationale.)

Les Racines des Plantes Herbacées. By A. P. Modestov. Livr. 1 (Publications 1–4). Pp. 138. (Moscow.)

The Bacterial Infection of Fresh Eggs. Bulletin 164. Agricultural Experiment Station of the Rhode Island State College, Kingston, R.I., U.S.A. Pp. 70 (Kingston, R.I.)

British Sea Fish. By H. Swithinbank and G. E. Bullen. Pp. xi+35. (London: Simpkin, Marshall and Co., Ltd.) 2s. net.

U.S. Department of Agriculture. Bureau of Biological Survey. North American Fauna. No. 37: Revision of the American Marmots. By A. H. Howell. Pp. 80+plates xv. No. 38: A Review of the American Moles. By H. H. T. Jackson. Pp. 100+plates vi. (Washington: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. lxii., No. 4: Hodgkins Fund. Reports on Wind Tunnel Experiments in Aerodynamics. By J. C. Hunsaker, E. Buckingham, and others. With five plates. (Washington: Smithsonian Institution.)

Smithsonian Miscellaneous Collections. Vol. lxiv., No. 3: Cambrian Geology and Paleontology, III. No. 3, Cambrian Trilobites. By C. D. Walcott. Pp. 157 to 258+plates 24 to 38. Vol. lxv., No. 14: The Sense Organs on the Mouth-parts of the Honey Bee. By N. E. McIndoo. Pp. 55. (Washington: Smithsonian Institution.)

United States Department of Agriculture. Report No. 108: The Acarina, or Mites. By N. Banks. Pp. 153. (Washington: Government Printing Office.)

Annals of the Missouri Botanical Garden. Vol. ii., No. 4. Pp. 659–841. (St. Louis, Mo.: Board of Trustees.)

University of Nevada Agricultural Experiment Station, Reno, Nevada. Bulletin No. 83, Technical: The Value of High-Level Meteorological Data in Forecasting Changes of Temperature. By Prof. S. P. Ferguson. Pp. 30. (Reno, Nevada: The University.)

The Daubeny Laboratory Register, 1904–1915, with Notes on the Teaching of Natural Philosophy, and with Lists of Scientific Researches carried out by Members of Magdalen College, Oxford. By R. T. Günther. Pp. x+139 to 292. (Oxford: Printed for the Subscribers at the University Press.) 7s. 6d. net.

Department of Commerce. Technologic Papers of the Bureau of Standards. No. 53: An Investigation of Fusible Tin Boiler Plugs. By G. K. Burgess and P. D. Merica. Pp. 37. (Washington: Government Printing Office.)

DIARY OF SOCIETIES.

THURSDAY, MAY 18.

ROYAL SOCIETY, at 4.30.—An Active Modification of Nitrogen: Hon. R. J. Strutt.—A Theory of Colour Vision: Dr. R. A. Houstoun.—Linkages Illustrating the Cubic Transformation of Elliptic Functions: Col. R. L. Hippisley.

ROYAL INSTITUTION, at 3.—Flints and Flint Implements: Sir Ray Lankester.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Notes on the Possibility of Ascending the Loftier Himalaya: Dr. A. M. Kellas.

CHEMICAL SOCIETY, at 8.—New Standpoints in the Chemical Study of Nutrition: Prof. F. Gowland Hopkins.

FRIDAY, MAY 19.

ROYAL INSTITUTION, at 5.30.—The Movements of the Earth's Pole: Col. E. H. Hills.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Spur-Gearing: D. Adamson.

SATURDAY, MAY 20.

ROYAL INSTITUTION, at 3.—The Finance of the Great War—New Problems and New Solutions: Prof. H. S. Foxwell.

MONDAY, MAY 22.

ROYAL GEOGRAPHICAL SOCIETY, at 3.—Anniversary General Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—Vibrations, Waves, and Resonance: Dr. J. Erskine-Murray.

TUESDAY, MAY 23.

ROYAL INSTITUTION, at 3.—Unconscious Nerves—their Functions in External Life: Prof. C. S. Sherrington.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 5.—The Canoes of British New Guinea: Dr. A. C. Haddon.

ZOOLOGICAL SOCIETY, at 5.30.—The Structure of the Skull in Chrysochloris: Lieut. R. Broom.—Note on the Sternum of a Bird from the Eocene of Nigeria: Dr. C. W. Andrews.—A Mammalian Mandible from the Cretaceous of Alberta, Canada: Dr. A. Smith Woodward.—(1) List of Carabidæ (Coleoptera) from Chopersk District, South Russia; (2) A New Species of the Genus Platysma (Coleoptera) from China; (3) Notes on Species of the Genus Platysma from Australia: V. Lutshnik.

WEDNESDAY, MAY 24.

GEOLOGICAL SOCIETY, at 5.30.

LINNEAN SOCIETY, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS, at 4.30.—Zinc: Its Production and Industrial Applications: J. C. Moulden.

THURSDAY, MAY 25.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: X-Rays and the Theory of Radiation: Prof. C. G. Barkla.

ROYAL INSTITUTION, at 3.—The Beginnings of the Orchestra and its Instrumental Combinations: Sir Alexander Mackenzie.

FRIDAY, MAY 26.

ROYAL INSTITUTION, at 5.30.—X-Rays: Prof. C. G. Barkla.

SATURDAY, MAY 27.

ROYAL INSTITUTION, at 3.—The Finance of the Great War: Prof. H. S. Foxwell.

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