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## Foundations of Empire.

WE regret our inability, at the present moment, to climb to philosophical heights with Aristotle and to declare that man is a political animal, or to sink into the comfortless cynicism of Schopenhauer and to assert that human society is a collection of hedgehogs driven together for the sake of warmth. Somewhere between the two exaggerations lies truth—whatever that may be. In the meantime our function, as we conceive it, is to probe, analyse, compare, and classify phenomena in the purely agnostic spirit which is the life and hope of science. This may be regarded merely as a restatement of something already grown platitudinous, yet it may appropriately serve as a prologue to some observations upon a programme of a forthcoming imperial event.

On June 20 the inaugural meeting of the third Imperial Education Conference is to be held. It will be open neither to the public nor to the press, membership being confined to delegates appointed by the Governments of the countries composing the British Empire—usually the permanent heads of their education departments—together with representatives of certain Government departments in Great Britain. For the first time in the history of the Conference, also, a few seats have been allotted to representatives of local education authorities and the teaching profession.

We are further informed that the advisory committee responsible for the arrangements, after consulting all the Governments of the Empire, "has drawn up a comprehensive agenda which covers not only important administrative questions but also a number of subjects of general educational interest." It is hoped, particularly, that some agreement may be reached on problems arising out of the variety of teachers' qualifications, salary scales, and superannuation, since these are matters where lack of reciprocal arrangements tends to hinder the movement of teachers from one part of the Empire to another. With that aspiration we are wholly in sympathy; it needs neither explanation nor argument.

When we turn to the groups of more general educational subjects which are to be discussed, however, we feel some misgivings. There is to be a very necessary reference to education in relation to the pupil's after-career, and here special interest will be attached to the views of overseas Dominions on the recent report of the Consultative Committee of the Board of Education—a report on which we have already expressed our views (Nature, Feb. 5). There is to be an important discussion on the

difficulties of rural education, while other sessions will be devoted to the cinema and wireless in education, physical training, adult education and the problems involved therein ; and, most importantly, there stands out a group of subjects " dealing with important new ideas and developments " which appears to pivot about " Empire History and Geography."

Now it is after glancing at these suggested discussions that we would beg leave to submit our doubts as to whether sufficient advantage is to be taken of the tremendous possibilities afforded by the Conference. We do not propose to inquire here into all the implications of the word ' Empire,' but we do desire to record our belief that, if it is to signify a progressive and cultural unity, it must sum up the felicitous relations of component parts based upon the mutual benefits arising out of trade and industry.

To that end we believe a considerable part of the Conference should be devoted to an examination of the possibilities of pure and applied science. We make the suggestion because we observe that a special feature of the Conference is the leaving open of a whole session for the discussion of a subject to be chosen by the members during the second week. We have a special reason for urging that a broad discussion of the value—both cultural and practical—of science and technology in education is necessary in matters of Empire development. If we say that the functions of science include intercourse for the purpose of more efficient co-operation and economy of intellectual labour by the discovery of general laws governing typical situations, we shall not be placing anything on record for the first time. We shall, however, be repeating something to which controllers of education and directors of imperial destinies often give lip-service and very little more.

It is the very fact that science possesses a more international quality than matters which usually come under the heading of literature or philosophy which makes us press specially its claims to the Conference. If it be neglected, if it be treated merely as incidental, a structure of recommendations will be erected by the Conference on an unsound foundation. We have already doubted whether man is a willing political animal ; we certainly doubt his ability to hold an Empire together by a repetition of academic theories.

The well-being and happiness of either a nation or an empire depend upon mutual production and exchange. Production and exchange—from raw material to the distribution of finished articles —involve change and adaptation of material, power, transport, and business organisation. All these, subdivided into the various branches of knowledge, form the subjects included in curricula of technical institutions. How far is the shaping of such curricula to be a subject of discussion by the Conference ? How far, in short, is science (in its broadest sense) to be dealt with with the view of producing methods which shall clear away disorders and anomalies capable of cure ?

In what light, for example, will ' History ' be treated ? Will there be an attempt to gain for the Empire the urge and the clarity of thought which might arise from a synthesis of those events which have made British imperial development possible ? How far have we clearly focussed the flow and direction of human endeavour arising out of geographical discoveries of the fifteenth century ?—Magellan's circumnavigation of the earth, the cosmic system of Copernicus and other liberations of the mind of the sixteenth century, the founding of experimental science by Galileo, Gilbert, and Harvey, and the vast spread of scientific knowledge which led up, finally, in the nineteenth century to the theory of evolution—the application of which to branches of art and industry has powerfully aided the demolition of time and space, and has enabled us, with our steamboats and our railways and our telegraphs, to hold together in a developing understanding the far-spread units which make up the British Empire ? The focussing of these things would, we believe, give to the Conference an impetus towards clear and rational efforts to grasp and remove the stupid barriers which so often hold back development, and to use the great instrument of education so that it shall more swiftly build up the materials of progress.

We realise that we may have laid ourselves open to the charge of waving our own particular flag of science and technology. It is not a charge we fear, since we have our own convictions concerning the liberal and cultural powers of what is often ignorantly regarded as ' merely utilitarian.' We realise, too, that we may be charged with beating the air, because all we have suggested will come within the purview of the Conference. If that be so, we shall plead guilty unblushingly. We shall freely apologise for traversing old ground even though, in making the apology, we insist that the fundamentals upon which education schemes should be built are so vital that their constant examination and repetition is not superfluous but supremely necessary.

## Weather and Weather Forecasting.

*Wetter und Wettervorhersage (Synoptische Meteorologie)*. Von Prof. Dr. Albert Defant. Zweite, vollständig umgearbeitete Auflage. Pp. vii + 346. (Leipzig und Wien: Franz Deuticke, 1926.) 18 gold marks.

THERE is an excellent arrangement in Austria under which from time to time one of the most promising of their meteorologists, after a period of official work in the State service, is appointed to the professorship of meteorology at Innsbruck, where he has leisure for the closer study of that branch of the subject in which he has become specially interested. This results not only in additions to our knowledge on the frontiers of the subject, but also in text-books which give in collective form and in logical sequence a summary of our knowledge over some sector of the meteorological circle. Notable examples are the "Meteorological Optics" of Perntner and the "Dynamical Meteorology" of Exner. The present officer at Innsbruck, Prof. Defant, adds as his contribution a book on weather and weather forecasting which is a development of a small book prepared and published originally in 1916–17.

The book is divided into three parts, corresponding with the author's general view of the subject. The first part, on weather, is devoted to a discussion of 'diagnosis'; the second part, on weather forecasting, indicates the methods to be followed in the 'prognosis.' The third part gives a summary of our knowledge of weather changes of longer period, a knowledge which has not yet reached the stage at which it can be applied for regular forecasts of months, seasons, or years in the European area.

In an initial chapter Prof. Defant indicates the development from weather rules and the weather prophet to the synoptic chart as the scientific basis of forecasting. He reproduces an interesting chart, due to Brandes, showing the distribution of pressure and wind in Europe on March 6, 1783, the first synoptic chart in meteorological history.

Detailed particulars are given of the revised International Code for Weather Telegraphy, but for some reason it is described as the 'Swedish' code, and Great Britain and Norway, where this code has been used since 1921 for international exchange, are represented as using different codes special to themselves. (There is an error on page 15, where the figure for alto-stratus is given as 4, which should have been allotted to alto-cumulus.) The importance of wireless telegraphy in post-War developments is emphasised, and a wireless installation is stated rightly to be now an essential complement to a weather service.

There is a remark in this chapter the importance of which cannot be too often emphasised. In forecasting, and in any examination of meteorological observations by means of maps, accidental errors of observation can often be readily detected; but there are atmospheric conditions in which individual stations may show apparently irregular differences from other stations, and there is a risk that the most interesting and instructive meteorological situations may pass without investigation, owing to the observations being regarded as erroneous and 'corrected' for the errors.

In the second chapter an account is given of the connexion between wind and pressure. In the original analysis by Guldberg and Mohn, the motion of the air near the earth's surface was assumed to be steady motion with a balance between the three forces due to the pressure gradient, the effect of the earth's rotation, and the surface friction, the last named being taken to act directly opposite to the motion. Prof. Defant, following Sandstrom, shows that a better agreement with the facts is obtained if the frictional force is assumed to act in a direction which is inclined at a finite angle (38° for central Europe) to the direction of motion.

This assumption of a single frictional force, which is essentially the vector difference between the force due to surface friction and the tangential stress due to transfer of momentum by eddies, obscures the physical reality. Actually the transfer of momentum to the surface layer from the layers above is so rapid that the tangential stress due to it is large in comparison with the forces due to the pressure gradient and the earth's rotation, even for a layer of finite thickness. The motion of the surface layer is, therefore, effectively determined by the balance between surface friction and tangential stress, acting in opposite directions *along the line of motion*. The pressure gradient and the earth's rotation do not directly affect in measurable degree the surface wind, or the wind in any layer where there is a rapid rate of change of horizontal velocity with height and the motion is turbulent; they determine completely the wind in those layers where the tangential stresses are small, *i.e.* generally in layers at heights of 1000 feet or more, and they play their part in the intermediate layers where the tangential stresses are of

the same order of magnitude as themselves, layers from which the momentum to maintain the motion near the surface is transferred.

The fact that the 'mass forces' due to pressure gradient and earth's rotation can be ignored in treating the surface layers, implicit in Taylor's discussion of the subject, was stated explicitly by Whipple in 1920. No mention is made of this in the book, and there is nowhere any account of the development in our knowledge of turbulence in the last fifteen years, and its applications in all dynamical and thermodynamical studies of the atmosphere. The statement on p. 30 that but for the earth's rotation the wind would blow direct in straight lines from the places of highest pressure to those of lowest pressure needs qualification; with curved isobars there would be usually a rotatory wind system irrespective of the earth's rotation, and waterspouts and dust-devils would occur much as they do at present.

Chap. iii. deals with the motion of the air and its connexion with cloud and precipitation, and it introduces the reader to the work of Bjerknes and the idea of fronts, lines of convergence and of divergence. It is pleasant to see in this chapter reproductions of trajectories of air over the Atlantic from Shaw and Lempfert's "Life History of Surface Air Currents." The reproductions are much superior in appearance to the originals printed by the British Stationery Office. In the description of a warm front on p. 47, Ci-Cu. should be Ci.St., and it ought to be noted that in the warm sector, where normally cloud diminishes and precipitation ceases and the barometer remains nearly steady, it is not infrequent to find an overcast sky with heavy precipitation and a rapidly falling barometer. Some account could appropriately have been given in this chapter or the next of "les systèmes nuageux" and the work of Schereschewsky and Wehrle, which constitutes the contribution of French meteorologists to the recent development in forecasting.

The discussion of the relation between the weather and typical forms of the isobars is an effort to combine the old ideas of cyclones and anticyclones and the new ideas of fronts dividing masses of air of different constitutions. Fortunately the new theories have, on the whole, gained pride of place. There is a good account of the ideas of Bjerknes and Solberg on the development of cyclones and occlusions, as well as an indication of the principal results of the important research of Bergeron and Swoboda, in which developments along a front extending from mid-Atlantic to eastern Europe in October 1923 were examined in detail and interpreted.

The fifth chapter deals with the non-periodic variations of pressure and of the motion of cyclones and anticyclones in the European area. Van Bebber's well-known diagram is reproduced, and Hanzlik's penetrating analysis of the temperature conditions in anticyclones finds here an appropriate place. The difference between the cold rapidly moving anticyclone and the warm stationary, or slow moving, anticyclone is of fundamental importance.

In the second part of the fifth chapter the author considers the constitution and origin of cyclones and anticyclones, and contrasts the wave theory of Bjerknes with the 'bar' theory of Exner. According to Bjerknes, depressions arise from waves at the sloping surface of separation between the cold polar air and the warm tropical air, and come in families, while according to Exner, depressions arise through a tongue of cold air projecting horizontally into a warm equatorial current and damming it up in such a way that vortical circulation results. Considerable space is naturally devoted to a consideration of thunderstorms and line-squalls, on which the experimental work of Schmidt on the motion of a heavy liquid spreading under a lighter one has thrown so much light; the diagnosis is, however, quite inadequate without some account of the thermodynamics of the phenomena and of the part which the condensation or evaporation of water in the atmosphere plays in causing instability.

The section on cyclones and anticyclones concludes with an account of periodic variations of weather. These are not sufficiently well established to be of much value in forecasting: the most interesting is a period between five and six days which Prof. Defant found in the general circulation of the northern hemisphere; this agrees generally with the theory of Bjerknes and Solberg on families of cyclones.

The section on weather forecasting occupies only about one-fifth of the book, the author's view being that diagnosis is the most important part of the forecaster's education. After some general remarks and a short discussion of Richardson's investigation of the method of weather prediction by numerical process, the author considers the use which can be made of local observations and statistics in forecasting, and he gives an interesting account of a method of determining the delimitation of the districts into which a country must be divided for forecast purposes. He deals

at some length with the rules of M. Guilbert and with the persistence of weather conditions. He examines in detail examples of weather charts for March 13, 1913, and June 1, 1924, and indicates how the charts are to be interpreted in the light of modern theory.

Many people appear to consider that weather forecasting is the sole purpose of meteorology; according to Prof. Defant, it stands in the same relation to meteorology in general as an applied science stands to a pure science. There are meteorologists of the purer kind who consider that weather forecasting is a combination of drudgery and humbug by means of which funds are obtained for the prosecution of work fundamental to the extension of knowledge. Such a view is based on a misconception. The desire to forecast the future course of the weather is as legitimate an impulse to the scientific investigation which is necessary for its satisfaction as the desire to understand or investigate any natural phenomenon. The two impulses—the desire to understand and the desire to foretell—are in fact the motive force in scientific investigation, and neither can be classed as better or worse than the other.

One of the principal difficulties of a forecast service is to obtain an objective test of the accuracy of forecasts. Prof. Defant indicates what progress has been made in this direction—unfortunately little. The subjective estimates of the accuracy or inaccuracy of weather forecasts formed by the public are of no real value, because a forecast covers a considerable number of phenomena and the public lays stress now on one and now on another; it is, moreover, influenced, broadly speaking, by its own optimism or pessimism. Such is Prof. Defant's view, but a good forecaster must have some understanding of the needs of the public, and must himself emphasise in his forecast the elements which will affect most those for whom the forecast is issued.

Hitherto there has been no book on weather forecasting in which the post-War developments, both in the collection of information and in its analysis, have been presented in their appropriate place as part of the whole scheme of weather forecasting. The present book is notable because it makes an endeavour to do this. Information which is scattered through many international reports and through many dissertations is here available for the reader. There are errors and gaps, but on the whole the result at which Prof. Defant aimed has been achieved successfully. E. GOLD.

## Land Politics and Economics.

*Politics and the Land.* By Cecil Dampier Whetham. Pp. x+215. (Cambridge: At the University Press, 1927.) 6*s*. net.

MR. DAMPIER WHETHAM has chosen a most opportune time for bringing out his book upon the land. It is so clearly and interestingly written that it should appeal to a wide public, to those who know little about the land as well as to those who are directly interested in the land and in agriculture.

There is no doubt that an ever-increasing number of people in Great Britain are being stirred to an interest in the land—but mainly from the political point of view. Now a purely political interest in the land can be dangerous unless it is balanced by some understanding of economics and of agriculture. The author is specially qualified to deal with the land problem precisely on account of his knowledge of economics and of agriculture from the practical side. His moderate and carefully reasoned reply to the policies (overwhelmingly political) put forward by Mr. Lloyd George and the Labour Party is admirable. Mr. Whetham shows conclusively that to resort to such drastic change (which would certainly be in the nature of experiment) as nationalising the land is not warranted, and would be fraught with danger.

It is interesting to note in this connexion that the decidedly socialistic government of Czechoslovakia, when it brought in sweeping land reforms, did not nationalise the land, but rather developed small ownership. The reason for this was given in the words of several of the leading statesmen of the country, that State ownership or nationalisation in any form could end in one thing only—the ruin of the agricultural industry.

Perhaps of even more importance than his handling of "politics and the land" is Mr. Whetham's exposition of "economics and the land." He shows how and to what extent certain economic forces affect agricultural prosperity. In simple language he goes deeply into the economic questions which it seems obvious few of the land reformers have studied or understood—and still fewer agriculturists. Yet they are questions which every agriculturist as well as every reformer should understand.

In thus ably refuting the attacks upon the existing land system in Great Britain, I feel that Mr. Whetham gives the impression that he is more satisfied with the present system than he really is; it is quite true that he points out that the system

is not perfect and could be improved, but I refer to the general impression. Mr. Whetham certainly regards the landlord-tenant system more favourably than I do. Before the great depression of the 'eighties, I concede that it was about as good a system as could be devised, but during the past forty years it has steadily become more and more unsatisfactory, especially from the landowners' point of view. It is obviously satisfactory to the tenant. Discussing this question with a frank and outspoken farmer, he summed up thus: "As long as you landowners are content to put your hands in your pockets and pay for us, pray go on doing so; when you get tired of it, see that we can purchase under sound financial conditions."

Mr. Whetham clearly does not favour the development of an increase in occupying ownership as a partial alternative to the tenancy system, and the strongest barrier against nationalisation; he fails to realise that unless occupying ownership is developed, then nationalisation of the land is inevitable. He points out that in the United States the tendency is away from ownership towards tenancy; but the farmers in the United States are, in the main, occupying owners, and the tenancy that is developing there is in no way like the British system, but rather a partnership tenancy resembling the *métayer* system in Italy and parts of France. Hand in hand with the development of occupying ownership in Great Britain might well go the creation of a system of partnership farming, but of a type very different from the *métayer*. Space does not permit me to give here a detailed account of the form of partnership farming which I advocate and have practised for nearly twenty years.

Coming to another point, the author does his best to persuade us that the yield from the corn land of Great Britain is as high or higher than any other country in Europe (except Belgium). He bases his argument largely upon the statistics of a particularly urban economist who shows that the corn yields of Denmark when 'corrected' are no higher than ours. I am interested in this 'correcting' of yields, and in future I must not believe my eyes when motoring through the Fens or Lothians, but take consolation in thinking that the very heavy corn crops one sees on every side when 'corrected' are no heavier than those of the poorer soils in my immediate neighbourhood! In general terms the corn lands of Great Britain are richer than those on the Continent, and the comparatively low average yield in France, for example, is due to the fact that the thrifty French peasant grows corn on land that we would not cultivate at all, and so the high yields of the Pas de Calais are pulled down.

Mr. Whetham deals admirably with the law of diminishing returns, and points out that at present prices it would not pay greatly to increase the yield of corn in England, that the extra expenditure on artificials and cultivation would only increase the loss. But it is a very different matter if a considerable increase is secured not only without greater but actually with a decreased expenditure. Lucerne will grow over a wide area of land in England. My own experience is that on poor arable land sown with lucerne which is allowed to stand for six years and then ploughed up, the increase in soil fertility is sufficient to secure for five to nine years subsequent corn crops that will average up to double the corn crop normal to that land; and this with a great reduction to the manure bill. This indicates one direction in which costs of production can be reduced, and I am convinced that still more can be done to reduce costs by the high organisation of the farm as a unit than is generally realised.

As regards the reverse of the medal—prices—I agree with Mr. Whetham that they are a governing factor, but if the prices are low, it is even more important that the farmer should get the potential maximum, that the spread between producer and consumer be reduced by organised marketing. A highly organised industry can always withstand depression better than one that is not organised.

Finally, while I quite agree that England is much more naturally (and economically) a grass country than the Continent, there is no getting away from the facts that much land is under grass which is not suited for grass, that the area of first-class grass land is limited, and that we have millions of acres of poorly handled grass which it would be economic to improve. I do not make these criticisms in any carping spirit, but because I believe it is of supreme importance that agriculturists in Great Britain should realise that the Government is not going to assist them to any material extent, and that it rests with the members of the industry to explore for themselves every avenue that will lead to an improved position. I am convinced that Mr. Whetham's book will prove of utmost value in this direction. It will stimulate thought, and, above all, every one who reads it will have not only a comprehensive but also a balanced view of the agricultural situation in Great Britain as it is to-day.

CHRISTOPHER TURNOR.

## Time and Perception.

*An Experiment with Time.* By J. W. Dunne. Pp. iv + 208. (London: A. and C. Black, Ltd., 1927.) 8*s*. 6*d*. net.

"'Tis the sunset of life gives me mystical lore,
And coming events cast their shadows before."
(CAMPBELL.)

THROUGHOUT the ages philosophers have amused themselves with time, with little to go on but their own uncertain introspections. More recently the scientific worker has found himself compelled to examine this concept critically and has exposed its interlocking characteristics with space. From the theorist to the experimentalist is a short step in science, but here a difficulty arises from the intangible nature of the material to be handled. There is no doubt that the man-in-the-street, the apparent ultimate arbiter of common sense, does not accord to time the same kind of reality as he accords to other objects in his universe. He has an uneasy feeling that it really is something purely psychological which dies with him, although he uses the same kind of terminology about it as he does about material objects. He talks of 'intervals of time,' of 'time flowing,' and so on; but if pressed he would probably agree with Bergson that only the present exists; past events have existed but do not now, although mental pictures or memories of them exist now; future events do not exist, no memories of them exist now, but pictures of them may be imagined now. The man-in-the-street may, however, be wrong. He has always been wrong, for has he not been rescued from the ignorance of the past? Relativity gave him a shock, but while relativists may contend that A's present may be B's future, so that in a sense A may remember B's future, it is not contemplated that A may remember his own future. If Mr. Dunne is correct, on waking from a dream we may, like the lady in the limerick, "return on the previous night."

There are two distinct portions to this book which ought to be dealt with separately, and the author practically does so. In the first part the startling experimental facts are described which serve as the end to which to direct an equally startling theory. The theory must wait, for it is so strange and unconvincing that the only justification for propounding and examining it would be found if the experimental facts turned out to be unimpeachable. Broadly, the theory assumes that our field of perception of events *moves* through time, and therefore its time-speed must be measured with reference to another and quite differently dimensioned 'time'; that this 'time' must likewise involve the existence of a third 'time,' and so on, giving what the author calls 'serialism' in time. Similarly our conscious perception of events, perceiving ourselves perceiving, involves the existence of a sequence of observers (ourselves) with the conscious observer at the head of the sequence, another form of serialism. On this as a basis, but apparently by an appeal to geometrical intuitions, the author seeks to show that every time-travelling field of presentation is contained within a field one dimension larger, travelling in another dimension of time, the larger field covering events which are past and future as well as present to the smaller field, and that all these are observable to the serial observer and therefore to the conscious observer at the head of the series. All that remains after that is for the author to show that the 'future' will be best observed when the mind is freed from the normal waking images, and this is what he attempts to do experimentally.

We may safely ignore the theory until the shock of the facts, if so they be, has spent itself. Whatever preconceived prejudices we may possess against what Mr. Dunne proposes to establish—and the present writer has them strongly—it must be at once admitted that the author appears to be a careful, sane experimenter quite alive to the dangers and pitfalls that may beset an observer in a strange field; and if only for the honest and straightforward manner in which he seeks traps and the precautions he takes to eliminate them, his work must be given due consideration.

