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THE MNEMIC THEORY OF HEREDITY.

Die Mneme als erhaltendes Prinzip in Wechsel des Organischen Geschehens. By R. Semon. Dritte Auflage. Pp. xviii+420. (Leipzig: W. Engelmann, 1911.) Price 10 marks.

THE theory of heredity which is associated more especially with the names of Ewald Hering, Samuel Butler, and Richard Semon, and endeavours to explain the phenomena of inheritance as due to a kind of unconscious memory, on the part of the developing organism, of the experiences of past generations, has not, at any rate in this country, met with a very large measure of acceptance. It is a noteworthy fact, however, that in 1908 Mr. Francis Darwin made it the subject of his presidential address to the British Association at Dublin, and expressed views which correspond very closely with those of the authors mentioned.

The mnemic theory, which is based upon a belief in the inheritance of acquired characters, naturally does not appeal to those who deny the possibility of such inheritance. The position taken up with regard to this question by Prof. Weismann and his followers, however, can scarcely be maintained much longer in face of the rapidly accumulating evidence which, it must be confessed, their unbelief has been perhaps the chief agent in eliciting.

Prof. Semon quotes several instances of this evidence in the work before us, the most convincing of which appears to be that obtained by M. E. Bordage in the case of peach trees. It has long been known that European trees, when grown in tropical or semi-tropical countries, tend to lose their deciduous character and become evergreen. This is the case in the Island of Réunion, where M. Bordage conducted his experiments. He found that in the course of twenty years peach trees imported from Europe become almost completely evergreen. This, of course, is an individual somatogenic, or so-called "acquired" character; but when seeds of these modified trees are sown in certain mountain districts where they are exposed to a considerable amount of frost, they produce young peach trees which are also evergreen, although seeds imported from Europe and sown in similar situations produce normal deciduous trees.

It is true that an attempt has been made with regard to such cases to uphold the Weismannian position by suggesting that the stimulus of changed environment affects both the somatic cells and the germ cells of the parent simultaneously, by what is called "parallel induction," so that the germ cells are modified in a corresponding fashion to the somatic cells, and will therefore give rise to similarly modified offspring; but this certainly looks very like a last attempt to maintain an untenable position, and, in any case, as Sumner and Semon have pointed out, it makes no difference as regards the importance of the action of the environment as a factor in organic evolution whether we suppose the effect upon the germ cells to be produced by "parallel" or by "somatic induction."

The mnemic theory assumes that the germ cells are not, as Weismann would have us believe, shut off from the influence of the body or soma, but that they are, like other cells, and more especially the nerve cells, capable of responding to stimuli by some definite alteration in their condition. The stimuli to which they respond are changes in what Semon calls the "energetic situation" of the whole organism. The effects of such changes are supposed to be impressed upon the germ cells as "engrams," and are of a lasting character.

We may here translate Semon's two mnemic "laws" ("Hauptsätze"):—

First Mnemic Law (*Law of Engraphy*).—All simultaneously acting stimuli within an organism form a coherent simultaneous stimulation-complex, which acts engraphically as such, *i.e.* which leaves behind a coherent and to that extent a unified engram-complex.

Second Mnemic Law (*Law of Ekphory*).—The partial recurrence of the energetic situation, which has previously acted engraphically, acts ekphorically upon a simultaneous engram-complex. To speak more precisely: the partial recurrence of the stimulation-complex which left behind it the engram-complex acts ekphorically upon a simultaneous engram-complex, whether it be a recurrence in the form of the original stimuli or of mnemic stimuli.

It is perhaps scarcely necessary to point out that by "Ekphorie" Semon means the calling forth again of the latent engrams by some appropriate stimulus, whereby they become manifested in the organism.

The condition of the germ cells is thus supposed to be more or less permanently modified by changes in the "energetic situation" of the parent body, and such modifications affect the development of the germ cells because the engrams are called forth in due sequence by appropriate stimuli and express themselves in corresponding modifications of the body of the offspring.

The germ cells are thus stored with the latent "memories" of past generations, and they may contain many engrams that may never get the chance to express themselves in any particular individual ontogeny. Thus a number of alternative routes are open to each individual at the commencement of its life-history, and the particular route followed will depend upon the nature of the stimuli which the developing organism happens to encounter.

Semon finds confirmation of these views in the experiments of Kammerer upon the toad, *Alytes obstetricans*. It is well known that most frogs and toads deposit their eggs in water, where the male embraces the female and squeezes the eggs from her by the pressure of his arms. As the eggs pass out they are fertilised, their gelatinous envelopes swell up, and they adhere together to form the spawn. In adaptation to this habit the forefinger of the male exhibits a characteristic pad or swelling, and the musculature of the forearm is hypertrophied.

In the obstetric toad, on the other hand, sexual union, followed by the fertilisation and deposition of the eggs, takes place on land. The eggs are larger and contain more yolk, and are produced in much smaller numbers. The male assists in the removal of the eggs from the female by means of his hind

legs, and as there is no water to cause the gelatinous envelopes to swell up, they remain sticky and adhere to his legs. No pads are developed on the forefingers, at any rate in the race with which the experiments were made. Thus these toads have departed widely from the ancestral habits of the Anura, but Kammerer discovered that they could be made to return to those habits in a very simple manner by environmental stimuli.

If the animals are kept at a relatively high temperature (25—30° C.) they are induced to seek the water in order to cool themselves, and there the processes of egg-laying and fertilisation take place. The gelatinous envelopes of the eggs now swell up and refuse to adhere to the legs of the male, and the spawn is accordingly left to take care of itself in the water. The animals become gradually accustomed, during several breeding periods, to this altered mode of procedure, and will at length behave in the same way even at the normal temperature. At the same time, the number of eggs which they lay increases and the eggs become smaller and poorer in yolk, and therefore more like those of ordinary frogs and toads.

More important, however, is the fact that the offspring of these toads are found to be modified in their habits exactly as the parents were. When sexually mature they seek the water, even when kept at the normal temperature, and there unite and deposit their eggs. Still more remarkable is the fact that in the fourth generation of the offspring of these modified toads, kept under the same conditions as the parents, the secondary sexual characters found in frogs and toads which normally lay their eggs in water, and which doubtless occurred also in the ancestors of the obstetric toad, are seen to have reappeared; pads are present on the forefingers of the male, and the musculature of the forearm is hypertrophied. Here, then, we have a case of atavism or reversion brought about by changed environment, and in which crossing or hybridisation has played no part. The ancestral engrams must be latent in the germ cells, and capable of being called forth by the recurrence of the appropriate stimuli; unless, indeed, we suppose that the characters in question have been produced altogether *de novo* by the changed environmental conditions, which seems highly improbable in so short a time.

As regards what we may perhaps call the physico-chemical nature of the engrams, Semon adopts a very cautious attitude. Apparently he objects to the idea of material primordia in the germ cells, and purposely avoids molecular interpretations; but he leaves this question entirely open, except in so far as he regards the engrams as being localised, chiefly, if not exclusively, in the nuclei of the germ cells. He also does not attempt to solve the question as to how the necessary stimuli reach the germ cells. That they do reach them, however, appears to be certain from experimental evidence, and that fact is sufficient as a basis for the mnemic theory of heredity.

The fact that this extremely interesting book has now reached its third edition, having been first published in 1904, affords a sufficient indication of the interest which is taken in Germany in the views so ably expressed by its author. ARTHUR DENDY.

BOY LABOUR AND APPRENTICESHIP.

Boy Labour and Apprenticeship. By Reginald A. Bray. Pp. xi+248. (London: Constable and Co., Ltd., 1911.) Price 5*s.* net.

QUESTIONS relating to industrial administration and regulation are of special interest in a time of widespread unrest in the working community. A marked improvement in trade has followed a long period of depression. A book on boy labour therefore arrives opportunely. The present production is interesting rather as a representation of the points of view of a London County Councillor than as an aid to the solution of the problems connected with the entry of the adolescent into the working community.

To deal in a book with these problems it is necessary to begin with a clear definition of the problems and to discuss them with direct reference to an actual issue. Mr. Bray recognises this necessity, but he has not escaped from the confusion of ideas which is too common where social problems are the subject, and his proposals for reform are definite only in the form of words in which they are embodied, but are hopelessly too vague to form a basis for any procedure. The confusion begins in the first chapter, on "The Essentials of Apprenticeship." It is stated that an apprenticeship system must satisfy three conditions. First, it must provide for the adequate supervision of the boys until they reach the age of eighteen; secondly, it must offer full opportunities of training, both general and special—the training of the citizen and the training of the worker; lastly, it must lead forward to some opening in the ranks of adult labour, for which definite preparation has been made, and in which good character may find reasonable prospects of permanent employment.

These requirements are followed by a general demand that they are to be applied to all boys; apprenticeship must be universal. How these essentials are to be assured is admitted to controversy, but that they ought to be assured is taken as axiomatic. Now if these essentials and their universal application to all boys are to be admitted, clearly they must not be specifically associated with preparation for industrial efficiency of workers, but applied to all classes of the community, and in this sense in a general way the propositions will not be disputed as a pious expression of desirable possibilities.

If suitable supervision can be provided, most people would be the better for it even after the age of eighteen. All training is good. A job of some kind for everybody is devoutly to be wished. But in proceeding to examine what the author calls the old apprenticeship system, he gets off at a tangent from his definition, forgets that he is dealing only with a very small number of the boys who lived in the time of trade guilds, and that the arrangements which he praises lacked the quality of universality, which lack vitiates the comparison which he proposes between the good old times and the present.

The summary of methods of apprenticeship, not in the sense defined in the first chapter, but in the sense of specific contract between employer and employed with mutual obligations, is interesting, but is marred

by interpolated references to individualism, collectivism, competition, &c.

The historical summary of the early part of the nineteenth century in respect to adolescent labour and the Acts relating thereto is germane to the subject, but all through there is a lack of clearness as to the aim of the arguments and voluminous quotations. The author bewails the bad state of what he calls the industrial system, or industrial organisation, when what he really means is that there was no system and no attention by the community as a whole to the organisation of industry. The decay of apprenticeships which he bewails did not arise from the cupidity or caprice of the employers so much as from the actual disappearance of the handicrafts for which the apprentices were being trained.

Another confusion of ideas occurs in connection with the use of the word "State." The author forgets that the "State" is ourselves. He speaks of the "State" as of some superior aloof deity, who is to carry out the requirements which he has laid down as universal for adolescents. The "industrial system," "the employer," "the capitalist," "the manufacturer," are used as terms antithetical to the "State." Again, the chapter on the guardianship of the State is a short summary of the laws relating to child labour. Here again, however, the author is dealing with a particular part of his general proposition, and when he comes to deal with the question of education he necessarily returns to very vague generalities.

The book closes with a series of "definite" proposals. None of these proposals takes any account of the boy's own attitude to the question.

1. That the school age should be raised to fifteen.

2. That the boy should be under the supervision of Government officials until he is eighteen. That the Labour Exchanges and the Advisory Committees attached to them are to keep in touch with every boy by official and voluntary visitors during these three years.

3. That the employment of boys between fifteen and eighteen should be restricted to half-time.

4. That they should be regularly medically inspected during those years.

5. That the Advisory Committees in connection with the Labour Exchanges should find jobs for all boys.

The author omits to make any suggestions for the specific organisation of the vast additional public service outlined, except that he places it in the hands of the Board of Trade. Still less does he show how the community—that is to say, ourselves—is to be induced to go on working for our offspring until all of them are eighteen years of age, or to beg from our neighbours who have none the means wherewith to feed and clothe them. It is quite simple to put these functions on the "State" as a duty, but it does not look quite so simple when we call the "State" by its other name.

He does not realise that the London County Council may go much farther in making social experiments than the State can, and that London is becoming a bad place for the study of social economics other than those associated with its own special conditions. The taxable capacity of London is considerable, and it is therefore a good place for sanguine people imbued with "the sentiment of humanity" and "imaginative reason" to make social experiments from which other parts of the country may learn useful lessons both of a negative and positive character.

The happy picture of elementary and secondary education under the County Council will amuse some of its ill-natured critics, and the suggestion that all the youths of the country should be subjected to the supervision of the "State" or the L.C.C. until they are eighteen years old, because parents and employers are no longer to be trusted to discipline and train except as voluntary assistants to Advisory Committees at the Labour Exchanges, will seem humorous to anyone who can appreciate a solemn jest.

BRITISH AND IRISH FRESH-WATER FISHES.

The Fresh-water Fishes of the British Isles. By C. Tate Regan. Pp. xxv+287. (London: Methuen and Co., Ltd., 1911.) Price 6*s*.

MR. REGAN is to be congratulated upon the publication of this little manual, which should find a place in the library of every person who takes an interest in the natural history of our islands. The lack of a convenient manual of moderate size and modest price must often have been felt by many besides ourselves, and this want has been well supplied by the book now before us. Concise but adequate descriptions are given of all fishes native to the fresh waters of these islands, including such marine and estuarine species as are known to ascend into fresh water, and in our opinion Mr. Regan's work marks a distinct step in advance of any of its predecessors. The figures have been drawn by the author himself, and are well adapted for showing the salient features of the fishes illustrated; in one or two instances they have been drawn from examples which have barely attained the characters of adult fish, but this is not really a matter of very great moment, for the changes due to age, sex, and maturity in each species are generally pointed out in the text and the size of the examples figured is given. The importance of the latter information is, unfortunately, not always as fully appreciated by those who describe fishes as by those who have to identify particular individuals with the aid of the descriptions and figures given.

The vast bulk of our fresh-water fishes are either salmonids or cyprinoids, and the treatment of these families by Mr. Regan is in some respects fuller than that accorded by any earlier author. Probably few families provide greater puzzles for the framer of specific definitions than the Salmonidæ, and it is not to be expected that the course adopted by Mr. Regan in recognising no fewer than fifteen species of char and eight of whitefish will commend itself to all his readers. What constitutes a species is, however, a question upon which any person in possession of the requisite information may form his own views; the point of practical importance is that Mr. Regan has given us by far the fullest extant descriptions of the numerous forms (whether regarded as species, subspecies, races, or varieties) of char and whitefish found in the lakes of Great Britain and Ireland. In this he

has been aided by the excellent series of specimens now in the collection of the Natural History Museum, the formation of which was, we believe, largely due to his own exertions, and it is much to be hoped that it will not be long before this series is completed by the addition of examples from any lakes the char or whitefish of which are still unrepresented in the national collection.

Although the whitefish of Lochs Lomond and Eck, of the English lakes, and of Bala Lake were treated by Mr. Regan as subspecies of a single species in 1908, he now treats them on pages 121–5 as representing three substantive species, but states on p. 263 that they "are only local forms of one species, which is closely related to *Coregonus wartmanni* of the Alps, to forms inhabiting Scandinavia, and to anadromous Arctic species." Both this and his statement that the "species" of char are "of quite another nature from widely distributed forms, such as the pike or roach," give some indication of the difficulty which he has himself felt in adopting his present position.

The cyprinoids present a difficulty of a quite different nature; they are normally gregarious fishes, many well-defined species of which are found in the same waters, and the rudd is proverbial in northern Europe for its disregard of specific distinctions when on the spawning-beds. In these circumstances natural hybrids are by no means infrequent, and in carefully describing and often figuring these Mr. Regan has rendered readily available information which was previously only accessible to those who were conversant with purely scientific literature.

The results of recent researches into the life-histories of the salmon and the eel are carefully and clearly summarised, and some information as to the life-histories of other species is given; but the statement that the eggs of the roach are shed on the bottom is, if not inaccurate, at least not universally true. We cannot blame Mr. Regan for the very inadequate accounts given of the breeding, eggs, and larvæ of many species, for these are matters which have been much neglected by naturalists and particularly by British and Irish naturalists, and the available information is, at the best, somewhat meagre. We think, however, that descriptions (and dimensions) ought to have been given of the eggs and larvæ of such fishes as the shads, the pike, and at least one typical cyprinoid; such information is to be found in the works of Continental writers, and is of considerable practical value both to the naturalist and the fisherman.

Care has been taken throughout to verify the size and weight attained by each species, and; in the case of the pike, the history of the great fish of Loch Ken is given in some detail, and an account of the large pike taken when Whittlesea Mere was drained is given in an appendix.

The final chapter, which deals with the origin and geographical distribution of our fresh-water fishes, is, perhaps, one of the most interesting in a book which throughout reflects great credit upon both author and publishers, and deserves to become a standard work.

L. W. B.

STUDIES OF BIRD-LIFE IN UGANDA.

Studies of Bird-life in Uganda. By Dr. R. A. L. van Someren and V. G. L. van Someren. (London: John Bale, Sons, and Danielsson, Ltd., 1911.) Price *1l.* 11*s.* 6*d.* net.

THESE studies comprise more or less beautiful photographic pictures of the red-headed woodpecker, Egyptian goose, sacred ibis, stone curlew (thicknee), little green-backed heron, sandpiper, rufus-necked nightjar, bateleur eagle, darter, cormorant, black and white African chats, paradise fly-catcher, hagadash ibis, whydah finch, black-headed shrike, crowned crane, and pied kingfisher. The last-named is an excellent picture. That of the crowned cranes is also of interest as showing the appearance of the immature bird at a stage not usually illustrated in museums. The red-headed woodpeckers are also fine pictures. There are some charming studies of ibis and of the little green heron on its nest with eggs; of the darters on their nests amongst the trees, and an excellent figure of their white, downy young; and a characteristic representation of the black chat with a white splash across the wing, which is such a constant and charming feature in Uganda landscapes.

But in a general way it cannot be said that this collection of pictures is remarkably illustrative of bird-life in Uganda. The picture of the Egyptian goose might have been done even better in St. James's Park. The sandpiper also might have come from many other parts of the world, and there are studies of the mature crowned crane issued from the London Zoological Gardens which are better pictures than the one here given. In fact, when we consider the extraordinary wealth of bird-life in Uganda (a wealth scarcely equalled elsewhere in the whole continent, since we have in Uganda a mingling of western, eastern, northern, and southern forms), the reviewer is a little surprised that the authors should not have devoted their photographic skill to a wider and more typical selection. For example, they could have done a great deal to clear up for science disputed points about the marabou stork. Marabous abound in the Uganda Protectorate, and snapshots of the flying marabou would have shown us conclusively whether (as I maintain) it flies with neck outstretched, or whether, as other observers declare, with neck withdrawn, as in the case of herons.

It should not either have been beyond the opportunities of the van Somerens to have given us pictures in a wild state of the *Balaeniceps rex*; or of the splendid blue plantain-eater of the Uganda forests, or the smaller and equally handsome violaceous plantain-eater, especially when the tameness of these birds is taken into consideration. Then there is the handsome saddle-billed stork. There are many types of heron and egret, of duck and goose, never seen in English parks, of barbets and hornbills, which might have been as easily illustrated as the world-wide stone curlew or cormorant.

The notes which accompany these well-executed photographs are of considerable interest. The native name of the bird is always given, together with char-

acteristic stories and proverbs concerning the birds (in one or two instances these are rendered in broken English, which is scarcely necessary, since they are not likely to have been given to the authors in that form). The nesting habits of the birds, the appearance of the nestlings and of the eggs, the times of the breeding season, are supplied, and here one gets a good deal of new information based on careful observation. Even on the subject of the Egyptian geese the remarks contain novel information, as, for example, those describing their habits as tree-perchers. Unlike the real geese (which, of course, they are not), they would seem to pass the night, not on the water, but perched on trees. Yet the nests are not constructed in trees, as is the case with some allied forms, but in shallow depressions of the ground, and after incubation the young at once resort to the water and apparently do not take to the trees until they are able to fly.

The African chat (*Myrmecocichla nigra*) is well described as a merry-looking bird, and his courting attitude is set forth in words exactly corresponding to the picture drawn by me in my own work on the Uganda Protectorate The authors rightly compare the song of the male chat to that of the blackbird. "After feeding the young he would often perch on an ant-hill near by and burst into song as if in pure joy and pride in a lusty family." These chats are certainly the most lovable birds the traveller can meet with throughout East Africa and Uganda. They are very tame, and have a fancy for frequenting native villages or European encampments. Another creature that is well illustrated by photograph and description is the beautiful paradise fly-catcher (*Tchitrea viridis*).

H. H. JOHNSTON.

CACAO-PLANTING.

Cacao: a Manual on the Cultivation and Curing of Cacao. By J. H. Hart. Pp. x+307. (London: Duckworth and Co., 1911.) Price 7*s.* 6*d.* net.

IT is a curious fact that in spite of the enormous political and financial interests possessed by the United Kingdom in tropical countries, and therefore in tropical crops and products, the technical literature on these subjects should be almost entirely exotic. There is, for example, nothing in English to compare with such works as those of Semler and Wiesner in German, or with the several series of handbooks on tropical crops published in France.

This state of things is no doubt due to the fact that serious, organised instruction in tropical agriculture scarcely exists within the British Empire, though it has been found expedient to undertake such work in Holland, Germany, and France, countries the tropical possessions of which are far less important than ours. There are signs, however, of an increased interest being taken in tropical agriculture in this country, and one of them is the occasional publication of a book of the kind now under review.

A sad interest attaches to this book, since though the author was able to see it through the press, he died before it was published. Mr. Hart was well qualified to write on cacao. During his long career in the tropics, he spent no fewer than eighteen years in Trinidad as superintendent of the Botanical Department, and in that capacity was continuously engaged in dealing with the problems that confront cacao planters. He writes therefore with a full knowledge of the needs of planters, and consequently his book is thoroughly practical from a planter's point of view. At the same time, he recognises the provisional character of many of the deductions drawn from past experience, and lays due stress on the necessity for further investigation, and makes many valuable suggestions as to the direction this should take.

Naturally the book is concerned very largely with cacao cultivation and curing as practised in Trinidad, but since that colony produced in 1910 nearly one-seventh of the world's supply of cacao, and this mostly of high grade, this is not a great disadvantage, since Trinidad practice may well be followed by planters elsewhere.

So far, practically no attempt has been made in cacao-growing countries to keep different varieties of the cacao-tree separate, and as a result most plantations contain many varieties, and yield a mixed product. In forming new plantations, it is desirable that this state of things should be avoided, and for this purpose Mr. Hart recommends, in preference to the sowing of selected seed, the grafting of good but delicate kinds of cacao on hardy "stocks." The work already done in the West Indies seems to indicate that this is practicable on the large scale.

Another equally important problem is that of the curing of cacao by fermentation. Trinidad is fortunate in this respect, since although the plantations contain a mixed population, the mixed produce obtained is easily cured, and routine practices in curing are followed, which give on the whole good results. Mr. Hart is therefore perhaps inclined to attach too little importance to this question. In British West Africa it is not so simple. There the variety of cacao grown is initially poor, and is difficult to cure properly. Further, the native farmers are disinclined to take trouble in the matter, with the result that British West African cacao is of low grade and likely to remain so for some time to come, in spite of the strenuous efforts of the Gold Coast Department of Agriculture to induce natives to improve their methods. Much of the difficulty that surrounds the production of better, native-grown cacao in West African colonies may disappear if the investigations recently carried out by Fickendey result in the application on a large scale of simpler curing methods not involving fermentation.

The two series of problems to which allusion has been made are of peculiar importance to the cacao-grower, but in common with other tropical planters he has to deal with fungoid diseases, insect pests, and depredations by animals, and on these and other equally important matters Mr. Hart gives useful and much-needed guidance. He rightly points out that cleanliness in agricultural operations is one of the best means of avoiding disease in a plantation.

The book contains a number of good illustrations of pods of the chief varieties of cacao, of tools used

in harvesting the pods, and of typical scenes on plantations.

It should be a source of satisfaction to Mr. Hart's friends that he was able to embody in this satisfactory form his unique experience in the cultivation of cacao.

T. A. H.

A YEAR-BOOK OF SCIENCE.

Jahrbuch der Naturwissenschaften, 1910–1911. Sechsundzwanzigster Jahrgang. Unter Mitwirkung von Fachmannern herausgegeben von Dr. J. Plassmann. Pp. xv+458. (Freiburg im Breisgau: Herdersche Verlagshandlung; London: B. Herder, 1911.) Price 7*s*. 6*d*.

A GENERAL survey of scientific progress becomes increasingly difficult, and more valuable when accomplished, as the number of original contributions becomes more unmanageable. The excellent publication of which we have here the twenty-sixth annual volume represents a serious attempt to cope with an equally serious situation. To compress the 6000 or so papers by which physical science is annually enriched into some forty pages seems a hopeless task, and the manner of its accomplishment necessarily depends upon the individual outlook of the enterprising reviewer. He will almost inevitably emphasise some things which are of little value and neglect some which future developments may show to be of fundamental importance. If, however, he limits himself to such matters as have reached a certain degree of conclusiveness, if not a conclusion, he will do good work, and can safely leave the unfinished and inconclusive things to his successor.