For years Mr. Dunne has kept a systematic record of his dreams recorded immediately on waking, since dreams fade away so rapidly. He piles up case after case of dreams that have been followed a few days later by their counterparts in actual occurrences. Mere coincidence in one or two details he rules out. For example, to dream of a pile of coins toppling over, and to see such a catastrophe next day, would not suffice. Any bank clerk might experience that without significance, but to dream of a pile of *sixpences* toppling off a *red book* and to experience the event shortly afterwards would require examination. To take an actual illustration at random: while staying at the Hotel Scholastika in Aachensee in 1904 he dreamed he was walking along a path between two fields separated by high railings, when suddenly a horse in a field on his left appeared to go mad, tearing about, kicking and plunging in frenzied fashion. Having glanced at the railings to see that he was safe, he was continuing

on his way, when suddenly the horse, which had somehow entered the path, came after him. It was a full-fledged nightmare. Like a hare he sped towards a flight of stairs at the end of the path, the horse in close chase, when he awoke. Next day, while fishing with his brother, he witnessed a drama which tallied in most of its particulars with the dream. It was his brother who directed his attention to the plunging horse. Looking up, he saw the fields—smaller than in his dream—the path, the railings (also smaller), and the flight of stairs leading to a bridge over the river. In a moment the horse had jumped the railings and was tearing down the path towards them as if demented. It swerved, avoided the stairs and plunged into the river, swam towards the fishers, clambered out of the river, snorted, and calmly trotted off.

These dreams the author claims were not impressions of distant or future events, but merely the usual commonplace dreams composed of distorted images of waking experiences, strung together in the usual half-senseless fashion peculiar to dreams. If they had happened on the nights *after* the events they would have exhibited nothing in the smallest degree unusual, but they occurred on nights *before* the events. The author claims to have convinced a number of sceptical friends who placed themselves under his guidance that such dreams occur to them also, so much so that one of them endeavoured to use it to spot a Derby winner!

If this work is not a practical joke, and it does not sound like it, and if the author is sane, and there is ample contributory evidence of this, the subject he has opened up ought to be examined so that his contentions are either substantiated or demolished. The ordinary scientific worker will not easily concede that in effect unknown future events can influence the state of the brain in the present, except indirectly in the sense that the present state of the brain and the future events may be affected by a common agency. It is quite possible, on the other hand, that certain of the confirmatory events described that mainly involved action on the part of the author may actually have been suggested by the dreams. The present writer once dreamt that he had invented an incandescent gas mantle which he in his dream called the "Elijah Mantle"! He has often since then thought of following up the suggestion. Although many of the illustrations vouched for in this book would be exceedingly difficult to explain away on these hypotheses, it would appear to be the hypotheses, if not the only ones, on which to proceed once the evidence has been thoroughly verified and sifted. H. LEVY.

## Popular Biology.

*Essays in Popular Science.* By Prof. Julian Huxley. Pp. xii + 307 + 6 plates. (London: Chatto and Windus, 1926.) 16*s*. net.

THE task of the populariser is becoming more and more difficult. If he attempts to produce something better than the superficial stuff that is served up by the popular Press, he is met with two difficulties: first, that science itself is over-specialised, and the results achieved in each little compartment of study are of interest only to the very few who can appreciate them; and secondly, that the cultivated public on the whole lack the necessary mental background of scientific knowledge and the understanding of scientific method which would enable them to assimilate results of major or general value. But if his task is more difficult, it is also more important, and in both directions. For not only can he exercise great influence on the general thought of the community by skilful presentation of the matured and general results of scientific research, but he can also do great good to science itself by taking a bird's-eye view of the specialists' domains and extracting from their multifarious details something of general import, some view or theory which may not be altogether accurate, but may act as a stimulus, or even as an irritant, and lead to more adequate synthesis. There is a close connexion in fact between popularising and generalising.

It is too often forgotten that science does not consist in the mere accumulation of knowledge, that facts buried away in papers and text-books do not by themselves constitute science. There is needed in addition the spirit of synthesis and the power to fuse all the facts into a coherent system which in its turn shall link up intelligibly with some general philosophical *Anschauung*. Prof. Huxley expresses this all-important point admirably in the following passage:

"The works of man only live in so far as man vivifies them: and this *corpus* of fact that to some people constitutes the reality of natural science is only a vast stamp-collection, no more than a lumber room, unless each generation in its turn will make it live. It lives most strongly (so is the human mind constructed) by being woven into the general background of some general philosophy of things. The history of science shows us how a body of fact, comparatively inert and lifeless while held in one framework of opinion, may be seized by another more vigorous movement of the mind and used as a living battering-ram to beat open the doors of progress" (p. 164).

Better, on the whole, a wrong or premature synthesis than no synthesis at all. It is a curious fact that some of the most potent theories, theories that have most stimulated thought and research, have been found in the long run, after a period of vogue, to be very largely wrong. One might instance Weismann's brilliant theory of the germ-plasm, which exercised an extraordinarily powerful and lasting influence on biological thought.

The present volume of essays by Prof. Julian Huxley is a more heterogeneous collection than his previous book entitled "Essays of a Biologist," and some of the shorter articles and reviews might well have been omitted. There remain, however, many papers of real value, of interest both to the general public and, particularly in one case, to the professional biologist. Prof. Huxley's gifts as a popular exponent of biological science are undoubted; he is always lucid and interesting, and links up his themes with human life and literature in such a way as to appeal to any cultivated reader.

The first half-dozen articles deal with the problems of heredity and sex in the light of modern genetics. It seems to us that Prof. Huxley states the gene theory in too confident terms. The paper on "Chromosomes, Mendelism and Mutation" is a triumph of lucid exposition, but it will give the ordinary reader the impression that the problems of heredity are all solved. But this is far from being the case. Other articles deal with "The Control of the Life-Cycle," "The Meaning of Death," "Birth Control," "Evolution and Purpose," and there is a sympathetic and penetrating study of the author's grandfather and his attitude towards religion. Apart from a number of republished reviews, the rest of the volume is taken up by two papers, hitherto unpublished, on "The Frog and Biology" and "The Tadpole: a Study in Developmental Physiology," the latter based upon an address delivered at the British Association meeting in Liverpool. The paper on the frog gives an interesting and well-illustrated account of the action of internal secretions upon metamorphosis and colour-change; the other, some 85 pages in length, is a very valuable sketch and well merits attention from the professional biologist—it is rather too 'strong meat' for the ordinary reader. We have here a good summary and a thoughtful discussion of the modern work by Spemann, Harrison, and others, on this classical object. One is interested to see that the quite fundamental ideas of Wilhelm Roux on the importance of function are at last being given the attention they deserve. E. S. R.

## Our Bookshelf.

(1) *A View of Sierra Leone.* By F. W. H. Migeod. Pp. xii + 351 + 8 plates. (London: Kegan Paul and Co., Ltd., 1926.) 31*s.* 6*d.* net.

(2) *Sierra Leone: its History and Tradition.* By Capt. F. W. Butt-Thompson. Pp. 275 + 11 plates. (London: H. F. and G. Witherby, 1926.) 15*s.* net.

(1) MR. MIGEOD has given us the results of a visit to Sierra Leone of six months' duration in 1925. His book falls into two parts: the first, a descriptive narrative dealing with the colony, its people, and something of their history; the second, an analytical account of the Mende, their physical anthropology, social organisation, secret societies, religious beliefs, games, songs, and folklore. Their language is dealt with in an appendix. Sierra Leone, being one of those parts of Africa outside the northern radius which has been longest in contact with European civilisation, presents many difficulties to the student of culture, which are by no means mitigated by the presence of the Creole and Mohammedan elements. Mr. Migeod, an anthropologist with a conscience which sets a high standard, is keenly conscious of these difficulties, and they must be held responsible for much in the first part of the book which the reader may regard as scrappy and incomplete.

(2) Mr. Migeod devotes his opening chapters to the identification of places mentioned by early geographers which, there is reasonable probability to conclude, were situated in this part of Africa. Capt. Butt-Thompson writes of an area much more restricted than that covered by Mr. Migeod. Instead of the Sierra Leone of to-day with its three 'Provinces' and thirteen 'Districts,' he deals only with the history of the colony comprised in the peninsula on which Freetown stands. Nor is he concerned with the chronicles of the earliest voyagers. His history begins in the sixteenth century with the movements of peoples down to the river and the conquests of the Temne kings, which are recorded in or may be deduced from the reports of Ogilby, Fletcher, and others.

Capt. Butt-Thompson writes with a wealth of detail, and much of his material, gathered by members of his own family, has not previously been published. Much is derived from oral tradition. Travellers, colonists, missionaries, and administrators are all passed under review, and their achievements, both good and bad, recorded with commendable impartiality. Capt. Butt-Thompson's book will serve as a valuable guide to those who wish to understand the conditions out of which have grown the many and serious problems with which the administration is confronted to-day.

*The Analysis of Pigments, Paints, and Varnishes.* (Oil and Colour Chemistry Monographs.) By Dr. J. J. Fox and T. H. Bowles. Pp. 179. (London: Ernest Benn, Ltd., 1927.) 16*s.* net.

THIS is a book which can be heartily recommended to all who are concerned with the chemical examination of the materials in question. It is, in

fact, in many respects the best of all those dealing with the subject. The first 124 pages deal with the analysis of pigments, white, red, blue, yellow and brown, green and black; then follow two chapters dealing respectively with the analysis of mixed paints and with the examination of varnishes. Three appendices dealing with (*a*) specimen analyses, (*b*) a method for the determination of tung oil in paints and varnishes, and (*c*) distempers, together with index of subjects and index of names, complete the work.

Each subject is treated in a comprehensive manner and the methods given or recommended are those which the authors, in the course of their large and varied experience, have found to be trustworthy. They are especially useful in the case of some of the rarer pigments, which are so frequently in analytical works either ignored or dismissed by a reference to "the usual methods of analysis" that, when applied, are so often found to fail. Full analytical details are always given, a course which should always be followed in analytical methods of this description. A large number of references appear at the end of each chapter, enabling any analyst who wishes to do so to consult the original papers. It is gratifying to note that the authors have made use of the specifications of the British Engineering Standards Association, to the committees of which they have given so much valuable advice. In view of the tendency to give viscosities in C.G.S. units, the authors have rightly included instructions as to how this can be done (pp. 144-150), and it is to be hoped that with this lucid description now available, those concerned with the examination of varnishes will record the viscosities of the varnishes in C.G.S. units and not, as has been so frequently the case in the past, in arbitrary units which mean little or nothing to any one other than the observer. The only small criticism we have to offer is that the symbol *p*H might have been briefly explained (p. 163), as we know from experience that there are still a number of paint and varnish 'chemists' who are not conversant with its real meaning.

In conclusion, we have no hesitation in saying that this book should be in the possession of every pigment, paint, or varnish works' laboratory.

G. R.

*Constitution et évolution de l'univers.* Par A. Véronnet. (Encyclopédie scientifique: Bibliothèque d'astronomie et de physique céleste.) Pp. 475. (Paris: Gaston Doin et Cie, 1927.) 28 francs.

IN the larger problems of astronomy it is not to be expected, or indeed to be desired, that there should be universal agreement. The subject of this book, as indicated by the title, is the ultimate problem of all astronomical and physical research, and a final pronouncement at the present time is obviously out of the question. Cosmogony, in fact, has only just emerged from the field of unalloyed speculation, and the tentative hypotheses which can now be put forward are more of the nature of convenient summaries of known facts and indications of new directions of observation than aspirants to the dignity of absolute truth. In the volume before us, M. Verronet, following lines of thought previously laid out by Henri Poincaré, considers the problem of the past, present, and future constitution of the individual bodies in the universe and of the universe as a whole. He reaches some very definite conclusions, which differ considerably from the more familiar views which we associate chiefly with the names of Eddington, Jeans, and Russell. For example, he maintains that the interior of a star is homogeneous, and has a sensibly uniform temperature about double or triple the surface temperature. Needless to say, he rejects Eddington's theory of radiative equilibrium, which he regards as being mathematically impossible. The age of the sun is placed at a few million years, and the past history of the universe is held to be almost negligible in duration compared with the future. These views are sufficiently unfamiliar to attract attention, and since M. Verronet gives reasons for the conclusions at which he has arrived, his work demands respectful consideration. It will doubtless not meet with general acceptance, but may nevertheless have some part to play in the advancement of knowledge.

*Cours de physique à l'usage des élèves de l'enseignement supérieur et des ingénieurs.* Par Prof. Jean Becquerel. Tome 2: *Élasticité. Acoustique.* Pp. ii+427. (Paris: J. Hermann, 1926.) 6*s*.

THE second volume of Prof. Becquerel's treatise on physics contains sections on elasticity and sound, the former subject occupying about one-quarter of the available space. The first chapter deals with the physical study of elasticity and the determination of the elastic constants; the second treats of the mathematical theory of elasticity. On the experimental side particular attention is given to the researches of Wertheim and of Amagat; on the theoretical side the aim has been to emphasise only essential questions and to derive the formulæ necessary for the propagation of waves in a homogeneous, isotropic medium. This discussion paves the way for the treatment of wave propagation in the next chapter, which deserves special mention for lucidity of treatment. In fact, throughout the volume the author gives an exceptionally clear exposition of what may be termed the classical theory of acoustics. Stress is laid for the most part on the mathematical rather than on the experimental aspects of the subject, but there is a valuable chapter dealing with the applications of acoustics in music which is unusually complete for a book of this character.

On account of the greater novelty of the subject matter and of the methods employed, the last three chapters in the book are, perhaps, the most interesting. The first of these deals with noises heard in the air, underground, and under water; instruments are described, many of them devised for use by the French army during the War, for determining the direction of the source of sound, and the subject of range-finding is given a chapter

to itself. Finally, we have a short but suggestive chapter on the acoustics of halls, containing an account of the experiments of Sabine and of Marage.

*The Preparation and Analysis of Organic Compounds.* By J. Bernard Coleman and Dr. Francis Arnall. Pp. xvi+352. (London: J. and A. Churchill, 1926.) 15*s.* net.

THE task of an author in compiling a text-book of practical organic chemistry is by no means an easy one, on account of the difficulty in framing a systematic scheme of qualitative organic analysis. The present authors, however, have made a very successful attempt to give a rational scheme of analysis of unknown organic substances and mixtures.

About a third of the book is devoted to a systematic description of the methods of synthesising the important members of the main groups of organic substances, the reactions, preparation, and properties of which are described, together with notes on precautions necessary to be observed. This forms a striking feature of the book, as the complete experimental detail for the preparation of eighty-nine representative bodies is associated with an explanation of the theoretical processes involved.

The next portion deals with the qualitative analysis and identification of organic compounds, and this, equally with the preceding section, has been carefully devised and should prove of great value to students. The systematic manner in which the properties of different types of organic substances are displayed appears to the reviewer to be specially valuable, although from his personal experience a few of the physiological tests, such as those depending upon smell, are not in accordance with his own observation.

Finally, there is an excellent portion dealing with methods of ultimate analysis and estimation of typical groups.

This book can be confidently recommended to students of organic chemistry. L. C. N.

*The Amarna Age: a Study of the Crisis of the Ancient World.* By the Rev. James Baikie. Pp. xix+465+32 plates. (London: A. and C. Black, Ltd., 1926.) 12*s.* 6*d.* net.

WHEN the discovery of the tomb of Tutankhamen was made the occasion of a newspaper 'stunt,' some misgiving was felt whether such wide publicity was likely to be a real benefit to archæology in the long run. In that particular instance it probably was not; but it had the advantage that it made the general public to a certain extent familiar with a very important period in Egyptian history. Indeed, as Mr. Stanley Cook says in his preface to Mr. Baikie's excellent account of the Amarna age, it was one of the great crises in the ancient world. Mr. Baikie's book has been written for those whose interest in this period has been aroused by the discovery of the tomb, and it is for such that he has been anxious, incidentally, to fit that discovery into its true perspective by placing it side by side with the less sensational but far more important discovery of the Tel-el-Amarna tablets to which we owe our detailed knowledge of the history of this period and from which he quotes freely.

The greater part of Mr. Baikie's book is concerned with the political, military, and diplomatic history of the expansion and decline of the Egyptian empire, but naturally the character and religious reform of Akhenaten occupy a prominent position. Mr. Baikie discusses the origin of the Aton worship, but, while he acknowledges the existence of a strong Mitanni element in Egypt, he is not inclined to admit Asiatic influence in either its universality or its monotheistic tendency.

*A Guide to the Orchids of Sikkim: being a Guide to the Identification of those Species of Orchids found between the Terai and the Northern Frontier of Independent Sikkim, including the Chumbi Valley and British Bhutan.* By Prof. Paul Brühl. Pp. xvi+208. (Calcutta and Simla: Thacker, Spink and Co., 1926.) 5 rupees.

THIS little book will be warmly welcomed by lovers of the flora of the Darjeeling district. The text takes the form of a key, first to the genera and then to the species, the alternatives on the whole being well chosen and distinctly expressed. Unfortunately the technical finish of the book is not so satisfactory, there being a number of misspellings of generic names, while the taxonomy is not always in line with present-day conceptions; for example, *Tainia hookeriana* has been referred to Ascotainia for about twenty years, while *Cypripedium venustum* has not been included by botanists in that genus since 1898. At the same time a book of this nature seems scarcely the most suitable place for the publication of a new genus (Cleisocentron). Nevertheless, Prof. Brühl may be congratulated on having produced a useful guide to Sikkim orchids. V. S. S.

*Lehrbuch der Elektrodynamik.* Von Prof. Dr. J. Frenkel. Erster Band: *Allgemeine Mechanik der Elektrizität.* Pp. x+365. (Berlin: Julius Springer, 1926.) 28·50 gold marks.

As the title implies, this is an attempt to treat electromagnetic theory as a branch of general mechanics. The fundamental unit is not the charged particle, the existence of which depends upon the existence of the corresponding opposite charge, but the electric doublet or dipole, the moment of which vanishes in a neutral particle. This makes it possible to deal with vector quantities, instead of the scalar quantities represented by 'charges.' Vector algebra is therefore liberally employed, and the author devotes 36 pages to a consideration of its principal operations. It becomes necessary to regard electrons as geometrical points, or rather as point singularities in the space-time continuum. The author, as is natural in the atmosphere of Leningrad, seeks to break with the historical development of electricity, and as a first step discards the conception of the ether, which he regards as obsolete. It is an interesting attempt, but whether it will be fruitful is another matter. E. E. F. D'A.

## Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### Pinholes in Photographic Negatives.

PINHOLES are a serious problem in the case of some photographs. For example, a number of pinholes in a delicate cloud photograph will quite spoil the effect, unless they are carefully spotted out. Spotting out may be easy for a professional, but the ordinary amateur finds a considerable difficulty in doing it properly, and if lantern slides are to be made the technique is still more difficult.

The common cause of pinholes is that small particles get on the face of the plate and during exposure they cause shadows, which on the resulting negative appear as clear patches. Particles may get on to the plate at various stages of its history, but the plate makers never, or scarcely ever, admit that any particles can be on the plates before they are taken out of their wrappings. My own experience, however, is against this supposition. My procedure, up to quite recently, has always been the same; I have dusted out the dark slides, opened the packets of plates very carefully, and very carefully put the plates into the dark slides; but pinholes sometimes occur and sometimes do not, and the occurrence or non-occurrence of pinholes coincides with the use of a new box of plates. With all the plates from one box I may get many pinholes, with all the plates from another I get very few; the inference is that the particles that cause them are on the plates as they come from the makers. Moreover, I have opened plates in the light and have found minute particles on their faces. Quite recently I have heard indirectly from a leading firm of plate makers that it is almost impossible to prevent small fragments of glass from the cut edges of the plates from getting on to the sensitised surface; this agrees with my experience that the pinholes are worse round the edges of a plate than near the centre. The above observations were made on plates that had not been carried about in a dark slide. Of course, if this is done, pinholes must be expected even on plates which were the most immaculate when they left the maker.

Since apparently plates can, and do, leave the makers with foreign particles on their faces, it would appear to be necessary to remove the particles before the plate is put into the dark slide. Thirty years ago or so the amateur used to be told to dust his plates; more recently, however, he has been told on no account to do this; it has also been stated, and often repeated, that dusting plates electrifies them and causes small particles to be attracted. No one who has so written can have tried the experiment; at ordinary room temperature and humidity I find that it is not possible to electrify a plate even by a very vigorous rubbing of the coated side. When, however, the plates are made very hot, and therefore dry, they can be electrified by fairly moderate rubbing; if, however, they are left for half an hour or so, they are found to have returned to their original condition. Backed plates are still more difficult to electrify by rubbing, though different makes differ in this respect; some backed Ilford Special Rapid Panchromatic and Wellington Spectrum plates showed no electrification when rubbed vigorously, even when heated to such a temperature that they could scarcely be touched by the hand; some backed Imperial Panchromatic plates, however, were easily electrified by rubbing, when made very hot. The Ilford and Wellington plates could be electrified by rubbing if the backing was removed and if they were heated. Thus in the ordinary way, at room temperatures, there is no danger of electrification even if the plates are rubbed quite vigorously. I now wipe the sensitised surface of the plate with a pad of velvet, and have found a very considerable diminution of pinholes as a consequence; a single sweep of the velvet across the plate is sufficient.

Probably a professional finds little difficulty in spotting out pinholes, but, as I have said, the amateur finds a good deal of difficulty. When using water-colour, for example, if there is too much colour on the brush, or if it is too watery, the colour leaves the pinhole and collects in a circle round it, thereby aggravating the evil; if one uses the brush very nearly dry it entails taking fresh colour for nearly every pinhole, and the process becomes very laborious. I have lately, however, taken to using ink supplied by the Cambridge Instrument Co. for their recording apparatus; this ink consists of colouring matter dissolved in nearly equal proportions of glycerine and water with a small admixture of gum arabic. This used with a fine brush makes the best medium I know of for spotting out pinholes; it takes longer to dry than, say, water-colour, but this disadvantage is far outweighed by its ease of application.

C. J. P. CAVE.

Stoner Hill,
Petersfield, Hants, May 25.

### The Polymorphism of Higher Fatty Acids.

IN continuation of former work, I have extended the study of the polymorphism of such substances (Piper, Malkin, and Austin, *Jour. Chem. Soc.*, 1926, 2310; J. Thibaud, *Comptes-rendus*, **184**, 24 and 96, 1927; de Boer, NATURE, Jan. 8, 1927) to the even and odd series of saturated acids of higher molecular weight. Thin films are prepared on a glass slip either by melting or by evaporating from a solution in ether, or better in carbon disulphide, and examined with respect to the $K\alpha$ rays of copper by the turning crystal method. The result is as follows: the long spacing measured for an evaporated film differs from that obtained from a melted acid, the latter being smaller than the former. This property is quite general: for every acid which contains more than 16 carbon atoms in the molecule, the magnitude of the long spacing depends on its manner of preparation and the two kinds thus possible both seem very durable. For stearic acid I have been able to obtain upon one and the same evaporated film, two coexistent crystalline modifications.

The following table summarises the data obtained with the even and odd series of saturated acids:

| Acid. | | Spacing (Å.U.) of the Modification. | |
|---|---|---|---|
| | | Evaporated. | Melted. |
| Myristic . . | $C_{14}H_{28}O_2$ | 31·2 | 31·2 |
| Palmitic . . | $C_{16}H_{32}O_2$ | 38·8 | 35·4 |
| Daturic . . | $C_{17}H_{34}O_2$ | 43·2 | 41·4 |
| Stearic . . | $C_{18}H_{36}O_2$ | 43·95 | 39·9 |
| Arachidic . . | $C_{24}H_{48}O_2$ ? | 59·0 | 53·4 |
| Cerotic . . | $C_{27}H_{54}O_2$ | 69·0 | 64·2 |
| Melissic . . | $C_{31}H_{62}O_2$ | 80·4 | 73·5 |
| Lacceroic . . | $C_{32}H_{64}O_2$ | 82·0 | 73 |
| Sebacic . . | $C_{10}H_{18}O_4$ | 11·4 | 11·4 |

In the accompanying diagram (Fig. 1) the observed spacings are plotted against the number of carbon atoms of the corresponding acid. Piper's values and my data are complementary. The diagram shows that, for every modification, the spacings lie upon nearly straight lines (even acids show a small increase in their lines with increasing molecular weight) and it is necessary to consider a bundle of straight lines for the even acids and another for the odd ones. The lines of the "evaporated" B-modification lie above those of the "melted" C-modification. The increase of the chain's length per C-atom is respectively 1·327 and 1·146 Å.U. for the B- and C-kinds of odd acids, and 1·21 and 1·10 Å.U. for the B- and C- kinds of even acids.