Dr. Konen's summary of physics deals with some seventy papers under sixteen different headings, and includes such diverse matters as Lebedef's measurement of the pressure of light on gases, the controversy concerning the possibility of electric charges smaller than that of an electron, and the quantitative study of Brownian motions by Perrin, Chaudesaigues, Seddig, and Siedentopf.

The chemistry section, edited by Dr. Dammann, is mainly practical, and describes such things as Harries's synthesis of rubber from isoprane heated in glacial acetic acid; the chemistry of "Ehrlich-Hata 606," the new specific against syphilis; and the synthesis of racemic adrenaline. The astronomical section, compiled by Dr. Plassmann himself, deals with spectroscopic binaries, variable stars, Mars, comets, and the determination of time and geographical situation, picking out a few papers only, and omitting a large number of contributions of at least equal interest.

Dr. Kleinschmidt, of Friedrichshafen, deals very appropriately with aëronautics and meteorology. Other sections are presented on anthropology and ethnology (Birkner), mineralogy and geology (Wegner), zoology (Recker), botany (Weiss, a very full section), forestry and agriculture (Schuster), geography (Schotte), medicine (Moeser), and technology (Ruegg). An astronomical calendar for 1911 and an obituary for 1910 complete the volume, which, in spite of the German type used, is bound to be of great utility as a first line of reference for the year's scientific progress.

OUR BOOK SHELF.

Engines and Boilers Practically Considered: a Handbook for Young Engineers on the Construction and Working of Steam, Gas, Oil, and Petrol Engines and Steam Boilers. By W. McQuade. Pp. xv+87. (London: G. Bell and Sons, Ltd., 1911.) Price 3*s*. 6*d*. net.

THE author of this little book states that his object has been to treat in a simple, straightforward, and practical manner the various types of engines and boilers met with in general engineering with the view of providing a practical handbook for young engineers in general. Matters connected with the theory of the subject are not touched upon, or to the slightest extent only. The book contains sixty-two illustrations dealing with steam engines, steam boilers, and internal-combustion engines. The text comprises descriptions of these illustrations.

Remembering the class of student for whom the book is intended, one expects that the text and illustrations should be easily followed. In many cases index letters are not used in the drawings, an omission which is not calculated to help the young beginner. The drawings are clear as regards draughtsmanship, but in some cases are out of proportion, and a few contain minor errors. For example, a marine connecting-rod given on p. 9 has the set screws used for locking the nuts shown with the heads home against the face of the rod, thus rendering the screws useless for the purpose of locking. In some cases additional views of the part under consideration would have been useful.

Some important details are briefly described in the text without any descriptive sketches being given. An idea of the unevenness of treatment may be gathered from the fact that the action of the slide valve occupies eight pages, while a description of a set of triple-expansion surface-condensing engines shown in the frontispiece occupies one page. There is doubtless a place for a well-got-up book on the lines suggested by the author, and the present book, with considerable revision and additions, might be rendered capable of taking this place.

A Text-book of Physiological Chemistry. By Prof. O. Hammarsten. Authorised translation from the author's enlarged and revised seventh German edition, by Prof. J. A. Mandel. Sixth edition. Pp. viii+964. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 17*s*. net.

PROF. OLAF HAMMARSTEN has resigned the chair he held for so many years at Upsala, but one is rejoiced to learn he has not relinquished work in the field where he has done such important service. Original papers from his pen still appear in the journals, and his well-known text-book continues to flourish, and has now reached a seventh German edition. The translation of this has, as in the past, been carried out by Prof. J. A. Mandel, of New York, who has performed what in his preface he terms a labour of love with his usual efficiency.

The book has considerably grown in size since its last edition; every chapter has been rewritten to bring it up to date, but the principal new feature is a chapter on physical chemistry in biology, which has been contributed by Prof. Hedin, Hammarsten's successor at Upsala. This adds considerably to the usefulness of the text-book. A book which has seen seven editions carries its own recommendation; one can merely congratulate its author, and express the hope that he may live to see many more editions through the press.

W. D. H.

The American Annual of Photography, 1912. Vol. xxvi. Edited by Percy Y. Howe. Pp. 328. (New York: The American Annual of Photography; London: G. Routledge and Sons, Ltd., 1911.) Price 3*s.* 6*d.*

In these pages the photographic reader will find much that will interest him, for a host of photographic subjects are delightfully treated, and the illustrations are both numerous and good. Turning over the pages one finds some simple hints regarding telephoto lenses, then a brief discourse on the fascinating procedure of taking photographs against the light productive of many pretty pictures. Simple apparatus for photomicrography and sensitising platinum paper are later dealt with, followed by an interesting article on "Daguerreotype Copying." Much useful information is imparted to the reader in the articles on stereoscopic night scenes, botanical photography, colouring photographs, the English cathedrals, &c. Nearly all the various subjects dealt with are well illustrated, and these add greatly to the value of the annual. At the end there is brought together a typical collection of formulæ and tables which will no doubt be found useful to the working photographer. Good indices to the articles, subjects, illustrators, and advertisers facilitate easy references to the various portions of the book.

Einführung in die Mykologie der Nahrungsmittelgewerbe. By Prof. A. Kossowicz. Pp. viii+138. (Berlin: Gebrüder Borntraeger, 1911.) Price 4 marks.

This book deals with bacteria, yeasts, and moulds in their special relation to foodstuffs, and forms a welcome addition to technical bacteriology. Portions of it particularly concern the domestic arts, and would be of service in connection with courses of "domestic or home science," a branch of training which is now coming to the fore. Commencing with a brief introduction on the morphology and methods of study of the organisms dealt with, the subjects of milk, butter, and cheese are first considered. Then follows the more special section of the book, which is devoted to the consideration of the decomposition and preservation of meat and fish, eggs, vegetables, and fruit. In this the various organisms producing the "spoiling" of these foodstuffs are briefly considered, together with the chief methods of conserving food. It is interesting to learn that the air of the Cuxhaven fish market is ozonised, with the result that the fishy odour is destroyed. Finally, the mycology of the bakery, of sugar, and of fodder is briefly described. The book is a very readable one, and is well and sufficiently illustrated. R. T. H.

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.*]

Spectroscopic Methods.

In his interesting address on spectroscopic methods, Prof. Michelson falls into a not uncommon error when he says that, in order to obtain a pure spectrum, "two important modifications must be made in Newton's arrangement. First, the light must be allowed to pass through a very *narrow* aperture, and, secondly, a sharp *image* of this aperture must be formed by a lens or mirror."

Both these modifications were made by Newton himself, and with a clear understanding of their advantages. In "Opticks,' Exper. 11, we read:—"In the sun's light let into my darkened chamber through a small round hole in my window—shut, at about 10 or 12 feet from the window, I placed a lens, by which the image of the hole might be distinctly cast upon a sheet of white paper, placed at the distance of six, eight, ten, or twelve feet from the lens. . . . For in this case the circular images of the hole which comprise that image . . . were terminated most distinctly without any penumbra, and therefore extended into one another the least that they could, and by consequence the mixture of the heterogeneous rays was now the least of all."

And further on:—

"Yet instead of the circular hole F, 'tis better to substitute an oblong hole shaped like a long parallelogram with its length parallel to the prism ABC. For if this hole be an inch or two long, and but a tenth or twentieth part of an inch broad or narrower, the light of the image *pt* will be as simple as before or simpler [*i.e.* as compared with a correspondingly narrow circular hole], and the image will become much broader, and therefore more fit to have experiments tried in its light than before."

Again, it was not Bunsen and Kirchhoff who first introduced the collimator into the spectroscope. Swan employed it in 1847, and fully described its use in Edin. Trans., vol. xvi., p. 375, 1849. See also Edin. Trans., vol. xxi., p. 411, 1857; Pogg. Ann., C, p. 306, 1857.

These are very minor matters as compared with what Prof. Michelson has to tell of his own achievements and experiences, but it seems desirable that they should be set right. R.

Are Eyes ever Autophanous?

The following communication was written about 1889, soon after my change of residence from Collingwood (in Kent) to Slough (in Buckinghamshire), that is, about twenty-three years ago, and having been laid aside, through the intervention of other interests, has now come to light again in weeding the accumulation of half a rather long lifetime. It seemed unadvisable to recast, from memory, what was set down from present observation. At the same time, the form in which those observations are presented required explanation, such as is now offered.

I propose in the present letter to describe some observations of a rather unique character, and have thought that the occasion warrants my coining a word in connection with—though not descriptive of—their general nature. I had never given much credence to the sayings and statements, not infrequently met with, expressive of a rather widely entertained belief that the eyes of some animals, especially those of the feline *genera*, have the property of "shining in the dark," of emitting light, or (as I now venture to describe it) of being *autophanous*. But I saw no prospect of disproving its existence until accident pointed out a ready way of producing the effect, and thus raising a pretty strong presumption as to the true source of the belief. I propose in a few words to put your readers in a position to verify and extend my subsequent experience, and to enable all who try it to judge for themselves whether the suggested explanation is not sufficient, without attributing to the eye a specific inherent luminosity.

About five years ago I was presented with a puppy, of a good breed of collie, the history of which I must briefly summarise by saying that, until I lost him last November, he was my constant companion day and night. His sleeping quarters during the spring and summer months of '84 were in a kennel placed on the landing of a flight of stone steps leading up to a garden door facing my habitual seat in an inner room, so that we could always see each other when the intervening doors were open. When there was a lamp on the table it was not long before I learnt to look for, and generally to see, Bruno's great eyes watching me out of the darkness. It is immaterial now to recall exactly by what successive steps I learnt the essential conditions of the phenomenon: they now seem so obvious. Eventually I was led to use a bull's-eye lantern, the adoption of which opened the wide field of experience of which I will now endeavour to give some particulars. Let it not be supposed that it is enough to direct the light of a lantern upon a dog's eyes. If such were the case, the observation would long since have been made; for it is by no means essential that the dog's sight shall be turned directly upon the source of light, as will presently appear. What is essential, and what makes all the difference between what the holder of the lantern sees and what a

bystander sees, is that the eye of the observer shall be as nearly as practicable in a line with the light and the reflecting eyeball. A policeman, for instance, may go his rounds night after night for years carrying his bull's-eye at the usual waistbelt level, and never have a notion of the numberless pairs of cats' eyes which he would infallibly see along the area rails should he raise it to the level of his face, so as to look closely past his hand. There! I have let out my secret, and it only remains to tell what I have seen in this way.

First, then, as to Bruno. It was my habit to stroll in the garden with him of an evening, and I carried a bull's-eye, by means of which I could always see where he was, provided he was not moving away from me, or otherwise having both eyes hidden. As to the distance, the next observation will give a fair idea. It was the way I generally chose to show the sight to other people. Bruno's greatest pleasure in life—next to accompanying me with a gun—was to run after a ball, and after bringing it back to gnaw it if not prevented. He would always prefer his ball to his food if the former was thrown. His power of scent was something remarkable. Hundreds of times have I thrown his ball—wooden ones, which I turned for him in the lathe as required, owing to his aforesaid destructive practice, like full-sized croquet balls—when it was too dark to see where he was, and he has never failed to find and bring it, being guided as to general direction partly by my action and partly by the sound of the ball falling. Taking advantage of this, I could always send him forth into the darkness with the certainty that he would shortly be seen [1] by anyone holding a bull's-eye properly, returning in the form of a pair of gig lamps bounding towards one in an undulatory fashion most ludicrous to see. Under such favourable conditions fifty yards would be quite an easy distance.

I will now pass on to cats. My experience of cats' eyes is not so varied, but my belief is that, in relation to their size, they reflect more light. I am sure they could be seen, under similar conditions, at eighty yards, for I have seen them *brilliantly* at half that distance. At greater distances there is not the same inducement for a cat to turn her face in the right direction unless she has taken refuge from a dog, say, in a tree. In such cases I have had good opportunities. The greenish light from a cat's eyes—decided greenness at five yards at least—is easily distinguishable from the redness which is so noticeable in that from a dog's.

The next experience I shall mention relates to sheep. I was completely deceived the first time I saw the light in sheep's eyes. A flock had been let into the field adjoining my evening walk without my knowledge, and there had not been any there for, maybe, a fortnight. Moreover, it was in the early days of my discovery of this amusement, and I had not anticipated its range. However that may be, the appearance of a number of lights, moving and stationary, some down in a hollow, all more or less faint and shimmering, gave me quite a turn; for I have never myself seen natural lights of this sort such as we hear of. I believe I solved the riddle by getting over the fence—after ascertaining that the phenomenon was connected, in the aforesaid essential way, with the position of my lantern—and studying it *ambulando*, thereby learning, *inter alia*, that sheep's eyes can be seen singly if the beast is walking past, and, of course, equally well, or even better, as a pair if it is facing you. They are certainly visible at fifty or sixty yards' distance with the light of an ordinary bull's-eye as source.

I have also seen rabbits' eyes, in the same way, sufficiently well to speak positively, but not often enough or under favourable enough conditions to describe precisely. The light was certainly feebly seen at about twenty yards.

I have not seen the like satisfactorily in horses myself, but others have seen it.

Lastly, I have failed to see any trace of it in human eyes, nor have I heard of anyone else doing so.

J. HERSCHEL.

[1] I am told that readers not in the habit of using such lanterns, naturally suppose that the *dog's whole form* would be seen by its light. The fact is, however, that even a strong light of this kind shows objects very feebly at more than ten yards, unless of a light colour. Practically the dog is not seen at all till quite close.

The Weather of 1911.

AFTER my letter on the above subject (NATURE, January 11) had been posted, it occurred to me to investigate to what extent temperature deviations in Egypt are opposite to those in England, and for this purpose I compared the annual mean temperatures at Abbassia (near Cairo) with those for England S.W. and South Wales (Weekly Weather Report, 1908, p. 429). This district was selected because Dr. W. N. Shaw, F.R.S. (NATURE, vol. lxxiii., 1905, p. 175), had already compared rainfall in this region with wind velocity at St. Helena, and I had compared the same rainfall with the volume of the Nile flood (Quart. Journ. Roy. Met. Soc., xxxvi., 1910, p. 341).

In the present case, a coefficient of correlation -0.427 ± 0.097 was found for the annual mean temperatures from 1877 to 1910. This looked promising, and an analysis by quarters was then undertaken with the result:—

		Temperatures °F. S.W. England		Abbassia	
		Mean	S.D.	Mean	S.D.
1st quarter	$r = -0.724 \pm 0.056$	41·6	1·945	57·7	1·607
2nd ,,	-0.277 ± 0.108	51·6	1·252	75·4	1·423
3rd ,,	-0.165 ± 0.114	58·5	1·397	80·8	1·316
4th ,,	-0.544 ± 0.083	46·2	1·557	65·2	1·478
Year	-0.427 ± 0.097	49·5	0·944	69·8	0·922

The column headed S.D. gives the standard deviation, from which, in conjunction with the means and coefficients of correlation, the equations of regression can be obtained.

The connection between temperature in S.W. England and Lower Egypt, as represented by Abbassia, is certainly real in the first and last quarters, but only plausible in the second. What the physical connection may be is a more difficult problem to solve. In the winter half-year Lower Egypt lies close to the axis of the ridge of high pressure which stretches across the Atlantic, northern Africa, and Siberia, and the variations of weather here are dependent very largely on the position of this ridge. It seems probable that the explanation will be found here, but the physical connection would still require investigation. In summer, on the other hand, Egypt lies on the slope between the Atlantic anticyclone and the Indian monsoon depression, and probably receives its weather from different regions from those which control weather in England.

It is hoped to analyse the interrelations more fully and to investigate the position of the boundary between the regions of positive and negative correlation with S.W. England.

J. I. CRAIG.

Survey Department, Giza, Egypt, January 6.

Microscope Stands.

I HAVE read with interest the article on the above subject in NATURE of December 21 last. It would be interesting to hear if our expert workers agree with the conclusions arrived at.

With regard to the centring of the condenser, in how many of the cheaper Continental stands does one find any accurate means of centring whatever? Also, what grounds are there for the assertion that the mechanical stages on the Continental stands "as instruments of precision are of a higher order than is obtained in the English models"? Then, with reference to the mechanical draw-tube. Which is cheaper, a mechanical draw-tube built with the stand to work with any objective, or a correction collar on each objective? Is the latter arrangement really more accurate than the draw-tube properly used?

I should also like to point out that the worker can easily keep sprung fittings in adjustment for an indefinite period, but ground fittings would require the attention of the repairer. Lastly, is there any evidence obtainable from our most eminent workers with the microscope that the English instrument has lost its former position as the finest scientific instrument of its kind, and that that position is now occupied by the product of a German house?

JOHN A. L. SUTCLIFFE.

Boston Spa, January 5.

UNDER THE GREENWOOD TREE.[1]

TO say that this is a delightful book is not nearly enough, for quite apart from its marked literary excellence it embodies—we were almost writing enshrines—the select experience and seasoned reflection of a man of taste and understanding, who has lived and moved for sixteen years among the things that he writes about. It is one of the best books on Indian sport that it has been our good fortune to read, and from the lyrical dedication "To my '450" to the final chapter on weapons and explosives, there is scarcely a paragraph that has not salt and savour.

The author's method is as good as his matter and manner. He gives us, first of all, a pleasing map of his district, with all the physical and administrative features plainly marked. Then in forty-four telling pages he completes the introduction to his country, giving in a few terse and relevant sentences a good general idea of its hills, streams, and forests; of its climate and rainfall; of its political oscillations until it became settled by Europeans and fixed in the fabric of the Madras Presidency; and of its economic ups and downs in the way of coffee-planting and gold-mining. How the latter "industry" has changed the face of certain parts of the district (in south-east Wynaad) is so well pictured that we must quote, or cull, the author's words. After acquiring dozens of planting properties, "the various gold companies . . . took no heed of their fine coffee. . . . Weeds soon overtopped the coffee. . . . Fire got in when the hills were burnt according to the annual custom." And now "for mile after mile nothing but an interminable sea of *dhub-bay* grass marks the site of what were smiling estates. . . . A wilderness made by the abortive search after gold."

Having given us our bearings in time and space, the author holds up the mirror, and we follow him and his trusty trackers—Paniyas, Karumbas, and other relic jungle-men—after elephants, tigers, leopards, "bison," bear, "ibex," sambur, and other smaller game. Many new and interesting things he tells us about all these animals, and what is not new he recounts with proper emphasis, and with critical appraisement of the observations and opinions of others. For the elephant, tame or wild, he has an intense admiration: he has watched the whole tragedy of an elephant fight under nature's own conditions, and although he knows the sensation of being charged by an enraged tusker, and of bearing off the spoils of victory, he says: "I never see an elephant without a feeling of regret that the death of even the one I shot can be laid at my door, and nothing would now induce me to shoot another unless he were a confirmed 'rogue,' or in self-defence." He maintains,

FIG. 1.—Needlerock. From "Sport on the Nilgiris."

against Sanderson and Blanford, that the elephant is intelligent above all the beasts of the forest; and he considers—with much justice, we think—that the ease with which this animal when captured can be tamed and taught is a proof, not of dulness, but of that highest form of intelligence which quickly adapts itself to a new environment.

The author has often been at close quarters—both accidentally and by design—with tigers, and he knows these beasts well, in all their ways and moods; and the outcome of all his experience is that, unless it is wounded, the tiger in Wynaad (where the man-eater is unknown) is a "cowardly beast" in the presence of man. He describes, among other things, the way the jungle-men have of netting and spearing tigers. He once saw a tiger that had been killed, at very close quarters, by a single charge of buckshot; and the sight so impressed him (six pellets were found to have entered the brain), that he is inclined to recommend

[1] "Sport on the Nilgiris and in Wynaad." By F. W. F. Fletcher. Pp. xix+456. (London: Macmillan and Co., Ltd., 1911.) Price 12*s.* net.

the buckshot method in dealing with a wounded tiger that has to be followed on foot.

Though in many passages—particularly in a short digression on his tame sambur and his other pets—the author reveals a kindly humour, he is far removed from the drossy sentiment of some of the camera sportsmen who regard all killing as murder. He admits that the sporting instinct ("the killing instinct, if you will") may be a brutal instinct, but its brutality does not much trouble him if men "refrain from the killing of any inoffensive animal save a male with a trophy worth the taking."

We like the way in which the author speaks of his native attendants. He always has a good word for them, and if occasionally—for such things are—he is provoked to address a casual hand in terms that are not exactly complimentary, he is always ready to listen to an explanation and to admit extenuating circumstances.

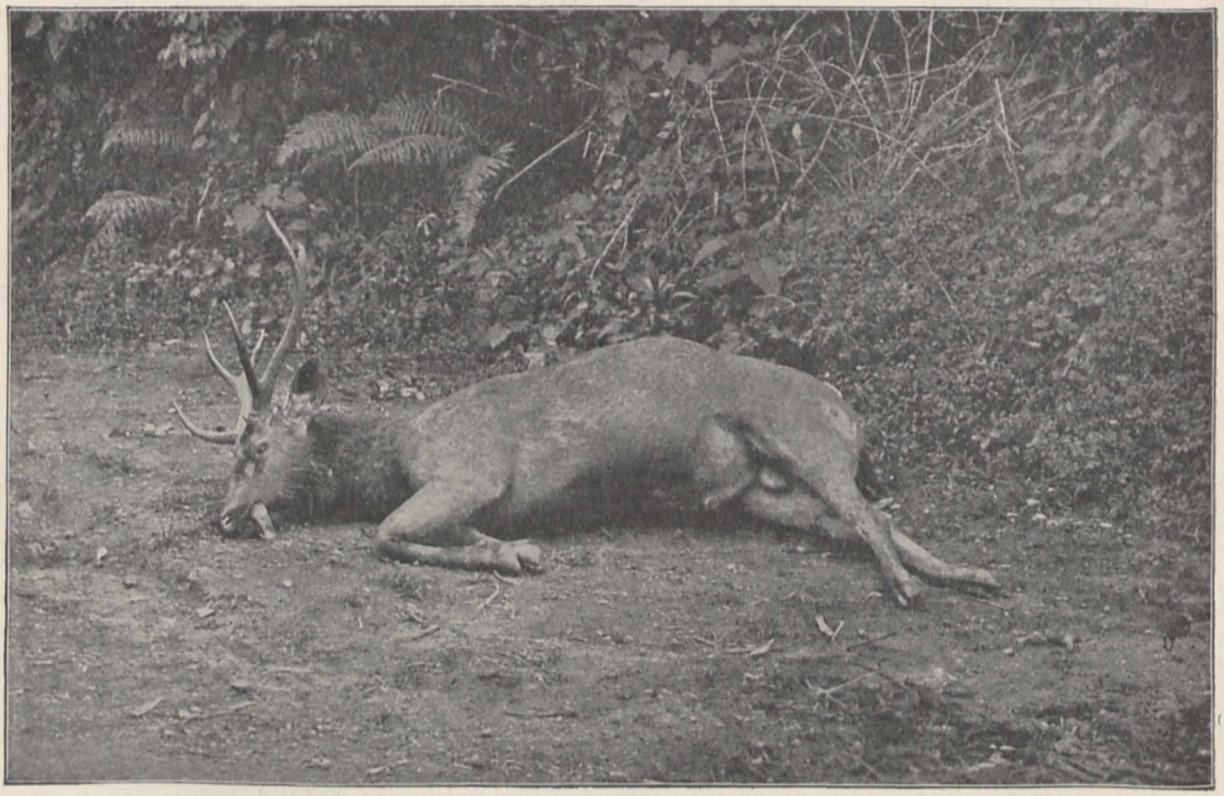

FIG. 2.—The Sambur. From "Sport on the Nilgiris."

There is so little for even a carping critic to gleek at in this excellent book that we almost hesitate to express our surprise that anyone nowadays should talk of malaria as if it were in any direct way due to disturbance of the soil. It is also unexpected to find an author who has so much philosophy in him, and so much sympathy with nature, referring to the mental processes of animals as if they were all a kind of instinct, and appearing to ignore the fact that many illustrious authorities, from Hume onwards, have supported and justified the opinion that the inferences of the higher animals differ from the inferences of the paragon man not in nature, but only in degree.

The illustrations are wonderfully well reproduced, and most of them are extremely good in themselves; but the elephant is far from representing the magnificent creature of the author's election, and the wild dog appears in quite an innocent and dignified disguise.

There is no index; but as the table of contents is very full, and as each chapter deals with one complete subject, no one who is not bound to formulas will miss it.