It is to be noted that arachidic acid, which was examined in several samples, exhibits for these two B- and C-modifications, numbers well placed upon the even-acid diagram for 24 C-atoms, in good agreement with Piper's data for lignoceric acid. Therefore I ascribe 24 atoms to arachidic acid.

By comparison an attempt to show the polymorphic properties of a dicarboxylic acid ($C_{10}H_{18}O_4$) was unsuccessful. Afterwards, having a crystal of stearic acid, which was comparatively large and showed the long spacing (44 Å.U.) of a B-modification, I investigated the distribution of the scattering matter in this

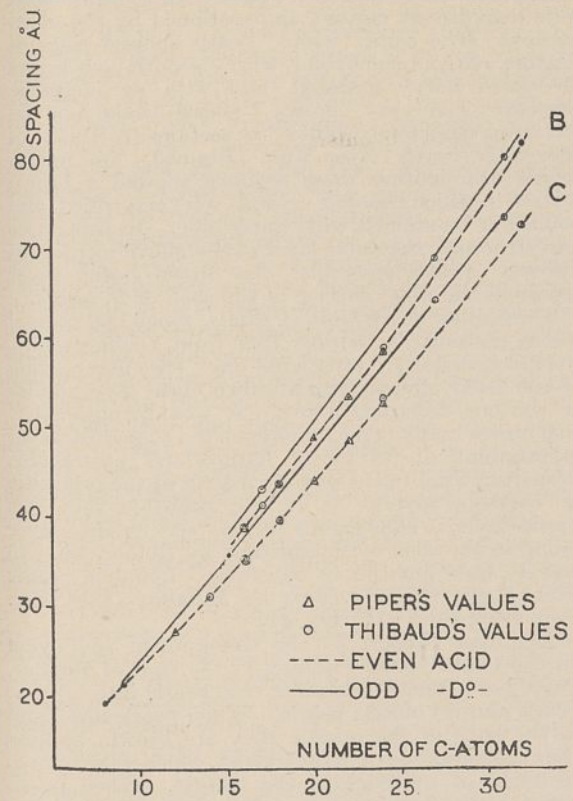


FIG. 1.

chain from a study of the higher orders of reflection (Müller and Shearer, Prins and Coster) from the long spacing, by means of the $K\alpha$ copper and molybdenum rays. The spectrum (Fig. 2) shows first, that the odd orders are much stronger than the even; then, from the 10th order onwards the even orders are the stronger, their intensities increasing regularly to a maximum at the 20th order, afterwards decreasing abruptly. Later maxima occur at the 38th and more strongly at the 40th order. With a melted stearic film (C-modification) a maximum occurs at the 18th-20th order. Then the distribution of matter in a chain of a B-modification is similar to that of a C-modification, but it shows a small discrepancy in the situation of the terminal $CO_2H$ groups.

In addition to the long spacings there is a number of small ones which afford information concerning

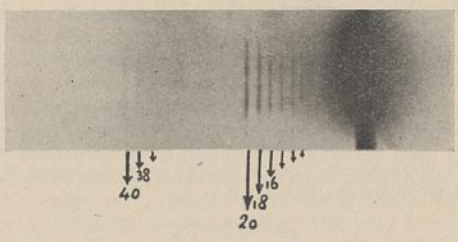


FIG. 2.—Stearic acid (Mo $K\alpha$).

the structure of the $CH_2$-chain. For all acids mentioned in the preceding table and for micro-crystalline films showing the B- as well as the C-modification, I have registered the rays from these small spacings by means of the turning crystal or by Debye and Scherrer's ring method. The small spacings appear unchanged in magnitude as well as in relative intensities whatever may be the purity or crystalline variety of the acid investigated. It follows that for every saturated acid the arrangement of the C-atoms in the chain is precisely the same and is in agreement with data of a beautiful work of Müller (*Proc. Roy. Soc.*, April 1927, p. 542) upon stearic acid.

I have to thank Mr. de Broglie for advice during this work.

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**Quantum Theory and Gravitational Relativity.**

WE wish to announce a result which indicates an inner unity between the quantum theory and gravitational relativity. The connecting link is the wave theory of Schrödinger.

Einstein's gravitational relativity is an invariantive treatment of particle dynamics, with respect to transformations of co-ordinates. Hence the notions of clocks, yardsticks, moving observers, etc., which he introduces to make his theory plausible, belong primarily to the classical kinematics of particles. On the other hand, Schrödinger makes his fundamental physical phenomenon a wave phenomenon: that is, a phenomenon expressed by a linear hyperbolic differential equation of the second order in four variables. It is thus not unnatural to seek for the real meaning of the Schrödinger theory in an invariantive investigation, not of a quadratic form, as in Einstein's theory, but of a differential equation:

$$\sum_{\lambda,\mu}^{1,\ldots,4} g^{\lambda\mu}\frac{\partial^2\psi}{\partial x^\lambda \partial x^\mu} + \sum_{\lambda}^{1,\ldots,4} g^{\lambda}\frac{\partial\psi}{\partial x^\lambda} + g_0\psi = 0, g^{-1} = \mathrm{Det}|g^{\lambda\mu}| \neq 0.$$

Cotton (*Annales scient. de l'école normale supérieure*, 3e sér. **17**, 211-244; 1900; comp. also T. Levi-Cività, *Atti R. Istituto Veneto*, 8a ser. 15, parte 2, 1331-1357; 1913) has shown that this equation can be written in the form

$$\Box\psi - 2\sum_{\lambda}^{1,\ldots,4} p^\lambda\frac{\partial\psi}{\partial x^\lambda} + \big(-D + F - H(x^1, x^2, x^3, x^4)\big)\psi = 0,$$

where $g^{\lambda\mu}$ is a contravariant tensor, $p^\nu$ a contravariant vector, and

$$\Box\psi = \frac{1}{\sqrt{g}} \sum_{\alpha,\beta}^{1,..,4} \frac{\partial}{\partial x_\alpha} \sqrt{g}\, g^{\alpha\beta} \frac{\partial \psi}{\partial x^\beta}, \quad D = \frac{1}{\sqrt{g}} \sum_{\alpha}^{1,..,4} \frac{\partial}{\partial x^\alpha} \sqrt{g}\, p^\alpha,$$

$$F = \sum_{\alpha,\beta}^{1,..,4} g_{\alpha\beta} p^\alpha p^\beta, \quad H = D - F + g_0.$$

As Cotton points out, if we suppose that

$$\mathrm{K} - 6\mathrm{H} = \text{Constant} = 6C,$$

K being the curvature scalar of the $g_{\lambda\mu}$, the $g_{\lambda\mu}$'s and the $p^\nu$'s are in general determined in one and only one way. If we identify the $g_{\lambda\mu}$'s with those of Einstein, and assume his equations

$$\mathrm{K}_{\lambda\mu} = 0,$$

where $\mathrm{K}_{\lambda\mu}$ is the contracted curvature tensor, it follows that $\mathrm{K} = 0$, and $\mathrm{H} = -C$. If we take for our constant of normalisation :

$$C = \frac{4\pi^2 m^2 c^2}{h^2},$$

where $m$ is the rest mass of the electron, $c$ the velocity of light, and $h$ the Planck constant, our wave equation assumes the form of the relativistic Schrödinger equation as given by De Donder in *Bull. Classe des Sciences, Acad. Royale de Belgique*, séances du 5 février et du 5 mars, 1927. Thus the quantisation of the Schrödinger equation is determined by the Einstein equations.

The vector $p_\nu$, apart from a constant factor, determines the electromagnetic vector potential. The Maxwell auxiliary equation, as De Donder points out, is $D = 0$. This can be satisfied without affecting our previous considerations if we change our dependent variable $\psi$ by multiplying it by an appropriate factor of calibration.

To sum up, if we define our gravitational field in the proper invariantive manner in terms of a wave equation, the quantisation of this equation follows from the gravitational field equations. The equation also defines an electromagnetic potential, to which most of Weyl's considerations apply.

A detailed discussion of the present theory will appear in a near number of the *Journal of Mathematics and Physics of the Massachusetts Institute of Technology*.

NORBERT WIENER.
D. J. STRUIK.
Department of Mathematics,
Massachusetts Institute of Technology,
Cambridge, Mass., U.S.A.,
April 2.

We can make our fundamental equation homogeneous in order by the substitution $u = \psi e^{ix_0}$. We then obtain a treatment of our theory analogous to that of O. Klein, *Zeitschr. f. Physik*, **37**, 895-906; 1926. The fifth dimension turns out to be a mere mathematical convention that can be compared to the introduction of homogeneous co-ordinates in other parts of mathematics.

May 10.

## Structure of Pearls.

IN a recent paper by Dr. Orton and myself (*Jour. Marine Biol. Assoc.*, vol. 14, No. 4, in the press) it has been pointed out that a thin, brown horny layer occurs in the form of a skin on the *inner* surface of the shell of oysters (*Ostrea edulis*), and is especially well developed in those from the Fal Estuary beds, in addition to the four normal strata found in the shells of lamellibranchs. This layer was found to peel off in specimens collected in the autumn of 1926, thus indicating that it was secreted at the end of the autumn period of growth. Layers of similar material have been found by us in sections of oyster shells (*O. edulis*) and by Römer in the shell of Margaritana (*Zeitschrift für wissensch. Zoologie*, 1903, 437, Taf. XXXI., Fig. 14), alternating with layers of nacreous material. It is well known from the work of Herdman and Jameson that the structure of pearls from *Margaritifera vulgaris* is intimately related to the structure of the shell, and that new shell growth and pearl growth are probably comparable phenomena. It is also known that layers of brown material similar to that found in shells are also found in some pearls. The occurrence of a layer of brown horny material on or in the shells of *O. edulis* indicated, therefore, that similar layers might be found in the pearls taken from *O. edulis*.

In order to determine the structure of pearls from *O. edulis*, ten dry specimens were decalcified in about 20 per cent. hydrochloric acid. Some time after the pearls were immersed in the decalcifying fluid, it was noticed that two still remained at the bottom of the fluid, whereas the remaining eight were floating, due to bubbles of carbon dioxide becoming entangled in the meshwork of the organic matter left after the calcium carbonate had been dissolved from the calcareous layers. The two specimens that did not float were the only ones that were brown in colour, while the remainder were of nacreous lustre. All the specimens were dehydrated, cleared, and sectioned by the usual method. The eight 'white' pearls showed rings of organic matrix (conchyolin) with discontinuous layers of brown horny material, and with an inorganic nucleus. The two 'brown' pearls could not be sectioned completely, but a few sections (8$\mu$ thick) of the outer horny layer were obtained. On microscopic examination these sections showed a brown matrix in which rhombic crystals were embedded, and could not be stained with water-blue. In properties and structure, the outer layer of the above-mentioned 'brown' pearls resembles the brown horny layer found on the inner surface of the shell of *O. edulis*.

Three other pearls from *O. edulis*, which had normal lustre, obtained in October 1926 from Yealm oysters, were mounted dry; after a few days, the outer coating of one broke off, exposing a brown horny layer similar to the one described above. It would appear that this brown horny layer is more related to periostracum on account of its horny nature and unstainable properties than to the organic matrix of the prismatic or nacreous layers. It is also probable that this brown layer is homologous to the 'conchyolin' layer found in the shell of Margaritana by Römer (*loc. cit.*) and to the 'amorphous substance' found in pearls from *Margaritifera vulgaris* by Jameson (*Proc. Zoo. Soc.*, 1912, Pl. XLII., Fig. 41).

Herdman (Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Mannar, Parts I.-V., 1903–6) classifies true pearls into (*a*) cyst pearls and (*b*) muscle pearls. When pearls are found in the edge of the mantle they are brown, because they are composed of periostracum, which is the normal secretion of the edge of the mantle. When pearls occur in the region of the muscle attachment they possess a lustre due to their hypostracal composition, which is the normal product of that region. When pearls are formed in the mantle or in the epithelium of the visceral mass, they possess a lustre due to the nacreous secretion, which is the normal product of those regions. From the above statements it is clear that brown pearls would appear in the region of the visceral mass, or of the mantle, only when the normal rhythmic secretion is disturbed.

Jameson (*loc. cit.*) states that "it would appear that the lime salts and the albuminous fluid which

hardens to form the conchyolin are independent of each other and may be secreted in varying proportions." Under favourable conditions the secretions of the shell-secreting epidermis are so regulated that nacreous layers are formed. It is possible that under unfavourable conditions, such as a fall in temperature or the want of lime in the food of the animal, only the horny layer is secreted. It is therefore suggested that the brown horny layers found in the pearls of *O. edulis* and on the inner surface of the shell of *O. edulis* are identical.

The occurrence of concentric layers of horny periostracum-like substance in pearls generally and in the shells of oysters and other molluscs may therefore be due to a disturbance in the rhythmic action of the secreting epithelia whereby only the first part of a phase of shell-formation is completed with the oncoming of winter or at the end of a shell-growing period.

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Plymouth, May 14.

### The Absence of a Cellulase in Limnoria.

OWING to the almost invariable presence of fragments of wood in the stomach and gut of the wood-boring isopod, *Limnoria lignorum*, it has been assumed that this animal is capable of digesting cellulose. Thus Calman (Brit. Mus. (N.H.) Economic Series No. 10) states: "*Limnoria* certainly swallows, and probably digests, the wood which it gnaws away to form its burrow, but it is not known whether it has any other source of nourishment." In a report on the Marine Piling Investigation, published in the Bulletin of the American Railway Engineering Association (vol. 28, No. 290, Oct. 1926), the definite statement is made that "the main food of the *limnoria* is the wood into which it bores." No experiments on the digestive powers of Limnoria appear to have been made, and it is never advisable to draw definite conclusions as to the food of any animal from the contents of its stomach, for a great deal of material may be passed through the gut which cannot be acted upon by the digestive enzymes. Though it is known that wood is ingested intracellularly by Teredo which, as shown by Harington (*Biochem. Jour.*, vol. 15, p. 736) and Dore and Miller (*Univ. Calif. Publ. Zool.*, vol. 22, p. 383), possesses a cellulase, it by no means follows that a similar enzyme is present in the crustacean, Limnoria, in which both the alimentary system and mode of digestion are totally different.

In the hope of discovering whether wood can be digested by Limnoria, I carried out a series of experiments during a period of work on behalf of the Sea Action Committee of the Institution of Civil Engineers. Great numbers of Limnoria were collected by placing infected wood in sea water containing 20 per cent. of alcohol, as a result of which the animals came out of their burrows in great numbers and were collected from the bottom of the vessel. They were carefully isolated from other organisms, dried on filter papers and weighed. In the first experiment 2·6 grams of Limnoria (*i.e.* very many hundreds) were collected, and in the second 0·63 grams. They were then ground up with sand and an extract made in toluol water. The action of this extract was tested on sawdust, the digests being incubated at 32° C. for two weeks in the first experiment and for four weeks in the second. Control experiments were carried out with the boiled extract, while in the first experiment the action on starch was also tested. *No indication of any digestion of the cellulose* in wood was found in either experiment, although the starch was quickly digested, the presence of glucose being indicated by means of Benedict's solution.

It appears, therefore, that Limnoria does not possess an enzyme capable of attacking cellulose. Such enzymes are rare in the animal kingdom, as I have pointed out elsewhere (*Science Progress*, vol. 20, p. 242) in a résumé of the literature on the subject. There is, moreover, no evidence of the presence of protozoan symbionts in the stomach of Limnoria, such as are invariably present in the gut of the wood-boring Termites, which enable these insects to extract nourishment from the wood (Cleveland, *Biol. Bull.*, vol. 46, p. 177, and subsequent papers). There remains the possibility of bacterial digestion, but, owing to the difficulty of obtaining sufficient material from the minute stomachs, no experiments were carried out.

Examinations of the stomach contents revealed the presence of a certain quantity of microscopic plants and animals such as diatoms, peridinians, etc., and no doubt more would have been identified but for the triturition of the gastric mill and the action of digestive enzymes in the stomach. There is a large micro fauna and flora on the wood which may quite easily supply the needs of the animals. It would appear at first sight as though this would not be easily obtained in the burrows, but, as recorded by Calman (*l.c.*), Limnoria has been found boring in the insulating covering of a submarine cable in the Mediterranean, so that it obviously can feed in this manner, since it is in the highest degree unlikely that it can digest the substance of the cable! Teredo is never found burrowing in anything but wood (though the giant Teredo apparently spends at least the latter part of its life encased in its calcareous tube buried in the sand), but Xylophaga—an allied genus resembling Teredo in its burrowing apparatus but *not* in the modifications of the gut which enable it to digest wood—has also been found burrowing into the covering of cables.

The amphipod borer, *Chelura terebrans*, resembles Limnoria in all respects. Experiments revealed the absence of a cellulase, there are no symbionts, the stomach contents are similar to those of Limnoria, and it has been found boring into the covering of cables.

There appears, therefore, to be every indication that Limnoria and Chelura bore into wood solely for *protection* and that, though they possess adaptations which fit them for boring, they are not so highly adapted as the Teredinidae, which are alone amongst wood borers—either molluscan or crustacean—in their capacity for actually feeding on the wood into which they bore.

C. M. YONGE.
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### Nomenclature of the Vertebrate Gut.

IT is, of course, well known to all zoologists that certain names have been applied to structures in different animals without due regard to the real significance either of the name or of the structure, with the result that by now these names have lost their definiteness and with it their scientific utility. This is particularly the case of certain terms used to designate parts of the vertebrate alimentary canal, and this letter is to ask for criticism upon the following attempt to clear up at least part of the matter. Excluding many names which still have a sufficiently accurate meaning for all practical purposes (although they vary widely in significance, as some are simply topographical, others presume a similarity of function, while others again imply a true homology), I want to focus attention upon the terms 'œsophagus,' 'stomach,' 'small and large intestine,' and 'rectum.'

It is obvious that 'stomach' should only be

applied to that part of the canal, whatever its shape, where the typical simple tubular (gastric) glands are present. In it should be included the pylorus, the part, long or short, characterised by the great development of the circular muscle layer; but œsophagus should be strictly segregated. If 'stomach' only means, as seems usual at present, an expanded part of the canal in this region, we need a term to apply to the region when it is not expanded and, in addition, we have to talk about part of a 'stomach' being a 'true stomach' and about 'stomachs' being partly œsophageal. After all, there should at least be one name for each functionally distinct part, unless two or more of such parts are always found in combination, and here we are actually one short. So this is the solution I propose: Stomach to be as defined above, œsophagus to be the part between the pharynx and the stomach, crop or ingluvies to be an expansion of the œsophagus, and a new term, œsogaster, to be applied to an expansion of the posterior part of the œsophagus combined with the stomach: this œsogaster may be simple, like that of the Polypterini, or complex like that of the Ruminantia. By this means all the names would, I believe, have a really useful application.

Let us now consider the other three names. The differentiation of the intestine into 'small' and 'large' took place at the time when so many other fundamental changes occurred in the anatomy of the vertebrata, *i.e.* when they took to life on land. It was as necessary to develop a 'large intestine' as to substitute a pulmonary for a branchial method of respiration, because the conservation of water became an essential item in the economy of the individual. So the intestine lengthened, a hinder portion lost its digestive function so as to specialise in absorption, and the differentiation of the 'large' and 'small' intestine was thus brought about. In the higher forms these two parts have elongated and undergone further differentiation, so that more names have been found useful, but these should not be applied to parts of the lower forms. 'Rectum' (the name applied to that last portion of the large intestine concerned with the preparation of the intestinal contents for defæcation) should therefore not be used as a synonym for 'large intestine,' and the latter name should not be applied to the post-valvate portion of the intestine of fish.

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### An Improved Mercury Vapour Trap.

INGRESS of mercury vapour from mercury vapour condensation pumps into systems undergoing evacuation is prevented in practice by freezing out the mercury vapour in liquid air-cooled traps. The chief drawbacks to this method lie in the cost of liquid air and in the need of attention in replenishing the liquid air as long as the trap is required to remain in action.

Hughes and Poindexter (NATURE, vol. 115, p. 979; 1925) described an alternative method of trapping mercury vapour by means of thin films of distilled alkali metal, either sodium or potassium. This method, whilst probably as efficient as freezing out by liquid air, suffers from the disadvantages that the surface of the metal soon becomes clogged, particularly with large pumps, and that renewal of the alkali metal film involves distillation of the metal; a process destructive of glass or silica apparatus.

During the last ten months I have used with complete satisfaction a liquid alloy of sodium and potassium in order to trap mercury vapour. The alloy is prepared by melting together, in an inert atmosphere, sodium and potassium in the proportions 1 to 2. The liquid alloy is then poured through a tap funnel into the trap, filled with an inert gas, and consisting of a twelve-inches long wide-bore glass tube provided with inlet and outlet tubes for attaching to the pump and vessel undergoing evacuation. Oxides and scum remain in the tap funnel, clean alloy alone passing into the trap.

Mercury vapour is retained by the alloy in the form of a solid amalgam which collects on the surface of the alloy. The latter may be oxidised to a considerable extent before its powers of retaining mercury fall off to any considerable extent. Regeneration of the alloy surface can be simply effected either by shaking the trap and thus causing cracks to develop in the surface layer of amalgam or oxide, or, better, by sweeping the alloy surface free from such layers by means of a ball or coil of iron wire originally inserted into the trap and moved about therein by means of an external electro-magnet.

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### Dug-out Canoe in Algoa Bay.

THE canoe found on the shore of Algoa Bay and illustrated in Mr. FitzSimon's letter in NATURE of May 21, p. 746, differs in several respects from those of the Mawken or Selungs of the Mergui Archipelago. During many months spent among those people, I do not remember ever to have seen a Mawken canoe, a kabang, in which the solid hull, apart from the palm stem bulwarks, did not have a gradual sheer from amidships upwards to bow and stern. But more important still, the Selung kabang has a semi-circular notch cut out of the prow and stern of the hull. These form steps by which it is safe and easy to climb into the canoe from the water. I feel sure that whatever may be the origin of the canoe found in South Africa, it did not come from the Mergui Archipelago.

R. N. RUDMOSE BROWN.

The University, Sheffield,
May 23.

I WOULD suggest that, in order to find the home of the canoe which Mr. F. W. FitzSimons discovered on the beach of Algoa Bay (NATURE, May 21, p. 746), it is scarcely necessary to look across 5000 miles of ocean. Canoes of this type, with two upturned ends, are commonly carried as tenders by the many Arab dhows which trade along the northern part of the east coast of Africa and from Port Sudan to Zanzibar —and also along the west coast of Madagascar; very similar canoes, either with or without outriggers, are ordinarily employed by the local fishermen.

A model of one of these dhows' canoes may be seen in the Ship-Model Collections of the Science Museum, South Kensington, and if viewed from the direction in which the photograph of the Algoa Bay derelict was taken, it shows a very close similarity in shape. Owing, however, to the derelict having lost the light wash-boards which served to heighten its sides, the photograph gives an appearance of less depth amidships and of exaggerated height at bow and stern.

Instead of the upturned bow of the Algoa Bay canoe, the typical canoes of the Mergui Archipelago are built with the projecting bow, suggestive of the ram of late nineteenth-century warships, which is so commonly seen on the Irrawaddy.

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## Rigidity and other Anomalies in Colloidal Solutions.[1]

By EMIL HATSCHEK.