THE BRITISH SCHOOL AT ATHENS.[1]

IN its sixteenth volume, the "Annual" of the British School at Athens has returned to a manageable size for its format, and in this respect is a great improvement on its immediate predecessors.

The remarkable excavation at Sparta has come to a close, and the description of it ends in this volume. The final work of the season of 1909–10, which is described, consisted chiefly in picking up the pieces that remained. The most important of these was the excavation of the remains of the Mycenæan town near the Menelaïon. These are of interest as showing that the valley of the Eurotas was only occupied in late Mycenæan times; no trace of any period before "Late Minoan III." was found. Of this period houses with typical pottery of that age were discovered. These are described by the director of the School, Mr. R. M. Dawkins, who also sums up the results of the discovery and excavation of the Temple of Artemis Orthia, which has shed such well-deserved lustre on British archæology. This history of the famous sanctuary is traced, from the establishment of the earliest altar on the site by the Dorians, down to Roman times. The importance of this "record" piece of archæological work is evident, and its two

1 "The Annual of the British School of Athens." No. xvi. Session 1909–10. Pp. ix+343+xvii plates. (London: Macmillan and Co., Ltd., n.d.) Price 25s. net.

subsidiary results are equally important: first, the discovery of the Laconian style of vase-painting, and its identification by Mr. Droop with the style previously known as "Cyrenaic"; secondly, the recovery of the great harvest of inscriptions, many of them in Doric dialect, relating to the worship of Artemis Orthia and the contests of the boys at her shrine, which have been published by Mr. Woodward. The director shows how important to the history of Greek pottery is the accurate chronology of the Laconian ware which this excavation has rendered possible. Of inscriptions only a few new ones have been found, which Mr. Woodward publishes. A minor excavation at a shrine of the Eleusinian Demeter at Kalývia tís Sochás, not far off, has yielded some of these. Some early pottery from a site at Geraki is described by Mr. Wace, and Mr. H. A. Ormerod writes on the topography of Bardounia and north-eastern Maina.

FIG. 1.—Remains of the Roman Theatre in the precinct of Artemis Orthia, looking towards Mount Taygetos.

An interesting paper by Mr. C. H. Hawes, on "Some Dorian Descendants?" may fitly be mentioned in connection with the Laconian work. Mr. Hawes has made interesting researches into the skull-form of the modern inhabitants of Maina, the peculiar dialect of which part of Laconia is certainly of Doric origin, and of Sphakia in Crete, where the dialect shows possible Doric peculiarities, and where the native stock has been kept purest from foreign admixture, since the Turks never tried to hold Sphakia, and only once penetrated to its fastnesses. Mr. Hawes shows that the typical skulls of both Mainotes and Sphakiotes show a peculiar brachycephalic form very like that of the Albanians, and since the Dorians certainly came from Illyria, he tentatively regards this as the typical Illyrian-Doric skull-form, and the Mainotes and Sphakiotes as typical Dorians. This may be, but the Albanians are not, and never were, Greeks, any more than the Italians are or were; whereas the Dorians were the most Greek of the Greeks. Doric Greek was probably the freest of foreign admixture; but the Albanian language is totally different from Greek, and forms a distinct Indo-European linguistic sphere, equally apart from Greek, Slav, or Italian. Also this hyperbrachycephalic form of skull is found in Asia Minor, especially among Kurds and Kizilbashes. We doubt the identity of Albanians and Dorians. But the paper is an extremely suggestive one.

The rest of the "Annual" is taken up by a number of interesting minor articles, the most important of which is that by Messrs. Woodward and Ormerod, describing a journey in south-western Asia Minor, where Mr. Woodward has found inscriptions, and Mr. Ormerod important prehistoric sites, with pottery of considerable interest, which he describes. It belongs to a class distinct from that of the Ægean, and the painted sherds perhaps show analogies to the geometric ware found by the Pumpelly expedition at Anau in Turkestan, and by de Morgan at Tepé Musyân (Moussian) and Susa, in Persia.

Mr. Hasluck continues his descriptions of the extant relics of Latin domination in the Ægean, which have been a feature of recent volumes of the "Annual." This year he describes the traces of the Genoese rule and of the Giustiniani in Chios, besides a quaint French inscription recording the conquest of Adalia by Pierre I., King of Jerusalem, in 1361. He also contributes an article on the once-famed medicinal earth, *terra sigillata* or *terra Lemnia*, which was an im-

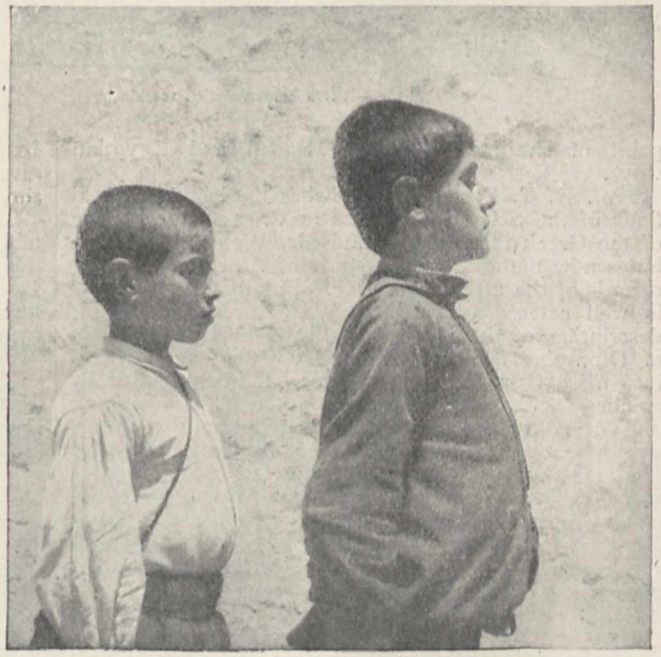

FIG. 2.—Contrasted Head-forms from Sphakia: Mediterranean (cephalic index 75·4) and Dorian? (cephalic index 88·7).

portant article of Levantine commerce in the Middle Ages. The contemporary specimen of this earth in the Pharmaceutical Society's collection, he says, "can hardly be genuine"; by this we suppose he means that it is probably a British "fake" of the seventeenth century. The modern specimen he gives of the Turkish stamp which used to be the "sigillum" of the earth (now put on clay bowls), reads *tîn makhtûm*, "sealed earth," in Arabic (not "*tini maktoum*," as Mr. Hasluck prints it: *kh* must not be confounded with *k*!). Old specimens of this Arabic seal are figured from Belon by Mr. Hasluck; but why has he printed them all on one side? Or is this the fault of Belon?

Mr. H. R. Hall contributes "An Addition to the Senmut-Fresco" at Egyptian Thebes, which shows Minoan Cretan (Keftian) ambassadors bearing gifts to the court of Queen Hatshepsu. The addition he has found in a drawing by Robert Hay, now in the MSS. Department of the British Museum, made about the year 1837, which shows the fresco as it was then, with additional figures, vases, and a great sword. Mr. Walters notes that the peculiar method of sealing vases in vogue at Mycenæan Sparta is paralleled by Egyptian seals of Roman times; we might carry the comparison further back, for the Egyptians always sealed vases in this way, at a period contemporary with the Spartan specimens. Here is another minor

FIG. 3.—A Genoese Inscription at Chios.

point of similarity between Minoan and Egyptian ways.

Prof. R. C. Bosanquet publishes the last of the old finds of the School at Præsos in Crete, in the shape of the Greek inscriptions, and Mr. Woodward contributes new material to the study of Athenian building records of the fifth century B.C. Finally, anthropology is well catered for in Mr. Wace's very interesting description of the modern survivals in North Greece of Dionysiac festivals (which have now degenerated into mere Guy Fawkes *bacchanalia*, accompanied by chicken-stealing and frowned upon by the police), and Mr. W. R. Halliday's critical examination of the Argive festival of the *Hybristika*, in connection with Herodotus's description of the marriage of the Argive women with their slaves on account of the ὀλιγανδρία caused by the defeat of Argos by the Spartan King Kleomenes I. (Hdt. vi. 83). He finds the origin of this story in the festival of the *Hybristika*, when the slaves had full licence, and the women donned men's clothing, the men that of women. This custom of "changing 'ats" is found all over the world, as he shows, and is probably the origin of several Greek stories; for instance, he thinks, that of the Cumæan tyrant Aristodemos, who, says Plutarch, "is said to have brought up the boys of free birth to wear their hair in long tresses and to adorn themselves with gold, while he compelled the girls to have their hair cut at the level of their shoulders, and to wear cloaks like youths and little short frocks." However, this tale of a freakish tyrant may be a true one, and not connected with any *hybristika*; the pranks of Greek despots were often peculiar, and sometimes took forms of this sumptuary kind.

The frontispiece to the volume is a reproduction of a colour-photograph, by Mr. Robert Mond, of the Semnut fresco as it is to-day, which gives the most accurate possible representation of its colouring. Mr. Mond has done a good deal for archæology by his excavations of tombs at Egyptian Thebes, and his application of the latest resource of photography to the representation of this important Egyptian fresco, and gift of the picture to the School at Athens for this volume, merit special acknowledgment.

THE WASHINGTON MEETING OF THE AMERICAN ASSOCIATION.

THE sixty-third meeting of the American Association for the Advancement of Science was held in Washington, district of Columbia, on December 27–30, 1911, under the presidency of Dr. Charles E. Bessey, professor of botany in the University of Nebraska.

The meetings began in the morning of December 27 with a meeting of the council, after which sections and affiliated societies proceeded with business meetings and programmes of papers.

The formal opening exercises were held in the Assembly Room of the New U.S. National Museum at 9 p.m. of the same day, the exercises being preceded by a reception from 8 to 9 o'clock. The President of the United States, Mr. Taft, was present at the opening exercises, and delivered an address of welcome, directing attention especially to the close similarity between the attitude of mind of the scientific investigator and that of the judge. Truth, in both cases, is the aim, and the judicial temperament is necessary to the successful scientific man. The secretary of the Smithsonian Institution, Dr. Charles D. Walcott, was to have given a second address of welcome, but was absent through illness.

The president-elect, Dr. Bessey, responded to the address of welcome, and, in view of the fact that the address had been delivered by the President of the United States, took occasion to point out the importance of scientific work to Government affairs, and to urge President Taft to give all his support to scientific bureaus of the Government.

The address of the retiring president, Dr. A. A. Michelson, of the University of Chicago, was then delivered. His subject was, "Recent Progress in Spectroscopic Methods." This address was published in full in NATURE of January 11th.

The meeting, as a whole, is the largest in the history of the association. The actual registration of the association proper was 1402, while members of affiliated societies and others in attendance at the meetings, including very many members of the association who were unable to register, undoubtedly would have swelled the number to more than 2800.

The addresses of the retiring vice-presidents were as follows:—Vice-President Eliakim H. Moore, before the Section of Mathematics and Astronomy, on "The Foundations of the Theory of Linear Integral Equations"; Vice-President E. B. Rosa, before the Section of Physics, on "The Work of the Electrical Division of the Bureau of Standards"; Vice-President George B. Frankforter, before the Section of Chem-

istry, on "The Resins and their Chemical Relations to the Terpenes"; Vice-President A. L. Rotch, before the Section of Mechanical Science and Engineering, on "Aërial Engineering"; Vice-President Jacob Reighard, before the Section of Zoology, on "Adaptation"; Vice-President R. A. Harper, before the Section of Botany, on "Some Current Conceptions of the Germ Plasm"; Vice-President R. B. Dixon, before the Section of Anthropology and Psychology, on "The Independence of the Culture of the American Indian"; Vice-President Theodore Burton, before the Section of Social and Economic Science, on "The Cause of High Prices"; Vice-President F. G. Novy, before the Section of Physiology and Experimental Medicine, on "Carriers of Disease"; Vice-President A. Ross Hill, before the Section of Education, on "The Teaching of General Courses in Science." (Owing to the death of Vice-President Christopher W. Hall, of the Section of Geology and Geography, no address was delivered before that section.)

The meeting showed, as in other recent years, an increased number of affiliated scientific societies of national scope, and was marked by the presence of the strong group of societies of economic character, including the American Economic Association, the American Statistical Association, the American Association for Labour Legislation, the American Sociological Society, and the American Home Economics Association.

As has been the growing tendency in the association, several important symposia were held, and a number of meetings of interest to several sections and societies. Among these may be mentioned a symposium relating to safety in mines; one on aërodynamics, and another on good roads; one on ten years' progress in vertebrate palæontology; one on mineral wastes and conservation, and a joint session of the zoologists and psychologists on questions relating to animal behaviour. A most important conference on psychology and medical education was held at the Government Hospital, in which eminent psychologists and alienists discussed pertinent questions. The Botanical Section held a symposium on soils, and another on modern aspects of palæobotany. Still another symposium was conducted on acapnia and shock.

The council passed resolutions favouring the establishment of a national quarantine and inspection service directed against the introduction of injurious insects and plant diseases, and others favouring the establishment of a national department of health. Reports of delegates to several international congresses were read.

The general committee selected Cleveland, Ohio, for the place of the next meeting, to open December 30, 1912, and recommended to the following general committee that Atlanta, Georgia, be selected for the meeting in the winter of 1913–14. It also expressed the desire that arrangements for a summer meeting during 1915 be made.

The following officers for the ensuing year were elected:—*President:* Dr. E. C. Pickering, director of the Harvard Astronomical Observatory, Cambridge, Mass. *Vice-Presidents (or Presidents of Sections):* Section A, E. B. Van Vleck, University of Wisconsin, Madison, Wis.; Section B, A. G. Webster, Clark University, Worcester, Mass.; Section C, W. Lash Miller, Toronto, Canada; Section D, J. A. Holmes, Bureau of Mines, Washington, D.C.; Section E, J. E. Todd, University of Kansas, Lawrence, Kansas; Section F, W. A. Locy, North-Western University, Evanston, Illinois; Section G, D. S. Johnson, Johns Hopkins University, Baltimore, Maryland; Section H, J. Walter Fewkes, Smithsonian Institution, Washington, D.C.; Section I, J. Hays Hammond, New York, N.Y.; Section K, J. J. R. Macleod, Western Reserve Medical College, Cleveland, Ohio; Section L, J. McKeen Cattell, Columbia University, New York, N.Y. *Secretaries of Sections:* Section B, W. J. Humphreys, U.S. Weather Bureau, Washington, D.C.; Section E, George F. Kay, University of Iowa, Iowa City, Iowa; Section K, Waldemar Koch, University of Chicago, Chicago, Illinois. *General Secretary:* Henry E. Summers, Iowa State College, Ames, Iowa. *Secretary of the Council:* H. W. Springsteen, Western Reserve University, Cleveland, Ohio.

The first meteorological gathering in connection with a meeting of the association was held in the Forecast Room of the Weather Bureau on December 28, the second day of the Washington meeting. As the interval of time between the morning and afternoon sessions of the various sections and societies was too short—and the meeting places were too widely separated—to admit of a "meteorological luncheon," in emulation of the British Association, a "meteorological tea" was decided on as the most practicable and agreeable form of gathering for the interchange of ideas among persons interested in the science of weather. After an hour spent in informal intercourse and an inspection of the buildings and installations of the bureau, five-minute talks were given on the subject, "The Relation of Meteorology to Other Sciences" by Prof. A. Lawrence Rotch ("Aëronautics"), Prof. E. B. Frost ("Astronomy"), Prof. Henry Crew ("Physics"), Prof. W. M. Davis ("Physical Geography"), Prof. W. I. Milham ("Education"). The chief of the Weather Bureau, Prof. Willis Moore, gave the address of welcome, and the speakers were introduced by Prof. W. J. Humphreys.

As a whole, both from the point of view of the attendance and the character of papers read and the general interest shown in the symposia, conferences, and important papers, the meeting undoubtedly will rank as the most important ever held.

The social features of the meeting were of great interest, receptions, dinners, smokers, and visits to the many places of interest in and about Washington more than occupying all the time which could be spared from the sectional meetings. The most notable social function was a reception to the lady visitors at the White House in the afternoon of December 28.

NOTES.

ON January 21 mathematicians of many countries will meet at the Sorbonne to do honour to M. Gaston Darboux on the jubilee anniversary of his entry at the Polytechnic School. As the successor, first of Liouville, and then of Chasles, M. Darboux has added lustre to two famous chairs, and by his published works has earned a reputation of the very first order. To Englishmen he is perhaps best known by his connection with the Bulletin, his researches on cyclides (in conjunction with Casey), and his admirable treatise on the theory of surfaces. The last-named work, both in style and method, may be compared with Salmon's classical treatises. Like Salmon, M. Darboux has an equal mastery of geometrical and analytical theories, and combines them with the happiest effect; like him, too, he has the power of drawing material from the most diverse sources, and fusing it into a homogeneous whole. In offering him our congratulations, we feel that we are expressing a sentiment shared by all who are acquainted with M. Darboux's scientific work; and we are sure that they will join with us in hoping that his energy and vigour may be long maintained.

THE possibility of the discovery of a remedy for cancer has been advanced a stage by the preparation by Prof. Wassermann, of Berlin, of a substance which possesses a curative action experimentally on cancer of mice. Prof. Wassermann reasoned that since the cancer-cells are growing rapidly, their oxygen requirements would be different from, and greater than, those of the cells of the body generally. He sought for some substance which might interfere with the oxygen supply to the cancer-cells, and finally adopted selenium as a means to do this. The next problem was to convey selenium to the cancer-cells by means of the blood stream, and after testing some hundreds of preparations a compound of selenium with an anilin dye eosin was found to fulfil this condition. If the eosin-selenium compound is injected into a healthy mouse it becomes pink all over, but if into a mouse with a cancerous tumour the tumour only becomes coloured, demonstrating the selective absorption of the substance. After two or three injections of the substance into a mouse the subject of cancerous tumours, the tumours are found to have softened, and after six to eight doses they become cystic, diminish in size, and finally disappear, and no recurrence takes place. The eosin-selenium compound is, however, poisonous, and a certain number of mice succumb under the treatment. Moreover, only small tumours (up to the size of a cherry) are definitely cured; with larger tumours so much disturbance ensues that the animals die.

THE death is announced, at seventy-one years of age, of Dr. Otto Liebmann, formerly professor of philosophy in the University of Jena.

IT is announced in the *Revue Scientifique* that M. Louis Gentil has been elected president of the French Geological Society for 1912, and M. Stanislas Meunier, Général Jourdy, Abbé Bourgeat, and M. Henri Boursault, vice-presidents.

AT the business meeting of the Association of Public School Science Masters on January 11 the following officers were elected for 1912:—President, Sir Archibald Geikie, P.R.S.; chairman, Mr. D. Rintoul, Clifton College; and Mr. D. Berridge, Malvern College, and Mr. F. M. Oldham, Dulwich College, honorary secretaries.

THE Rhodesia Scientific Association's gold medal, recently offered for an original paper advancing the knowledge of the transmission of any insect or arachnid-borne disease affecting Rhodesia, has been awarded to Dr. Edward Hindle, Beit memorial research fellow, for his paper on "The Transmission of *Spirochaeta duttoni*."

THE Geological Society of London will this year award its medals and funds as follows:—Wollaston medal, to Mr. Lazarus Fletcher, F.R.S.; Murchison medal, to Prof. Louis Dollo; Lyell medal, to Mr. Philip Lake; Wollaston fund, to Mr. C. I. Gardiner; Murchison fund, to Dr. Arthur Morley Davies; Lyell fund, to Dr. A. R. Dwerryhouse and Mr. R. H. Rastall.

MR. W. M. COATES, fellow, assistant tutor, bursar and lecturer of Queens' College, Cambridge, and one of the most successful mathematical coaches at the University, died on Tuesday, January 16, in his fifty-fifth year. Mr. Coates entered Queens' College in January, 1884, read mathematics with the late Dr. Routh, and was third wrangler in the Mathematical Tripos, part i., in 1886, and in the following year he was placed in Class I. of Division 2 of part ii. of the Tripos. He examined in the Mathematical Tripos in 1891 and 1892.

MR. F. H. SOMERS-GARDNER sends us a cutting from *The Gibraltar Chronicle* of January 4 which reads:—"On the leg of a seagull which was trapped by some fisher-boys yesterday at the eastern beach was found an aluminium ring bearing the inscription 'Museum Leiden 704.'—J.G.D." In reply to an inquiry, Dr. E. D. van Oort, of the 'S Rijks Museum van Natuurlijke Historie, Leiden, informs us that the seagull referred to is a black-headed gull (*Larus sidibundus*, L.) which was marked June 25, 1911, at Ellemeet, on the island of Schouwen, province Zeeland, Netherlands.

DR. A. R. WILLIS, who for the past forty years had been assistant professor of mechanics and mathematics at the Royal College of Science, South Kensington, retired from his post at Christmas. It is believed that many who have studied under Dr. Willis would welcome an opportunity to express their regard for him, and a committee of past and present students has been formed, therefore, to arrange for the presentation of a testimonial to him on his retirement. Subscriptions should be sent to the treasurer, Prof. A. Fowler, F.R.S., Royal College of Science, South Kensington, S.W., on or before the end of this month.

The British Medical Journal announces that the ninth annual congress of the Association Internationale de Perfectionnement Scientifique, which is under the patronage of the French Government, will be held on August 3–31 in the Balkans, in Turkey, and in Greece. The congress will be opened in Evian-les-Bains or Thonon-les-Bains, and will be continued at various other places. Persons wishing to present communications on subjects belonging to medicine, surgery, and the cognate sciences are requested to intimate their intention to the president, 12 Rue François-Millet, Paris XVI. The general secretary of the congress is Dr. Ghislain Housel.

WE learn from *The Times* that Captain Otto Fulton recently gave a private demonstration of his apparatus for the projection of pictures in natural colours by the method of opaque projection. In order to overcome the great loss of light inherent in this method, two powerful electric lamps illuminate the prints. These are ordinary black and white photographs taken, as usual in three-colour work, through blue, green, and red screens, respectively, and the images are superposed on the screen. The remarkable part of the method is that the colour screens used in the projection are stated to be white, pale green, and pale orange, but we are assured that the rendering of the colours of the original was remarkably accurate. The method is stated to be applicable to kinematography.

THE expedition of the Egypt Exploration Fund which, under the leadership of Prof. Naville, is now excavating for the third season in succession at Abydos, in Upper Egypt, reports (in *The Times* of Monday, January 15) that interesting discoveries have been made in the great necropolis, including tombs dating from the pre-dynastic age to the Roman period. "Of the latter a magnificent example was found. It consisted of a vaulted chamber, some 20 feet in length, built of mud bricks, and originally almost hidden in the sand. The building of another similar tomb over it at a slightly later date had saved it from the plunderer. On its floor lay twelve heavy coffins of limestone, each with its carefully sealed cover. Within each lay the mummy, carefully and laboriously wrapped in its linen bandages, the blue and gold of its painted coverings as fresh as when laid in the tomb two thousand years ago." Other burials are also reported, especially one of

a woman of the twenty-second dynasty, who was found with all her ornaments, bead-necklaces, &c., including a ring of five scarabs, one of them bearing the name of Shishak, the conqueror of Jerusalem, and on her nose "still lay the small nose-ring of silver." Lastly, a burial of the twelfth dynasty may be mentioned; its period is known from an amethyst scarab, a stone rarely met with as used for scarabs after the time of the Middle Kingdom. These excavations have been carried on by Prof. Naville's assistants, Messrs. T. E. Peet, Whittemore, J. P. Droop, and the Hon. Robert Trefusis. On the arrival of Prof. Naville this month, the work of completing the excavation of the Osireion, the subterranean temple of King Meneptah (the supposed Pharaoh of the Exodus) will be taken in hand.

MR. A. ROSE, C.I.E., British Consul at Tengyueh, Yunnan, read a paper on the Chinese frontier of India before the Royal Geographical Society on Monday, January 15. The paper dealt mainly with the very interesting problems of political geography which have recently come into prominence in Asia, where China has of late years been active in increasing her influence on her southern and western frontiers. The lecturer dealt specially with that portion of the Chinese frontier which marches with that of Burmah, the region with which he was intimately acquainted, and described a hurried march to Hpimaw, close to the frontier. The frontier tribes were described and their characteristics discussed, while much interesting information was given concerning the systematic spread of Chinese influence over this border country in which suzerainty is claimed by China. An interesting collection of dresses and of metal and other objects made by these wild border tribes was also exhibited.