THE technical definition of the term rigidity is arrived at by considering a cube of an elastic solid one face of which is held while a tangential force is applied to the opposite one. The cube undergoes a deformation called a 'shear' and resists it by virtue of a property called its rigidity, which causes it to return to its original shape when the force ceases to act. The terms of the experiment lead to a quantitative expression, the modulus of rigidity, that is, the force which, applied to a cube of unit dimensions, would produce unit deformation.

In a transparent isotropic material, such as gelatin jelly, a further change accompanies the deformation: the material becomes double refracting. This accidental double refraction is easily observed in polarised light and is a delicate means of detecting strains in transparent media.

It must be added that the rigidity of a perfectly elastic material does not vary with time, so that the stress required to maintain a given deformation remains constant.

Rigidity is one of the most characteristic properties of the solid state and absent in all normal liquids. The difference between solids and liquids is best realised by considering the ideal case of a liquid between two indefinitely extended parallel planes, one of which is fixed. If now a force, however small, is applied to the other, it moves, not only a small distance as with the elastic solid, but also continuously so long as the force acts and comes to rest when it ceases to do so. The force required to maintain a given velocity is proportional to the area of the plates and the velocity gradient, that is, the velocity of the moving plate divided by its distance from the fixed one, and depends on the viscosity of the liquid. A quantitative expression again suggests itself from the terms of the mental experiment: the force per unit area required to maintain unit velocity when the plates are unit distance apart; this is called the viscosity coefficient. In all liquids it decreases with rising temperature.

A very remarkable feature of this physical constant is that in all normal liquids it is quite independent of the velocity gradient. If all else is kept constant, the forces required to maintain two different velocities are exactly proportional to these velocities.

Instead of expressing the viscosity coefficient in the absolute units of the definition, it is customary in work on solutions, such as we shall consider, to express it as 'relative viscosity,' the viscosity of a standard liquid, generally the solvent itself, being taken as unity. Thus the relative viscosity of a 60 per cent. solution of cane sugar at 20° is 56·5.

Since a normal liquid yields at once to the smallest force, no deformation can be set up in it, nor the accompanying phenomenon of double refraction. Attempts to detect such an effect at very high shear gradients were first made by Kundt in 1881, and afterwards by other physicists, with negative results except in a few liquids which we now know to be colloidal solutions.

The arrangement of two parallel planes with liquid between them, from which the definition of the viscosity coefficient was deduced, is not realisable experimentally. We can, however, without materially altering the conditions, so to speak 'roll up' the two planes, and confine the liquid between two coaxial cylinders, the outer of which is rotated while the inner is at rest. Such an arrangement can be used for measuring viscosities and will be referred to again.

Historically, it is not the first device used for this purpose. The study of viscosity was begun by Poiseuille, who in 1841 discovered empirically the law, called after him, which governs the flow of a liquid through a capillary tube. This 'transpiration method,' as it was originally called, attracted the interest of Thomas Graham, the founder of colloid chemistry, who applied it to many colloidal solutions. He was so much struck with the changes in viscosity caused by the addition of electrolytes or by mere ageing, that in his famous paper on silicic acid he made the often quoted remark that "a liquid transpiration tube may be employed as a colloidoscope."

The transpiration tube, or, as it is now called, the capillary viscometer, was used by a large number of observers, generally in the simple form given it by Wilhelm Ostwald, in which the pressure causing the flow of liquid is produced by a column of the liquid itself. As measurements accumulated it became evident that many colloidal solutions did not behave like normal liquids, but the instruments in general use were theoretically inadequate to reveal the nature of their anomalies. On a somewhat different footing stands an investigation by Garrett, published at Heidelberg in 1903. He studied the viscosity of a number of colloidal solutions both in the capillary and by a method not used before. If a circular, horizontal disc suspended from a wire is made to oscillate round its axis in a liquid, the viscosity coefficient can be calculated from the damping effect. Garrett found in this way that colloidal solutions exhibited a number of bewildering anomalies. The values found by the disc method did not agree with those determined by the capillary; they were not even consistent among themselves, but varied with the amplitude of the oscillations and altered even during the course of the experiment. This investigation is quoted in all the text-books published about 1910 to show the complexity of the problem, but no very definite attitude towards it is taken up by the authors.

The first deliberate attempts to bring some light into the matter were made about this time by Prof. W. R. Hess, of Zürich, and by myself, working

[1] Discourse delivered at the Royal Institution on Friday, Mar. 18.

in ignorance of each other. Hess had been induced to attack the problem by practical considerations: measurements of the viscosity of blood had become a clinical method, but the results obtained by various observers were difficult to reconcile. Hess showed in an improved capillary viscometer that the viscosity of blood and of some colloidal solutions like gelatin was not a constant but varied with the shear gradient; the faster these liquids were sheared the less viscous they appeared to be, until above a certain gradient the viscosity coefficient became a constant.

In a theoretical paper published early in 1911, I had reached the conclusion that colloidal solutions of a certain type should have a variable viscosity which should become constant above a certain velocity gradient. I proceeded to test these conclusions in a modification of the concentric cylinder apparatus which was first used by Couette in 1890.

This apparatus consists of an outer cylinder, which can be rotated at constant speed, and an inner cylinder coaxial with it and suspended from a wire. When the outer cylinder revolves, the viscous drag of the liquid carries round the inner one, until the torsion of the wire balances this drag. If all end effects are eliminated—which can be accomplished by screening the ends of the inner cylinder by suitable fixed guards—theory shows that the deflexion of the inner cylinder, which is read with telescope and scale, is exactly proportional to the product of angular velocity into viscosity.

The first results obtained with this apparatus were published in 1913. Dilute gelatin solutions were investigated, and the viscosity was found to decrease rapidly with increasing velocity: at 10° per sec. it was about 2·5 times as great as at 100° per sec. The curves representing the variation of viscosity with velocity all show a tendency to become horizontal at high velocities, and to rise asymptotically at low velocities. The same behaviour has been found in a very large number of colloidal solutions, examined either in the concentric cylinder apparatus or in improved forms of the capillary instrument, in which the rate of flow can be varied. In a few instances apparent exceptions have been found by some observers, *i.e.* viscosities which appeared to be constant. These discrepancies have been cleared up by extending the range of investigation to much lower velocity gradients, when the usual behaviour could be demonstrated again. Increasing viscosity with decreasing shear gradient may now be considered a general property of colloidal solutions.

Since this behaviour is thus characteristic of a large and important class of liquids, and in the most striking contrast to that of normal liquids, it is of great importance to find some explanation of it. One suggested by several authors, including Prof. Freundlich, is that these solutions, unlike normal liquids, possess rigidity as well as viscosity. It can indeed be shown mathematically, by making the simplest assumption regarding this rigidity, that the result will be what has been found experimentally, namely, decreasing viscosity with increasing velocity gradient.

The suggestion that solutions which nobody could hesitate to describe as liquids should possess one of the fundamental properties of solids is so surprising, that one is naturally anxious to have a direct demonstration rather than an inference from mathematical treatment. There is no difficulty in providing this demonstration with delicate apparatus, which permits measurements of the modulus to be made. I have, however, been fortunate enough to discover a solution, the rigidity of which can be demonstrated without any apparatus at all, namely, dilute ammonium oleate. If a freshly prepared solution is given a rotary movement in a beaker it gradually comes to rest like any other liquid, but then *rotates backwards*.

The ammonium oleate solutions are mechanically very labile systems, the elastic properties of which depend on their age and previous treatment. In view of their marked rigidity they appeared to be excellent test objects for the assumption that it was this property which caused variable viscosity. Examination, however, revealed the further striking anomaly that these solutions had viscosities which varied even at constant velocity gradient and oscillated periodically between well-marked maxima and minima.

This anomaly fortunately is unique, although a decrease in viscosity after continued shearing is quite common. As regards rigidity, no other solution so far examined shows it in the same striking manner as ammonium oleate, and special apparatus is necessary to demonstrate it and to measure the modulus. The first measurement of this kind was carried out by Schwedoff in 1889 on a 0·5 per cent. gelatin solution; a series of such solutions was investigated by Rohloff and Shinjo at Göttingen in 1907. We were desirous of studying solutions other than gelatin, more especially those which had shown markedly variable viscosity, and employed Schwedoff's method for the purpose.

This method again uses the artifice of confining the liquid between concentric cylinders, the inner one being suspended from a wire. If now a certain torsion is given to the wire, and if the liquid between the cylinders is merely viscous, the suspended cylinder begins at once to follow the wire and continues to do so, until no torsion is left in the wire. If, however, the liquid has rigidity, the cylinder does not follow, but describes a much smaller angle than that by which the wire has been twisted, and remains in this position for some time, the rigidity of the hollow cylinder of liquid now balancing the torsion. From the two angles and the constants of the apparatus the modulus of rigidity can be calculated.

All the liquids we have examined lose their rigidity at or below 40°, and, to obtain a satisfactory zero, they are charged into the apparatus at this temperature and allowed to cool in it for twenty-four hours before measurements are made. The moduli are of the order of *milligrams per sq. cm.*, whereas the modulus of 10 or 12 per cent. gelatin jellies is about 100 grams per sq. cm. and that of metals

of the order of tons per sq. cm. Solutions of ammonium oleate, gelatin, benzopurpurin, and cotton yellow (two dyes), and of mercury-sulphosalicylic acid, have been studied in this fashion. In all of them the modulus increases with age; a corresponding increase in viscosity has been known to occur for some time.

Since these liquids can support a small deformation, one may expect them to exhibit accidental double refraction, and they all do so, though in very different degrees. The phenomenon is most strikingly shown by quite dilute solutions of cotton yellow and of mercury-sulphosalicylic acid, when they were stirred or caused to flow. This accidental double refraction disappears with the rigidity on heating.

Although the solutions described exhibit measurable rigidities, the properties of the liquid state yet manifest themselves inasmuch as, unlike elastic solids, they do so for a short time only; very soon the phenomenon called by Maxwell 'relaxation' sets in and, in the apparatus described, the inner cylinder gradually follows the wire. From the constants of the apparatus and the time required for a given angular displacement the viscosity of the liquid at extremely low velocity gradients can be calculated; a number of determinations have been made at speeds which correspond to one revolution of the viscosity apparatus described above in 7·5 days, while the lowest speeds so far used have been of the order of one revolution in 2·5 *minutes*. At these very low velocity gradients the relative viscosities (water = 1) approach 100,000, which confirms the result of a very large body of measurements at ordinary gradients, namely, that the viscosity with decreasing gradient grows asymptotically and at infinitely small velocities really becomes infinite.

We thus have a considerable body of evidence for the existence of rigidity in many of the solutions which exhibit anomalous viscosity, and numerous series of measurements of the latter over a wide range of velocity gradients. As regards the causes of these anomalies we are still in the dark, although there has been no lack of the *ad hoc* hypotheses which are characteristic of a vigorously growing discipline like colloid chemistry. To explain the anomalies it has been suggested that the particles forming these solutions have peculiar shapes and arrange themselves in a special manner; although the particles are of much larger than molecular sizes, they are yet supposed to be modelled on the shape of the molecule. Thus the long chain molecules of the fatty acid salts, or the long chains of amino-acids forming proteins like gelatin, are assumed to produce filamentous aggregates or ramifying structures. There is little direct evidence of such structures, since most of the solutions in question show no particles in the ultra-microscope, and the extreme chemical diversity of the substances the solutions of which show anomaly makes the explanation at least inadequate. While compounds like the oleates undoubtedly have long chain molecules, the mercury-sulphosalicylic acid is a very simple aromatic compound of a type which makes chain formation difficult to conceive.

It is, however, not only the extreme diversity of chemical structures which makes such attempts at explanation unconvincing, but also we have experimental evidence showing beyond any doubt that variable viscosity can be produced by simply suspending in a normal liquid a small volume percentage of microscopic particles of nearly spherical shape. I showed in 1916 with Dr. Edith Humphrey (and the measurements have since been repeated and extended) that such suspensions (of rice starch in an indifferent organic liquid of the same density) exhibited viscosities which varied with the velocity gradient exactly as do the viscosities of colloidal solutions: with decreasing velocity the viscosity grows asymptotically, while with increasing velocity it approaches, and in the lower concentrations reaches, a constant value.

There is no evidence, and certainly no probability, that such particles aggregate into chains, and the cause of the variable viscosity must therefore be sought, not in their configuration, but in some effect which they produce on the surrounding liquid. There is a very large amount of evidence drawn from the most diverse phenomena to show that particles in a liquid are surrounded by films or layers of it in which the properties of the liquid are altered. The viscosity measurements on suspensions suggest that these layers must extend some distance into the bulk of the liquid and must be sufficiently labile to be affected by the shearing of the liquid. These considerations would apply to all particles, whatever their shape or arrangement, and the combined effect of these factors would necessarily be complicated.

There is a further strong argument for the view that the cause of the anomalies of these solutions has to be sought partly or largely in some change in the solvent, and that is the striking uniformity of their behaviour regarding temperature. Solutions of substances differing as widely as possible in their chemical constitution behave alike, inasmuch as they lose their rigidity about the same temperature, namely, 40°. It seems natural to look for the reason of this uniformity in the factor common to all the solutions, the water, for the properties of which this temperature is significant.

There is no doubt that the anomalies here discussed have an important bearing on processes in organisms, all of which consist largely of colloidal material. It is impossible to enter on so vast a subject, but attention must be directed to the general physical aspect of rigidity and variable viscosity in colloidal solutions. It is known that under enormous pressures solids behave like liquids, *i.e.* flow; colloidal solutions exhibit the converse behaviour: under exiguous stresses they approximate to the behaviour of solids by exhibiting rigidity and enormous viscosities. Many of them pass continuously into jellies which, within limits, behave more and more like elastic solids, and these colloidal systems thus provide a remarkable series of transitions from the liquid to the solid state.

## The Progress of Hittite Studies—II.[1]

By Prof. J. GARSTANG.

THE new documents bearing on home affairs, though numerous, are not easy of interpretation. It is known from a cursory examination of more than 2000 fragments that the subject matter includes kings' speeches, chronicles and decrees, wills, deeds of gifts and patents of nobility, treaties, legal agreements, inventories (both civil and military), registers of landed property, codes of law as well as detailed military regulations. A large proportion deals with religious matters, including descriptions of festivals and ritual; prayers and legends; questions for the oracles, soothsayers' texts, incantations, and so forth. There is evidently material for reconstructing the social institutions and organisation of Asia Minor under the Hattic kings that will in due time become intelligible. Already, notwithstanding the difficulties of language, the nature of the kingship and government, and the military organisation of the confederated states may be discerned in outline with a measure of certainty.

The Hattic kingship was essentially military, and it was established on a feudal basis. All lands and offices were received from the king on terms of service, whether military or civil. All officers and functionaries were sworn in to personal loyalty, from the viceroy to the royal shoemaker. In the wider aspect of the Great-King as head of the vassal or allied Hittite states, the same principle prevailed. Each king or chieftain owed military service to the central throne, whether by way of levies to the standing army or terms of special service. When princes were enthroned or re-enthroned after revolt, the terms of service were defined by treaty. This applied to conquered territories of non-Hittite or not purely Hittite peoples. Thus the kingdom of Arzawa on the southern coast, which appears frequently opposed to Hattic rule, was dismembered by Muršil III. after one such revolution, and each state was separately bound by agreement to fealty and military obligations. In the time of imperial domination over the states of northern Syria (the fourteenth and thirteenth centuries B.C.) the duties of each vassal in regard to the Great-King's wars were defined and their relations towards one another were dictated to them. The powerful Amorite rulers of the Lebanon area were treated with a certain measure of respect, but even they were bound to join their forces to the Hittite armies in the greater enterprises, and among these the possibility of a conflict with Egypt was foreseen.

While the king's position as head of the army was absolute, and his dominion over the vast agglomeration of Hittite states and conquered territories was maintained by a ready sword, yet in the conduct and organisation of military affairs there was an accepted procedure and code of regulations. The position, rights, and duties of the army, its units and its leaders, were carefully and strictly defined. Army orders covered all such questions as the requisitioning of private property, reservation of quarters, lodging of prisoners, guard duty, the construction of camps—even to the detail of the dimensions of ramparts and ditches and the length of palisades when encamped in enemy country. It is also noteworthy that proper personal credit is given to the generals and officers. A sense of social equity pervades the records, in which the historical sense was equally impartial, no difference being seen in the narrative of events whether to the glory of the king or of his generals, or even when revealing the weakness of either.

This sense of equity finds its official expression in the constitution of a general assembly to advise the king on questions of law and constitutional procedure. The princes of allied and vassal states had their places at this meeting and many of them held high office or high titles at the court itself. The system permeated the administrative organisation of the land: each principality had its local assembly and each township its council of elders. The constitutional history of the later empire suggests, in fact, the presence of the same tendencies, and much the same processes at work, as later in early England.

By the side of the military absolutism, modified by gradual infiltration of democratic principles, there is always visible a theocratic element of power around the throne. The king was hereditary High Priest of all the gods. His duties and functions at the chief rites were formulated and are preserved. Before and after his campaigns the young warrior Muršil III. never failed to invoke the blessing of the sun-goddess of Arinna, the maker and dethroner of kings, mistress of oaths, and goddess of war—and to render to her all the glory of his successes. This duty was not self-imposed. A deep religious sense permeates numerous documents and was evidently a national heritage, and an offence against the gods might involve national disasters. Some of the latest documents reveal this element most strongly, and in several parts of Asia Minor, as is well known, the theocratic system survived the military kingship. Until earlier documents give their evidence it is not possible to say whether this tendency was a new and growing one, or whether, as would seem more likely, the military rule of the Hattic kings was originally imposed upon a theocratic society, of which, as in religious worship, it assimilated the strongest elements. It is significant that while the duties of the priests were laid down in detail, they were restrained from holding property of any kind except by royal gift and favour.

In regard to the organisation of the land, with its numerous principalities and fiefs, there are many important documents of which the full interpretation is not yet possible because the geographical names are unfamiliar. The outline of the picture is clear but the detail is confused.

[1] Continued from p. 820.

The interpretation of documents relating to foreign affairs has been greatly facilitated, not only by the Semitic language of the texts but also by the fact that names of places in the Semitic world are in some cases permanent or at least transparent. An immediate example of survival is the name of Aleppo, namely, Ḫalab, or Ḫalpa, which is essentially the same to-day, and was so in Egyptian. In other cases tentative identification based on similarity of sound or general indications of position can be checked by comparison with parallel documents from Egyptian or other sources. Thus the name Yaruwaddaš (written also Yaruwandaš) scarcely disguises the name of Arvad, Egyptian Aruad, the island city near modern Tripolis on the coast of Syria. The equation is confirmed by reference to the Amarna letters, in which the same persons and situations are mentioned as in Hittite documents. Working on these lines, certain points may be fixed (*e.g.* Kinza = Kodshe = Kadesh), so that narratives of campaigns may be followed on the map, and in so doing other identifications can be tentatively formulated with due regard to the physical and political geography of the areas involved.

The documents concerning Asia Minor, however, contain hundreds of place names which have not survived the various changes of race and language, and except for the capital itself (the name of which has also disappeared), there is scarcely a fixed starting-point upon which students are agreed. The few maps published by German scholars accordingly show profound and disappointing differences. Nevertheless, possible clues may be found in the grouping of the names, having regard to the physical features of the country, and the possibility of some surviving sound-elements in classical or Turkish names. Thus a town Wi.ya.na.wa.an.da, grouped with a river Aštarpa, which is a boundary of a district Kuwalia, with which in turn there is associated a boundary River Šiyanti and a tract called Mira, suggest respectively the Lycian Oeneanda (the digamma disappearing), the River Isparta (an assimilation by metathesis to a local and relatively recent place name), the district of Kabalia (the digamma this time becoming $\beta$, a tendency noted by Ramsay, *H.G.* p. 22), together with the Eshenide River or Eshen (classical Xanthos) and the district of Milyas (Lycian Mira). This grouping in Lycia accords precisely with the indications of physical and classical geography; but Dr. Forrer, whose line of attack is different, places the same group in the east of Cilicia, where also was a classical name Oeneanda. In the latter district, moreover, some English scholars would locate an entirely different state called Kizzuwadna.

Another group of Hittite names, from a list of hiera, which is several times repeated with variations, associates:

Dunna . . . Ḫubišna . . . Tuwanuwa . . . Laanda and Maššuḫanda.

With these may be compared the Cappadocian group from Ptolemy (Cataonia, etc.):

Tynna . . . Kabassos (? Kybistra) . . . Tyana . . . Leandis and Mazaka.

The identity of Tyana is generally admitted; and the suggested identity of Maššuḫ-anda with Mazaka recalls the tradition that its founder was Mošoḫ (cf. Meshekh), which may account for the composition of the Hittite name. In this way, group by group, a working theory of the identity of the Hittite places, and so of the disposition and military organisation of the Hittite states, can be constructed. In it a number of names appear to survive plausibly; *e.g.* Alše as the Assyrian Alze (Arzen); Damašḫunaš as Damascene; Ḫumišenaš as Komisene; Kuššar, of which the variants are Kuššara and Kuššaraš, and the latest form apparently Gaz-zi-u-ra-aš, as Gaziura (Strabo xii. iii. 15); Kuwanna as Kuwania (Konia); Teburzia as Trapezus (Trebizond); Urušša as Eriza; Zimurria as Zimara, etc. The result shows the main political divisions which are based upon physical features to have been permanent. Thus the central Ḫatti state is represented generally by Cappadocia; the allies of Arzawa and Kizzuwadna reappear as Cilicia and Pontus respectively, Gasga as Lesser Armenia; while the rival state of Ḫarri was the forerunner of Armenia, east of the Euphrates.[2]

In general it may be argued that the power which resisted for centuries the old monarchies of Egypt and Babylonia and occasionally challenged them in Syria was presumably master of all Asia Minor. In particular the control by Ḫatti of the passes of anti-Taurus towards the Euphrates and Syria may be assumed; and the general resemblance of the Hittite monuments, borne out by comparison of details, may be adduced in support of the view that nearly all the monuments characterised as Hittite by special hieroglyphs or symbolism throughout south-east Cappadocia and anti-Taurus (including the palace sculptures of Marash and Malatia) are Hattic in inception. The result indicates a strategic organisation of the south-east frontier which is accordant with its physical features and the course of history.

Turning to the rest of Asia Minor, the names in the north-west are more baffling than elsewhere, possibly owing to the Phrygian and other historical immigrations. But the line of monuments along the main highway from the capital to the coast near Ephesus, is evidence of an extension of Hattic dominion to the Ægean, at a time more or less contemporary with the religious sculptures of the capital.

The menace and gradual penetration of the Achæans on the western and southern coasts provides further evidence that the later Hattic kings regarded these tracts as within their dominion. The attempts of the newcomers to settle on the Carian coast in the thirteenth century have been indicated by Dr. Forrer. In amplification of his thesis, we may point to a group of names mentioned in connexion with the expedition by sea with 100 ships of Attarišiyaš (who is identified tentatively with Atreus by Forrer, and with Perseus by Sayce). Among these names (Wallarimma, Ialanti, Bitašša, Maraša, and Millawanda) there appears the unusual form Khuršunašša, which seems to equate perfectly

[2] For a fuller discussion and map, cf. "Index of Hittite Names" (Sp. Publ. of the British School of Archæology in Jerusalem).

with Khersonesos, and so to give a clue to the identity of the whole. Accordingly the following possible identifications may be suggested, following the same order: Hillarima, Alinda, Pedasa, Mylasa, and Miletos respectively. The last is based on the analogy and variant forms of Yaruwaddaš. If these equations stand test, it would appear that the coast at any rate preserved its Hittite names remarkably, unless indeed the texts are quoting names which, as in Syria, were new or foreign to the Hittite scribes.

However that may be, two further points respecting the Achæans' movements may be mentioned. Repulsed from Caria, they gained a footing in Cyprus about 1226 B.C. Almost immediately they are found in company with Trshu and Luku, as well as Shekelesh and Sherdenu, raiding the Egyptian coast in the time of Merenptah. Their base in Cyprus explains the association about which there has been much uncertainty, suggesting a local geographical group in which the Akwesh (Achæans from Cyprus) are combined in this adventure with peoples from Tarshish and from Lycia, as well as others possibly from Sagalassos and from Sardis.

Lastly, it is becoming apparent that these texts connected with the Achæan penetration are gradually unfolding the background for the Trojan War. For in the time of Mutalliš (*c.* 1288) various new peoples with Trojan names, Derden, Luka, Pedes, Kelekesh, and others, are found newly leagued with the Hittite king against the Pharaoh. About the same time appears the name of Alakšanduš as an ally of the Hittite and settled by treaty at Uiluša (? Elaeusa). Greek legend also tells how Paris on his return from Egypt and Syria (according to one version of the story of Helen) was hospitably entertained by the 'Assyrian' king 'Motulos.' Whether this prove relevant or not, there is definite indication in these records that while the Achæans were menacing by sea the western and southern coasts of Asia Minor, the Dardanians were already being accepted as allies by the monarch and peoples of the mainland. The clash of arms around Troy (which by name Taroisa already appears in the texts) was but one crisis in the struggle which heralded the downfall of the Hattic empire. For long critical centuries European civilisation and society had been taking shape, protected by the Hittite organisation in Taurus and Anti-Taurus against the older ambitious monarchies of the Euphrates and the Nile. With the rise of the Iron Age, when Europe was able to fend for itself, the old Hittite barrier gave way.

## Obituary.

### PROF. EDOUARD BRÜCKNER.

THE death of Prof. Edouard Brückner at the age of sixty-four years, which took place at Vienna on May 21, removes a figure well known to both meteorologists and geologists. Brückner was born at Jena on July 29, 1862, his father being Alexander Brückner, the historian, which may account for the historical bias of his early meteorological work. He received the degree of Ph.D. at Munich in 1885, and from 1886 until 1888 he acted as assistant editor of the *Meteorologische Zeitschrift*. It was during this period that he discovered the weather cycle of 35 years which is universally known as the Brückner Cycle. During the next two or three years he collected a great deal of statistical evidence in support of this cycle, which he published in 1890 under the title: "Klimaschwankungen seit 1700," now one of the classics of meteorology.

Brückner's life-work was not mainly meteorological, however, for in 1891 he became professor of geography at Bern, and in 1906 professor of geography at Vienna, and although he continued to publish occasional meteorological papers so late as 1918, the main interest of the second half of his life was in the Quaternary history of the Alps, a subject in which he collaborated with Albrecht Penck. The fruit of this collaboration was a series of three large volumes, containing 1199 pages, published between 1901 and 1909—"Die Alpen im Eiszeitalter." To appreciate the service which this work did for glaciology, one must consider the position of the science in 1900. The battle between the supporters of one and of several glacial periods still raged hotly, the nomenclature was confused, and the wildest ideas of chronology prevailed. The thoroughness and minute detail of "Die Alpen im Eiszeitalter" decided the battle in favour of the polyglacialists, laid the foundations of a sound chronology, and provided a standard of reference and nomenclature which, by the general acceptance it compelled, has rendered incalculable assistance to glaciology in all parts of the world.

DR. VIKTOR ROTHMUND, professor of physical chemistry in the German University at Prague, died on May 10, at the age of fifty-seven years. A native of Munich, Rothmund was appointed to a lectureship at the University of Munich in 1898, which he held until 1902, when he was appointed to the chair at Prague. His published papers deal with a variety of subjects, including solubility, ozone, hydrogen peroxide, perchlorates, permutit, and the passivity of metals.

WE regret to announce the following deaths:

Dr. Carl H. Eigenmann, professor of zoology and dean of the graduate school of the University of Indiana, known for work on the variation, distribution, and embryology of fishes, on April 24, aged sixty-four years.

Prof. W. Lochhead, emeritus professor of biology in Macdonald College, McGill University, known for work on insect and fungus pests of orchards, on Mar. 26, aged sixty-two years.

Mr. W. H. Shrubsole, who worked on modern and fossil diatoms and related forms and was awarded the Lyell Fund of the Geological Society in 1898, on May 19, aged eighty-nine years.

Prof. William Carleton Williams, professor of chemistry at the University of Sheffield from 1883 until 1904, on May 25.

## News and Views.

THE list of honours conferred by the King on the occasion of his birthday on June 3 includes the following names of men of science and others associated with scientific work: *Order of Merit:* The Hon. Sir Charles Parsons, in recognition of his eminent services in scientific research and its application to industries. *G.B.E.* (*Civil Division*): Sir Frank Heath, until recently Secretary to the Department of Scientific and Industrial Research; and Sir Richard Threlfall. *K.B.E.* (*Civil Division*): Dr. C. E. Ashford, Headmaster of the Royal Naval College, Dartmouth. *Knights:* Mr. W. G. Lobjoit, until recently Controller of Horticulture, Ministry of Agriculture; and Prof. C. J. Martin, Director of the Lister Institute, London. *C.M.G.:* Prof. R. W. Chapman, professor of engineering in the University of Adelaide. *C.I.E.:* Mr. A. G. Edie, Chief Conservator of Forests, Bombay. *C.B.E.* (*Civil Division*): Mr. D. J. Davies, Government Analyst, Department of Public Works, Newfoundland. *O.B.E.* (*Civil Division*): Mr. G. W. Grabham, Government Geologist, Khartoum; Mr. T. F. Main, Deputy-Director of Agriculture, Bombay; and Mr. V. E. Pullin, Director of Radiological Research, War Office.

THE new Science School at Clifton College, an account of which is given on p. 871 of this issue, was formally opened on Thursday, June 2, by H.R.H. The Prince of Wales. The boys gave a rousing welcome to their distinguished visitor, who was received at the Memorial Gate by the president of the College (Field-Marshal Lord Haig) and the headmaster. After lunch in the School House, the Prince proceeded to a dais outside the new building, where he made a felicitous reply to short speeches given by the president and headmaster. Referring to his presidency of the British Association, he said that it had brought him into touch with what was more or less a new world to him—the world of science—and had given him many new interests and new contacts. In declaring the new building open, he expressed the hope that it might prove the cradle of many future men of science—of future Faradays, or Kelvins, or Tildens—who would win further laurels for British learning and confer on all humanity benefits equal to those conferred by these great men in the past. He also laid emphasis upon the value of some training in science even to those who in later life were not to embark upon a professional scientific career. A number of presentations were then made, including representatives of the donors, the architect (Mr. Alan E. Munby), the head of the department (Mr. E. J. Holmyard), and the head of the physics department (Mr. W. C. Badcock). Many distinguished representatives of science and other branches of learning were present, and they were much interested in the display of books in the fine library in the new building, where an exhibition had been arranged. Clifton is fortunate in possessing the copy of Dalton's "New System" formerly belonging to William Henry, to whom the book was dedicated; a copy of Tyndall's "Faraday as a Discoverer," presented to Mrs. Faraday by Tyndall himself; a copy of Cannizzaro's works presented to Victor Meyer by the author; a copy of Avogadro's "Fisica" with an inscription in the author's hand; and first editions of Newton, Boyle, and Galvani. It also has a large collection of books on alchemy and early chemistry, so that if Clifton does not rear a succession of historians of science it will not be through lack of early opportunity.

A SURVEY prepared by Science Service of the recent legislative season in the United States discloses what appears to be a temporary collapse of the great anti-evolution drive in the various State legislatures. During the past winter and spring no less than twelve State legislatures had anti-evolution bills brought before them and all twelve have adjourned without the passage of a single one of the measures. In six of the States—California, Delaware, Minnesota, New Hampshire, North Carolina, and North Dakota—the bills did not even reach the floor of their respective Houses, but were disposed of in committee by decisive or unanimous votes. In Missouri, declared to be a pivotal Fundamentalist State, the bill reached the House, but was there rejected by 82 votes to 62. In West Virginia and Oklahoma similar bills were defeated by House votes of 57 to 36 and 46 to 30 respectively. An aggressive campaign in Arkansas resulted in an anti-evolution bill passing the lower house by a very close margin, but it was rejected in the Senate by an overwhelming aye-and-nay vote. In two States, Alabama and South Carolina, anti-evolutionist bills have been temporarily shelved. In Florida, where the legislature meets later in the year than in other States, a bill is at present being hotly debated, predictions being that it will not pass. In Tennessee, one of the two States where an anti-evolution bill has become law, there prevails considerable doubt amongst legal authorities as to its interpretation; and in Mississippi the law has not yet been tested in the courts.

THE Education Association of the Southern Methodist Episcopal Church in the United States has condemned the anti-evolution legislative programme. The resolution was introduced by the president of Duke University, one of the largest and most influential of southern educational institutions, and only two delegates voted against it. Prominent southern Baptist churchmen have also declared themselves as opposed to legislative restrictions on teaching. All the other churches have fought this wave of obscurantism virtually from the start; but the southern Methodists and southern Baptists are by far the most numerous bodies in the American south, and their attitude is highly significant. On the whole, in spite of a new movement recently set on foot to organise local opinion against the appointment of 'evolutionist' teachers, or to try to secure their dismissal, the situation seems not unsatisfactory. The future seems to depend upon the ability of the teaching

profession in America to resist what may be called the dictatorship of the illiterate.

A RECENT article published in NATURE (April 2, p. 481) on the subject of the scientific slaughtering of animals has elicited an interesting letter from Mr. Herbert Kidd, 331 Franklin Street, San Francisco, contrasting the British and American methods of slaughtering. From this letter it would appear that the subject has hitherto attracted far less attention in America than in some European countries, and that the modern method of the captive bolt pistol is very little used there. Mr. Kidd states that cattle are stunned with a sledge-hammer, the Argentine practice of afterwards pithing with the stem or handle having been abandoned because it involves the loss of about ½ lb. of meat per beast through bruising. Sheep are killed on the floor at the high over-all rate of 6 sheep per man per hour, and the spinal cord is not severed. Mr. Kidd's letter brings out a point which gives a good deal of trouble to those who are concerned about this backward aspect of civilisation, namely, the great variations in local practice which make generalisations on the subject precarious: a standard practice throughout the world of the method which has been found statistically to be the most humane is much to be desired. It would be interesting to know the position as regards small private slaughterhouses in a country where large-scale operations are so common as in America: in England (as contrasted with Scotland) local authorities which have built public abattoirs are unable to work them at a profit because they have no power to close the competing private slaughterhouses, either with or without compensation.

A SMALL booklet has been issued by Mr. Ernest A. Chapman, 69 Hayter Road, London, S.W.2, with the view of further elucidation of four small pearl shells which are not only very peculiar and highly interesting in themselves, but also seem to have had a curious history. The pamphlet is very carefully illustrated with excellent photographs, and any one interested should be able to gain a fairly complete idea of the problem from it. The four shells are really four similar valves, none of them having its partner. Each valve contains a pearl attached to the shell by nacre deposition. It is stated that experts in four continents have been consulted without success, and that eminent conchologists in Great Britain are of opinion that the shells belong to an extinct or unknown species. They have been heirlooms in the possession of a family in the south of Ireland for many generations, but no knowledge is forthcoming of how they reached that family. The names of several well-known experts are mentioned in the pamphlet, and the reader is left with the statement that they regard these little shells as a unique set, the only specimens of the type seen or reported.

PROF. W. J. DAKIN, Derby professor of zoology in the University of Liverpool, has been kind enough to examine the shells on our behalf, and he states that he is not prepared to accept the views put forward in the pamphlet. "It seems rather singular," he says, "that the four shells should be so like in appearance, and each with a blister of the same large size in the same place. There is also no doubt that the margins of the 'shells' and the hinge lines have been trimmed and polished. It seems probable that the 'shells' are not real in the natural history sense at all, but have been carved from the nacreous part of a larger pearl shell. I do not agree with the statement that the shells are too deep for this; such is decidedly not the case. Neither can it be admitted that artificial work would be more easily detected. It is not fair to compare what an amateur might do with what can be done by an accomplished Oriental worker. There remains to be granted an extraordinary resemblance (indicated by Prof. Morley Davies) to an extinct Miocene species which is depicted in the pamphlet. It is not, however, altogether convincing. Shell collectors and others who have been interested in cameos and curios carved out of mollusc shells might take a hand in solving this tantalising little puzzle."

THE seventh annual report of the British Non-ferrous Metals Research Association shows rapid growth. The total expenditure on research during 1926 was £22,000, and that figure will be increased during the present year. The period of full Government grant has now expired and that source of income diminishes progressively, but sufficient support is being received from the industry to continue the research work on the same scale. It is remarkable, however, that even now prominent firms sometimes fail to take advantage of the scientific results of the investigations and withdraw the support which they have previously given. A study of the report will show that manufacturers have everything to gain by becoming members of such an organisation. Among the investigations which are making good progress and are of general interest are those concerned with the wastage of locomotive firebox stays, in which all railway companies are interested, and the deterioration of lead cable sheathing, which is of importance to the telegraph and telephone industries. Much is expected of the investigations in hand on materials capable of resisting high temperatures, and valuable results have already been obtained in this direction. Researches on electro-deposition and on methods of casting and jointing have engaged the attention of many workers, and the combined researches on die-casting are doing much for an industry which is of growing importance. Among other activities the Association has made a survey of annealing furnace practice, and has been able to advise as to improvements in annealing practice. The report contains much that is of interest to metallurgists in general.

RADIO communication is proving of great value to isolated communities on various parts of the earth's surface. For example, the lonely Farsan Islands in the Red Sea, which are about 400 miles north of Aden and the same distance south-east of Port Sudan, are being examined for oil by the Red Sea Petroleum Company. The prospectors are equipped with an ordinary Marconi ship's transmitter. Through the

neighbouring ports, or through any of the large number of ships within radio range passing up and down the Red Sea, they can easily link up with main telegraph circuits, and also secure, if necessary, medical advice and other assistance.

THE new short wave beam stations enable news to be transmitted to the Dominions much more rapidly than by ordinary radio services. Last year it took sixty seconds to transmit the name of the winner of the Derby to the Melbourne central telegraph office. This year the name of the winner was transmitted in three seconds, and in fourteen seconds after the finish of the race the full result was known in all the principal newspaper offices in Australia. This result was equalled on Budget day this year, only a few days after the beam stations had been handed over to the General Post Office. A thirteen-word 'empiradio' message, giving the first news of the Budget, was transmitted to Australia in thirty seconds.

ON Tuesday, May 24, Mr. J. L. Baird gave a successful demonstration of television between Motograph House, London, W.C.2, and the Central Hotel, Glasgow. Two ordinary Post Office telephone lines were used, one being for conversation and the other for the television transmission. The inventor has simplified the method of synchronising the two machines employed by means of a new arrangement of filter circuits. The telephone lines connecting the two stations were 438 miles long. Possibly owing to induction effects with neighbouring circuits the images were sometimes unsteady, but in most of the experiments they were steady and clear. Instructions given through the telephone to the operator at London were shown by the image to be immediately obeyed. Arrangements are being made to demonstrate television between London and New York.

A NEW observatory on Kilauea—the Uwekahuna Observatory and Exhibition Room of the Hawaiian Volcano Research Association—was opened on April 19 (*Volcano Letter*, April 21). It is intended for the use of visitors, to explain to them in an appropriate setting the mechanism of volcanoes. Built on the highest rim of the Kilauea crater, the view from it includes Mauna Kea and Mauna Loa, the cones of the Kau Desert, and the Halemaumau pit, the latter a great chasm less than a mile away, as well as all the details of the Kilauea crater.

ON June 6, Mr. Clarence Chamberlin and Mr. Levine landed at Eisleben after a non-stop flight from New York of about forty-three hours. Thus Capt. Lindbergh's record for distance and time in the air without landing, set up so recently as May 22 last (NATURE, May 28, p. 792), has been broken. Mr. Chamberlin, with Mr. Levine as passenger, started on June 4 at 6·5 A.M. in a Bellanca monoplane, the *Columbia*, and was forced to land at 5·35 A.M. on June 6 by the exhaustion of his petrol supply, after covering a distance estimated at 4400-4700 miles. The machine was fitted with a 200 h.p. Wright "Whirlwind" radial engine and was in other respects similar in type to that used by Capt. Lindbergh.

AN expedition under the leadership of Mr. G. P. Putnam to Baffin Island is announced in a recent issue of *Science* (No. 1689). The expedition will leave New York this month in the schooner *Morrissey*, and will be under the auspices of the American Geographical Society, the Museum of the American Indian, and the American Museum of Natural History. The course is to be through Hudson Strait to Fox Basin, which is one of the least explored parts of Arctic Canada. Most of its eastern coast is still uncharted. Expeditions into the interior of Baffin Island will be attempted. The main aims of the party are the collection of zoological and anthropological specimens.

AT the recent annual meeting of the U.S. National Academy of Sciences, Prof. T. H. Morgan, of Columbia University, distinguished for his work on hereditary processes and evolution in animals, was elected president. Dr. F. E. Wright, of the Carnegie Institution of Washington, was elected vice-president of the Academy, and Dr. David E. White, of the U.S. Geological Survey, was re-elected home secretary. Three new members of council were appointed: Prof. George E. Hale, Mount Wilson Astronomical Observatory; Dr. John C. Merriam, president of the Carnegie Institution of Washington; and Dr. J. McKeen Cattell, editor of *Science* and other scientific publications.

THE following were elected members of the U.S. National Academy of Sciences at the recent annual meeting: Eric Temple Bell, professor of mathematics, California Institute of Technology, Pasadena, California; Charles Peter Berkey, professor of geology, Columbia University, who has recently made investigations of the ancient rock layers of Asia; William Bowie, chief of the Division of Geodesy, U.S. Coast and Geodetic Survey, Washington, an authority on isostasy; Arthur Holly Compton, professor of physics, University of Chicago, known for his work on the Compton effect; Benjamin Minge Duggar, botanist of the Missouri Botanical Gardens, St. Louis, known for his work on plant diseases and plant physiology; Thomas Alva Edison, the distinguished inventor; Rollins Adams Emerson, professor of plant breeding, Cornell University; Herbert McLean, professor of anatomy, the University of California, the discoverer of vitamin E; William King Gregory, curator of palæontology in the American Museum of Natural History; Edwin Powell Hubble, of the Mount Wilson Observatory, California, known for his work on distant nebulæ; Claude Silbert Hudson, chemist at the U.S. Bureau of Standards; Alfred Newton Richards, professor of pharmacology at the University of Pennsylvania; Francis Peyton Rous, physiologist of the Rockefeller Institute for Medical Research, New York City, who has done fundamental work on the nature of cancer; Albert Sauveur, professor of metallurgy at Harvard University; Henry Van Peters Wilson, professor of zoology at the University of North California, an authority on sponges and the lower vertebrates. The following foreign associates have been elected: Paul Sabatier, professor of chemistry,

University of Toulouse, known for his work on metallic catalysts; Godfrey Harold Hardy, Savilian professor of geometry at the University of Oxford, and Carl Stumpf, emeritus professor of philosophy at the University of Berlin, originator of a new theory of sound and music.

SIR RICHARD GLAZEBROOK has been appointed, by Order of Council dated May 26, to be a member of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

SIR DANIEL HALL retired on June 4 from the post of Director-General of the Intelligence Department of the Ministry of Agriculture, which he has held since 1920. Sir Daniel will continue to act as Chief Scientific Adviser and chairman of the Research Council of the Ministry.

MR. H. C. SAMPSON, who was recently appointed economic botanist at the Royal Botanic Gardens, Kew, is leaving on June 11 for British Guiana at the invitation of the Governor and under the auspices of the Colonial Office and Empire Marketing Board, to study and report on various agricultural matters in the colony. He will also visit Trinidad and the Imperial College of Tropical Agriculture, and Barbados.

THERE have already been published, through De Gruyter of Berlin, two volumes of the *Vorgeschichtliches Jahrbuch*, dealing with the literature for 1924–1925. Owing to the sudden death of the collaborator for Great Britain and Ireland, the report on the literature of prehistoric archæology issued in those countries during 1926 has been undertaken by Dr. A. Mahr, Naturhistorisches Museum, Burgring 7, Wien 1, Austria, and to him all relevant publications should be sent, either as a gift or on loan, at the earliest date possible.

AT the anniversary meeting of the Linnean Society of London, held at Burlington House on May 24, the following were elected officers of the Society for 1927-28: *President*, Sir Sidney F. Harmer; *Treasurer*, Mr. H. W. Monckton; *Zoological Secretary*, Dr. W. T. Calman; *Botanical Secretary*, Mr. J. Ramsbottom. The Linnean Gold Medal was presented to Dr. Otto Stapf in recognition of his contributions to the advancement of botanical science. The Crisp Award and Medal were given to Dr. H. Graham Cannon, professor of zoology at the University of Sheffield, for his paper "On the Post-Embryonic Development of the Fairy Shrimp," published in the Society's journal.

WE have received the fourth number of *Brighter Biochemistry*, the illustrated journal of the Biochemical Laboratory, Sir William Dunn Institute, Cambridge. It fully maintains the reputation of its predecessors in dealing with the lighter, but not always apparently the brighter, sides of this science. Opportunity is taken to publish a First Depression from the Sir William Dunn Academy, in which a now famous portrait is but faintly disguised. New features are Researchers' Fables and an account of a visit to the twelfth International Congress of Physiology at Stockholm. For the rest, poems—or had we better say rhymes—and short 'scientific' articles amuse the reader, and can be enjoyed by any one for the moderate price of half a crown, payable to the editors at the Sir William Dunn Institute.

THE Swiss Society of Natural Sciences is holding its annual meeting this year on Sept. 1-4 at Basel. This will be the hundred and eighth session of the Society and the seventh occasion on which it has met in Basel. The general programme includes the opening address by the president, Dr. Fritz Sarasin, on Sept. 1, followed by a lecture by Prof. A. Brachet (Brussels) on the causes and factors of morphogenesis; other lectures will be given by Prof. L. Courvoisier (Berlin) on recent work and views in astronomy, by Prof. L. Duparc (Geneva) on the Urals from the point of view of geophysics, geology, and mining, and by Prof. H. E. Sigerist (Leipzig) on Paracelsus in relation to modern thought. The general work of the meeting will be divided among fourteen sections covering various aspects of science, communications for which should be received before June 30. All correspondence regarding the meeting should be addressed to Dr. Fritz Sarasin, 22 Spitalstrasse, Bâle.

THE series of postcards issued by the British Museum (Natural History) has received an interesting and attractive addition in the form of reproductions in colour of illustrations of medieval natural history from "Hortus Sanitatis," printed by Jacob Meydenbach at Mainz in 1491. Of particular interest are the drawings of mythological animals, such as the tyras, draconopede, sea horse, maricomorion, onocenthaurus and orasius, where the artist has had to rely on his own imagination, aided by the writings of classical mythology. The illustrations of animals such as the hippopotamus, chameleon, cameloleopard and the great ant, which the artist had never seen but had drawn from some traveller's description, are extraordinarily fascinating in their quaintness. The whole series is one of remarkable interest, and it is to be hoped that further additions will speedily follow. The illustrations are very clearly and pleasingly reproduced, and well maintain the excellent standard of the coloured postcards already issued by the Museum.