A SECOND contribution by Dr. C. K. Edmunds, president of Canton Christian College, on science among the Chinese, appears in the January issue of *The Popular Science Monthly*. Some intimate students of Chinese literature and life claim that in many cases Chinese philosophy has anticipated the doctrines of modern science. During the Sung dynasty, in the century 1020–1120 A.D., lived several famous Chinese philosophers, of whom Chu was the most distinguished, and it is in his writings that these references are found which it is claimed foresaw modern views. Dr. Edmunds thinks it may be admitted that Chinese philosophers entertained some general ideas concerning an all-pervading medium, that they had clear ideas on mechanical action and reaction, and very crude views concerning the transformation of energy, which vaguely suggest those held to-day. He sees no just grounds for believing that they held any ideas comparable with the modern vortex motion in the æther, of the conservation of energy, or of biological or cosmological evolution. As he points out, the method of modern science is its distinguishing characteristic, and this was almost completely lacking among the Chinese.

IN the summers of 1909 and 1910 Mr. Charles Rothschild had the good fortune to discover on trees near the Serpentine specimens of a minute fly of the psychodid group which proved to belong to a species previously unknown to science. This is described by the Rev. A. E. Eaton in the January number of *The Entomologist's Monthly Magazine* as *Telmatoscopus rothschildi*.

IN the administration reports for 1910–11, Dr. J. Pearson, director of the Columbo Museum, pays well-deserved testimony to the services rendered to that institution by his predecessor, Dr. Arthur Willey (now Strathcona professor of zoology at McGill University), pointing out that during his eight years' term of office the building was enlarged, the collection greatly increased, and *Spolia Zeylanica*, the museum journal, founded. During his own term of office Dr. Pearson is enabled to record continued progress in the museum, but he pleads for further extension of the building, and likewise for additional library funds.

ACCORDING to the January number of *The Museums Journal*, the experiment of giving illustrated explanations of the exhibits in certain sections of the Royal Scottish Museum on two evenings in each week to visitors has proved a decided success. The demonstrations are now held in the examination room of the University, which is sufficiently large to permit of the display of lantern illustrations of the objects in the collection, as well as of others which serve to throw further light on the subject of each demonstration. In the same issue an extract is reprinted, without comment, from a daily paper in which the writer alludes to musk-oxen, to say nothing of tigers, as Russian animals!

FOR some years past the Trivandrum Museum, Travancore, has issued only a brief summary of each year's work. It has, however, been decided that fuller reports are desirable, and the director, Colonel F. W. Dawson, has accordingly issued a combined report for the years 1904–9. During this period the museum appears to have made good progress, a special feature being the preparation of plaster casts of specimens that are difficult to prepare in other ways. So excellent are these casts (of which examples may be seen in the Natural History Museum, South Kensington) that Dr. Willey, while director of the Colombo Museum, paid a visit to Trivandrum in order to learn the technique of these castings. Another feature of the work of the museum is the number of cetaceans of various species which have been acquired and described during the period under review.

TO No. 18 of the *Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg*, for 1911, Dr. N. V. Nasonov, director of the zoological museum of the academy, communicates a well-illustrated paper—unfortunately in Russian—on the mouflon and kindred species of wild sheep, the greater and more important part of the memoir being devoted to the forms commonly included under the title of Gmelin's sheep (*Ovis orientalis*). That species—then regarded as a race of the mouflon—was described in 1824 by Brandt and Ratzeburg, and stated to inhabit the "Ceraunian Mountains" of Persia, the Greek Islands, and Cyprus. As Persia is first mentioned, that country has generally been regarded as the type locality; but Dr. Nasonov accords this position to Cyprus, and therefore regards the Cyprian so-called *O. ophion* as the type of the species. The validity of this view will require careful consideration. In addition to the Cyprian sheep, *orientalis* is taken to include the Armenian *gmelini* and the Anatolian *anatolica* as local races. On the other hand, the sheep from the Lake Urmi district, originally described by Dr. A. Günther as *O. ophion urmiana*, is considered to represent a distinct species, with a local race (*erskinei*) from the Elburz Range, and a second (*isphahanica*) from the Ispahan district. Judging from the figures of the skulls and horns (for the text is incomprehensible to the writer of this note), Dr. Nasonov appears to rely largely on the direction of the horns in distinguishing *urmiana* from *orientalis*. In the former they extend far behind the occiput, while their tips do not descend much below the level of the teeth, whereas in the latter they curve downwards, so that their tips are far below the plane of the upper teeth. The local races seem, however, to show

some degree of gradation in these respects; but the forms included in *orientalis* probably have a smaller development of the throat-ruff. Whether these features are of specific value is doubtful. In his latest communication on the subject Mr. Lydekker regarded *erskinei* as equivalent to the typical race of *orientalis*.

MR. C. H. O'DONOGHUE contributes to the current number of the *Quarterly Journal of Microscopical Science* (vol. lvii., part ii.) an interesting memoir on the mammary glands of the Australian marsupial cat (Dasyurus). The gland arises as outgrowths from the follicles of certain hairs which appear on the rudiment of the teat, and these hairs, which subsequently disappear, are equal in number to the main milk ducts in the adult teat. The author also discusses the causes which contribute towards the hypertrophy of the mammary gland during pregnancy and at other times, and concludes that the stimulus to growth is not a nervous one, but is due to an internal secretion or hormone circulating in the blood. It has long been known that there is an intimate correlation between the presence of the corpora lutea in the ovary and the fixation of the fœtus to the uterine wall, and it is supposed that the corpora lutea are glandular bodies the secretion of which, conveyed by the blood, stimulates the wall of the uterus to undergo the necessary changes in preparation for the reception of the fœtus. Mr. O'Donoghue gives good reasons for believing that the secretion of the corpora lutea also stimulates the mammary glands, and thus causes their enlargement, although other factors are probably responsible for causing the actual secretion of milk. We note that Mr. O'Donoghue makes use of the German term "Anlage," where, as it appears to us, "rudiment" would be greatly preferable.

THE third volume of the Indian Forest Records begins with an important part prepared by Mr. R. S. Troup, in which the author examines statistical and other information regarding the teak forests of Burma. It is noted that the limits of natural teak forests, except to the east, lie within the province. The total area of teak forests cannot be computed, but with regard to the reserved forests, exceeding 25,000 square miles, rather less than one quarter is returned as teak-bearing (which implies about 6 per cent. of the growing stock). The greater part of the teak forests may be designated either as "upper mixed," occupying hilly country and characterised by the prevalence of bamboos, or as "lower mixed," on flat ground. In the former class distinction is drawn between dry forest, where *Dendrocalamus strictus* is a common bamboo, and moist forest, which often contains *Bambusa polymorpha* or *Cephalostachyum pergracile*. According to available figures, teak trees require 110 to 190 years to reach a girth of 7 feet, upon which basis the exploitable age has been fixed at 150 to 180 years.

Petermann's Mitteilungen for December, 1911, contains a map of the world to show the state of our knowledge regarding the relief of the earth's surface. Five grades are employed, both on land and sea areas, to classify the data according to their completeness. Over the oceans the number of soundings in a 1° square (2° beyond the 60th parallel) is used as the basis of classification, but on land the scale on which maps have been published is adopted on the assumption that the density of points of which the altitudes have been determined, and the accuracy of the results, are comparable with the scale on which maps are published. A close investigation of every land area to determine the density of determined altitudes and the accuracy of the determinations would be a long piece of work, but it is the only satisfactory way of arriving at the present state of our knowledge of the earth's relief.

MR. E. K. SUVOROF explored the Commander Islands in the summer of 1910, and his observations are described in the Izvestiya of the Russian Geographical Society (No. 6, 1911). The group consists of four islands, the well-known Bering and Copper Islands, and two small ones which, having no fresh water, are inhabited only by innumerable birds. Bering Island consists of two parts, a northern, low, and covered with tundra, and studded by a few hills not reaching 600 feet, and a southern, which is a chaotic mass of elevations in chains and groups attaining a height of 2200 feet, and is almost inaccessible except along the coast. Volcanic tuff is the prevailing formation. The northern tundra has been formed by the silting-up of lakes which were originally inlets from the sea, and have been cut off from it by upheaval of the land. In some places may be noticed two, or even three, clearly marked terraces. One of the lakes still in existence, the Sarannoie, is supposed by the natives to be of unfathomable depth, but Mr. Suvorof found its deepest hollow sounded only 57½ feet. Nor are the reports of its extraordinarily low temperature correct, for on July 4 the temperature fell from 54·3° F. at the surface to 50°. Copper Island has a more complicated geological structure. Tuff and tuff conglomerate certainly predominate, but dacite, basalt, augite, and andesite occur on the north-east coast. The line of coast is determined by a fault. The inhabitants of the islands, Aleuts, with an admixture of several other elements, keep a few cattle and pigs and catch salmon, cod, blue foxes, and sea-otters, the last almost exclusively at Copper Island.

AMONG the very useful summaries of the geology of British districts, prepared by specialists and published in the Proceedings of the Geologists' Association, should be mentioned those on "The Districts around Settle and Harrogate," by Prof. Percy F. Kendall (vol. xxii., 1911, p. 27); on "The District around St. David's, Pembrokeshire," by Mr. J. F. N. Green (*ibid*, p. 121); on "The Neighbourhood of Fort William," by Mr. E. B. Bailey; on "The Neighbourhood of Broadford, Skye," by A. Harker; and on "The Geology of the Cuillin Range," by Mr. W. F. Gwinnell. The last three follow one another in part 4 of vol. xxii., pp. 179–214. The photographic illustrations and the sections in these papers make them additionally serviceable to teachers. In plate xi. the famous unconformity at the Arco Wood Quarry, Ribblesdale, is reproduced, and the view of Ingleborough (plate xii.) is one of the finest that we know. Prof. Kendall publishes (p. 37) his conclusion that the Yoredale and Pendleside series are really contemporaneous, a matter on which much more is certain to be written. Mr. Bailey's paper includes a description of the "cauldron-subsidence" of Glencoe and of the igneous history of Ben Nevis, where sinking is also recognised, and where it accounts for the preservation of the summit andesites in an encircling ring of granite.

AT the meeting of the Vienna Academy of Sciences on November 30, 1911, Prof. J. Hann submitted a work entitled "Results of Dr. E. Glaser's Meteorological Observations at Sana (Yemen)." The observations were made between January and October, 1883, only, but as no complete data for the interior of Arabia were previously available, the present carefully made series is of considerable interest. By comparison with observations for corresponding months at stations on the adjacent coast, and the use of interpolation formulæ, Dr. Hann was able to deduce very approximate monthly and yearly values of

pressure and temperature. The regularity of other phenomena also made it possible to obtain mean values for them also, rainfall being the most uncertain. The mean pressure (altitude 2370 metres) is:—winter, 577·5 mm.; summer, 573·3; year, 575·5; temperature for same periods, 14·2°, 20·6°, 17·5° C. Mean annual humidity, 50 per cent.; rainfall, 452 mm. The daily range of temperature is very large, especially in winter. The mean minimum in winter is about 4·8°, mean temperature at 2h. p.m., 24°; in summer, 13·5° and 25·8° respectively. Once in February −0·4° was recorded (which is not unusual on the plateaux); the absolute maxima at 2h. p.m. often exceed 30°, and a reading of 33° has been recorded by the maximum thermometer. In 1883 the rainy period lasted from March to August, with a complete break in June (which was abnormal). During thunderstorms rain and hail showers are often heavy (on July 23, 52 mm.). From May to October north and north-east winds, January to April south winds, were most prevalent; the latter are mostly light morning breezes; all the stronger winds are northerly, and sometimes reach storm force.

The Scientific American for December 23, 1911, contains an illustrated one-page article on Sir Joseph Thomson, by Dr. P. Phillips. It gives a short sketch of his education, and describes how Sir Joseph, after his appointment as professor of experimental physics at Cambridge when a "mere boy," gradually built up the present school of research and made the Cavendish Laboratory famous throughout the world. A clear picture is drawn of the great master amongst his students; and at this stage the author cannot keep up the formal references to "Sir J. J. Thomson," but lapses into the old affectionate "J. J." The portrait which illustrates the article shows Sir Joseph in a very characteristic attitude.

The Central for December, 1911, has an interesting article on a new aluminium industry, by Mr. A. V. Hussey. It describes the methods used in the manufacture of large vats and tanks from sheet aluminium. The joints, which are generally butt joints, are welded by means of an oxy-hydrogen blow-pipe, which melts the metal at the joint, while a special flux dissolves the oxide formed and allows the two edges of metal to run together. When the joint has been trimmed and hammered it is as smooth as the rest of the sheet, and under test proves as strong as the unworked parts. The development of the industry has apparently been in the hands of old students of the City and Guilds College throughout. The editors appeal to old students for their views as to the values of individual portions of the three years' course at the college. These may be of special value, as it is not often that those taught get an opportunity of expressing themselves. We trust the anxiety expressed by the editors as to the future of the Old Students' Association, owing to the numerous changes now taking place at South Kensington, will prove to be unfounded.

OPTICAL wedges have been in use for a long time, but the graduated tint was always narrow in proportion to its length. It is only about eighteen months ago that Dr. Goldberg suggested the use of "wedge-screens," and showed how they could be produced by casting pigmented gelatine in a mould of two sheets of glass that touch at one edge, and are slightly separated at the opposite edge. Wedge-screens are now made of great accuracy by Messrs. Ilford, Ltd., and at a recent meeting of the Royal Photographic Society Mr. Renwick described some of their uses. The essential feature of the wedge-screen is that it is wide, that is, square or approximately square, and this allows of another plate upon which, for example, a graduated tint has been produced for testing purposes, being rotated upon the wedge-screen. If the gradation of the plate is exactly the same as that of the screen, and they are brought face to face in reversed positions, the two together give a uniform tint. Then, knowing the values of the screen, the gradation of the plate is known also. But if the two gradations are not equal, by isolating a strip and rotating the one upon the other it is possible to get the visible strip of equal density throughout its length; and Mr. Renwick showed the exact relationship between the angle of rotation and the comparative steepness of gradation of the screen and the plate, whether the plate is steeper or less steep than the screen. The one screen plate, therefore, permits of the measurement of the steepness of gradation of any plate, the screen with its known values being the standard, without the use of any photometric instrument, except perhaps in a secondary sense and of the simplest description, to determine the equality of the density of the observed strip.

IN connection with the application of photography to the detection of adulteration, the current (January) number of *The World's Work* contains some interesting reproductions of photomicrographs, by Mr. Ernest Marriage. Of these, the following may be specially mentioned:—pure apple jam; "improved" strawberry and gooseberry; "improved" raspberry and currant; pure blackcurrant jam; blackcurrant "improved" with fruit jelly. In all these samples of so-called "improved" jams the characteristic apple-cells are clearly discernible. The photographs are published in illustration of an article by "Home Counties" entitled "Unsophisticated Jam."

THE Bulletin of the St. Petersburg Academy of Sciences, part xv. of 1911, contains an important paper, by Prof. Walden, of Riga, on formamide as an ionising solvent. This solvent has the property of imitating in a remarkable degree the physical characteristics and constants of water. In the present paper its behaviour as a solvent in cryoscopic measurements and the electrical conductivity of its solutions are described. It is shown that when binary salts are used as solutes, solutions are obtained for which the coefficient of ionisation may be even greater than in water. Moreover, the cryoscopic and the electrical measurements agree in giving concordant figures for the coefficient of ionisation over a range of dilutions from 5 to 100 litres per gram-molecule. Strong organic acids, such as tribromoacetic acid, do not, however, become ionised to any marked extent when dissolved in formamide. It was found that starch dissolved in formamide gave a molecular weight M=645, corresponding with the formula $(C_6H_{10}O_5)_4$, and that its specific rotatory power was +189°. Casein gave a molecular weight M=400, and specific rotatory power −106° to −88°.

THE *Revue générale des Sciences* of December 15, 1911, contains an article by M. Lamotte on the recent work of the Cryogenic Laboratory of Leyden. An account is there given of the methods used in liquefying helium on an extensive scale, and two diagrams are reproduced to show the arrangement of the apparatus. The work recently carried out with the help of liquid hydrogen and liquid helium includes:—(1) a determination of the critical pressure of neon (29 atmospheres) and of its pressure at the triple point (35 centimetres); (2) an investigation of the constants of argon; (3) measurements of resistance of metals at low temperatures, whereby it has been shown that the resistance of gold and of mercury falls almost

to zero at 3° A.; at this temperature the resistance of mercury is less than one ten-millionth of its value at 0°, whilst at 1·5° A. it is still smaller; (4) investigations of magnetic susceptibility and thermoelectric force. Attention may also be directed to two articles on the fixation of atmospheric nitrogen in the same journal of November 30 and December 15, 1911; these are accompanied by a series of interesting and unfamiliar illustrations.

THE first number of *The Chemical World* is a very readable production. The new journal is a monthly periodical published by Messrs. J. and A. Churchill; its aim is "to present to those interested in the many branches of chemistry an account of progress in both theory and practice." Written from this viewpoint, a number of short articles deal with various topics of chemical interest, and form the chief feature of the magazine. Among these are "The Detection of Mydriatic Alkaloids," by Mr. F. H. Carr, discussing a problem which arose recently in a notable murder trial; "The Chemical Characterisation of Soils," a useful contribution by Dr. E. J. Russell; "The Recent Progress of Organic Chemistry," in which Dr. A. Clayton describes Knorr's isolation of the ketone and enol forms from ethyl aceto-acetate; and a summary of "Metallurgical Progress in 1911," by Mr. G. T. Holloway. An illustrated article on the chemical department of the Royal College of Science, with a portrait of Sir Edward Thorpe, is the first of a series of similar accounts which will deal with the chemical establishments of modern universities and technical colleges. Other serial contributions commenced are one by Mr. E. Hatschek on "The Physics and Chemistry of Colloids," and one on "Chemical Research" by the editor. Sections are also devoted to physical chemistry, chemical engineering, and chemical industries, whilst patents and commercial matters are not forgotten. Thus the new venture appeals to many interests, and, judging by the first issue, it deserves a cordial welcome.

IN a paper on the direct experimental determination of the stresses in the steel and in the concrete of reinforced-concrete columns, read before the Institution of Civil Engineers on January 9 by Mr. W. C. Popplewell, is described a method of measuring the simultaneous shortening of the steel bars and of the concrete. Martens extensometers were used; for the steel these were applied to the ends of pairs of pins projecting from the reinforcing bars through holes in the concrete; for the concrete the extensometers were applied to the surface as near as possible to the steel. The elastic moduli for the steel and the concrete were thus found to be 30,200,000 and 1,535,000 lb. per square inch respectively. A further set of experiments carried out to determine the intensity of the frictional grip of the concrete on the steel resulted in values ranging from 300 to 600 lb. per square inch of bar surface, to cause slipping. When all the effects of eccentric loading have been eliminated from the results of the tests on columns, there is no evidence to indicate that slipping took place. In columns of this kind, made up with plain smooth bars, the two materials behave like one, so far as their strain effects are concerned.

AN article on propeller erosion in *Engineering* for January 12 gives an account of a research conducted by Dr. O. Silberrad, of Buckhurst Hill, Essex, in conjunction with the Manganese Bronze and Brass Company, Ltd. Propellers driven by comparatively slow-running reciprocating engines are free from erosion when constructed of manganese bronze. When, however, the same alloy was used for turbine-driven propellers erosion reappeared, and often of a very serious character. In the case of the *Mauretania* and *Lusitania*, had no remedy been found the propellers would have required replacing every few months at a cost of some thousands of pounds. Each propeller weighed about 20 tons, and the cost ranges from 130*l.* to 180*l.* per ton. The erosion seems to have been due to the eutectic being washed away, the mixed crystals constituting the main mass of the alloy being practically unaffected. The research has been successful in the discovery of an alloy which is now in actual service on the *Mauretania*, and has proved itself practically inerodible. The new alloy is patented conjointly by Mr. P. R. Parsons, of the Manganese Bronze and Brass Company, and Dr. Silberrad, and is called Parsons' New Turbadium. It has a tensile strength of 38 to 40 tons per square inch, an elastic limit of 18 to 19 tons per square inch, and an elongation of 15 per cent. on 2 inches. In the erosion tests it showed an endurance about five times that of ordinary high-tension bronze, and this result has been confirmed in actual service. We understand that the British Admiralty has approved its use for the propellers of war vessels fitted with turbine engines.

THE thirty-ninth issue of "Willing's Press Guide," that for 1912, has, as usual, been carefully revised, and well maintains its character as a handy and easily consulted index to the Press of the United Kingdom and to the principal colonial and foreign periodicals. A variety of general information adds to the value of the volume.

A COPY of a convenient monthly weather chart for daily observation has been received from Messrs. George Philip and Son, Ltd. Provision is made for a record of readings of the wet and dry-bulb thermometers, maximum and minimum thermometers, rain-gauge, and barometer. Space is also allotted to wind and weather observations. The price of each sheet is one penny.

A NEW and enlarged edition of "Soap-bubbles: their Colours and the Forces which Mould them," by Prof. C. V. Boys, F.R.S., has been published by the Society for Promoting Christian Knowledge. The several new and original sections which the present issue contains provide, like the lectures Prof. Boys has been giving lately to the Royal Society of Arts juvenile audiences, still further evidence of the author's genius for experimenting and his talent for clear and interesting exposition. The price of the new edition is 3*s.*

SIR EDWARD THORPE'S well-known "Dictionary of Applied Chemistry" is being revised and enlarged, and Messrs. Longmans and Co. announce that the new edition will be issued in five volumes. The first volume will be ready in a few days, and vol. ii. early in the summer. It is hoped that the work will be completed within two years. Messrs. Longmans announce also that the work on "Surgery," by Sir W. Watson Cheyne and Mr. F. F. Burghard, has been entirely revised and rewritten with the assistance of Mr. T. P. Legg and Mr. Arthur Edmunds. The first volume will be issued before the end of the present month, and vol. ii. in April next.

OUR ASTRONOMICAL COLUMN.

POSSIBLE CHANGES IN SATURN'S RINGS.—At the meeting of the Royal Astronomical Society, held on Friday last, it was announced that a telegram had been received, by Sir David Gill, from Prof. Todd, in which he said:—"Near the extremities of the major axes of the bright outer ring of Saturn, with the aid of a powerful telescope, I have

observed a certain sparkling flocculence which I interpreted to be a dissipation of the ring."

Commenting on this message, the Rev. T. E. R. Phillips stated that he had observed Saturn the previous night, but had failed to note any extraordinary feature such as was described in Prof. Todd's message; it was, however, possible that the affected section of the ring was not then in view. He also added that, according to the accepted view of the constitution of the rings, disturbances of some kind were likely to occur from time to time, and that these might be revealed by irregularities in the shape of the shadow of the ball on the rings. At the previous apparition he had seen such irregularities, but recently he had thought the shadow perfectly uniform. Other observers, who had been able to see the Encke's division easily, had also noted nothing irregular or unusual.

A *Daily Mail* inquiry at Greenwich elicited the suggestion that the phenomenon may have been produced by the collision of two of the particles forming the ring, the heat generated by the impact possibly raising the particles to incandescence. Owing to the comparatively large separation of the particles and their uniform motion, such collisions would not be of frequent occurrence.

MARS.—Numerous observations made at the Sétif Observatory are recorded in No. 4545 of the *Astronomische Nachrichten*. Among other things, the disappearance of the south polar spot since December 13, 1911, is noted, and it is remarked that its position was occupied by a large, well-marked area having the same hue as the southern "islands." Special attention has been paid recently to the study of Libya, which M. Jarry-Desloges considers important in the study of abnormal clear places on Mars. He gives details of observations showing changes in the brightness and tint of Libya during the period December 14–23, 1911. A telegram received on December 28, 1911, states that the Thyle region had been abnormal since December 18, being whitish with brilliant spots. The Styx was observed double, and M. Tyrrhenum and Syrtis Minor were always vague. Telegraphing on December 30, the same observer stated that considerable changes had taken place in the north polar cap during the preceding twenty-four hours. An important white band was seen between Propontis and Palus Mæotis, and M. Tyrrhenum was extended over Eridania. On January 4 M. Jarry-Desloges announced the reappearance of the south polar cap.

A NEW VARIABLE OR NOVA, 87, 1911, PERSEI.—Mr. C. R. D'Esterre, in a note appearing in No. 4545 of the *Astronomische Nachrichten*, describes his observations of an object in Perseus which would appear to be a new variable star or a nova. On a photograph taken on November 13, 1911, when the object was at its maximum brightness, about mag. 11–12, the image of the newly discovered variable overlapped the images of two neighbouring stars, whereas it is not shown at all on photographs showing objects much fainter than the eleventh magnitude taken with the same instruments during August, 1911. The position of the object in question is 2h. 0m. 13·1s., +56° 29·8′ for 1855·0, and 2h. 3m. 16·3s., +56° 42·8′ for 1900·0.