THE first number of *The Countryman*, a new illustrated quarterly review and miscellany of rural life, edited and published by J. W. Robertson Scott at Idbury, Kingham, Oxford, appeared in April last. It is a periodical concerned with the welfare of the men and women who live on the land and *their* cultivation, and has as its object the provision of brisk, timely, and authoritative articles, together with skilful and appetising digests of that practical information in every department of rural welfare which is at present scattered in books, journals, and papers. It is non-party in character and is intended to be of equal interest to men and women, and to help stimulate their efforts in the improvement of rural conditions, whether their activities are concerned with the problems of education, housing, village clubs or women's institutes,

etc. Amongst the varied articles in the first number are the following: "Countryman Conversations," "The Trees we might have," "Is the Farmer Dead Beat?" "Aerials for Arable," "The Genteel Cottage," and "New Rural Tales," while authors include Sir Daniel Hall, Sir Francis Acland, Mr. Noel Buxton, and Sir Charles Bright. A special treatment of country books is promised for the second number.

THE third issue of the *Journal of the Royal Technical College*, Glasgow, bearing the date December 1926, is a handsome production, and affords evidence of the activity of members of the College in research. The contents range over the fields of chemistry, physics, engineering, metallurgy, and bacteriology. An important paper by A. D. Third deals with compression losses in nozzles, the method used being that of photographing through the parallel glass sides of a diverging nozzle, the faces of which have been coated with a layer of a very viscous oil, which is thinned or swept away by the jet of air. A. S. Clark describes experiments to determine the relation between rapid tensile tests of metals at high temperatures and their creep limits, whilst O. Sneeden has determined the efficiency of arrangements for preheating air for furnace combustion. J. H. Andrew suggests an explanation of the fact that overheated mild steel usually appears on microscopical examination to contain more than its actual amount of carbon, and R. Hay and R. Higgins make a further contribution to the vexed question of the relations between austenite and martensite in hardened steels. The chemical papers deal with double salt formation, the induline dyestuffs, and the activity theory of solution, as well as with the preparation of a number of organic compounds. A curious photo-electric phenomenon observed by J. B. Somerville on steel surfaces suggests further investigation. There are other contributions of considerable scientific interest.

THE annual report for 1925–26 of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington has recently been published. The non-magnetic ship *Carnegie* was out of commission during the year, and such ocean work as was done was due to Amundsen's ship *Maud*, which is associated with the Department in its magnetic work. Land survey work was also mainly in abeyance, though two survey parties were at work in Africa and America. The Department now maintains two magnetic observatories, in Western Australia and in Peru, and co-operates in the electric work of the Samoa Observatory. Vol. 5 of the Researches of the Department, dealing with the ocean work of the *Carnegie* from 1915 until 1921, was published during the year, and progress was made in the reduction of other observations made in various regions, to be published in vols. 6 and 7. The Department co-operated with the Geophysical Laboratory of the Institution in an important research upon the effect of high pressures on the magnetisability of nickel, meteoric and other kinds of iron; the high pressures are found to reduce the critical temperature, and the research seems to preclude the possibility that the earth's magnetism is due to permanent magnetisation of the interior. The Department has co-operated in radio investigation of the high-level conducting layer of the atmosphere, and members of its staff have also made researches on problems of atomic physics.

THREE catalogues of second-hand books, maps, etc., numbered respectively 495, 496, and 497, have recently reached us from Mr. F. Edwards, 83A High Street, Marylebone, W.1. They deal with publications concerning "The West Indies," "London and its Environs," and "The Indian Empire." Copies can be had free from the publisher upon application.

MR. JAMES THIN, 54 South Bridge, Edinburgh, has just issued a very full list (No. 215) of books dealing with natural history subjects. Upwards of 2700 works are catalogued under the headings of agriculture and husbandry, bees and bee-keeping, botany, entomology, ferns, forestry, fruit culture, fungi, gardening, geology and palæontology, grasses, marine and fresh-water zoology, mosses, natural history (local and general), and ornithology. The catalogue is obtainable free upon request.

THE course of lectures on "The Mind" which was delivered this year at King's College, London, by various authors, is to be published by Messrs. Longmans and Co., Ltd. The subjects and contributors are as follow: Biology, Prof. J. S. Huxley; Physiology, Prof. R. J. S. McDowall; Psychology, Dr. F. A. P. Aveling; Psychotherapy, Dr. J. A. Hadfield; Physics, Prof. F. A. Lindemann; Philosophy, Dr. W. R. Matthews; Education, Prof. J. D. Wilson; Æsthetics, R. G. Collingwood; Anthropology, Prof. C. G. Seligman; and Sociology, Prof. L. T. Hobhouse.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in engineering and a lecturer in chemistry and physics at Stockport College for Further Education—The Principal (June 17). A vice-principal of the Somerset Farm Institute, Cannington—The Principal, Somerset Farm Institute, Cannington, near Bridgwater (June 20). An assistant pathological chemist at St. Mary's Hospital, Paddington—The Secretary, St. Mary's Hospital, W.2 (June 20). A part-time demonstrator in geology at Bedford College for Women—The Secretary, Bedford College for Women, Regent's Park, N.W.1 (June 24). A full-time lecturer in mathematics and science in the School of Science and Art, Newark—The Principal, School of Science and Art, London Road, Newark-on-Trent (June 25). A vice-principal of the Royal Agricultural College, Cirencester—Dr. J. A. Hanley, The University, Bristol (June 25). A professor of technological chemistry in the Manchester Municipal College of Technology—The Registrar, Municipal College of Technology, Manchester (June 28). An assistant professor of metallurgy at University College of Swansea—The Registrar, University College, Swansea (July 2). A biochemist and a bacteriologist at the National Institute for Research in Dairying—The Secretary, National Institute for Research in Dairying, Shinfield, near Reading.

## Research Items.

MADI RAINSTONES.—Mr. F. H. Rogers contributes to *Man* for May some valuable notes on rainstones in three areas in East Africa—Meturu, near Dufile, on the Nile, Metuli and Laropi, also near Dufile. In Meturu there are two sets of these stones; one, of four stones, is said to have been brought from the Bari country by Moyi when flying from a jealous brother—the present chief is sixth in succession from Moyi. As there was a good deal of rain when Moyi arrived, he gave out that it was on account of these stones. The second set of stones consists of ten, which have been found from time to time during the reign of the present chief. They also are much venerated. On account of their special shape and smoothness they are considered to have been moulded by God. The stones are kept in a pot and nominally are in charge of the chief, but as they may be handled safely only by boys and old men, he usually deputes some one else to guard them and carry out the rain-making ceremonies. At present the guardian is the chief's mother. If the government has found it necessary to appoint a reigning chief from another family, the custody of the stones still remains in the hereditary rain-making family. When the rains fail, a meeting is called under the *rudu* or sacred tree, a bull is killed and eaten, and a general request for the rain-making ceremony is put forward, when the custodian is instructed accordingly. The custodian then kills a black sheep and anoints a young member of the family, who is under instruction, on the forehead, chest, back of the hands, and dorsum of the feet, with fat from the kidneys. He is then sent to fetch water from the River Areze, with which the stones are carefully washed, first separately, then in the pot. They and the pot are then smeared with fat and put away after the remainder of the water has been poured on them. The boy then goes to sleep for the night, lying prone on his face to ensure an equal distribution of rain over the whole country.

THE PHYSIQUE OF FILIPINOS.—In the *Philippine Journal of Science* for March, Juan C. Nañagas and Leon C. Santiago have analysed measurements of 713 university students, of whom 564 are male and 149 female. These measurements were not made by the authors themselves, and though both sets present certain deficiencies, those of the female students are in particular especially defective, and can scarcely, for the most part, be regarded as significant for the authors' purpose. The coefficient of variation in each group of measurement is such that the groups cannot be regarded as homogeneous. This is as might be expected, as the regional distribution of the students is wide and there is considerable blood intermixture, ranging from Filipinos of pure Malay type to those of near or distant Chinese and Spanish lineage, as well as hybrids of the various constituent elements of the population. The measurements here analysed are stature, weight with the derivative indication of build, and vital capacity, chest circumference, and the derivative index of constitution or robustness. The figures for the Filipinos are compared with university students of Great Britain and the United States where these are available, and the military measurements of Europeans, United States, and Mongolians—North and South China—Korea, and Japan; also Siamese civilians. In stature the Filipinos correspond with the South Chinese group, the measurements being Filipinos 163·3, South China 163·1, but in all the other measurements they show a surprising deficiency, both proportionate and absolute. The authors regard this as an indication of serious underdevelopment and malnutrition among the students, and, as they may be regarded as a select class, of a still more serious condition among the average of the inhabitants. The figures relating to the female students, notwithstanding their defects, point even more emphatically in the same direction.

BIOLOGICAL STUDIES AT THE TORTUGAS.—An interesting summary of the work carried out at the Tortugas Laboratory during the summer of 1926 is contained in Year Book No. 25, 1925-26, of the Carnegie Institution of Washington. Investigations were conducted by eleven workers, Dr. W. H. Longley acting as administrative officer for the season. Floristic studies, both on algæ and diatoms, were carried out, and the fauna, especially in the case of fish and amphipods, was further investigated. Dr. Paul Bartsch continued breeding experiments on cerions, while a series of interesting experimental studies were carried out by other workers. These included experiments on the electrical conductivity in the alga, Valonia; on the behaviour of trematode larvæ; on the organisation of echinoderm eggs; and on regeneration in the starfish, Linckia. Working with the micro-manipulation apparatus designed by himself, Dr. C. V. Taylor, together with D. H. Tennent and D. M. Whitaker, found, as a result of work on the eggs of *Lytechinis variegatus*, that, in opposition to Boveri's classic observations, there is no localisation of micromere-forming material nor any evidence that this substance has been differentiated before fertilisation. They found evidence, however, of the differentiation of ectoderm-forming substance over the entire surface of the egg even before fertilisation, the endoderm substance being excluded from the superficial layers of the egg. J. M. Valentine's work on regeneration in Linckia revealed a number of interesting points, notably that, though autotomised arms in this genus can regenerate an entire animal, this did not occur after isolated arms had been cut off, also that the latent period before the beginning of regeneration, where an arm only was concerned, was about a third of that necessary when a part of the disc was involved. Where arms were amputated at various levels the buds which developed nearest the disc grew most quickly.

A PARASITE OF THE GREENHOUSE WHITE-FLY.—In the *Bulletin of Entomological Research*, vol. 17, Part 3, March 1927, Mr. E. R. Speyer, of the Cheshunt Research Station, gives an account of the life-history of a small chalcid, *Encarsia formosa*, which parasitises the common greenhouse white-fly. It appears that an individual female Encarsia may lay its eggs in the pupæ of fifty or more of its host. The parasitic larvæ that emerge from these eggs destroy the white-fly pupæ: the skins of the latter become black, and this feature distinguishes the parasitised pupæ from normal white scales and pupæ. The parasite thrives best at high temperatures and is probably a tropical insect possibly imported into Great Britain from India. It is noteworthy that fumigation with hydrocyanic acid gas as practised commercially for the control of the white-fly is stated to leave the parasites unaffected. Whether this insect can be utilised as an auxiliary method of controlling the white-fly it would be premature to decide, as the author mentions, for example, that it is uncertain how it passes the winter, if indeed it is able to do so in Great Britain, without artificial heat. The species is parthenogenetic, males are scarce, and have so far only been found under conditions that were

preceded by low temperatures in September and October. In a glasshouse that was specially heated over the same periods, no males could be found. It appears probable, as in some other chalcids, that males play an insignificant rôle in the economy of the species and that habitual parthenogenesis prevails. This latter feature is an advantage from the economic point of view, in that pairing has not been arranged for and the insect evidently reproduces freely and would require comparatively little attention.

THE COTTON PLANT.—M. A. Bailey and T. Trought, of the Egyptian Ministry of Agriculture, working along the analytical lines first introduced by Dr. W. Lawrence Balls, have made some considerable contribution to our knowledge of the development of the cotton plant (Technical and Scientific Series Bulletin, No. 60, Ministry of Agriculture of Egypt). They adduce evidence to show that the normal period of development of a flower bud of cotton in Egypt is not less than 42 days, and the period required for boll development about 52 days. The development of the sympodial flowering branch is traced from an early stage, and it is shown that the four succeeding internodes are laid down before the first internode has reached its final length. The existence of regular flowering intervals in Egyptian cotton plants is demonstrated, and the intervals are shown to be of a similar order to those found by Harlan in the case of Sea Island cotton. Balls has directed attention to the fact that the daily flowering curves for a group of plants exhibit marked fluctuations from day to day, and further, that the curves for two different crops of cotton grown apart often exhibit a marked concordance in their fluctuations, to explain which he suggests some fluctuating environmental factor with a wide range of influence, *e.g.* day and night temperatures obtaining at commencement of flower-bud development. The present authors are unable to confirm this suggestion, and data are given to show that the minimum temperatures which occur when the bud primordia are being differentiated have no effect on the length of the interval between the flowers which open about 42 days later. They conclude from their evidence that flower-bud shedding is not only the principal factor affecting the fluctuations of average flowering curves, but also one of the most important factors affecting the yield of cotton in Egypt at the present time. A further paper on the nature and effect of bud shedding is promised.

CHROMOSOMES OF PIGEONS.—A study of the chromosomes of the pigeon, by Mr. Kan Oguma (*Jour. Coll. Agric. Hokkaido Imp. Univ.*, Sapporo, Japan, vol. 16, part 6), yields some interesting results. In counting the chromosomes from seven embryos belonging to four clutches of eggs, four embryos had 61 chromosomes and three 62, including in each case six very minute pairs. The unpaired or X-chromosome is a large one. In the spermatogonia of adult males, 62 chromosomes were counted, including two (XX) of the maximum size. These numbers are much higher than those found in early studies of the pigeon, in which the chromosomes were lumped through insufficient fixation. Also there is no evidence of a double reduction division, as reported by Guyer. These chromosome conditions indicate that the female is the heterozygous sex, which is in harmony with the genetic evidence for birds. It has long been held that each clutch of eggs in the pigeon produces one male and one female, but in 50 clutches examined both eggs were of the same sex as often as they were of different sexes. Contrary to the description of the chromosomes of fowls by Hance, no fragmentation of chromosomes is found in the pigeon. Similarities between the chromosome groups of birds and reptiles (lizards) have been pointed out, each having both macro- and micro-chromosomes; but birds have also some chromosomes of intermediate size.

SUGAR BEET.—The fourth Rothamsted Conference (London: Ernest Benn, Ltd., 1927) deals with the culture and manuring of sugar beet. Some account of continental practice is given, which though of great value to the English farmer, must be thoroughly tested under local conditions before it can be used to full advantage. The yield of beets in England is at present unsatisfactory though the quality is good, but under existing terms of contract the total yield is of greater importance provided both conditions cannot be realised simultaneously. The methods of cultivation of the crop require much further experimental work. The question of manurial treatment is less urgent, though the latter has yet to be correlated with the varied conditions of soil and climate in Britain. The suitability of climatic conditions for growing sugar beet in England seems indisputable, and points to the possibility of success for the industry.

WOOD PULP FROM POPLAR.—Science Service has issued an illustrated popular account of recent experiments in crossing poplar trees to produce a rapidly growing hybrid tree for the production of wood pulp. Poplar gives a higher quality of paper than spruce, and the rapid depletion of forests for the production of wood pulp has led to this attempt to regenerate forests at a more rapid rate. Hybrid vigour is a well-known fact, observed by Darwin. Although the cause remains somewhat obscure, certain hybrid walnuts have long been known to grow at a rapid rate, and the best of these hybrid poplars are said to be capable of growing to a diameter of 18 inches in 18 years and yielding 100 cords of wood to the acre. There will be plenty of need for them, as the United States consumed a total of 5,565,831 tons of wood pulp in 1925. Once produced, the hybrids can readily be multiplied by cuttings, since they root as readily as willows. This is probably the first attempt to increase wood production by breeding methods, and it may lead to large results.

NEW SPECIES OF MOLLUSCA IN THE UNITED STATES NATIONAL MUSEUM.—The veteran Dr. Dall (now, alas, deceased), in continuation of similar work on the same lines, publishes some diagnoses of undescribed new species of mollusca in the collection of the United States National Museum. The shells dealt with belong to the Scaphopoda, Gastropoda, and Polyplacophora. Unfortunately the descriptions are not accompanied by figures, which would have added to the value of the paper.

EARTHQUAKES AND THE TILTING OF THE GROUND.—For some years before the Japanese earthquake of 1923, mareograph records revealed a continuous depression of the coast of Sagami Bay. This was succeeded by a period of repose, and then came the great earthquake and with it a marked elevation of the coast (NATURE, vol. 119, p. 254). Led by these observations, Mr. M. Ishimoto erected a pair of horizontal pendulums of the Zöllner type in a cellar of the Imperial University of Tokyo in order to determine if any tilting occurred before or after earthquakes. He has recently published a preliminary paper on the observations made last summer (*Bulletin of the Earthquake Research Institute*, Tokyo, vol. 2, 1927, pp. 1-12). The principal change of inclination

is diurnal, and closely follows the change of air-temperature. When distant earthquakes occur, the instrument shows no change of inclination. But after some near earthquakes the record shows a slight change, either of elevation or depression, in the direction of the epicentres. One observation may prove of considerable interest. On Aug. 3 a strong earthquake occurred with its epicentre in Tokyo Bay and 33 miles south of Tokyo. Two weeks before, there was an anomaly in the N.-S. component independent of the diurnal variation. Just before the earthquake, the pendulum indicated no change. After it, the record was lost owing to the fracture of the suspending quartz-fibres.

INTERFERENCE OF RADIO-WAVES.—In the *Zeitschrift für Hochfrequenztechnik* of December last, E. Quäck discusses the interference which is produced when using high-frequency radio-waves, by the waves which have travelled one way round the earth with those that have travelled the other way. In the short-wave radio messages sent last October between America and Berlin, the signals recorded on the tape were often mutilated in such a way as to suggest an interference of this kind. The Telefunken Company investigated the phenomena and proved conclusively that the waves did travel round the world in opposite directions. Assuming that the velocity of the waves is the same as that of light—$3 \times 10^{10}$ cm. per second—the difference between the lengths of the paths of the two waves comes out to about 28,800 kilometres, the time lag being 0·096 of a second. In another experiment a signal transmitted from Nauen on a wave-length of 15 metres was received at the neighbouring town of Geltow. The first signal came directly over a few kilometres; the second was given by the waves which had travelled round the world. The time lag between them showed that if the waves had travelled with the velocity of light at a height of 182 kilometres above the earth's surface, the time difference between the arrivals of the signal would have been the same. It is curious that this so-called 'echo' effect has only been observed when using wave-lengths lying between 15 metres and 22 metres. Further investigation of this phenomenon may throw light on the method of the propagation of the waves through the upper atmosphere.

PIEZO-ELECTRICITY OF QUARTZ.—A new investigation by L. H. Dawson of the piezo-electric properties of crystalline quartz has brought to light a number of fresh facts (*Physical Review*, **29**, p. 532; 1927). When a parallelopiped cut with an electric axis normal to a large face was explored, it was found that the local charges developed varied from point to point both in magnitude and sign, but the irregularities were of a permanent nature, surviving, for example, temporary transition to the $\beta$ modification. The accepted Curie constant is only an average value when large areas are employed. The curved surface of a cylinder the end of which was parallel to the plane of the electric axes showed three positive areas and three negative areas, spaced symmetrically, providing a way of finding the electric axes when only the optic axis was known. When the temperature was varied, the piezo-electric effect passed through a maximum at 60° C., and the cooling curves showed a lag. All the crystals were cut under exceptionally good conditions, and appeared free from flaws when examined optically. The results seem to be consistent with the idea that large crystals are not perfectly formed, for which there is independent evidence from X-ray analysis, but the author considers that it will be difficult to account for them completely with the present knowledge of the molecular structure of quartz.

COMPUTING MACHINES.—Computing machines of various kinds have become part of the normal equipment of most scientific departments and large business firms. It is of especial interest, therefore, to examine the relative merits of these machines. In a lecture delivered under the auspices of the Office Machinery Users' Association on Feb. 15, Dr. L. J. Comrie performs this useful function. According to him the ideal machine should perform all the operations with equal facility (adding or listing machines merely, are deficient in this respect), and the result should be visible immediately on completion of the operation. The keyboard should be uniform to touch for all numbers, and should not allow two keys to lock simultaneously. Moreover, it should not be necessary to reverse a special lever for subtraction, or, as in the case of most arithmometers, should the carriage require to be lifted at any stage; there should be tens transmission throughout the multiplier and product registers, and it should have a sight dial. A number of other important points are dealt with and the various machines are classified according to whether or not they possess these characteristics. In the case of the hand-operated barrel-type machine, Dr. Comrie holds that the Nova Brunsviga stands out above the others, but with the electrically operated machine the case is not so clear. Dr. Comrie evidently in his merit classification has in mind the use of such a machine in a department where every second saved in the computation is of importance. While this is so in large insurance offices, and even in statistical and mathematical laboratories, the ordinary scientific worker is not so pressed usually that he requires to consider a minute or so gained on a long calculation. Where the machine is to undergo strenuous operation of the type contemplated, the life of the machine, wear and tear and elastic fatigue become important considerations. These factors do not appear to have been dealt with by the lecturer.

FLAME MOVEMENT.—Among the large amount of work carried out by the Safety in Mines Research Board, one of the most important subjects is the study of the propagation of flame in closed vessels. Paper No. 32, published by H.M. Stationery Office (1*s*. net), by O. C. de C. Ellis, contains a summary of the principal methods used in the study of flame movement. Although the earlier methods enabled the speed of the flame to be measured, it was not until the method of snapshot photography had been devised that a close determination of the mode of propagation could be made. This method is fully described in the paper, and is illustrated by means of a number of excellent plates.

ANALYSIS OF COAL.—We have received a copy of the report on the methods of analysis of coal which has been prepared by the Fuel Research Division of the Department of Scientific and Industrial Research. The methods which this report (London: H.M. Stationery Office, 1927. 9*d*. net) describes have been adopted by the Research Department for the purpose of its work on coal, and it is hoped that they will be adopted generally by analysts throughout Great Britain so that all results of coal research may be strictly comparable. The paper contains detailed information with regard to the analysis, and the determination of the caking index and the calorific value of a given sample of coal. Two methods of carbonisation assay are described, and an example illustrating the form in which an analysis should be reported is included.

## The New Science School at Clifton College.

IN the development of the teaching of natural science in schools, Clifton College has, from the earliest days, played a very important part. Fortunate in possessing a succession of sympathetic headmasters, and in securing the services of men like Debus, Worthington, Sir William Tilden, Shenstone, and Rintoul, Clifton rapidly acquired a reputation for sound scientific education, and exerted a powerful influence upon contemporary educational practice. Laboratories were built and well equipped, and there was a constant stream of visitors to see what were then the latest developments of the new movement. At this time the College far out-distanced other schools in accommodation for science teaching, but, like many other pioneers, it has since been left behind by those to whom it pointed the way. Some expansions and improvements were made from time to time, but finally the buildings became so much out-of-date and inadequate to the needs of the school that new and extensive premises were a necessity. When, thanks to the initiative of Mr. Norman Whatley, the present headmaster, the problem was at length seriously taken in hand, it was resolved to erect an entirely new science block, worthy of the tradition of the school, and one, too, which should restore to Clifton its former position in the van. Old Cliftonians responded generously to the call for funds, and sufficient was soon forthcoming to allow the council to proceed with the scheme. A stroke of good fortune came at once, in that it proved possible to secure the services as architect of Mr. Alan E. Munby, whose genius in this particular *genre* is well known to scientific workers. The total cost of the scheme is estimated at £50,000; and Mr. Whatley was able to announce at the opening of the building by the Prince of Wales on June 2 that four-fifths of this amount, or £40,000, had already been given. This satisfactory result is due almost entirely to the unaided efforts of the Right Hon. J. H. Whitley, Speaker of the House of Commons, who has interested himself personally in the scheme from the outset.