THE LIGHT OF COMETS 1911*b* AND 1911*c*.—In a note appearing in No. 4545 of the *Astronomische Nachrichten* M. Orlow discusses the varying brightness of Kiess's (1911*b*) and Brooks's (1911*c*) comets. Admitting that the brightness is proportional to Δ^{-2}, he seeks for the different comets the exponent of the quantity r. For Brooks's comet, from twenty-three observations made during August 27 to October 13, he finds that $1/\Delta^2 r^{3\cdot2}$ gives the nearest approximation to the observed curve, H_0, the mean brightness, being 5·1.

From twelve observations published by Dr. Holetschek he finds that $H_0=7\cdot2$ and $r^{-3\cdot4}$ are the values which best fit the brightness of Kiess's comet. For two other comets, 1910*a* and 1908*c*, he derives the values $H_0=5\cdot4$, $r^{-4\cdot6}$, and $H_0=4\cdot3$, $r^{3\cdot5}$, respectively.

THE SOLAR CONSTANT.—In No. 5, vol. xxxiv., of *The Astrophysical Journal* Prof. Very has an article on the need of adjustment of the data of terrestrial meteorology and of solar radiation, and on the best value of the solar constant. In it he criticises the recent work of Abbot and Fowle in the determination of the solar constant, and argues that while their methods purport to follow Langley's methods, they have abandoned the essential principle of the latter, and more nearly approximate to Pouillet's. Prof. Very argues that too low a value has been assigned to the effective depletion of the incident solar rays, and consequently too low a value has been obtained for the solar constant. Whereas the value of approximately 2 calories is given in the second volume of the Annals of the Astrophysical Observatory of the Smithsonian Institution, Prof. Very finds evidence on every hand that the value should be greater than 3 but less than 4 calories.

THE SURVEY OF INDIA.[1]

THE report of the operations of the Survey of India during the year 1909–10[1] has just been issued by Colonel S. G. Burrard, R.E., F.R.S., the Officiating Surveyor-General. During the year the new scheme of reorganisation which had been approved was brought into operation, and in it provision is made for three topographical circles, the northern, southern, and eastern, each under a superintendent. Four topographical survey parties are allotted to each, and there are six trigonometrical parties under the direction of the Superintendent of Trigonometrical Surveys. Details are given of the topographical work executed in each of the three circles, and maps show the distribution of the areas surveyed and the portions which have been surveyed since October, 1905. The forest surveys were carried out in almost every case by the particular topographical parties in whose spheres of work the forests lay, and were mainly on the scale of 2 inches to 1 mile.

The principal triangulation was continued in the North Baluchistan series, the Kashmir series, and in the Upper Irrawaddy series, a total of thirty-five stations being observed from, and thirty-nine triangles being completed, the average angular errors being 0·303″, 0·591″, and 0·381″ respectively in the three areas of work. A series of comparisons was carried out to test the accuracy of mercurial barometers, aneroid barometers, and hypsometers as height-measuring instruments. The results showed that the aneroid barometers differed greatly from one another and from the mercurial barometers. The latter gave heights in defect, and the hypsometers gave heights considerably in excess of those obtained by triangulation; the excess at 16,000 feet being as much as 600 feet. Astronomical latitudes were observed in Oudh, and pendulum operations were extended to the east and north-east of the area investigated in the season 1908–9 in Central India, twelve stations having been visited this year in the tract situated between lats. 21° and 26° N., and longs. 79° and 83° E. The magnetic survey and the tidal operations were continued.

At Dehra Dun the base-line observatory was commenced in 1909, and its construction is now in hand. A complete apparatus of wires has been purchased to replace the old compensation bars, and approximate sites for base lines in Burma and Baluchistan have been selected. The simultaneous reduction of the levelling was completed during the summer of 1910; all closing errors of circuits were eliminated, and the level net was connected to sea-level at nine different points; orthometric corrections were applied, and adjusted values of all bench-marks fixed between 1858 and 1909 were obtained. The results are published as vol. xix. of the 'Account of the Operation of the Great Trigonometrical Survey of India," and the publication of this volume marks the close of the first half-century of levelling work in India, thus providing a scientific and consistent basis for the levelling operations of the future.

H. G. L.

[1] The General Report on the Operations of the Survey of India during the Survey Year 1909–10. Prepared under the direction of Colonel S. G. Burrard, R.E., F.R.S., Officiating Surveyor-General of India. (Calcutta, 1911.) Price 2 rupees or 3*s*.

THE SAND-DUNES OF NEW ZEALAND.[1]

SAND-DUNES originating from the shore occupy an area of 290,000 acres in the North Island and 24,000 acres in the South Island of New Zealand. Protection against inroads of the sea is not a pressing matter in New Zealand, but protection of fertile lands from burial by marching dunes is, and it is for the latter purpose that the dunes have to be fixed. With this object in view, the Sand-drift Act of 1908 was passed. By it the Minister of Lands is empowered to cause operations to be undertaken for controlling sand-drift within a proclaimed area, the cost being apportioned among the owners of land within that area. The order is subject to appeal to the local magistrate, the final decision resting with a board consisting of the magistrate and two assessors, one appointed by the Government, the other by the local authority.

Photo. [*L. Cockayne.*

FIG. 1.—Interior of Plantation on Dunes, New Brighton, chiefly *Pinus insignis*.

The rainfall of New Zealand being ample, it is only necessary for the first stage of reclamation to select a plant which can withstand the impact of driving sand and adjust itself to a rising surface. The best of all is the marram grass (*Ammophila arenaria*). Practical directions for planting are given in the report. This plant has little value for grazing, and farmers are warned that it is impossible to fix the dunes by means of any plant valuable for pasture. When the dune-tract is so fixed by marram grass that the sand no longer drifts, the grass dies off in patches. Here pasture grasses may be sown, *e.g.* Yorkshire fog and clovers, to be replaced later by more compact turf-formers. Thus the whole dune-tract is gradually converted to pasture. Great care is necessary to plant uniformly, avoiding the formation of trough-like wind-channels; and "wounds" in the marram or turf must be attended to at once.

The proper use of dune-tracts is, however, in Dr. Cockayne's opinion, for the growth of valuable trees. *Pinus insignis* is stated to be the most suitable. These should be planted from 2½ to 3½ feet apart. In Germany, generally speaking, marram grass is only used for the foredune; while immediately in its lee the planting of trees takes place without any preliminary fixing by sand-binding plants, the sand being, however, partially fixed by a network of sand-fences consisting of upright sticks. In France the area behind the foredune has been converted to forest, not by planting, but by sowing.

Measurements of the rate of march of a dune are always useful. The following case is given in the report. The position of a wandering dune in the Kaipara district, Auckland, was determined in 1866. By the end of 1910 it had advanced 132 yards, *i.e.* 9 feet per annum.

Photo.] [*L. Cockayne.*

FIG. 2.—Successful planting of Marram Grass in a Wind Channel. Plants rather too far apart. Cliff-dunes south of Manukau Harbour.

Dr. Cockayne's valuable report contains a list of seventy-four papers bearing upon the subject of the sand-dunes of New Zealand.

VAUGHAN CORNISH.

[1] Report on the Dune-areas of New Zealand: their Geology, Botany, and Reclamation. By Dr. L. Cockayne. (Wellington, 1911.)

BREWING AND MODERN SCIENCE.[1]

THE industry of brewing has earned unenviable notoriety as affording a subject for every possible kind of controversy: it has been also the most favoured field for the application of modern science. The brewer, faced by competition and by repeated increases of taxation, has sought the help of science in order to make the best possible use of his materials; the result has been in every way a complete justification of his action.

The industry has been more than fortunate in the men it attracted in its early days—Griess, O'Sullivan, Horace and Adrian Brown in this country, to name but a few, have been all men of science of the very first rank. Moreover, the problems of brewing have been so fascinating in themselves, and so intimately bound up with the study of vital change, that they have attracted the interest of a host of other workers not connected with the industry.

In consequence, however much brewing may owe to science, it may be claimed that the advance of modern science has received material assistance from investigations connected with brewing. There is probably no other industry which, in this respect, can exhibit as good a record.

The brewer's task—to make a fermented liquor from malt, hops and yeast—does not appear at first sight to present such complications, but on closer examination it will be found that problems, often of the most vexed nature, are experienced both in the choice of the barley, in the manner of malting it, and in the methods of mashing and fermenting the liquor to the best advantage.

Any comprehensive review of the achievements of science in brewing during the last forty years is impossible within reasonable limits: it must suffice to indicate a few instances in which the progress has been most striking. The examples selected by Prof. Brown serve particularly to show how diversified in character are the problems with which the industry, in its successive operations, is faced.

Barley.

It is characteristic of many of our industries, and brewing offers no exception, that there is often a lack of that full sympathy which might be expected to exist between the producer of the raw material and its user. This is so often the case when agricultural interests are concerned, the farmer preferring, for example, to grow weak wheats rather than the stronger wheats in favour with the miller. In the case of brewing, the estrangement is due to a variety of causes, all tending, unfortunately, to diminish the consumption and lower the value of home-grown barley; most of these are beyond the brewers' control.

It is tempting to digress from the subject covered by the title of this article and reflect on the advantages of beer made entirely from malt and hops. There is a widespread opinion that the quality of English beer is not what it was, though it is equally true that the present article is in every way wholesome and suited to the public taste; indeed, if this were not the case, its production would soon cease to be possible commercially.

Before the abolition of the malt tax in 1880 the number of varieties of barley which the brewer could use with advantage was comparatively small. Since this date any suitable barley can be malted, and much has been done to put the knowledge of the subject on a scientific basis by the work of Beavan, first published so recently as 1900.

All barleys may be classified into two broad groups from the position and character of the flowers: these are six-rowed barleys and two-rowed. In addition, each group may have short and broad or narrow and long heads, making in all four distinct classes. These are well shown in Figs. 1 and 2.

In this country two-rowed barleys are the special consideration of the farmer. "Chevalier" barley represents the long, narrow-eared type, and "Goldthorpe" the short, wide-eared kind. The widest difference of opinion exists about their respective merits for malting and brewing. At present the evidence is in favour of Chevalier for the production of the higher qualities of ale, in spite of which, in many parts of the country, the culture of Goldthorpe barley is displacing that of Chevalier.

[1] Royal Society of Arts Cantor Lectures by Prof. Adrian J. Brown, F.R.S.

An altogether model series of investigations to determine the yield and money value of different varieties of barley has been carried on for six years by the Irish Department of Agriculture, assisted by Messrs. Guinness. The yield of the crop per acre for each of the varieties tested was determined under strictly practical conditions, and its commercial value ascertained on the market. From these data the value per acre was determined for each variety. Archer, a type of Chevalier, proved to be the best barley, being superior and more profitable to grow in every case. Goldthorpe was the best of the wide-eared barleys, but from the farmer's point of view it always gave poorer results than Archer. This conclusion applies primarily to Ireland, but probably it is equally true of English conditions. Another point brought out by the experiments was the importance of using pure seed; indeed, it is claimed that an increase of yield of six bushels per acre, and an increase in value of 200,000*l*., would be effected in Ireland if pure selected Archer were substituted for the present varieties of barley sown.

B. *A.*

FIG. 1.—Six-rowed Barley. *A*, Wide-eared, with short joints (*H. hexastichum*). *B*, Narrow-eared, with long joints (*H. vulgare*).

The market values barley by empirical methods, based on such characteristics as the character of the skin of the grain, its size and shape, colour and relative hardness, together with other factors comprehended under the term "maturation." It is of interest that the scientific investigations of Beavan entirely uphold these methods of valuation, and enable them to be controlled more exactly in the laboratory.

The six-rowed barleys are obtained from countries possessing a warmer and more sunny climate than our own. Many of them are very heavy croppers, and possess valuable characteristics; there is obviously a considerable field open for the scientific plant-breeder to adapt them to English conditions.

B. *A.*

FIG. 2.—Two-rowed Barley. *A*, Wide-eared, with short joints (*H. zeocriton*, Goldthorpe). *B*, Narrow-eared, with long joints (*H. distichum*, Chevalier).

Malting.

The process of malting involves the germination of the barley grain up to the stage when the starch begins to be attacked; further action is then stopped by drying the malt. Although probably the germination changes of the barley corn have been studied more thoroughly than those of any other seed, our understanding of them is but of the slightest, and much requires to be done before malting is placed on a scientific basis.

The food reserve of most seeds is directly associated with the germ, but in cereal seeds this is not the case, the food

reserve being utilised through the agency of special physiological processes. The young plant may be dissected out from the endosperm without injury; a portion of it, called the scutellum, lies in contact with the endosperm, and feeds the germ from it (Fig. 3). As Fig. 4 shows, the endosperm is composed of two very different types of cells. The inner larger portion consists of thin-walled starch cells surrounded by the thick-walled aleurone cells without starch granules. When moistened, the dry barley corn absorbs water, swelling to the extent of 50 per cent. The characteristic re-entering ventral furrow (Fig. 5) allows of expansion, and so prevents rupture of the seed coverings. Internally, the cell walls nearest to the scutellum swell and disintegrate, and this action slowly spreads through the endosperm. Within about ten days the cell walls throughout the whole length of the corn are modified. The endosperm, in consequence, becomes soft and mealy instead of hard, and it can be broken and rubbed between the fingers. This stage of mealiness is that desired by the maltster. At the same time, the starch granules within the cells begin to be attacked; but this action is at first very slow, and only very little has been acted on when change is arrested by drying the malt.

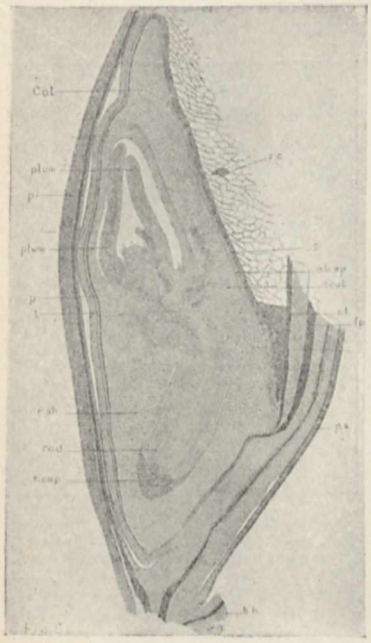

FIG. 3.—Longitudinal Section of the Germ End of a Barley Corn (Highly Magnified). "Plum," plumule; "rad," radicle; "scut," scutellum; "ab ep," absorptive epithelial layer. (After Holzner.)

FIG. 4.—Section of Portion of Endosperm of a Barley Corn (Highly Magnified). *A*, Coverings of the corn. *B*, Aleurone cells containing no starch. *C*, Thin-walled starch-containing cells comprising the greater part of the endosperm. The starch granules are visible lying embedded in the remains of the cell protoplasms.

Brown and Morris found that the scutellum of the growing embryo secretes two enzymes, cytase and diastase, which bring about the changes described, whereas the endosperm is inert and without life. Later experiments by Brown and Escombe confirmed the contention of Haberlandt that the cells of the aleurone layer also secrete the same enzymes.

At various stages of the malting process the nitrogenous compounds originally present in the endosperm migrate to the embryo. These changes are due to the action of two other enzymes, a peptase and a tryptase. Probably these originate in the same parts of the corn as cytase, but direct evidence on this point is still wanting.

Barley and indeed all other seeds are specially protected by their coverings to prevent loss of the stored-up food material by diffusion. The testa, or inner thin skin of barley, constitutes a very remarkable semi-permeable membrane, allowing water to pass through, but preventing the passage out of the cell of the soluble carbohydrates and nitrogenous materials, or into the cell of such substances as mineral acids and salts. Still more remarkable is the power of selective permeability displayed by the skin: it allows such substances as mercuric chloride, acetic acid, acetone, ethyl acetate, and a few others to pass through, whilst keeping all other materials out. The elucidation of this peculiar behaviour is leading to results of most fundamental significance in connection with plant chemistry.

Mashing.

Having transformed the barley corn into a material full of diastase and other enzymes, it is the brewer's next care to cause further digestion to take place inside his vessels, his object being to transform the starch into soluble constituents. Much depends in practice on the way in which this operation is effected; the composition of the water, the state of division of the ground malt, and the temperature and duration of the process are all factors of prime importance. For the moment, however, we are only concerned with the nature of the transformations.

It is not yet forty years since O'Sullivan rediscovered maltose, and showed that this sugar, and not glucose, is formed from starch by the action of diastase. The new field opened up by this discovery attracted numerous investigators, but, notwithstanding their labours, the essential points are still in dispute: the constitution of the starch molecule and the manner of its breakdown are still far from being settled. The question is too complicated for discussion here other than from its more technical aspect.

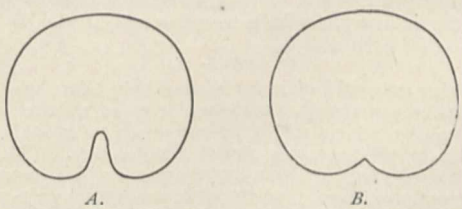

FIG. 5.—Diagram of Transverse Sections of Dry and Steeped Barley Corns. *A*, Dry corn. *B*, Steeped corn.

Brown and Morris have shown that among the products of a starch conversion performed at temperatures much the same as the brewer chooses in practice, are certain unfermentable maltodextrins. If the products from the starch consisted of maltose and stable dextrins only, the maltose would be entirely fermented in the brewery, and the beer obtained would be highly alcoholic and very thin in palate flavour. More important still, it would contain no carbohydrate material suitable for undergoing the secondary fermentation changes in the cask or bottle. Such material is supplied by the maltodextrins, which, though not fermentable during the primary fermentation, are slowly fermented by the secondary yeast forms which develop in beer when in cask or bottle, and give to good beer its characteristic qualities.

Fermentation.

Science has undoubtedly made very great strides in the elucidation of the fermentation process. Pasteur's famous investigations, in which he demonstrated the existence of anærobic life, led him to regard yeast as an organism endowed with two modes of life. When air was present it lived the life of an ordinary fungus and exhibited the usual actions of cell life; in the absence of air it took on the new properties of a ferment, and attacked sugar. This view persisted for many years, until Adrian Brown showed that, in malt wort, yeast cells increase until a definite number are present in a given volume; they then cease reproducing. This property of yeast is independent of the food supply, and makes it possible to work with a constant number of yeast cells. Under these conditions, it was found that oxygen, far from arresting the fermentative

power of yeast, as Pasteur supposed, actually tended to stimulate it.

Undoubtedly the most striking advance in connection with fermentation is Buchner's famous discovery that the direct cause of the fermentative power of yeast is an enzyme present in the cell. This at once destroyed all theories connecting fermentative power with the vital activity of the cell. The enzyme has been termed zymase, and its behaviour, which in many respects differs from that of other enzymes, has been studied very fully both by Buchner himself and also by Harden, whose results are of a very remarkable character.

When yeast juice, which contains active zymase, is filtered through a Chamberland gelatine filter, it is separated into two portions, one of which remains on the filter, whilst the other passes through. Apart, neither portion has any fermentative power; when united they ferment sugar. The filtrate still retains the power of activating the residue after it has been boiled; it has been named the co-enzyme. The part retained on the filter is destroyed by boiling; it is considered to be the enzyme.

Further experiments showed that dilute solutions of sodium or potassium phosphate have a marked stimulating effect on the activity of zymase, and proof has been afforded that a compound of sugar and phosphoric acid is formed when such addition is made. At the same time, a part of the sugar is decomposed to alcohol and carbon dioxide. An enzyme, appropriately named hexosephosphatase, is present in yeast juice, and serves to break down the compound of sugar and phosphate into its components.

Such facts as these have introduced altogether new conceptions into the knowledge of enzymes.

Without going into greater detail in so complex a subject, Dr. Harden's explanation of the fermentation process may be summed up somewhat as follows.

Enzyme and co-enzyme act in unison on a mixture of hexose sugar and phosphate; one half of the sugar is decomposed into alcohol and carbon dioxide, and the other half combines with the phosphate, forming hexosephosphate. The phosphate is thus for the time being put out of action, but the hexosephosphatase enzyme comes into work and resolves it into free phosphate and free sugar, when the cycle of changes begins anew. The speed of fermentation is regulated by the activity of the hexosephosphatase. Dr. Harden has calculated that with ordinary brewer's yeast at 25° C. the whole of the phosphorus of its cell goes through this cycle twice in every five minutes!

It is well known that, besides ordinary ethyl alcohol, small quantities of other higher alcohols are formed during fermentation, particularly under the working conditions of a distillery. The explanation of the formation of these "fusel oil" constituents has been long outstanding, but quite recently Ehrlich has proved beyond doubt that they arise from the action of yeast on the amino-acids ordinarily present in fermentable liquors. These alcohols are physiologically of great importance as stimulants and excitants of protoplasmic activity. Their presence, even in the minutest quantity, has considerable bearing on questions of flavour, so that technically the proper understanding of their mode of formation is a matter of great importance. Ehrlich's researches have gone far in this direction, and their application in practice is bound to lead to valuable results. It is not improbable that many of the subtle flavouring materials met with in plants may originate from amino-acids in the same manner.

Much has been done in studying the influence of traces of other substances on yeast, since the final character of the beer depends to a large extent on the fermentation being normal. As showing how sensitive the living cell is to stimulus, the effect of zinc on the growth of the mould fungus, *Aspergillus niger*, may be cited. Almost inconceivably small amounts of this element—a dilution of 1 part in 50 millions—are capable of exercising a noticeable effect in favouring growth. Copper in like dilution is known to have a poisonous effect on bacteria, and it is evident that the brewer must use the greatest care in the selection of his vessels.

In addition to the thirteen elements which are generally stated to be essential to plant life, many others are found in plants in very small quantities. The tendency has been, for the most part, to regard these as accidentally acquired, and not essential. Latterly the point of view is changing, and there is evidence that some at least of the elements present in minimal quantities play a very important part.

Sufficient has been said to indicate how closely science and brewing are connected, and how many problems still await solution.

EDUCATIONAL CONFERENCES CONSIDERED IN RELATION TO SCIENCE IN PUBLIC SCHOOLS.

I.

THE end of the second week in January marks the close of a series of conferences which are annually attended by teachers. The majority of these conferences are concerned, in the main, with topics which have only a remote connection with the subjects usually connoted by "science." An exception to this statement must, of course, be made in the case of the proceedings of the Association of Science Masters in Public Schools, which have a strong and beneficial influence on the early training of men who may be expected to take leading positions, not only in the university, but in the country generally. It is owing in part to the realisation of this influence, in part to the sensitiveness and ready response to stimuli of the audience, in part to good management of the society, that the association has been able to secure, year by year, an address from a man of real eminence, and this time special importance was given to the meeting by the fact that Sir Joseph Thomson had accepted the office of president. His address is reproduced elsewhere in this journal; we may here testify to the obvious enjoyment which its delivery gave to the audience, and ask the serious attention of headmasters to the weighty remarks concerning neglect of the German language.

The first paper was contributed by Mr. M. D. Hill (Eton), who has been led by his own experience to doubt the necessity, or even the wisdom, of previous training in chemistry and physics for young biologists. In the discussion the weight of opinion was clearly in favour of insistence on such training. Mr. E. I. Lewis (Oundle), in the next paper, argued that plant biology should be taught in every secondary school. It was a subject the interest and value of which increased throughout life. For junior pupils the subject of plant life affords a preparatory study full of suggestion for the after-study of chemistry, and it does not demand a special technical knowledge on the part of the teacher. The work can consist almost entirely of observation and experiment in the class-room and out of doors; it abounds in examples of comparative method. Another paper dealing with the sequence of subjects was read by Mr. C. E. Ashford (Royal Naval College, Dartmouth), who discussed the place of electrostatics in a school course of electricity. Mr. Ashford began by excluding from the discussion the case of those students of eighteen years and above who are studying as "science specialists" with good mathematical equipment, and invited consideration of the average boys about fifteen years old. He supported the theory which deprecates teaching subjects for their artificial "discipline," and attaches importance to the value of the "content" or subject-matter. On these grounds, and by reason of the great interest evoked in the inquiring mind of boyhood by the everyday phenomena of current electricity witnessed in modern life, it seemed good to begin with the effects of the current, and to postpone electrostatics until some idea of Ohm's law had been obtained. One unfortunate result of insistence on preliminary electrostatics had been unduly to postpone the study of electricity in those practical applications which appeal to the ordinary boy.

Mr. Ashford had been convinced by his experience at Harrow of the soundness of these propositions, and he proceeded to sketch a plan of teaching in accordance therewith. He showed by demonstrations with the current from the lighting supply, and with commercial instruments, how readily electrostatics could be made to follow the current work, and directed attention to the fact that success did not depend on the weather. Prof. Worthington criticised the details of Mr. Ashford's scheme, and advocated the older plan of taking electrostatics first. Mr. Sanderson, on the contrary, regarded the teaching of electrostatics to

young boys as part of the system of too rapid driving of immature minds. Mr. B. M. Neville had tried the plan of taking voltaic electricity early, and leading the class to the problems of electrolysis. The behaviour of electrolytes suggested the existence of discrete quantities or particles of electricity, whence the boys obtained the concept of a measurable static charge. Upon this concept the structure of electrostatics could be built. Several speakers took part in the discussion, of which the outcome appeared to us to be as follows:—Current electricity is attractive to boys, and it takes an unusually poor teacher to deprive it of its interest; electrostatics can be made very interesting by a very good teacher. As a rule, the current work is far more successful than the other. A weak spot in past teaching has been the link between current and static effects; it was felt that Mr. Ashford's demonstration would help members to strengthen that link. Supposing the first difficulty of the transition to be mastered, several of the subsequent difficulties would be in the same position whichever approach had been adopted, except for the important consideration that the boys, by previous current work, had gained some familiarity with, and confidence in discussing, the problems of potential difference, &c. If boys had to leave school before finishing the electrical course, it was more profitable to them to have had the current electricity than the electrostatics, supposing time did not allow both to be taken.

The important question of the possibility of "formal training"—in the psychological sense of the term—was introduced by Mr. A. Vassall (Harrow) in a paper of remarkable lucidity. He advised science masters to study the recent work of psychologists, and took as a particular example the problem of formal training. He was led from his own experience to doubt the "faculty psychology" by which much of our present practice is usually justified, and found that general powers of observation are not necessarily increased by special training. A boy highly trained as an observer of chemical phenomena only develops his observational powers for chemical phenomena; there is no "overflow" which will increase his general powers of observation *except where there is some identity*. We must cultivate wide knowledge and interests, and pay more attention to the subject-matter of the curriculum and less to mental gymnastics. It seemed little less than a crime to use the lower or middle-school divisions simply as a training-ground for the later study of formal science when the majority of boys in the divisions are not proceeding to such later study. There is a marked tendency so to use them at present—*e.g.* there is too much weighing and mensuration, glass-working, and other chemical manipulation. These boys should work on broad lines—in physics at such things as the electric installation of a house; in chemistry at real experiments in breathing, burning, and decay, and other topics of wide application. The ideal curriculum would give the boy (1) as much knowledge of certain subjects as is required for culture and æsthetics; (2) of other subjects only so much as will not sap his intellectual self-reliance by their being attempted beyond his capacity; (3) a special knowledge, when possible, of a subject or subjects which will be useful to him in his after-life.

Prof. Armstrong stated that he accepted neither the experiments of the psychologists nor their inferences. He was convinced that types of mind differed more than was commonly recognised. An engineering, constructive mind could only be interested, for instance, in chemistry by appealing to it through topics closely in agreement with its own bias, *e.g.* through problems concerning the corrosion of metals. We must keep in mind man's experience through the ages. Man had been accustomed only to fight, to work, and to use his commercial instinct; and almost all modern education was alien to the experience of the race. We must make our instruction practical enough and simple enough for the majority of minds, and avoid the common tendency to postpone introducing a subject to too late in age. Dr. T. P. Nunn said that psychologists were quite alive to the present imperfections of their science, and all leaders in the subject advised caution in the application of recent inferences. The idea that the mind was like a photographic plate, the sensitiveness of which to all subjects could be increased by attention to one, was quite wrong. None the less, there was a development beyond a mere record of the actual thing observed. A student by observing gained self-reliance; he learned that he was capable of drawing a rational inference without depending on external authority; he learned that he must not be in a hurry if he wished to observe aright. These acquirements *did* increase a boy's power to behave duly and perform correctly in various situations. While listening to the discussion, which was well maintained, we could not help feeling that science teachers of all grades would gain much by a study of the papers on formal training which were read by Dr. Myers, Dr. Sleight, and Mr. C. L. Burt at the London County Council Conference of Teachers during the preceding week. They would gain a clearer idea of the present position of psychology, especially of the importance of the elements common to various mental performances.

We have brought together the above four subjects somewhat out of their order in the programme of the science masters' meeting, because they appear to manifest a common tendency. They all deal with the problem of suiting the subject-matter and the order of its presentation to the growing intelligence and developing interests of the boy. A few years ago the sequence of studies in the science side of the curriculum was determined by considerations of their logical order, and no one doubted that the logical order was the right one to follow. The new movement tends to make the logical order less dominant, and to determine the sequence rather by the psychological order of the boy's mental growth. We venture to put forward our personal impression of the direction in which, judged from the general attitude of the conferences, the science curriculum is evolving. Before doing so, we note with pleasure the action of the Headmasters' Conference with regard to Greek at entrance examinations, which was taken at the December (1911) meeting.

The headmasters of the largest public schools have definitely committed themselves to action which shall relieve the preparatory schools from teaching Greek to little boys. This makes it possible for a boy during his school life to follow such a course as the following:—(1) In the preparatory school a course of practical and seasonal nature-study with gradually increasing thoroughness and method; (2) in the lower school of the public school courses of, say, astronomy and plant physiology (as suggested in the paper by E. I. Lewis); (3) in the middle school a course of physics and chemistry, in which the utilitarian interest of the boys is utilised and made more and more scientific (*cf.* C. E. Ashford and A. Vassall), the quantitative side being well-developed, but not exclusively so. It is supposed that many boys will carry school science no further than this. For those who intend to pursue scientific study after school life there will be (4) a course of systematic study in physics, chemistry, and often biology. The work in this stage may best be treated by the method of the seminar, and considerable encouragement may well be given to the historical and philosophical aspects. It may even be wise to encourage theoretical speculation in order to inculcate habits of independent, self-reliant observation and reflection. Books of reference should be used, including French and German texts, and such works as Jevons's "Principles of Science" and Pearson's "Grammar of Science" should find readers. The suggestions for this stage appear to be in harmony with Sir Joseph Thomson's address.

The annual meeting of the Mathematical Association and the remainder of the science masters' programme will receive consideration in a subsequent article; but it may be stated at once that both meetings were well attended, and showed a growth in the area of effectiveness of the societies.

G. F. DANIELL.

THE PROTECTION OF ANCIENT MONUMENTS.

THE question of the protection of ancient monuments in this country has reached a new phase by a paper recently read by Sir Schomberg McDonell, secretary to the Office of Works, before the Society of Antiquaries. He referred to numerous cases, such as those of Stonehenge, the camp at Penmaenmawr, Meavy Bridge, Chichester Cross, the wall paintings of Tewkesbury Abbey, the proposed restoration of Carnarvon Castle, as instances

in which much damage had been, or was likely to be, caused to national monuments by reckless interference. To meet this evil, he suggested the establishment of an advisory committee, composed of men eminent in archæology and public life, with representatives of the leading archæological societies, the British Museum, nominees of the Archbishops of Canterbury and York, and of the Ecclesiastical Commissioners.

It should be the duty of the committee, when satisfied that any monument of national importance was in danger, to recommend to the First Commissioner of Works that the custody of it should be assumed by the nation. On receipt of this report, the First Commissioner, if he thought fit, should move his Majesty to declare by an Order of Council that the monument was one of national importance, and was accordingly transferred to the custody of the First Commissioner. The scheme should not, he suggested, apply to dwelling houses in actual occupation, but in the case of important ecclesiastical buildings now in use he proposed that no scheme of restoration should be carried out until the plans had been passed by the advisory committee. Until the question has been more fully discussed, it would be premature to pass an opinion upon it. But, on the whole, it seems to offer a suitable remedy for a very important and growing evil.

NOTES ON MUSEUMS AND MENAGERIES.

IN *The Field* of December 9, 1911, there is an illustrated account of the new buildings recently added by the Hon. Walter Rothschild to his zoological museum at Tring, these additions considerably more than doubling the size of the original structure. As extended, the building forms three sides of a square, of which, when viewed from the front, the central transverse portion and the right wing are new. The exhibition galleries are throughout lighted by windows placed high up in the walls, so that comparatively little direct sunlight falls on the cases, this being screened, when necessary, by scarlet blinds, which are claimed by the owner to prevent all the ill-effects of actinism. The new exhibition galleries are fitted along each outer wall with a continuous series of glass and steel cases, 10 feet in height, and constructed on a modification of the principle adopted in the zoological museum at Dresden, these being stated to be absolutely dust-proof. A similar but wider series of cases, divided by a longitudinal partition of wood, occupies the middle line of each of the new galleries. The new buildings include also a library, containing 30,000 volumes, forming about 6000 separate works, workrooms, studies, &c.

With characteristic promptitude and energy, Mr. Rothschild has already arranged his specimens (which were previously crowded together) in the new cases, so that naturalists and the general public are able to appreciate the vast extent and excellent mounting of this really marvellous collection. The mounting of the larger mammals, as well as of many of the birds, has been in recent years mainly executed by Rowland Ward, Ltd. For a notice of some of the specimens in the exhibition galleries our readers may be referred to the article already cited.

The La Plata Museum forms the subject of an article by Dr. E. H. Ducloux, the vice-director, in the *Revue générale des Sciences* of November 15. That institution, which the writer considers to be the most important of its kind in South America, is the work of a single individual, Dr. H. P. Moreno; and to write the history of the former is practically the same as to write a biography of the latter, who was the first director. The museum was established by the Provincial Government in 1889 on the base of an anthropological and archæological museum founded in 1877. In its foundation Dr. Moreno had to wage an uphill fight against indifference, and sometimes hostility, in high quarters; but he eventually succeeded in getting the present palatial building erected, and brought together the wonderful collection of Argentine and Patagonian extinct vertebrates which has rendered the institution deservedly famous throughout the scientific world. It was the aim and intention of its founder that the functions of the museum should include not only science, but to a certain extent art; and, as at present constituted, its organisation embraces geography, geology, mineralogy, palæontology, botany, zoology and anatomy, anthropology (including ethnography and linguistics), and chemistry and pharmacy, while a special annexe is devoted to a school of design.

The statute of September 25, 1905, which organised the National University of La Plata—of which, according to the author, the already existing municipal scientific institutions ought to form the foundation—will, it is hoped, open to the museum a wider horizon, and remove it from the verge of penury which, under any other direction, would eventually bring about its ruin. The article contains several illustrations, one of which shows part of the wonderful series of the giant armadillos, or glyptodonts, of the Pampean epoch.

In the November number of *The Zoologist* Captain Stanley Flower concludes his notes on zoological institutions in various parts of Europe recently visited by himself. Dealing in this contribution with Stuttgart and Vienna, he remarks that, among the forty-eight institutions inspected, "the Tiergarten at Doggenburg, near Stuttgart, would be the most profitable to visit. The site is small, the collection is small, and the animals are of no great value, but the arrangement is such that everything is exhibited to its best advantage. The lover of animals who visits Doggenburg will carry away with him the impression that he has seen but few species, but these all carefully provided for and happy; the schoolchild will have seen the principal types of the vertebrate fauna of Europe, and enough exotic ones to excite his further interest; the casual visitor will not know exactly what he has or has not seen, but will feel satisfied that he has had 'his money's worth.'"

CARBOHYDRATE FORMATION IN PLANT FOLIAGE.

A VALUABLE and interesting contribution to the study of the formation of carbohydrates in the foliage leaf is contained in a paper, by Mr. John Parkin, published in *The Biochemical Journal* (vol. vi., part i.). In order to simplify the case as much as possible and to reduce the conflicting factors to a minimum, the snowdrop (*Galanthus nivalis*, L.) was chosen as the plant to be investigated, as in a previous research the author had shown that in no case is starch or inulin to be detected in the mesophyll of the leaf. It was therefore probable that maltose would be absent in the leaf also, and the research would be thus narrowed down to studying the relationship between cane sugar, dextrose, and lævulose under different conditions. The object aimed at in the beginning was to test Brown and Morris's view, enunciated in 1893, that cane sugar is the first product of carbon-assimilation in plants.

It was found, actually, that maltose is always absent from the snowdrop leaf, so that it appears probable that maltose, when present in foliage leaves, is a hydrolysis product of starch. The quantity of total sugars in the snowdrop leaf is considerable, being from 20–30 per cent. of the dry weight in leaves actively assimilating. The amount of sugar increases from above downwards in a single leaf, and, at the same time, the ratio of the cane sugar to the hexoses (dextrose and lævulose) diminishes. The *proportion* of cane sugar to the hexoses decreases as the season advances, that is to say, in the early part of the season there is more cane sugar in proportion to reducing sugar than later, the comparison being made between leaves gathered about the same period of the day. During any single day the *percentage* of hexose sugars in the leaf remains fairly constant, no matter at what hour out of the twenty-four the leaves may be examined. That of the cane sugar, however, fluctuates greatly, increasing during the day and decreasing during the night. Further, leaves detached and insolated contain decidedly more cane sugar than their controls, but the quantity of hexose sugar remains nearly the same. The lævulose, as a rule, is in excess of the dextrose, irrespective of the time of day or the period of the spring the leaves are picked for analysis.

In discussing these results, the author inclines to the view that cane sugar is, as suggested by Brown and Morris, the first sugar formed in the leaf. But they are not entirely incompatible with the idea that dextrose is the

first recognisable sugar, which recently obtained strong support from the discovery in 1907, by Strakosch, that dextrose is the only sugar present in the actual mesophyll of the leaf of the sugar beet, and that cane sugar, which is almost the only sugar in the root, first makes its appearance, together with lævulose, in the lateral veins of the lamina, and increases in amount in the midrib and petiole.

From an interesting discussion of the function of cane sugar in plants, with which the paper closes, the following may be quoted:—"Its special physical and chemical properties are of interest. It is very soluble and readily crystallises—more so than the other sugars occurring in plants. It is very easily hydrolysed by acids and by invertase. It shares with trehalose, alone among the disaccharides, in having no reducing properties. Maltose, lactose, &c., do reduce, and so may be said to have the aldehyde group in their molecule functional.

"Sucrose may thus have been selected in the higher plants as the chief circulating sugar, partly on account of its non-reducing properties and soluble (mobile) nature, and partly on account of the ease with which it can be hydrolysed into its two components, glucose (dextrose) and fructose (lævulose). These hexoses may, as a rule, play distinct parts in metabolism—the glucose more readily lending itself to the respiratory needs and the fructose to constructive work, such as the building up of the plant's framework. It is also within the bounds of probability that cane sugar itself may take a direct part in the formation of cell-walls. Just as it appears able to be condensed to starch without previous inversion, so it may be transformed directly to cellulose in the construction of cell-walls. Fenton's work is interesting in this connection. He has shown that various kinds of cellulose respond markedly to a special ketose test, and thus concludes that this substance may contain one or more groups identical with that present in fructose."

THE DEMOCRATISATION OF MATHEMATICAL EDUCATION.[1]

THE work of the Mathematical Association, in connection with its activity in promoting the reform of mathematical teaching in our schools, necessarily involves the expenditure of much time and thought upon the detailed discussion of specific schemes for the improvement of the teaching in special departments of mathematical education. It is, however, well that we should sometimes reflect upon the more general aspects of our work; and perhaps a presidential address affords the most suitable occasion for reducing some such reflections to an explicit form, even though nothing essentially new can be said upon the matter.

In making a few brief remarks upon the general character of the reform movement, I propose to emphasise one or two governing principles which I regard as of fundamental importance in relation to mathematical teaching. If I venture, in the course of my remarks, to make some suggestions on less general matters, the adoption of such suggestions as parts of the policy of the Association would only be possible after much detailed discussion of the manifold points which would have to reach some degree of settlement before the suggestions could be translated into the domain of practice.

The modern tendency which has exhibited itself in our time in greater or less degree in all countries in educational policy in general may be described as the tendency towards the democratisation of education. This term, or some synonymous one, has frequently been used to denote the extension of education to wider classes of the population; but it is not in this quite general sense that I intend here to employ the expression. I mean by it rather the progressive adaptation of educational methods to the *intellectual democracy*; the transformation of the methods of teaching and of the matter of instruction so as to meet the needs of those who are lacking in exceptional capacity, at least in relation to the particular branch of study in question; in other words, the concentration of the attention of the educator, in a much greater degree than formerly, on the work of developing the minds of the average many and not solely of those of the exceptionally gifted few. The progress of democratisation of education, in this sense, has been perhaps more marked in the case of mathematical instruction than in other departments. In our own country the Mathematical Association has been conspicuous as an agent in furthering the democratisation of mathematical education. It is very certain that no such democratisation could be effected without more or less radical changes being made both in the methods of teaching and in the selection of the matter taught. It would be of but little avail that the attention of the teacher should be concentrated in a greater degree than formerly on the average many if the methods of teaching and the material taught remained unreformed.

With a view to the formation of some estimate of the profit and loss due to the changes which have taken place of late years in the teaching of mathematics in our schools, let me briefly glance at some of the differences, both in theory and in practice, which distinguish the older and the newer methods from one another. Any exaggeration of which I may be thought guilty must find its excuse in the fact that I am attempting to indicate only the more salient features in a continuously progressive movement.

In accordance with the older and traditional treatment of mathematical instruction in our schools, geometry was treated in a purely abstract manner, the idea being that Euclid, as a supposed model of purely deductive logic, should be studied entirely with a view to the development of the logical faculty. Any knowledge of space relations which might have been imparted by this study was reduced to a minimum by the excessive insistence on all the details of the syllogistic form, the whole attention of the pupils being engrossed by the effort to commit to memory a long chain of propositions in which the actual geometrical content was exceedingly small. On the other hand, algebra, and to a great extent arithmetic, were taught without any regard to their logical aspects, but mainly as affording discipline in the purely formal manipulation of symbols in accordance with prescribed rules, little or nothing being said as to the origin of such rules. The teaching of mechanics was assimilated, so far as possible, to that of geometry, the true position of the subject as a fundamental part of physical science being almost wholly obscured. That the average boy or girl is not by nature appreciative of formal logic or of the interest and meaning of abstract symbols was thought to be a reason why the subjects so treated should be especially insisted on.

In fact, the notion of mathematical teaching was that it should be in the main medicinal and corrective. Its advantages consisted largely in calling forth the use of faculties which are the rarest in the average boy or girl, and were therefore thought to be in special need of development. It was thought to be by no means wholly a disadvantage that these subjects, so treated, were found hard and repulsive by the majority. It was thought that the hard discipline involved in the attempt to assimilate them developed a kind of mental grit, and involved a certain species of moral training, even when the intellectual results were small. A certain strengthening of faith, to be acquired in the process of hard work spent on subjects of which neither the aim nor the utility was obvious to the pupil, was thought to be highly beneficial.

It is unnecessary for me to enlarge upon the defects of this system, and on the inadequacy of the ideals underlying it. The existence of the Mathematical Association is a warrant of the widespread dissatisfaction with these methods, both in their results and their aims. The system as it existed in our schools was condemned by its failure. It failed to attain even its own narrow ideals, except in the case of a very select few among the pupils. The many rejected the material which was for them wholly indigestible mental food. The system was, in the sense in which I have used the term, undemocratic. The results obtained in the case of the vast majority were deplorable; and it needs indeed a strong faith in the anti-democratic principle to imagine that this failure was compensated by the effect of a hard and bracing training on the few who, by mental constitution, were enabled in some degree to profit by it. Even the chosen few suffered severely from the effects of the narrow conception of education which lay at the base of the methods of instruction; for the

[1] Presidential address delivered to the Mathematical Association on January 10 by Prof. E. W. Hobson, F.R.S.

purely abstract treatment failed to disclose the close relations of mathematical ideas with the physical experience in which the abstractions took their origin. That Euclid has any relation to the problems of actual space was seen by the majority of those who suffered under this system only at a later time, if at all. The relations of symbols with the concrete, and the economy of thought involved in their use, remained for the most part unappreciated; such appreciation came, if at all, as the product of later reflection on the part of a very few of those who had attained to some facility in the manipulation of the symbols.

Mais nous avons changé tout cela. The modern methods of teaching appeal in the first stages to those interests which are strongest in the majority, instead of running atilt against the most undeveloped sides of the minds of the pupils. Geometry, the science of spatial relations, is introduced by the observational and experimental study of the simplest spatial relations, verification by actual measurement playing an important part; the abstract treatment in accordance with the deductive method being relegated to a later stage. The interests of the average boy are rather practical than theoretical, therefore, it is thought, he must be interested with space relations on their practical side. He is not interested in formal logic, therefore he must not be bored with learning a chain of theorems of which the object is not apparent to him. He is not usually ingenious, therefore, it is thought, no demands must be made upon him which require ingenuity. He does not readily move in the region of abstract symbolism, therefore he must be introduced to the use of symbols only in an arithmetic manner, in which the concrete implications are prominent. Laborious exercises in algebra, in which expertness in the manipulation of symbols is the object to be attained, should, it is thought, be for the most part omitted.

Owing in large measure to the activities of the Mathematical Association, a considerable transformation in the methods and in the spirit of mathematical teaching has already taken place in many of our schools, and the changes in the direction indicated by the newer ideals are no doubt destined to have even more far-reaching effects than at present. However, the old mechanical methods of teaching still linger on in many of our schools, in which conservative traditions are notoriously difficult to eradicate. The detailed discussions, both in print and *viva voce*, which arise in connection with the work of our association may be of inestimable value in directing aright the detailed development of the reformed methods of teaching. I hope, also, they may prove useful in the direction of checking those one-sided exaggerations which are always apt to arise in connection with activities in which the objects to be attained are various, as they must be in the case of so many-sided a branch of education as the one with which we are concerned. Some degree of compromise, without undue sacrifice of principle, may often reasonably be made in adapting the teaching so as to take account of the widely diverging future careers in prospect for different classes of pupils.

It may, I think, be safely maintained that, the better the theory underlying the method of instruction may be, the more exacting will be the demands made upon the skill, the knowledge, and the energy of the teacher. My own early recollections of learning mathematics call up memories of the classical master, without any real knowledge of, or real interest in, the subjects, hearing repetition of propositions of Euclid, or setting a long row of sums in algebra, monotonous in their sameness. Somehow a few of us managed to learn something, but I tremble to think what would have been the results, had the said classical master attempted to teach in accordance with the newer methods. For the success of the teaching in accordance with the reformed methods, a high degree of efficiency on the part of the teacher is essential if the results hoped for are to be attained, and even if those results are not in some respects to fall short of what was reached under the older system. The teacher must possess a high degree of skill in presenting his material; he must have a broad knowledge of the subject, reaching much beyond the range which he has directly to teach; he must have skill and alertness in handling a class, that skill having been developed by definite training, but, of course, presupposing a natural capacity for the kind of work. Some of the failures of which one hears, of the newer methods to produce satisfactory results, may probably be traced to a falling short on the part of the teaching in one or more of the points I have indicated.

At the present time it is not possible to form any precise estimate of the actual effects of the recent reforms in mathematical teaching. It will only become possible to do so when the confusion incident to a state of transition has passed away. That in many quarters the gain has already been considerable I have no doubt. I have no doubt that the principles underlying the newer methods are sounder than those which formerly held sway. I have no doubt that it is right to proceed from the practical and concrete side of the subject, rising only gradually to the more abstract and theoretical side. But the adoption of more correct principles is only one step; their actual translation into practice gives rise to many difficulties and to many dangers, some of which have most certainly not been altogether avoided. The process of change has as yet not been one involving pure gain.

A perusal of some of the current treatises on "practical mathematics" has led me to think that in some quarters the purely practical side of mathematics is unduly emphasised. The teaching should, without doubt, commence with this side, and should never lose touch with it; but the study of mathematics must be pronounced to be a relative failure as an educational instrument if it fails to rise beyond the purely practical aspect of the subject to the domain of principle. Purely numerical work, calculation with graphs, problems in which the data are taken from practical life—all these are excellent up to a certain point, and they form the right avenue of introduction to scientific conceptions. But if this kind of work is unduly prolonged, and too exclusively practised, it tends to develop a one-sided mechanical view of the capabilities of mathematical methods, and the study ceases to be in any real sense educational. Such practical work is only educational when it precedes, and leads up to, a grasp of general principles, and when it is employed to illustrate such principles. I do not wish in the least to depreciate the importance of mathematics as providing the tools for a vast variety of applications useful in various professions. This side should never be lost sight of in school work. But the most important educational aspect of the subject is as an instrument for training boys and girls to think accurately and independently; and with this in view the more general and theoretical parts of the subject should not be entirely sacrificed either to the exigency of providing useful tools for application in after-life or to the supposed need of sustaining interest in the subject by a too anxious adherence to its concrete and practical side.