The new buildings are the outcome of a number of alternative designs. The preservation of the Close for games was regarded as all-important, and this accounts for the somewhat recessed position of the buildings, which cover a considerable ground area. The frontage to the Close is shown in Fig. 1. Few modern science buildings are erected in the Gothic style, but in this instance it was felt that the architectural surroundings of the College left no possible alternative, and by the adoption of a late period in this style, the difficulty of securing the ample natural light necessary has been met satisfactorily. Bath-stone has been employed, with local stone for general walling, as used in other college buildings.

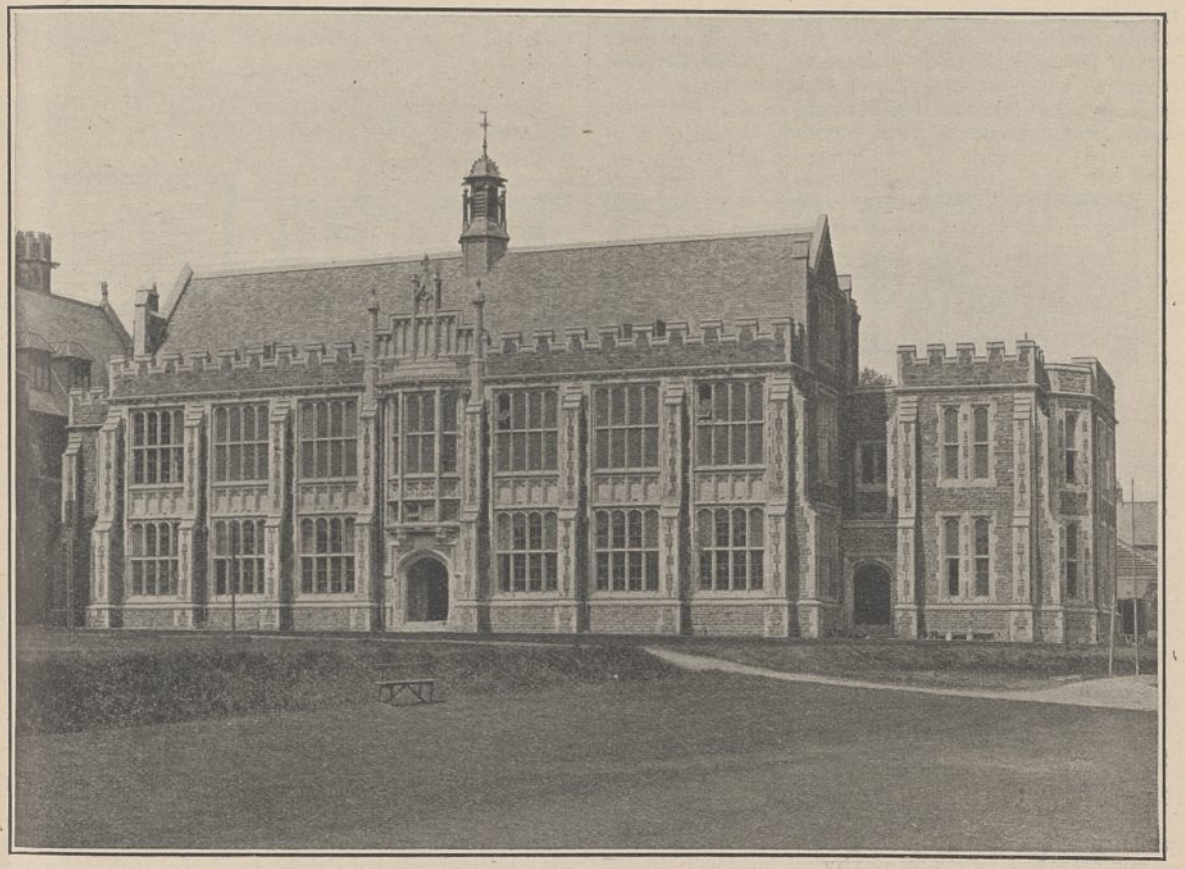

FIG. 1.—The new Science School, Clifton College.

The design comprises two principal floors with a partial basement and partial second storey. The extreme length of the building is some 160 ft. and the breadth about 64 ft. As shown on the plan (Fig. 2), there is a central block, which contains the laboratories and their adjuncts, with two wings of two storeys only, devoted to four lecture-rooms. This plan illustrates the first (chemistry) floor, as

presenting more technical details than the ground floor, the plan of which is similar.

### PHYSICS.

The old accommodation consists of one laboratory and two lecture-rooms. The latter will just suffice—with difficulty—for the theoretical classes, but the laboratory and storage places are greatly overcrowded. Classes much too large, for the laboratory follow one another continuously, so that the distribution and collection of apparatus seriously curtail the short time available for work, and no experiment can be left set up to be finished later. The school is well equipped with apparatus for this single physical laboratory, but lack of space and the vibration of the floor render the use of the more delicate instruments practically impossible. In the new Science School the ground floor is devoted to physics, and comprises two elementary laboratories on the frontage, 40 ft. by 32 ft., on either side of the central entrance. The latter gives access to a corridor, at the ends of the water, gas, and electric current are brought to convenient points on the walls. The adjoining store-room can be darkened for use as an optical room. All the working rooms are provided with gas, water, and steam supplies, and, as is necessary in the teaching of modern physics, liberal electrical supplies, including main and low-voltage alternating current, and direct current distributed from a battery in the basement by a switchboard specially designed to give to each room separately a full range of voltages with equal distribution of loads among the cells of the battery. All pipes and other bench fittings are non-magnetic. Firm supports to carry heavy mechanical apparatus have been built into the walls and ceilings at convenient places. The flooring of the whole of the physics section is of maple blocks on concrete, to ensure complete absence of vibration.

### CHEMISTRY.

The first floor (illustrated in Fig. 2) is devoted mainly to chemistry, but there is also a biological

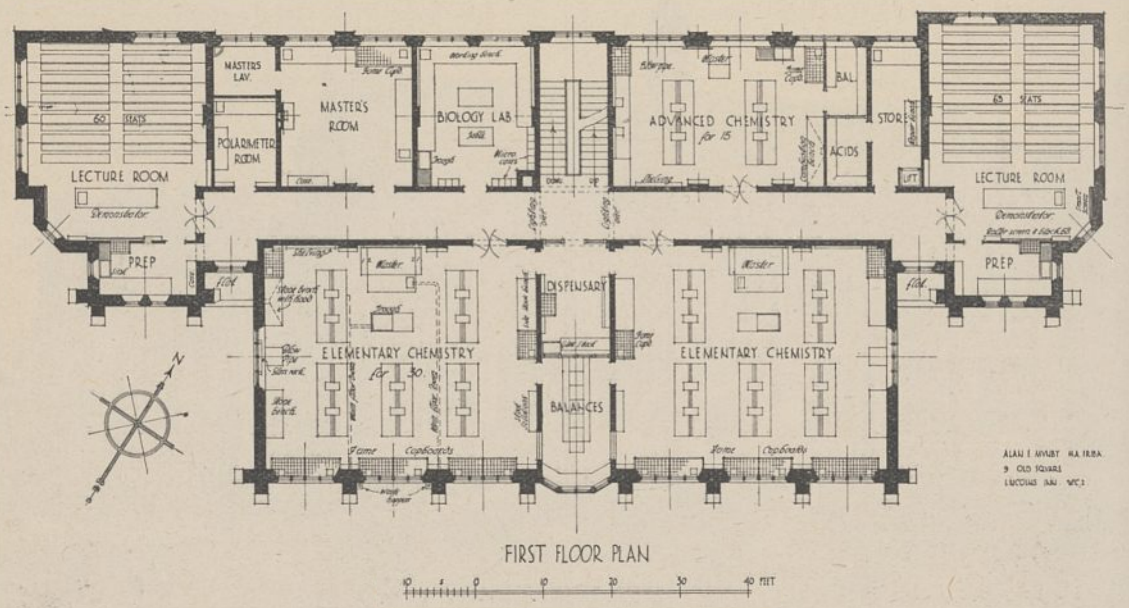


FIG. 2.—Plan of first floor of new Science School, Clifton College.

which are the two lecture-rooms with preparation rooms attached. Separate external approach to the preparation rooms is given by doors to the corridor terminations. On the other side of the corridor are, on the right, an advanced laboratory, 37 ft. by 20 ft., with adjoining store, and on the left of the central staircase a repair workshop 17 ft. by 20 ft., and a master's room 19 ft. by 20 ft. A research room and a photographic dark-room are also provided on this floor.

The two elementary laboratories are well lighted, and are spaced to give accommodation for classes of 30-36; they are large enough to store the necessary apparatus so that it is properly protected and easy to distribute. The apparatus drawers are uniform in size with those of the main physical store-room, so that a complete change of apparatus for each term's work may be effected with the minimum trouble and in a very short time. The benches are fixed, as the rooms will be used for large classes for short periods.

The laboratory for advanced work has been carefully designed to meet the requirements of higher certificate and university scholarship candidates. It has movable tables, to render it more elastic, and laboratory designed to accommodate 15 to 20 boys. In the general arrangement of the lecture-rooms advanced laboratory and elementary laboratories, this floor resembles the one below. The space occupied on the ground floor by the entrance hall is, however, usefully employed on the chemistry floor in providing a balance room and dispensary, common to both elementary laboratories. The dispensary, in which laboratory assistants are constantly on duty, serves as a distribution room and store for common apparatus.

The lecture-rooms will each hold sixty boys with ease and comfort; the average sets are of course only about half this size, but a large lecture-room enables two sets to be taken together upon special occasions such as lantern lectures or particular topics, and will also accommodate sectional meetings of the scientific society. Large lecture-rooms are also much pleasanter, in that the atmosphere of a small room, however efficiently ventilated, may become distinctly unfitted for boys during lectures on chlorine, phosphine, etc. In planning school laboratories and science rooms, too little consideration is often given to the fact that young people

are in general much more sensitive to fumes, poisonous gases, and other similar effluvia, than are many adults.

This important point has been borne in mind in the design of the elementary laboratories, where sufficient fume-cupboards have been erected (mainly along the windows) to provide for the whole class when working upon unpleasant substances. The cupboards are themselves efficiently ventilated, so that it is hoped that the air of the laboratories may remain fresh even in the most adverse circumstances.

In the balance-room the balances are enclosed in special cases built as part of the fittings. They are placed on stable benches, which are wide enough to take open exercise books immediately in front of the balances.

The advanced laboratory will provide good working accommodation for twenty boys. A stone slab, covered by an asbestos hood, will be used for combustions and similar work, while a Carius cupboard, fitted with concrete floor, tiled sides, sliding steel door and an interior light, is built under one of the fume-cupboards. A separate balance-room is attached to the laboratory. Steam, gas, electricity, and water are laid on to this as to all other working rooms. One feature worthy of special note is that all filter-pumps are worked, not from the general laboratory circuit, but from a separate main communicating with the town main in the adjoining road.

### Biology.

At present, biology is taught mainly in the junior school and the lower forms of the senior school; the biological laboratory in the new building is a small room (to hold eighteen or so) for the accommodation of the class of First M.B. candidates. Should further space be required for biology in the future, a large room on the second floor, to be used temporarily for physical geography, has been built in such a way that its conversion to a biological laboratory could be carried out with very little difficulty or expense.

The chemistry floor includes, in addition to the rooms already mentioned, a polarimeter room and a room—partly office, partly private laboratory—for the head of the science department. By reducing the corridor height on this floor some cross lighting and ventilation has been made possible.

### The Science Library.

The most attractive room in the building is the library, on the second floor. A large and airy room, it is floored and fitted throughout in oak. It may, perhaps, be claimed without exaggeration that the emphasis now laid in schools upon the humanistic aspect of science has been largely due to Clifton influence; and it is therefore not surprising to find that the science library at the College includes a rich selection of classical scientific books and memoirs, which will at length find a home worthy of them.

## The Royal Observatory, Greenwich.

### Annual Visitation.

THE annual visitation of the Royal Observatory took place on the afternoon of Friday, June 3; the usual Saturday date being changed owing to the Whitsun holiday.

The Astronomer Royal presented his report, which deals with the work of the observatory for the year ended May 10, 1927. The usual observations of the sun, moon, planets, and fundamental stars are being continued with the Transit Circle; also of stars brighter than mag. 8·0 between N. Decl. 32° and 64°, and the stars selected for comparison with Eros at the opposition of 1931. The corrections to Brown's Tables of the moon in 1926 were $+6{\cdot}5''$ in longitude, and $-0{\cdot}8''$ in latitude; they have been slowly diminishing since the Tables were first used, in 1923. Mr. Cullen has made a redetermination of the declinations and proper motions of the brighter stars, from observations made with the instrument during the whole interval since its erection in 1850. He finds for the correction to Boss $+0{\cdot}33'' + 0{\cdot}0068''\,(t - 1925{\cdot}0)$.

The Altazimuth has also been used in recent years to find the correction to Boss's declinations from observations in the Prime Vertical; the values found are $+0{\cdot}29''$, $+0{\cdot}44''$, $+0{\cdot}45''$, $+0{\cdot}51''$ at declinations 45°, 35°, 25°, 15° respectively. These are intermediate between the values given by Raymond and Eichelberger.

The Cookson Floating Telescope has been borrowed from the Observatory of Cambridge for a third period of seven years; it is used for determining latitude variation and the constant of aberration. The reductions for the second seven years are nearly completed.

Fourteen completed determinations of stellar parallax have been made during the year with the 26-inch refractor, bringing the total up to 330.

The 30-inch reflector has been used for a determination of the effective temperatures of stars of early type; the results for twenty-two stars have recently been published in the *Mon. Not. R.A.S.* The instrument has also been used by Mr. Merton for photographing comets Comas Sola, Stearns, Pons-Winnecke, and Grigg-Skjellerup.

Plates are being taken with the Astrographic Equatorial for determining proper motions by comparison with those taken twenty-five to thirty years ago. The work is now nearly complete from declination 65° to 71°. Dr. H. Groot is also examining the astrographic plates for detecting double stars on them. He has found 187 pairs with separation less than 5 seconds in the zones 65° to 71°. Mr. Merton mounted two aeroplane lenses of 20 inches focus, working at F/5·6 on the tube of the astrographic telescope. These have proved very useful for photographing comets; it was with a similar lens that Mr. F. J. Hargreaves photographed comet Grigg-Skjellerup in advance of Harvard and Yerkes Observatories.

The sun was photographed on 251 days; most of the missing days are filled by photographs taken at the Cape or Kodaikanal; solar activity has been considerable, but with marked depressions at times. Between May and January there were ten naked-eye groups; but since January there have been no very large spots. Messrs. Ross have supplied new enlarging lenses for both the photoheliographs, which improve the definition at the sun's limb.

The late Mr. W. H. Wesley made drawings of the corona from the Greenwich expeditions' photographs of 1898, 1900, 1901, 1905; also from Mr. McClean's of 1908. Miss A. M. D. Crommelin made similar drawings of the eclipses of 1914, 1919. These have been reproduced in the *Philosophical Transactions*, Series A, vol. 22. Mr. Davidson and Col. Stratton have discussed the photographs obtained in Sumatra in 1926. The results will shortly appear in the *R.A.S. Memoirs*.

A party from the observatory will visit Giggleswick for the eclipse of June 29. The programme includes comparison of the intensities of certain calcium lines,

the spectrum of the chromosphere from *D* to the extreme red, and direct photography of the corona. Mr. Greaves and Mr. Witchell are viewing the eclipse from an aeroplane.

The magnetic observations are now all made at Abinger; the mean values of the elements for 1926 are: Decl. W. 13° 10·4′; Hor. Force, 0·18581; Vert. Force, 0·42947; Dip, 66° 36·2′. Comparison of magnetic disturbances as recorded at Greenwich and Abinger shows that the latter are smaller by about 3 per cent. The quinquennial revision of the Admiralty magnetic charts was carried out, and isogonals for 1927·5 adopted. After some necessary improvements in the insulation, the Schuster-Smith coil magnetometer was adopted as the standard from February last. A redetermination of the moment of inertia of Dr. W. Watson's standard cylinder gave a result identical with his value found in 1903; this cylinder is now adopted as a standard.

The following weather statistics are for the year ended on April 30. The average is that of the seventy-five years 1841–1915: Temperature 50·2°, being 0·6° above the average. Mean daily movement of the air, 284 miles, just the average value. Bright sunshine, 1320 hours, being 29·7 per cent. of possible amount. Rainfall, 28·20 inches, being 3·96 above average. The wettest month was November, 4·77 inches; the driest December, 0·38 inches.

Two standard sidereal clocks (Shortt Nos. 3 and 11) have been in use since July; during the last fifty days their rates have been nearly coincident, and the clocks have never differed by more than $0{\cdot}05^{s}$. A mean time clock of the Shortt type has been ordered, which will be used for the distribution of radio time-signals through the Rugby Station. Rhythmic signals will be sent at $10^{h}$ and $18^{h}$.

The observatory took part in the radio longitude campaign last autumn. Advance copies of the time-determinations and the times of receipt of radio signals have been printed and circulated. The corrections to the adopted longitudes of Paris and Washington appear to be less than $0{\cdot}02^{s}$. The longitude of Pulkovo was determined by the Russian observers as $2^{h}\ 1^{m}\ 18{\cdot}572^{s}$.

Allusion is made in the report to Mr. G. Merton's researches on the comet Grigg-Skjellerup, published as an *R.A.S. Memoir*. The observed perihelion passage was earlier than the predicted time by 0·2 days.

Dr. A. C. D. Crommelin retired from the Observatory on May 10, after thirty-six years' service (see NATURE, May 28, p. 790).

## South-Eastern Union of Scientific Societies.

ANNUAL CONGRESS.

THE thirty-second annual congress of the South-Eastern Union was held at St. Leonards-on-Sea on June 25-28, the president being Dr. A. B. Rendle, whose address was devoted to "The Flora of Sussex, Past and Present." The Wealden flora dates from the fourth continental period. Tree-ferns and other ferns comprise twenty-three out of the seventy species of Wealden plants known, a flora representing a moist, warm, and possibly tropical climate. In a paper by Dr. E. J. Salisbury it was shown that the plants that had become extinct in certain countries or had definitely diminished numbered 294, or about thirty per cent. of the total British flora, although speaking for the whole country those that had become actually extinct was surprisingly small. About eighteen or twenty seaside plants were disappearing, principally by indiscriminate picking of the flowers. Seakale was believed to have been first offered for sale at Covent Garden in 1875, and this came from Pevensey. Members were surprised at the quantity seen in flower on the beaches east of Hastings. The Mayor of Hastings, an enthusiastic botanist, read a paper of much interest on the "Weeds of a St. Leonards Garden."

In the Zoological Section Prof. E. W. MacBride gave an address on "The Origin and Nature of Mutations," a subject he has made peculiarly his own. He defined mutations as conspicuous deviations from type which occurred suddenly without obvious cause and were strongly inherited, most of them, however, being failures from the point of view of natural selection. Reference was made to Tornier's theory that abnormal variations are due to the environment in which the eggs were laid and fertilised. The effects of the weakening of the germ could be recognised in the characters of domestic breeds of wild animals. Evil conditions surrounding the egg rapidly produced mutations, and quickly as they come they as quickly go.

In a paper entitled "Territory in Bird-Life," Prof. C. Lloyd Morgan dealt with the habit of birds to separate from the flock in early spring to enter upon their territory period. Dealing particularly with the lapwings, he said that so long as the birds were in flocks the behaviour of all the male birds was much the same, and no marked hostility was shown, but directly they got into the territory phase hostilities broke out. If a cold snap came after a warm period, the males resorted to the flock-phase and all became perfectly friendly once more. When once a male had fixed his territory he sang his best to attract the females to his area, but the males were warned off, and their presence in his territory was resented. The female that joined him was just as jealous as he was. How the territory was defined is a subject for further examination, but evidently it was a directive factor of some sort.

In the Geological Section, Mr. H. B. Milner chose for his address "The Weald-Boulonnais Section of the English Channel," and with the assistance of carefully prepared plans showed the structure of the submarine ridges in the Channel area. With the help obtained from Admiralty charts he was able to show that the gravel and other banks arranged themselves in a remarkable manner on the lines of the Armorican foldings which are so well shown in the structure of the chalk downs and the Wealden rocks. It was also seen from the charts that near the French coast there was a remarkable gorge stretching away from near Cape Blanc Nez to the North Sea, which was clearly an old drainage line, and may have some connexion with the river system which existed before the Dover Strait was pierced. There is an important bank off Dungeness, called by the French "Roc d'Angleterre", and it may be that here is an uprise of the Wealden rocks which underlie the Ness. A paper by Dr. W. M. Whittard was read on "Fossil Vertebrates from the Weald."

A large party of geologists visited Mr. Lewis Abbott's collection at 8 Grand Parade, attracted thither by the discoveries made by Mr. Abbott when the ground was excavated for the building of the White Rock Pavilion. White Rock proves to be a white chalky marl comparable to the Chalky Boulder Clay of elsewhere, containing many foreign boulders, and evidencing widespread glacial action. A large

'hand-axe' was found in the marl, and the implement was striated on its worked faces. In the upper layers of the section were found the remains of kitchen-middens, these being of later date than the glacial marl. The marl had been visited by officers of the Geological Survey, and they had accepted the glacial interpretation of the marl. In the construction of the new road here the Wadhurst Clay had been laid bare, and a whorl of a giant gasteropod was shown which had been obtained thence. The mollusc must have been several feet long. Several of the best specimens obtained by Mr. Abbott have been required for the Geological Museum. The glaciation of the south of England must now be an accepted fact.

A public evening lantern lecture was given by Mr. Edward A. Martin on "Some Amenities of the South Downs" at the White Rock Pavilion, where there was a large attendance. A fascinating cinema natural history lecture was given by Dr. Clarence Tierney to a large audience of children, and Mr. E. J. Bedford addressed another juvenile audience on "Wild Flowers."

The Union was stated to comprise seventy-eight societies, almost all of whom sent delegates to the Congress, and in addition there were many individual members of these societies present, whilst the Congress was also supported by a large number of the towns-people, and the Hastings and St. Leonards Natural History Society, at whose invitation the Congress was held there. At the Representatives' Meeting (the parliament of the Union) an invitation was brought from Rochester to hold next year's Congress at that city, when the local natural history society will celebrate its jubilee. The honorary secretary announced that Sir Martin Conway had accepted the post of president for 1928.

## University and Educational Intelligence.

BIRMINGHAM.—The chair of physiology, which will be vacated by the retirement of Prof. E. Wace Carlier at the end of the present session, is to be filled by the appointment of Dr. I. de Burgh Daly, lecturer in experimental physiology in the Welsh National School of Medicine, University of Wales, Cardiff.

The following are to be among the recipients of the honorary degree of LL.D. on July 2: Sir Arthur Schuster, honorary professor of physics in the University of Manchester; Dr. A. C. Seward, Downing professor of botany in the University of Cambridge; Prof. Arthur Lapworth, professor of chemistry, University of Manchester; Sir David Ferrier, emeritus professor of neuropathology, King's College, London; Sir Watson Cheyne, Bart., and Sir Walter Fletcher, Secretary of the Medical Research Council.

CAMBRIDGE.—The Rev. G. A. Weekes, Master of Sidney Sussex College, has been re-elected Vice-Chancellor for the ensuing academic year. Major P. A. MacMahon has been appointed Rouse Ball Lecturer, and will lecture on June 7 on "The Present Stage of Knowledge of the Theory of Determinants."

Mr. L. A. Pars, Jesus College, and Mr. H. A. Newman, St. John's College, have been elected university lecturers in mathematics.