I gather that, in some of the current teaching of practical mathematics, a kind of perverse ingenuity is exhibited in evading all discussion of fundamental ideas, and in the elimination of reference to general principles. Instead of a skilful use being made of practical methods to lead up to general methods and illuminating ideas, practical rules seem sometimes to be made the end of all things. I have been told, for example, that the use of logarithms is sometimes taught to students who at no time attain to a comprehension of what a logarithm really is, or of the grounds upon which the rules for the use of logarithmic tables rest. Students who are in the habit of employing, for purposes of calculation, formulæ the origin of which they do not understand have entered upon a path which will inevitably lead to disaster, not only as regards their mental culture, but also in the practical domain. If mathematics is degraded to the level of a set of practical rules, of which the grounds are not understood, for dealing with practical problems of special types, the unscientific character of such a study will avenge itself even on the practical side of life. A student who proceeds on these lines will fail to arrive at those points of view that are not only the most stimulating mentally, but of which the attainment is really essential for success in applying mathematics to practical matters. The practical applications of mathematics are much too varied to be capable of being confined within the range of any number of prescribed rules and formulæ. Practical problems will be found constantly to arise in connection with professional work which are not quite on

the lines of the rules that have been taught, and these problems can be effectually dealt with only by persons who possess some real grasp of mathematical principles, as distinct from a mere knowledge of certain practical rules and methods. Whilst maintaining that a student should thoroughly understand the grounds upon which the formulæ and rules which he employs are based, I do not believe that he ought to be expected to commit to memory, and to be able to reproduce at any time, formal proofs of all such formulæ and rules. Much precious time and energy has been unprofitably employed in the past in attempting to satisfy the unreasonable demands made by examiners in some branches of mathematics that formal proofs should be forthcoming of everything that the candidates are supposed to have learned. The burden thus thrown on the memories of the candidates is far too heavy, and much time and energy which should have been employed in an endeavour to grasp and realise principles has thus been diverted to a far less profitable use.

It appears to me to be eminently desirable that the time saved by the diminution, in school work, of the amount of time spent on unessential details and on unnecessarily prolonged drill in the manipulation of symbols should be employed in introducing the pupils to a considerably greater range of mathematical thinking than has hitherto been usual, and in particular in endeavouring to make them acquainted with more of the fundamental and fruitful ideas which make mathematical science what it is. In the higher classes some time might profitably be spent on the principles, as distinct from the practice, of arithmetic. It would be of great educational advantage if the principles which underlie the practice with which all the pupils have become familiar were brought explicitly to their consciousness. For example, they should understand the principle of our arithmetic notation, so that they may have an adequate appreciation of its beautiful simplicity, and of the fact that it embodies a great time-saving invention. In order to attain this object it is necessary to deal with the theory of scales of notation and radix-fractions, so that the arbitrary element involved in the adoption of the scale of ten may be clearly appreciated. I do not, of course, contemplate the introduction into such a course of artificial problems on scales of notation; only the fundamental principles should be explained, with such quite simple illustrations as may be found necessary for their complete elucidation.

I do not know to what extent some rudimentary and informal treatment of the properties of simple figures in three-dimensional space has at the present time become part of the normal instruction in geometry in our schools. I am quite sure of the urgent necessity for finding time for a small modicum of study of this part of geometry. I remember, a few years ago, in a paper on mathematics for candidates for a college scholarship in physics, the candidates were asked to construct the shortest distance between two given non-intersecting straight lines. One of the candidates, who showed a considerable knowledge of plane geometry, informed me that two non-intersecting straight lines are necessarily parallels. It is unnecessary to insist upon the importance of an endeavour to uproot ignorance of this kind, due as it is to lack of stimulation of the power of observing simple spatial properties.

In considering the various directions in which mathematical teaching may be made to extend beyond the domain that consists of drill in the employment of processes which up to a certain point is undoubtedly necessary, one question of great importance arises—that is the very important question as to the possibility of making a rudimentary treatment of the ideas and processes of the calculus part of the normal course of mathematics in the higher classes of schools. In the hands of a really skilful teacher, the purely formal element in the treatment of the calculus could be reduced to very small dimensions—all the leading notions and processes could be sufficiently illustrated by means of functions of the very simplest types. I believe that some of the time saved by lightening the matter in such subjects as algebra might be more profitably employed in this manner than in any other. The calculus, as embodying and utilising the fundamental notion of a "limit," is the gate to a mathematical world of incomparably greater dimensions than the one in which the student has moved during the earlier part of his course. Any method of presentment which evades the notion of a "limit," as it appears in the differential coefficient or in kinematics as a "velocity," is much to be deprecated. The possession of this notion is the most valuable result of the study, both for educational and for practical purposes. By means of carefully chosen examples in both the arithmetic and the geometric domains, a pupil may be led up to this fundamental notion, so that it may in the end become really his own. To this end it is wholly unnecessary that any treatment of the subject should be employed which would satisfy the logician or the professional mathematician. The important point in connection with this idea, as with many others, is that the student should really have the notion as part of his permanent mental furniture, and not that he should be able to give a complete description of it, or of its philosophy, in conceptual language. I do not propose to indicate now, even in outline, a schedule of those parts of the calculus which would be suitable as part of a general education. This is a matter which might with much advantage be fully discussed by the association, when the views of practical teachers as to the possibilities in this direction would receive the fullest attention.

There is a danger which arises in connection with the democratisation of education that less than justice may be done to the minority who, by natural aptitude, are capable of making much more rapid progress than the rank and file. The danger is probably not so great in our own country as in some others; with us, the old leaven which impels teachers to make the most of their more gifted pupils still works strongly enough, and the questionable stimulus provided by scholarship examinations and other competitions exercises an influence in the same direction which is very powerful, and perhaps, indeed, too powerful. In some countries the rigid system by which every pupil in a school is taken in a general class in a certain number of years through prescribed portions of a subject acts detrimentally upon those pupils who are capable of learning much more rapidly than the average. In America I was told that it would be regarded as undemocratic to make any special provision in a school for the more rapid advance of gifted pupils. This view seems about as reasonable as it would be to prescribe, as a thoroughly democratic arrangement, that all the pupils should be supplied with boots of the same size. The general good demands that, so far as possible, equality of opportunity should be afforded to all for their mental development in accordance with their enormously varying abilities; it does not demand a mechanical equality of treatment, represented by forcing all students to move at the pace of the less gifted or of the average. Although, however, this danger may be a real one in some quarters in this country, the opposite fault, of sacrificing to some extent the needs of the average to those of the abler students, is probably still the more prevalent one.

The movement which I have spoken of as the democratisation of mathematical education is a progressive development. Something not inconsiderable has been accomplished in our time; very much more remains to be done. The difficulties which arise in this connection are largely those of finding the true coordination between the practical and the theoretical sides of the subject. An undue emphasis placed on either side is apt to have disastrous results. The perfect mean is in all such cases probably an unattainable ideal: a certain degree of compromise, depending upon a variety of circumstances, is usually the practicable course; but the most earnest endeavours should be made to prevent such compromise going too far. Whilst recognising to the full the importance of the practical side of mathematics, both as affording the right approach to the subject, in view of sound psychological principles, and also on account of its importance as an equipment for various departments of practical life, let us never lose sight of the paramount importance of mathematics as part of a real education of the intellect. Such education is incomplete unless a few, at least, of the many illuminating notions which our race has achieved in its long struggle to attain clearness in the domain of mathematical thinking are made the common property of our *intellectual democracy*.

THE FUNCTIONS OF LECTURES AND TEXT-BOOKS IN SCIENCE TEACHING.[1]

I WISH to-day to speak of a tendency in education which I think is increasing, and in my opinion is mischievous; it is one, however, which is much more rampant with us at the universities than it is at schools—I mean the practice of attempting to teach everything by lectures; of making to a continually increasing extent the lecture supply the place of the text-book; of learning everything by being told it instead of reading it for oneself.

Now I should be the last to maintain that the reading of text-books is in many branches of study sufficient by itself to give a man a real grasp of his subject. The lecture, or something equivalent to the lecture, is in many subjects, notably in science, an essential part of the educational apparatus, perhaps more essential in science than in anything else. By means of the experiments in the lectures (though these by themselves are by no means all that is required) the students see the phenomena they are studying; the experiments make them realise that they are dealing with definite phenomena, and help towards one of the most important results which the teacher has to aim at to make their acquaintance with these facts as intimate and vivid as possible.

The position I am taking this morning is not new. Let me quote here from Boswell's "Johnson":—

"People have nowadays," said he, "got a strange opinion that everything should be taught by lectures. Now I cannot see that lectures can do so much good as reading the books from which the lectures are taken. I know nothing that can best be taught by lectures, except where experiments are to be shown."

As those of you who are acquainted with that inexhaustible book are, I am sure, longing to hurl another quotation from it at me, I will disarm them by quoting it myself. It relates to an occasion when an Oxford don, Dr. Scott, was present. Johnson lectures were once useful, but now, when all can read and books are so numerous, lectures are unnecessary. If your attention fails and you miss a part of the lecture, it is lost. "You cannot go back as you do upon a book. Dr. Scott agreed with him. 'But yet,' said I, 'Dr. Scott, you yourself gave lectures at Oxford.' He smiled."

I object to the lecture usurping so largely the function of the text-book, because I think when this is done the study of a subject has not the same educational value—is not such good intellectual gymnastics, to use the cant phrase, as when a student reads it for himself. This is especially true when a student is new to the subject; with a book he can confine himself to the consideration of the new ideas, and can take his own time, while in a lecture he has to take in these ideas at the pace presented by the lecturer, and, in addition, has to put them in writing as fast as his pen can travel; as a matter of fact, in many cases he takes little trouble to understand, but confines himself to taking down as many of the words of the lecturer as is possible in the time, and trusts to finding out later on what they mean. This practically amounts to substituting a manuscript, and I think it would not be an unfair description of many such notes to say a very corrupt manuscript, for a text-book. Now it is possible that in some cases there is an advantage in doing this; the lecture may be so good that even the imperfect notes of those that heard it may be better than the best text-book available. I am assuming, of course, that there is a text-book on the subject. This, no doubt, is sometimes the case; but I think those who have read lecture notes as they are taken down will agree with me that a text-book must be quite exceptionally bad if it is not more intelligible than the majority of the notes taken even in good lectures.

Another consideration which I think is of greater weight is that if the student rewrites his rough notes, the task of reducing them to sense and logical order is an excellent mental training. I quite agree that it is, and if the student attended only one such set of lectures a term I think he might greatly benefit by doing this; but when, as he often does under present conditions, he attends three or four such courses, it is impossible for him to treat them all in this way. Consider, for example, a case that came under my observation last term. A student came to me with his time-table; he had lectures or practical work in the laboratory every morning from nine to one, and on three afternoons in the week from two to five. His object in coming to me was to find if I could not help him to find lectures to fill up the three afternoons which he had vacant.

Even though the student attends lectures, it is, I think, important that he should have training in learning for himself, and not be encouraged to think that all he need know about a subject will be told to him in lecture. In after life he will have to acquire most of his learning from books. He will not always find lectures available; it is possible, indeed, that he will have no passion for lectures, and if he has not acquired the art—for there is an art of learning from books—he will be at a serious disadvantage. Is not an excessive reliance on lectures likely to leave us open to the reproach that we teach our students everything except how to learn? I sometimes wonder when I see the extent to which some students rely on their notes, and the appallingly long list of lectures which appears at the beginning of each term, whether the importance of the invention of printing has not been overrated.

Now I must express an opinion with which I think it quite possible that many here will not agree. The view is often expressed nowadays that students should be examined by their teachers, and not by outside examiners. I cannot agree with this; so far as my experience goes, the practice leads to one of the worst kinds of cramming—the cramming of note-books—and not always the student's own note-book. I think the teacher ought to have the fullest power over the syllabus, and not to have his method of teaching hampered by external authority; but when he is given this freedom I think he may be expected to produce results which need not fear the tests imposed by any sensible examiner.

But although I am urging a freer use of text-books and more independent reading by the students, the last thing I would do would be to abolish lectures, though I should like to see them reduced in number, and in some cases their objective changed. To my mind, the proper function of a lecture is not to give the student all the information he is supposed to require on the subject of the lecture, but to arouse his enthusiasm so that he will be eager to get that information for himself. A lecture ought to be interesting and to arouse interest; dullness should be the unpardonable sin. The lecturer should avail himself of the "purple patches" of the subject to supply the momentum which will carry his students over the less exciting parts. Again, in a lecture it is possible to emphasise the fundamental parts of the subject, to discuss at length the ideas and assumptions involved, and to illustrate them by a multitude of illustrations and examples which would be impossible in a text-book of moderate size.

If lectures were limited to these objects there need not be so many of them, and there would be more time available for what I regard as the most important part of teaching—the part when the teacher comes in contact with his pupils, not as a class, but as individuals. If the teacher could talk with his pupils, even for half an hour a week, cross-examine them to see that they really understand their work, make suggestions as to what they should read, suggest points of view, sometimes even point out that things are not quite so clear as they seem to appear to the student, then I think he would have far greater influence over his pupils—would educate them better than would be done by any amount of lecturing alone. I am aware that what I am advocating is done by many teachers already, but I think there is still room for expansion of a method which the collegiate system and the large educational staff at many of our colleges make especially feasible at Oxford and Cambridge. I would like to utter a word of warning against allowing this kind of tuition to degenerate into an explanation of difficulties brought to the teacher by the student; puzzling over a difficulty is often a very good way of getting clearer ideas on a subject, and a good teacher will not solve these difficulties until he feels sure that the student will not, perhaps with

[1] Presidential address delivered to the Association of Public School Science Masters on January 11 by Sir J. J. Thomson, F.R.S.

the help of a hint or two to put him on the right track, solve them for himself.

I am told that at a school which of late years has been one of the most successful in turning out good mathematicians, the older boys are under the impression that they get very little teaching in the higher parts of mathematics; they work in a class-room together at the text-book, abuse its obscurity, argue out with each other what it really means, while the master appears to take very little part in the proceedings; as a matter of fact, if he sees that a wrong conclusion is likely to be come to by the little parliament, by an apparently casual remark he gives the argument a push in the right direction. This seems to me the very best kind of education when the boys are of fairly equal ability.

Work of this kind, when the student tries to puzzle out his own difficulties, takes time, and the student cannot cover the ground so quickly as when his difficulties are solved for him by his teacher as fast as they arise. If the examination for which he is preparing covers a wide range of subjects, he is almost compelled, or at any rate he is very strongly tempted, to adopt the quicker and easier methods. The temptation is especially strong in the case of students of science. For the Natural Sciences Tripos at Cambridge, for example, the majority of the students take four subjects in part i.; there is really no need for them to do so, and the better students are in many cases strongly advised by their tutors to take only three; if they did so I feel sure they would not prejudice their chance of getting a first class. They think, however, that it is safer to take four, and as playing for safety is a very characteristic feature of the modern undergraduate, the majority of them take this course. As they have now to do a very large amount of practical work in each subject, the study of four subjects means if they take the first part of the tripos in the second year that the whole of their mornings and many of their afternoons are spent in lecture-rooms and laboratories, and that they have very little time to spend in thinking quietly over their subject. It may be said that they have the vacations in which to do this. But, as a matter of experience, it is found, I think, that this habit is either continuous or else non-existent; it is not one that can be flung aside in term time and then resumed as soon as term is over. We cannot all emulate the heroes in the Bab Ballads:—

> These men were men who could
> Hold liberal opinions,
> On Sundays they were good,
> On week days they were minions.

It is, I think, most important that they should form this habit of independent thought at school, for if they have not done so the conditions are not very favourable for them to do so at the university.

The popularity of science, the great increase in the numbers attending lessons, lectures, and laboratories makes it more and more difficult to arrange that our students shall have the opportunity of thinking out their own difficulties and developing their independence and power of relying on their own resources. Let me contrast the conditions under which I began in the 'seventies the study of practical physics at the Owens College, Manchester, with those which prevail at the Cavendish Laboratory at the present time. When I was a student there were perhaps a dozen working at practical physics in the laboratory; there was no need for any elaborate organisation; we used to work at an experiment until we were satisfied we had done as much as we could, by what we thought, generally erroneously, were improvements on the methods shown to us, and acquired in this way a lively interest in our subject and some facility in devising experiments to test various points which arose in the course of our work. This, I think, is the best kind of laboratory training it is possible to have, but it is only available when the number of students is small. If we adopted it at the Cavendish Laboratory, where last term there were above three hundred students doing practical physics, the result would be chaos; while the students would not learn physics, independence, or anything except proficiency in free fighting. With such numbers elaborate organisation and preparation are unavoidable, and we have necessarily to limit ourselves to trying to make the elementary demonstrations teach the students how to make accurate measurements, to give them a knowledge of methods, and to make the experiments as illustrative as possible of the fundamental principles of physics.

I think, however, that in some of our schools the number of boys taking practical work is small enough to make the other method possible, and when this is the case I would urge as strongly as I can the danger of excessive organisation and the importance of developing as much as possible the independence and self-reliance of their pupils, and I think they might do so with safety to a small number of subjects.

I cannot refrain from alluding to the remarkable and very gratifying increase which has taken place in the last few years in mathematical knowledge possessed by the students of science sent up from the schools, and is growing rapidly from year to year. When I first went to the Cavendish Laboratory the knowledge of mathematics possessed by many of the students was so meagre that I had to start classes to teach them the elements of the differential calculus; that class has gone on until the present year; but the number who required such teaching has diminished so rapidly during the last few years that I have decided it will not be necessary to continue these classes any longer.

In conclusion, I would like to offer a suggestion, which I make with great diffidence, but it is one which, if it were possible to carry out, would increase the efficiency of the student, especially in after life, to a very considerable extent. I mean, would it be possible to teach science students enough German to enable them to translate an ordinary text-book or paper? I do not ask that they should all know German—that I realise is, at present, impracticable. I do not ask that they should be able to write German, or even pronounce it, but merely that they should be able to make sense of a straightforward sentence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is announced in *The Jewish Chronicle* that a wealthy Jew, a native of India, has bequeathed a sum of 80,000*l.* for the endowment of a Jewish college in Jerusalem. This sum is likely to form the nucleus of an endowment for a university in Palestine.

PROF. J. G. HIBBEN has been elected president of Princeton University in succession to Dr. Woodrow Wilson. Prof. Hibben has been professor of logic at Princeton University since 1893, and is known as the author of works on logic and philosophy.

IT is announced that Sir Charles Chadwyck-Healey, K.C., who is a member of the governing body of Cranleigh School, has expressed his desire to present a laboratory to the school, and the offer has been accepted by the governors. The work has been put in hand, and it is expected that the cost will be about 4000*l.*

A REUTER telegram from Cape Town on January 13 states that, speaking at Moorresburg, Mr. F. S. Malan, Minister of Education, said he hoped to introduce and pass in the forthcoming session of Parliament a Bill dealing with higher education and the foundation of a university. Mr. Malan expects shortly to receive from Messrs. Wernher, Beit and Co., who have given half a million sterling towards the university scheme, a notification of their acceptance of the Bill, which will then be published.

AT a meeting of the executive committee of the governing body of the Imperial College of Science and Technology, held on Friday last, Prof. W. A. Bone, F.R.S., professor of applied chemistry (fuel and metallurgy), University of Leeds, was appointed professor of fuel and refractory materials in a new department of chemical technology now being established in the Imperial College at South Kensington. He will take up his new duties at the Imperial College about September of this year.

IN connection with the Francis Galton Laboratory for National Eugenics, a course of eight lectures will be given

at University College, London, on Tuesday evenings at 8.30 p.m., beginning on January 30. The first two lectures will be delivered by Prof. Karl Pearson, and will deal with "Sir Francis Galton: his Life and Parentage, Work and Teaching." These will be followed by two lectures on "Infantile Mortality," by Miss Ethel Elderton and Dr. M. Greenwood, jun. The fifth lecture will be on "Alcoholism," by Dr. David Heron; the sixth on "Physical Degeneracy," by Mr. Bishop Harman; and the seventh and eighth on "Heredity and Environment" and on "Social Problems," by Prof. Karl Pearson. Further particulars may be obtained on application to the secretary of the college.

AT the annual general meeting of the Royal College of Science Old Students' Association, held on January 13 at the college, Sir William Crookes, O.M., F.R.S., was elected as president of the association on the motion of Captain John Spiller, who shares with Sir William the honour of being the oldest students connected with the college. Prof. R. A. Gregory was elected as one of the vice-presidents in succession to Sir William Crookes, the remaining five vice-presidents being re-elected. Mr. T. Ll. Humberstone and Mr. A. T. Simmons were re-elected secretary and treasurer. The evidence relating to the college presented to the Royal Commission on University Education in London was to have been considered at this meeting, but owing to the lateness of the hour it was decided to adjourn the meeting, and another general meeting will be called shortly, on a date to be fixed by the committee, at which the principal business will be the discussion of this evidence. The report of the committee showed that the membership of the association had increased to 665, of whom 595 are associates of the college.

THE report of the principal of the Huddersfield Technical College, read at the prize distribution on December 21 last, has been published in pamphlet form. We find that the age of admission to evening classes was raised by one year, and the total of student hours was well maintained, in spite of the fall in the number of students which followed the raising of the age of entry. Although a number of individual students engaged in local industries attend day classes for one or more mornings or afternoons in the week, the conditions of employment seem to be unfavourable to the release of young persons during working hours for the purpose of attending classes. As yet, little success has attended efforts to make systematically organised arrangements for such students. In making recommendations with regard to the award of college diplomas, the staff has not hitherto had the advantage of any outside help or advice, such as is rendered in many university examinations by an external examiner acting conjointly with members of the university staff. To remedy this defect, the governors have sanctioned a scheme for the appointment of honorary assessors, whose cooperation and assistance will, it is expected, prove to be of value in determining these awards. There is an increasingly satisfactory relationship of the college with employers of all kinds. Cases are frequent in which students are allowed to leave work early on class nights, or are given help towards the payment of class fees or the cost of books or instruments. Much interest is displayed from time to time by employers and others in proposals for new classes, as well as in attempts to improve the existing instruction.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 11. — Sir Archibald Geikie, K.C.B., president, in the chair.—Lord **Rayleigh**: The propagation of waves through a stratified medium, with special reference to the question of reflection.—Prof. F. T. **Trouton**: The mechanism of the semi-permeable membrane and a new method of determining osmotic pressure. The amount of water taken up by a liquid, such as ether, from an aqueous solution, the solute of which is insoluble in the liquid, diminishes as the strength of the solution increases, the maximum amount taken up being from pure water. Reasons are given in the paper for expecting that the amount of water taken up from a given solution would increase under pressure, and further, that at the osmotic pressure of the solution the amount taken up would be the same as that from pure water at the atmospheric pressure. An account is also given of an experimental investigation which has verified these conclusions in the case of a 60 per cent. solution of cane sugar when osmotic pressure is about 80 atmospheres.—Dr. Alois F. **Kovarik**: Mobility of the positive and negative ions in gases at high pressures. Rutherford and Child have shown that the current i per sq. cm., between two parallel plates when an intense ionisation is confined to the surface of one plate, is given by $i = 9V^2K/32\pi d^3$, where V is potential difference, d distance between plates, and K mobility of ion. When theoretical conditions are fulfilled, the current through the gas in the two directions affords a direct measure of mobility of positive and negative ions. The surface ionisation was obtained by covering one of the plates with an active preparation of *ionium*, separated by Prof. Boltwood from the uranium residues lent by the Royal Society to Prof. Rutherford. Using high pressures, ionisation is mainly confined within a very short distance of the plate. The theory was tested experimentally, and it was found that over a considerable range i varied as V^2 and inversely as d^3. The results for the mobilities of the ions in these gases are as follows:—in dry air and dry hydrogen mobility varies inversely as pressure up to 75 atmospheres, the highest used; in moist carbon dioxide the product of mobility and pressure is constant up to 40 atmospheres, but for higher pressures the product decreases as the gas approaches the liquid state. The mean values for the products of mobility and pressure in atmospheres, for the range of pressures for which the product was constant, are for negative and positive ions, respectively, in dry air 1·89 and 1·346, in dry hydrogen 8·19 and 6·20, and in moist carbon dioxide 0·67 and 0·705 cm. per sec., for a potential gradient of one volt per cm.—G. A. **Shakespear**: A new method of determining the radiation constant. The rate of loss of heat of a silvered surface at a temperature of 100° C. in surroundings at 15° C. is observed (*a*) when the surface is polished, (*b*) when it is lamp-blacked. The difference is due to difference in radiation losses. The ratio of the rates of radiation is obtained by exposing the two hot surfaces in turn to a radiomicrometer. The rate of radiation from the lamp-black is assumed to be proportional to the difference between the fourth powers of the absolute temperatures 373 and 288. The lamp-black at 100° C. is compared with a full radiator at the same temperature by means of the radiomicrometer. Certain corrections are necessary, and these are dealt with in the paper. As a check on the comparison given by the radiomicrometer, an instrument which constitutes a closer approximation to a full receiver was devised and used. It was found, incidentally, that the apparent radiation from lamp-black depends upon the surface upon which the lamp-black is deposited. The value obtained for σ is $5{\cdot}67 \times 10^{-5}$ ergs per sq. cm. per sec. per deg^4.—Dr. R. A. **Houston**: The mechanics of the water molecule. Suppose that a hydrogen atom loses one electron to a second hydrogen atom, and that the second hydrogen atom loses two electrons to an oxygen atom. Then the oxygen atom has two negative charges, each hydrogen atom one positive charge, there will be one line of force between the first and second hydrogen atoms and two lines of force between the second hydrogen atom and oxygen atom. Let the three lines of force act as equally strong spiral springs, and let a wave of light pass through a medium composed of such molecules. It is shown in the paper, by means of the ordinary theory of dispersion, that the absorption spectrum of such a medium consists of two bands, the ratio of the wave-lengths of which is 2·32. Also from the intensity and width of each band it is possible to calculate e/m, the ratio of unit charge to the mass of the hydrogen atom. Water is transparent in the ultra-violet and visible spectrum, and has two great bands in the infra-red at 3·07 μ and 6·15 μ, which are not present in oxygen or hydrogen. It is shown in the paper that the values of e/m calculated from these bands are respectively 7110 and 1550 electromagnetic units. Hence the structure assumed for the molecule cannot be far off the truth.

Geological Society, December 20, 1911.—Prof. W. W. Watts, F.R.S., president, in the chair.—Rev. E. **Hill**: The glacial sections at Sudbury (Suffolk). The sections round Sudbury were described in two Geological Survey Memoirs: since the date of publication of these much more has been disclosed. A list is given of the principal sections now existing, with references to the descriptions in the Survey Memoirs and notes of those that are there undescribed. The paper gives an account of a series of sands and silts which lie at about 200 O.D. on each side of the present Stour Valley. They seem to indicate shallow-water conditions at a level more than 100 feet above the present valley-floor. On the silts lies Chalky Boulder Clay. The transition from silt to clay is continuous, and seems to show that here the transition from formation of silt to formation of Boulder Clay was a continuous transition. The undisturbed condition of the beds indicates that during this transition there was no action of thrust or drag. At lower levels, from 180 O.D. down to 100 O.D., on the flanks of the valley lie coarse gravels and sands, with current-bedding, which point to torrential water-action. Among these occur displaced masses of previously formed Boulder Clay, some contorted—as if by slip down slopes. At Little Cornard brickworks there is associated with current-bedded gravels a clay in which are embedded very large masses of remade Chalk. The deduction from these facts is that at Sudbury Boulder Clay began to be formed where there was quiet water, which stood on both sides of the valley at a level of more than 120 feet above the present floor, and that, after such clay had been formed, there came to be strong currents into or along the valley at various lower levels. These deductions agree with the probable course of events if a submergence preceded the Chalky Boulder Clay and an emergence followed it.—C. I. **Gardiner** and Prof. S. H. **Reynolds**: The Ordovician and Silurian rocks of the Kilbride peninsula (County Mayo). The Kilbride peninsula includes three principal groups of rocks. The northern and western part is, in the main, composed of igneous rocks, contemporaneous and intrusive, of Arenig age; the southern and eastern part principally consists of Silurian rocks, but these are in the south-eastern corner of the peninsula faulted against an area of gneiss. The Arenig rocks resemble the Mount Partry beds of the Tourmakeady and Glensaul districts in the fact that they include cherts and shaly beds with *Didymograptus extensus*, and in the presence of gritty tuffs and coarse breccias, the latter rocks showing a magnificent development. No coarse conglomerates, however, occur, and no limestone-breccias or other representatives of the Shangort beds of Tourmakeady and Glensaul, while Arenig sediments of all kinds are very scarce. The most interesting feature of the Arenig rocks is the great development of spilitic lavas, which are commonly associated with cherts and often show good pillow-structure. Their resemblance to the similar rock of the Girvan district is very close. An enormous mass of felsite with large quartz-phenocrysts, and often albite, as also pseudomorphs after rhombic pyroxene, occupies much of the northern part of the peninsula. There is no doubt that it, like the similar masses of Tourmakeady and Glensaul, is of Arenig date. The Silurian rocks consist principally of grits, sandstones, and calcareous flags, and dip with great regularity in directions varying from south to east. The calcareous flags (Finny School beds) are highly fossiliferous, and have yielded more than fifty species, principally of corals and brachiopods, which prove the beds to be of Llandovery age. Ill-preserved specimens of *Monograptus vomerinus*, found in the highest Silurian strata exposed, show that these are of Wenlock age. Dr. Henry Woodward, F.R.S., supplies an appendix giving a description of a new species of Caryocaris.

Mathematical Society, January 11.—Dr. H. F. Baker, president, in the chair.—G. H. **Hardy** and J. E. **Littlewood**: A new condition for the truth of the converse of Abel's theorem.—A. **Cunningham**: Mersenne's numbers.—W. H. **Young**: Successions of integrals and Fourier series.—W. H. **Young**: Multiple Fourier series.

Royal Astronomical Society, January 12.—Dr. Dyson, president, in the chair.—H. C. **Plummer**: Hypothetical parallaxes of the brighter stars of type A. The paper was an investigation of the radial velocities of brighter stars in a list furnished by Dr. Campbell. The velocities of class A stars near the Milky Way are greater than those of stars in high latitudes. This fact suggests that stars of type A have a tendency to move parallel to the plane of the Milky Way.—F. G. **Brown**: The absorption of light in space. For a determination of this absorption the author made use of nebulæ, for, since these possess a measurable diameter, their distances can be approximately determined. Nebulæ having a small apparent diameter must be, on an average, more distant than the larger objects, however their real diameters may differ.—H. H. **Turner** and F. G. **Brown**: An example of the use of spherical harmonic analysis. The authors showed the advantages of this analysis in various astronomical investigations, and gave an example, which also brought out the main features of the distribution of brightness of nebulæ in different parts of the sphere.—W. G. **Thackeray**: Personality and bisection error of some Greenwich transit-circle observers. The author's object was to obtain a determination of the magnitude equation in R.A. of the present regular observers with the transit circle. It seems clear that the bisection errors vary with the zenith distance, and these personalities may be due partly to the eye and partly to the different positions taken up by the observer, according to the zenith distance of the star observed.—C. P. **Butler**: An account of a new form of telescope recently constructed in America. The instrument was a modification of the principle of the equatorial *coudé*, the polar axis being also hollow, but so large that the observer was actually within it.

PARIS.

Academy of Sciences, December 26, 1911.—M Armand Gautier in the chair.—M. **Gouy**: A particular case of interkathodic action.—M. **de Forcrand**: The ethylates of calcium. The product of the action of ethyl alcohol on metallic calcium, its hydride, carbide, or nitride, is an alcoholate of calcium ethylate having the formula

$$(C_2H_5O)_2Ca+2C_2H_5OH.$$

When this substance is kept over sulphuric acid it loses ethyl ether and ethylene, until after several years its composition approximates to $(C_2H_5O)_2Ca+5Ca(OH)_2$. This is due to a catalytic action of lime, invariably present in the original compound, on the ethyl alcohol and calcium ethylate.—D. **Eginitis**: Observations on Brooks's comet (1911*c*) made at the Observatory of Athens. Observations on the position, magnitude, and appearance of the comet on various dates between August 23 and September 22.—G. **Pick**: Parallels, and differential geometry in non-Euclidean space.—René **Garnier**: The simplifications of a class of differential systems of which the general integral has fixed critical points.—G. **Kowalewski**: A class of infinitesimal transformations of functional space.—P. **Montel**: The indeterminate character of a uniform function in the neighbourhood of its essential points.—A. **Blondel**: Singular values of unsymmetrical nuclei.—Maurice **Potron**: Some properties of linear substitutions with coefficients ≥ 0 and their application to the problems of production and wages.—M. **Rosenblatt**: Algebraic surfaces admitting a discontinuous series of birational transformations.—E. **Barré**: Minimum surfaces generated by circular helices.—Émile **Giurgea**: Researches on the "Kerr effect" in gases and vapours. According to Lippmann, gases and vapours should, in an electric field, show an effect similar to the "Kerr effect" in solid and liquid dielectrics, resulting in a contraction given by the formula $\frac{\Delta v}{v}=\frac{K-1}{8\pi p}\frac{F^2}{e^2}$, the effect being proportional to the square of the field, and becoming greater as the dielectric constant K of the gas is greater. An interferential method was used, and the effect expected was produced to a very small extent by vapours having large values of K, for example, C_2H_5Br, CS_2, CCl_4, but it could not be elicited in air and CO_2, even under 25 atmospheres pressure.—E. **Estenave**: Synthesis of complementary colours by means of gratings. One side of a glass plate is ruled with parallel lines alternately green and red, and the other with black lines parallel to the coloured ones. When this plate is viewed

at a distance of about 30 cm. it appears red to one eye and green to the other, but when both eyes are used it appears greyish-white. The synthesis of red and green to form white is thus performed by the observer.—Edmond **Bauer**: The theory of radiation.—L. **Décombe**: The heat of Siemens, and the conception of capacity.—A. **Lafay**: The phenomenon of Magnus.—J. **Delvalez**: Representation of equipotential lines in electrolysis. Claim to priority against A. Brochet.—O. **Boudouard**: Electrical resistance of special steels. Measurements were made of the resistances of nickel, manganese, chromium, and tungsten steels, containing the metals mentioned and carbon, in very varying proportions.—P. **Mélikoff**: Method for separating phospho-molybdates from silico-molybdates. The molybdate test for phosphoric acid possesses the defect that silicic acid is also precipitated, and it is often desirable to have a means of distinguishing between the compounds. This is found in ammonium permolybdate solution (equal volumes of 30 per cent. H_2O_2 and of an 8 per cent. solution of ammonium molybdate in nitric acid), which will dissolve the phospho-molybdate, but not the silico-molybdate.—Oechsner **de Coninck**: Molecular weight of lime; atomic weight of calcium. Determinations of these constants by the ignition of calcium formate to the oxide, and by precipitation of the oxalate and its subsequent ignition also to the oxide. The mean value found was Ca=40·02.—A. **Raynaud**: Solubility of the oxide UO_2 in various acids. The anhydrous oxide dissolves very sparingly in hydrochloric, hydrobromic, sulphuric, and acetic acids, but is easily soluble in nitric acid and in nitro-hydrochloric acids, with production of uranyl salt.—E. **Boismenu**: Hypochlorous amides. An attempt was made to combine hypochlorous acid with amides to form hypochlorites of the amides, but instead of these mono- and di-chloro-derivatives were formed. Of these, mono- and di-chloroacetamide, dichloropropionamide, and dichloroformamide are described.—A. **Gascard**: Three normal saturated hydrocarbons: triacontane, tetratriacontane, and hexatriacontane. Triacontane, $C_{30}H_{62}$, was obtained as follows:—the palmitate of pentadecyl alcohol was obtained by the action of iodine on silver palmitate; this was then hydrolysed, and the alcohol converted into pentadecyl iodide, and this by the action of sodium into triacontane. The other hydrocarbons were made similarly.—Marcel **Guerbet**: Action of caustic potash on primary alcohols; preparation of the corresponding acids. The oxidation of primary alcohols by caustic potash always yields the corresponding acid, even in the case of complex alcohols, and the yield is generally good.—Henri **Coupin**: Localisation of the pigments in the integument of haricot beans.—M. **Guilliermond**: The origin of the leucoplasts, and on the cytological processes in the elaboration of starch in the potato.—M. **Delassus**: Influence of the partial suppression of the reserves of the seed on the development of the plant.—G. **André**: Removal by water of the soluble substances contained in the potato.—Em. **Bourquelot** and A. **Fichtenholz**: Application of the biochemical method to *Kalmia latifolia*, and isolation of a glucoside.—L. **Ravaz** and G. **Verge**: Mode of infection of the leaves of the vine by *Plasmopara viticola*.—Maurice **Arthus**: The specific nature of antitoxic sera. Sera for use against various snake-poisons. Poisons of *Lachesis lanceolatus*, *Crotalus terrificus*, and *C. adamanteus*. The action of these antitoxic sera is, with rare exceptions, quite specific.—Raphaël **Dubois**: The vacuolides of the colour-producing organ (of Murex).—H. **Dominici**, G. **Petit**, and A. **Jaboin**: Persistent radio-activity of the organism under the influence of radium in an insoluble form. In the case of a horse injected with 1 milligram of radium sulphate, the blood was still radio-active a year later.—M. **Ciuzet**: Instantaneous radiography of the diaphragm in tabetics.—H. **Claude** and A. **Baudouin**: The effects of certain extracts of hypophysis.—Gabriel **Bertrand** and M. and Mme. **Rosenblatt**: Activation of sucrase by various acids.—Jacques **Parisot**: Transformation of blood pigment into bile pigment under the influence of adrenaline.—L. **Launoy** and C. **Levaditi**: Researches on the therapeutic action of mercury in experimental syphilis of the rabbit. Some of the complex thio-derivatives of mercury are very active against the spirochæte pallida, but not against the spirillum of relapsing fever.—Ch. **Nicolle** and E. **Conseil**: Experimental production of measles in monkeys.—Henri **Violle**: The gall bladder as a point of inoculation.—MM. **Radais** and **Sartory**: The toxicity of *Amanita phalloides*. The toxicity of this fungus does not disappear after exposure to a temperature above 100°, and the dried fungus is still active after several years' keeping.—A. **Rochaix** and G. **Colin**: Staining of the tubercle bacillus. Non-specific nature of the granulations of Much.—J. **Repelin**: Observations on the geology of the Sainte-Baume.—V. **Commont**: Geological age of Quaternary remains.—Julien **Loisel**: Distribution of solar heat over France.—Henri **Fournier** presented a memoir on flight, which was referred to the Committee on Aëronautics.

January 2.—M. Armand Gautier, the retiring president, made his report to the academy, and was succeeded in the chair by M. G. Lippmann.—A. **Laveran** and Nattan **Larrier**: *Trypanosoma rhodesiense* (Stephens and Fantham). Human sera, which are inactive against *T. gambiense*, are active towards *T. rhodesiense*; this latter trypanosome is distinct from *T. gambiense* and from *T. brucei*.—MM. **Lambert, Ancel,** and **Bouin**: A novel means of defence of the organism. Skeptophylaxis. Extracts of certain organs, for instance, of corpus luteum, thyroid, or brain, ground up with sand, mixed with ten times their weights of normal saline, and centrifugalised, are highly toxic when injected without filtration. If, however, a toxic dose is divided unequally, and the smaller part injected first, followed by the larger within a few minutes, these toxic effects are not produced. To this very rapid protective action the name skeptophylaxis is given.—Émile **Borel**: The shuffling of cards. Calculus of probabilities; an extension to the case in which the probabilities of operations vary with the time.—H. **Parenty**: A form of meter. Description, with diagram, of the author's piezometric meter.—André **Léauté**: The development of a function in exponential series; application to the 100,000-volt installation at the Turin Exhibition.—R. **Fric**: The action of heat on nitrocellulose and nitrocellulose powders. The alteration by heat of these substances is indicated by the relative times of flow, through a narrow tube, of equal quantities of their solutions in acetone. The time of flow is decreased by subjecting the materials to heat.—Louis **Marmier**: Action of ultra-violet rays on sodium hyposulphite. A solution of sodium hyposulphite containing 6 grams per litre, after five minutes' exposure, produces sodium hydrosulphite with deposition of sulphur. Longer exposure destroys the hydrosulphite, with formation of sulphite. With higher concentrations the hydrosulphite is not formed.—Z. **Tchougaeff** and Mlle. D. **Fraenkel**: Some complex compounds of platinous bromide with organic sulphides. Bromo-platinous acid, H_2PtBr_4, like chloroplatinous acid, unites with organic sulphides to form crystalline derivatives, generally insoluble. These are bromoplatinites of complex bases, and are easily transformed by heat into isomers.—C. L. **Gatin**: The structure of the germ in Zingiberaceæ and Marantaceæ.—Lucien **Daniel**: Some abnormal methods of separation of grafts.—F. **Houssay** and A. **Magnan**: The wing-surface and tail in birds.—A. **Conte**: A hymenopterous parasite of the hive moth.—Henri **des Gayets** and Clément **Vaney**: Some observations on cattle-fly from the point of view of stock-raising.—G. **Raymond**: Results of photoelectric measurements made at Antibes during 1911.

BOOKS RECEIVED.

Illustriertes Handbuch der Laubholzkunde. By C. K. Schneider. Elfte Lieferung. Pp. 657–816. (Jena: G. Fischer.) 5 marks.

Die heteroplastische und homöoplastische Transplantation. By Dr. G. Schöne. Pp. v+161. (Berlin: J. Springer.) 8 marks.

Annuaire pour l'an 1912. Publié par le Bureau des Longitudes. Pp. vi+692+A.47+B.34+C.43. (Paris: Gauthier-Villars.) 1.50 francs net.

Elements of Agriculture. By the late Dr. W. Fream. Eighth edition. Edited by Prof. J. R. Ainsworth-Davis. Pp. xiv+692. (London: J. Murray.) 5s. net.

Soap-bubbles: their Colours and the Forces which

Mould them. By C. V. Boys, F.R.S. New and enlarged edition. Pp. 190. (London. S.P.C.K.) 3*s*.

Die Partiellen Differential-Gleichungen der Mathematischen Physik. Nach Riemann's Vorlesungen. By Prof. H. Weber. In fünfter Auflage. Zweiter Band. Pp. xiv+575. (Braunschweig: F. Vieweg & Sohn.) 15 marks.

Nietzsche als Bildner der Persönlichkeit. By Dr. R. Oehler. Pp. 31. (Leipzig: F. Meiner.) 60 pfg.

Untersuchungen über Pfropfbastarde. By Prof. H. Winkler. Erster Teil. Pp. viii+186. (Jena: G. Fischer.) 6 marks.

The Alphabet of the National Insurance Act, 1911. By C. G. Morgan. Pp. vi+164. (London: Methuen and Co., Ltd.) 1*s*. net.

Laboratory Exercises in Physical Chemistry. By Dr. J. N. Pring. Pp. xii+162. (Manchester and London: Sherratt and Hughes.) 4*s*. net.

Stars and Constellations: a Little Guide to the Sky. By A. Fry. Pp. 39. (Clifton: J. Baker and Son.) 6*d*. net.

An Introduction to Eugenics. By W. C. D. Whetham, F.R.S., and C. D. Whetham. Pp. viii+66. (Cambridge: Bowes and Bowes.) 1*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 18.

ROYAL SOCIETY, at 4.30.—The Physiological Effects of Low Atmospheric Pressures, as observed on Pike's Peak, Colorado (Preliminary Communication): Dr. J. S. Haldane, F.R.S., C. G. Douglas, Prof. Y. Henderson, and Prof. E. C. Schneider.—On the effect of altitude on the dissociation curve of the blood: J. Barcroft, F.R.S.—Note on *Astrosclera willeyana* Lister: R. Kirkpatrick.—*Herpetomonas pediculi*, nov. spec., parasitic in the Alimentary Tract of *Pediculus vestimenti*, the Human Body Louse: Dr. H. B. Fantham.—Antelope Infected with *Trypanosoma gambiense*: Capt. A. D. Fraser, R.A.M.C., and Dr. H. L. Duke.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton.

LINNEAN SOCIETY, at 8.—Some Features of the Marine Flora of St. Andrews: Dr. A. Anstruther Lawson.

ROYAL SOCIETY OF ARTS, at 4.30.—The Old District Records of Bengal: Rev. W. K. Firminger.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Adjourned Discussion*: Residence Tariffs: A. H. Seabrook.

INSTITUTION OF MINING AND METALLURGY, at 8.—A Submerged Flexible-joint Main: F. Reed.—Unwatering Tresavean Mine: C. Brackenbury.—Notes on the Operation of Two Winding Engines: H. M. Morgans.—Stoping at the Calamon Mine: C. P. Corbett Sullivan.

FRIDAY, JANUARY 19.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Evolution and Present Development of the Turbine Pump: Dr. Edward Hopkinson and Alan E. L. Chorlton.

ROYAL INSTITUTION, at 9.—Heat Problems: Sir J. Dewar, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Turbo-blower and Turbo-compressor: G. Ingram.

SATURDAY, JANUARY 20.

ROYAL INSTITUTION, at 3.—The Banyoro—A Pastoral People of Uganda; (1) The Milk Customs: Rev. J. Roscoe.

MONDAY, JANUARY 22.

ROYAL SOCIETY OF ARTS, at 8.—Ocean Waves, Sea-beaches, and Sand-banks: Dr. Vaughan Cornish.

ARISTOTELIAN SOCIETY, at 8.—The Relation of Willing to Cognition: Prof. G. Dawes Hicks.

AERONAUTICAL SOCIETY, at 8.30.—The Development of Animal Flight: Dr. E. H. Hankin.

VICTORIA INSTITUTE, at 4.30.—The Conditions of Habitability of a Planet, with special reference to the Planet Mars: E. W. Maunder.

TUESDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Anniversary Meeting.—8.30.—Some American Problems: A. P. Maudslay.

MINERALOGICAL SOCIETY, at 5.30.—The Relationship between Crystalline Form and Chemical Constitution; the Double Chromates of the Alkalies and Magnesium: Miss M. W. Porter and Dr. A. E. H. Tutton.—On Liveingite: Prof. W. J. Lewis.—A New Anorthic Mineral from the Binnenthal: R. H. Solly and Dr. G. F. H. Smith.—On Colemanite and Neocolemanite: Dr. A. Hutchinson.—Further Observations on the Optical Characters of Gypsum: Dr. A. Hutchinson and Dr. A. E. H. Tutton.—Note on a Large Crystal of Anatase from the Binnenthal: Dr. G. F. H. Smith.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: Reinforced Concrete Wharves and Warehouses at Lower Pootung, Shanghai: S. H. Ellis.—The Direct Experimental Determination of the Stresses in the Steel and in the Concrete of Reinforced-Concrete Columns: W. C. Popplewell.—Composite Columns of Concrete and Steel: W. H. Burr.—*Probable Paper*: The Central Heating and Power-plant of McGill University, Montreal: R. J. Durley.

WEDNESDAY, JANUARY 24.

ROYAL SOCIETY OF ARTS, at 8.—A New Process of Hydraulic Separating and Grading: W. J. Gee.

GEOLOGICAL SOCIETY, at 8.—The Upper Keuper (or Arden) Sandstone and Associated Rocks of Warwickshire: Dr. C. A. Matley.

THURSDAY, JANUARY 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Determination of the Co-efficient of Interdiffusion of Gases and the Velocity of Ions under an Electric Force, in terms of Mean Free Paths: Prof. J. S. Townsend, F.R.S.—Note on the Scattering of α Particles: Dr. H. Geiger.—The Effect of Temperature upon Radioactive Disintegration: A. S. Russell.—On the Relation between Current, Voltage, Pressure, and the Length of the Dark Space in Different Gases: F. W. Aston and H. E. Watson.—On the Viscosities of Gaseous Chlorine and Bromine: Dr. A. O. Rankine.—The Testing of Plane Surfaces: Dr. P. E. Shaw.

ROYAL INSTITUTION, at 3.—The New Astronomy: Prof. A. W. Bickerton.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Heat Paths in Electrical Machinery: Miles Walker and H. D. Symons.

FRIDAY, JANUARY 26.

ROYAL INSTITUTION, at 9.—The Pressure of a Blow: Prof. B. Hopkinson, F.R.S.

PHYSICAL SOCIETY, at 5.—Exhibition of a Direct-reading Instrument for Submarine Cable and other Calculations: R. Appleyard.—On the Vibration Galvanometer and its Application to Inductance Bridges: S. Butterworth.—Note on a Negative Result connected with Radio-activity: J. H. Vincent and A. Bursill.—On Sealing-metals: Dr. P. E. Shaw.—Krypton and the Auroral Spectrum: T. W. Page.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION, at 3.—The Banyoro: A Pastoral People of Uganda: (2) Birth and Death Customs; Rev. J. Roscoe.

CONTENTS.