Dr. Ernest Brown has been appointed to represent the University at the centenary of the University of Toronto.

EDINBURGH.—The Senatus Academicus has agreed to offer the Degree of Doctor of Laws to the following, for conferment at the Special Graduation Ceremonial on July 20, on the occasion of the visit to Edinburgh of the British Medical Association: Lord Dawson of Penn, Physician in Ordinary to His Majesty the King; Dr. A. Donald (Manchester); Dr. C. E. Douglas (Cupar); Sir William Hale-White (London); Mr. R. G. Hogarth (Nottingham); Dr. W. Hunter (London); Dr. T. H. Milroy (Belfast); Sir Berkeley Moynihan, Bart. (Leeds); Sir J. H. Parsons (London); Sir Humphry Rolleston, Bart. (Cambridge); Dr. G. F. Still (London); Mr. W. Trotter (London); Sir Almroth Wright (London); Prof. Vittorio Ascoli, professor of clinical medicine, Rome; M. Jules Bordet, director of the Pasteur Institute, Brussels; Prof. Harvey Cushing, professor of surgery, Harvard University; Prof. C. L. Dana, professor of nervous diseases, Cornell University; Prof. Knud Faber, professor of medicine, University of Copenhagen; Prof. Jan van der Hoeve, professor of ophthalmology, University of Leyden; Prof. Otto Meyerhoff, professor of physiology, University of Berlin; Prof. Otto Naegeli, professor of medicine, University of Zurich; Prof. W. S. Thayer, professor emeritus of medicine, Johns Hopkins University; M. T. M. Tuffier, Academy of Medicine, Paris.

OXFORD.—It is proposed to confer the honorary degree of D.Sc. upon Sir Robert Hadfield, Bart., and Dr. Richard Willstätter, professor of chemistry in the University of Munich, on Thursday, June 30; and the honorary degree of D.D. upon the Very Rev. W. R. Inge, Dean of St. Paul's, on the following day.

Sir William Dunn's Trustees have offered to provide a sum of £2000 for the endowment of a Departmental Library at their recently opened School of Pathology. A decree of acceptance and thanks will be promulgated on June 7.

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THE Royal College of Surgeons of England announces that the subject for the Jacksonian Prize for 1927 is "The Pathology, Diagnosis, and Treatment of Bronchiectasis and Abscess of the Lung," and that competing essays must reach the secretary not later than Dec. 31. The subject for the Jacksonian Prize of 1928 is "The Surgical Treatment of Pulmonary Tuberculosis."

THE subject of the Unity History School to be held this year at Woodbrooke College on July 29–Aug. 6 is "Unity in Industry." As in previous years, the 'school' is being organised by Mr. F. S. Marvin, who will discuss the general problem of industrial unity, while other lectures will deal with the 'Industrial Revolution,' the population problem, science and industry, industrial welfare, and the industrialisation of backward races. Applications to attend must reach the honorary secretary, Miss A. R. Wells, Woodbrooke, Selly Oak, near Birmingham, by June 30.

THE Empire Cotton Growing Corporation proposes to award in July next, to candidates of British nationality, a limited number of research and advanced study studentships for work in relation to cotton-growing. Each studentship will be tenable for one year, and of the value of £250 plus a further amount for necessary expenses. The research studentships are intended to enable graduates with a leaning towards research to receive training in research methods from leaders in their subject; the advanced study studentships are to enable men to receive specialised instruction in order to equip them for agricultural posts in cotton-growing countries. Further particulars of the studentships and application forms may be obtained from the Secretary of the Corporation, Millbank House, 2 Wood Street, Millbank, S.W.1. Candidates should state

whether their application is for a senior or a junior studentship. Completed forms must reach the Corporation not later than June 21.

THE Principal Officer's report recently published on the work of the University of London during the year 1926–27 indicates a steady growth. Admissions (including no fewer than 382 graduates of other universities) numbered 7668, as compared with 3852 in the last year before the War and 7577 in 1925; there were 3967 candidates at degree examinations, including 1585 external students; the roll of internal students now comprises 9342 names. Among other interesting new developments the report mentions the institution of chairs of international law at the School of Economics and of bacteriology and epidemiology at the School of Hygiene and Tropical Medicine; a Ph.D. degree in the faculty of music, and diplomas in archæology, public administration, anthropology, and nursing; the extension to University, King's, and East London Colleges of the plan, recently adopted in regard to the Imperial College, whereby alternative papers are set in the Final B.Sc. (Engineering) examination for internal students at the college; and an undertaking to contribute £200 a year for five years towards the maintenance of a British Institute in Paris. In connexion with university extension work were instituted a record of distinguished service and a system of stipendiary lectureships. Many benefactions are acknowledged; among them a gift of £180,000 from the Laura Spelman Rockefeller Memorial Trustees to the School of Economics. The report concludes with a reference to what, for the moment, overshadows all other interests of the University,—the decision to purchase eleven acres of land in Bloomsbury as its permanent home.

THE Association of Teachers in Technical Institutions held its annual conference at Plymouth on June 4. During the past year there have been abundant signs of increased appreciation of the value, both cultural and economic, of technical education, and this formed the chief theme of the presidential address delivered by Mr. H. Hall. The relationships of technical education to other forms of education and to industry and commerce, which have lately undergone investigation by a committee under the chairmanship of the late Lord Emmott, have in the past been associated with a good deal of scepticism as to the validity of the claims of technical teachers that their craft can provide the means of life as well as the means of livelihood; that they have on one hand opportunities not inferior to those of teachers in more academic fields, of developing character and endowing with the capacity for successful civic and social life, and, on the other hand, the power of increasing the capacity of their pupils for efficient service to industry and commerce. That this scepticism has, during the past year, been giving place to a more appreciative attitude is shown by quotations from speeches by the president of the Board of Education and the president of the National Union of Teachers, and from the reports of the Balfour Committee on factors in industrial and commercial efficiency and the Hadow Committee on the education of the adolescent. Mr. Hall ends this part of his address with a plea for definite action, and especially for an increase in day courses as recommended by the president of the Board on Mar. 31, when he said: "So long as employers are content with technical education of this type [evening classes], valuable as it is, they are missing the opportunity of conferring upon the work of their industry the dignity of a craft or profession for which a definite standard of education is required."

## Calendar of Discovery and Invention.

June 12, 1712.—In Devereux Court, Strand, are the Grecian Chambers. Until 1843, on this site stood the Grecian Coffee House, which two hundred years ago was a resort for the fellows of the Royal Society. Thoresby the antiquarian, in his diary for June 12, 1712, wrote: "Attended Royal Society, where were present the President, Sir Isaac Newton, both the secretaries, the two professors from Oxford, Dr. Halley and Keill, with others, whose company we afterwards enjoyed at the Grecian Coffee House."

June 13, 1901.—Dewar's work on the liquefaction of gases was referred to under May 28, 1898, when he first liquefied hydrogen. Three years later, on June 13, 1901, he successfully transported through the streets from the laboratory of the Royal Institution to the rooms of the Royal Society no less than a gallon of the liquid gas.

June 14, 1699.—In the *Philosophical Transactions*, vol. 21, p. 228, is the entry: "Mr. Savery, June 14, 1699. Entertained the Royal Society with showing a small model of his engine for raising water by the help of fire, which he set to work before them; the experiment succeeded according to expectation, and to their satisfaction."

June 15, 1919.—Alcock and Whitten Brown, on June 14-15, 1919, made the first direct flight across the North Atlantic from Newfoundland to Ireland. Their machine, now in the Science Museum, South Kensington, was a Vickers-Vimy biplane fitted with two 360-h.p. Rolls-Royce engines. Assisted by a following wind, they flew a distance of 1890 miles in 15 hours 57 minutes at an average speed of 118·5 miles per hour.

June 16, 1657.—The application of the pendulum to clocks was due to Huygens, who on June 16, 1657, presented his first pendulum clock to the States General of Holland. The following year he described his clock in detail in a brochure entitled "Horologium," and fifteen years later gave the theory in his fine work, "Horologium Oscillatorium," published in Paris.

June 16, 1864.—Stokes announced to the Royal Society his discovery that when diluted blood is treated with certain reducing agents, its colour and spectrum undergo a reversible change. "The colouring matter of the blood, like indigo, is capable of existing in two states of oxidation, distinguishable by a difference of colour and a fundamental difference in the action on the spectrum. It may be made to pass from the more to the less oxidised state by the action of suitable reducing agents, and recovers its oxygen by absorption from the air." Of additional interest is that this discovery, fundamentally important for physiology and biochemistry, regarding this animal respiratory pigment, should have been contributed by a mathematical physicist.

June 16, 1874.—The Cavendish Laboratory at Cambridge owes its existence to the Duke of Devonshire, who had been impressed with the need of institutions for experimental research. The Laboratory was formally opened on June 16, 1874, though the inaugural lecture had been given by Clerk Maxwell three years previously.

June 17, 1885.—Among the most famous balloonists of last century was Henry Coxwell, whose last ascent as made on June 17, 1885, when he was sixty-six years of age. Many of his ascents were made for scientific purposes, and it was with him that Glaisher, on Sept. 5, 1862, rose to a height of seven miles. Glaisher became insensible, Coxwell's hands became frozen, and he opened the valve of the balloon by tugging at the cord with his teeth. E. C. S.

## Societies and Academies.

LONDON.

Royal Society, June 2.—S. Chapman and A. E. Ludlam: A theoretical discussion of certain elastic constants of calcite and crystalline sodium nitrate. Upper limits are found theoretically for two of the elastic constants of calcite and crystalline sodium nitrate; the calculations are based on the theoretical determinations of the potential energy of these crystals in various configurations. The theoretical upper limits found are larger than Voigt's measured values for calcite but of the same order of magnitude.

R. W. Fenning and H. T. Tizard: The dissociation of carbon dioxide at high temperatures. If mixtures of carbon monoxide, oxygen, and nitrogen are exploded, the explosion pressure is greatest when there is an excess of carbon monoxide in the mixture. If no nitrogen is present the explosion pressure is greatest when the ratio $CO/O_2 = 2$, and varies very little with the composition of the mixture near the maximum point. When nitrogen is present, a determination of the composition of the mixture which gives the greatest rise of pressure on explosion, leads to a simple method for determining the dissociation of carbon dioxide at high temperatures. Accepted values for the dissociation of carbon dioxide at high temperatures are much too high.

L. H. Callendar: The influence of boundary films on corrosive action. The surface of metals liable to local corrosion is normally more or less covered with an oxide film; where this film is of higher potential than the metal itself, its distribution determines the location of the primary cathode and anode areas before the metal is in contact with the electrolyte. The distribution of this oxide film is determined by the presence of foreign substances on the metal surface and by irregularities in the surface itself. When metal and electrolyte come into contact, the oxide film is the primary cathode, metal passes into solution at unoxidised parts of the surface, and continuance of this current between cathode film and metal is dependent on the prevention of diffusion of oxygen to the anodes; the original location of cathode and anode areas is likely to be altered by the distribution of oxygen within the solution. Boundary resistance between electrodes and electrolyte is an indicator of rate of corrosion. The normal cathodic oxide film formed in air has little effect, but thicker oxide films formed by heating give high boundary resistance and must tend to retard corrosive action; oxidising electrolytes also retard by increasing boundary resistance. With aluminium, boundary resistance increases with increasing dilution of electrolyte and increasing thickness of any oxide film present on the metal surface.

F. H. Constable: The cause of the colours shown during the oxidation of metallic copper. Evidence has been collected showing that interference is the cause of the colours shown during initial stages of oxidation. The order of production of the colours corresponds with that for interference colours of air films of increasing thickness seen by transmitted light. Fall in electrical conductivity and mass of oxygen taken up per unit area of surface are proportional to the equivalent air thickness of the copper oxide film. The wavelengths of the maxima in absorption or reflection bands, in the spectrum of light reflected from the film, move towards the red as the thickness of the film increases. Finally, general absorption causes blackness of film.

C. F. Elam: Tensile tests on alloy crystals (Parts i., ii., and iii.). Crystals of alloys of aluminium and zinc, containing up to 18 per cent. zinc, have been prepared by the method of straining followed by heat-treatment. The direction and plane of slip under distortion is in a direction parallel to the diagonal of the cube (*i.e.* in a {110} direction) and on an octahedral {111} plane, as in aluminium. The alloys showed increased resistance to shear with increased zinc content, and the amount of elongation before fracture was reduced. Crystals were made by melting brass rods, containing 70 per cent. copper and 30 per cent. zinc, in graphite tubes and slowly cooling from one end. In every case these showed that slip under distortion occurred on an octahedral {111} plane in a {110} direction, as in copper. The elongation before fracture amounted in one case to 168 per cent. Resistance to shear in early stages of extension was slightly less than that of pure copper; final shear-stress was greater.

A. J. Bradley and J. Thewlis: The crystal structure of $\alpha$-manganese. Westgren and Phragmen have shown that the structure is cubic, the lattice dimensions being 8·894 Å.U. It contains 58 atoms per unit cell. The exact position of the atoms is defined by five parameters. The structure is based on a single body-centred cubic lattice, but each lattice point is replaced by a cluster of atoms, with tetrahedral symmetry. The interatomic distances range from 2·25 Å.U. to 2·95 Å.U., indicating an unequal distribution of electrons between the various atoms.

N. R. Sen: On Fresnel's convection coefficient in general relativity. A simple explanation of Fresnel's convection coefficient is furnished by Einstein's addition law of two velocities. But one would expect to obtain this law in the case of the addition of a small velocity to the velocity of light directly from Maxwell's electromagnetic equations in a moving material medium. We can take a gravitational field and try to obtain solutions of the form $f(x_1 - vt)$ of the modified Maxwell equations, in which there are two electromagnetic tensors F and H, which must also be connected by two more simple relations in a transparent medium. The conditions for the existence of the above plane waves lead to an algebraic quadratic equation for $v$, whose solution really gives Einstein's addition theorem for the electromagnetic wave velocity and the velocity of the medium.

Helga Pearson: On the skulls of early tertiary Suidæ, together with an account of the otic region in some other primitive Artiodactyla. Starting with the problem of the inter-relationships of the early tertiary Suidæ, it became necessary to reject from this family certain genera usually associated with it. This led to an examination of the otic region in those families, such as the Anthracotheriidæ and Hippopotamidæ, that are generally regarded as most nearly allied to the Suidæ. Finally, all available early Artiodactyl skulls were examined and an attempt was made to trace the probable course of evolution in this order of the otic region of the skull.

A. W. Greenwood and F. A. E. Crew: Studies on the relation of gonadic structure to plumage characterisation in the domestic fowl. (ii.) The developmental capon and poularde. It is not uncommon for a fowl as it attains maturity to assume the characters of the agonadic bird instead of developing male, or female, plumage and head furnishings. Such a bird is termed the developmental capon or poularde, and is in its characterisation entirely similar to the surgically caponised or ovariotomised individual. Examination of these birds, however, reveals that testicular or ovarian tissue is present though greatly reduced. This may be due to inherent imperfection in the gonadic tissue itself, or to imperfection in the environment (the body) in which it develops.

F. A. E. Crew: The laying hen with cock's plumage. (Part iii.) The cock-feathered laying hen is a female, normal in every respect save that her plumage becomes

as that of the agonadic bird following the moult, as the result of a transient disfunctioning of the ovary (and/or of the thyroid) at this time.

J. W. Trevan: The error of determination of toxicity. Curves expressing the relationship between mortality and dose for various drugs are discussed. It is suggested that, as a definition of toxicity, the average lethal dose for the animal and drug in question should be used. The expression 'minimal lethal dose' should be dropped, because of the various meanings that have been attached to it. The average lethal dose is represented, with sufficient accuracy, by the dose which kills 50 per cent. of a random sample of animals; the statistical error is at a minimum for doses in the neighbourhood of the average lethal dose.

C. K. Drinker and E. D. Churchill: A graphite suspension for intravital injection of capillaries. This fluid possesses qualities essential for physiological injections if employed in perfusion experiments in that the graphite particles are able to mix with blood without agglutinating and to pass through the capillaries without sticking to the walls. When injections of the fluid are made in intact animals, intravascular agglutination of the particles begins in about ten minutes and embolism takes place.

Geological Society, May 11.—P. G. H. Boswell: The Salopian rocks and tectonics of the district south-west of Ruthin (Denbighshire). The district extends southwards and south-westwards from Ruthin, and is bounded on the south by the northernmost fault (or Braich Fault) of the Llanelidan system of east-and-west fractures. It is composed of Salopian beds folded gently on axes running east-north-east and west-south-west. The western half of the area may be regarded as anticlinal; the eastern half shows a synclinal tendency. The dominant faulting is north-eastward in trend. Like the folding and cleavage (which is generally parallel to the fold-axes, with a steep northward dip), it is regarded as Caledonian. North-and-south faulting, which borders the Vale of Clwyd in the north-eastern part of the area, is of post-Carboniferous age. Similarly, the east-and-west Braich Fault limits the fault-system of north-eastern trend to the south, and is also post-Carboniferous. Where the north-east and south-west fault-system meets the north-and-south fractures and the Braich Fault, the beds are much shattered. The Braich Fault is an old fracture, throwing to the north in post-Silurian times, along which tearing movement took place at a post-Carboniferous date.—R. C. Blackie: The geology of the country between Llanelidan and Bryneglwys (Denbighshire). The Llanelidan district consists largely of Lower Ludlow deposits. Wenlock beds are restricted to the area west and north-west of Gwyddelwern, but there is also a small inlier in the centre of the Llanelidan anticlinorium. The Wenlock Series comprises the Denbighshire Grit, the upper limit of which is approximately the summit of the zone of *Cyrtograptus rigidus*; also a series of slab-like beds, representing the zone of *C. lundgreni*. The region came under the influence of the Caledonian movements, which resulted in folding, cleavage, and dominant south-west and north-east faulting. The Llanelidan and Bryneglwys Faults date also from this time. In post-Carboniferous times further movements of a torsional character affected the region, and movement was renewed along the master-faults, together with the initiation of smaller adjustment-dislocations between the Llanelidan and Bryneglwys Faults.

Physical Society, May 13.—J. W. T. Walsh: The theory of luminescence in radioactive luminous compound. From the brightness curves of compounds made with the same luminescent material but with different radium concentrations, the brightness-time relationship is found to be of the form $B=rf(rt)$, where $r$ is the radium content. The brightness curves are in excellent agreement with Rutherford's original theory of the destruction of active centres, provided this be combined with a simple hypothesis as to the cause of the progressive increase in the light absorption of the material which has been found experimentally. This leads to the following brightness-time relationship: $\log\{B/(b+B)\}+kt+a=0$, where $a$, $b$, and $k$ are constants, of which the last two are proportional to the radioactive concentration for any given grade of luminescent material.—E. Mallett: Distortion of resonance curves of electrically driven tuning-forks. Resonance curves with increasing exciting currents show increasing distortion until an unstable state is reached in which the amplitude for a given current over a certain frequency range can have two different values, depending upon whether the frequency has been approached from above or below. The indication here is that a decrease of resonant frequency takes place with increase of amplitude, and also an increase of damping. Static experiments show a departure from the straight line law both in the case of the deflexion of the fork prongs for given loads, and the flux change through the core for a given deflexion of the prongs. The effect of such departures on the equation of motion is considered mathematically, and it is shown that the term depending on the cube of the amplitude is the most important. Another effect of the non-linearity is the possibility of producing fundamental frequency vibrations in the fork by exciting currents of double frequency; distortions of a second type consist of 'coupled circuit' effects: these, at large amplitudes, are modified by distortions of the first type.

## DUBLIN.

Royal Irish Academy, May 9.—A. W. Conway: Undulatory theory of two electron orbits. In a previous paper (with G. Keating) the question of the quantisation of certain symmetrical orbits (with certain assumptions as regards the force between the electrons) was dealt with. The resulting negative energy terms were of the enhanced Rydberg form $4R/(n+\mu)^2$ for two different types of orbits. The principles of the wave mechanics of Schrödinger are now applied, and for one type of orbit the terms are of the correct Rydberg form $R/(n+\mu)^2$.

## PARIS.

Academy of Sciences, May 2.—Paul Appell: The creation of an institute of physico-chemical biology by M. Edmond de Rothschild.—Mesnager and Veyrier: The determination of the resistance of a structure on a reduced model. In the case of a dam, the effect of the water pressure can be studied experimentally on a small scale model by using a liquid of higher density than water (mercury) and material of smaller resistance than the material actually used on the dam.—G. Friedel: The existence of a salt dome in the Oligocene potash basin of the Haut-Rhin.—Charles Nicolle and V. Lumbroso: A new contribution to the knowledge of natural granular conjunctivitis of the rabbit. In man, and in the Barbary ape, the virus of the rabbit determines a granular conjunctivitis which differs from trachoma by its long incubation and its primitive and principal localisation on the lower eyelid.—Jules Amar: The origin and evolution of cancer. Reasons are given for the view that

cancer is a parasitic disease.—E. Cartan: The topology of simple real continued groups.—D. V. Widder: A theorem on the series of Dirichlet.—J. J. Gergen: Some theorems in Taylor's series having generalised gaps.—André Charrueau: The surfaces of equilibrium relating to a liquid mass of revolution possessing surface tension, in uniform rotation.—Giacobini: The Paris-Winnecke comet. On April 27, at the Paris Observatory, this comet showed as an elliptical nebulosity, major axis 10″ to 12″, with a marked condensation at one of the foci; magnitude between 12·5 and 13.—Henri George: Two qualities of silica glass. Discussion of the effect of the presence of moisture in the powdered silica before fusion on the properties of the glass.—R. Mesny: The energy radiated by electro-magnetic networks.—Armand de Gramont: A gyroscope kept in motion by an alternating current supplied through its axes of suspension.—Josef Mikuláš Mohr: The relation between the classes of lines (of the spectrum) determined by temperature and the groups of lines determined by pressure.—F. Croze and J. Gilles: The structure of the second order spectrum of nitrogen.—C. Mihul: The electronic configurations corresponding to the emission of the third order spectrum of oxygen.—M. Lambrey and D. Chalonge: The use of the discharge in hydrogen as a source of a continuous spectrum in the ultra-violet. The discharge in hydrogen has already been used as a source of a continuous spectrum in the extreme ultra-violet, but its use has been difficult and the intensity feeble. Details are given for setting up a hydrogen tube working with perfect regularity for long periods and giving an intense continuous spectrum.—P. Gabiano: The alkaline cuprotartrates.—P. Lecomte du Noüy: An anomaly in the evaporation of solutions of sodium oleate and of digitonin at high dilutions.—F. Bourion and E. Rouyer: The boiling-point constant of aqueous solutions of potassium chloride and molecular equilibria of resorcinol in this medium.—P. Job: The substitution of ethylenediamine for ammonia in complexes in solution. In most of the complex ammonia salts one molecule of ethylenediamine can replace two molecules of ammonia. With thallium salts ammonia forms the complex ion $Tl(NH_3)$. Ethylenediamine gives the ion (Tl en) in which the ethylenediamine replaces the ammonia molecule for molecule.—A. Andant: The application of the spectrography of fluorescence to the examination of organic compounds. Results are given for olive oil, vaseline oil, and castor oil. The method is of analytical value.—Jean Bouldoires: The transformations undergone by aluminium bronzes.—G. Gilta: The isomerism of *p*-hydroxyphenylarsenic acid.—A. Demay: Hercynian strata and folds of the Massif of Maures.—R. Bureau: Anomalies of long duration in the propagation of short [Hertzian] waves.—Jacques Maheu and J. Chartier: The botanical origin of the lesser striated Ipecacuanha. This has been identified with *Manettia ignita* of the family of the Rubiaceæ.—L. Maume and J. Dulac: The minimum of toxicity of a mixture of two salts with regard to plants.—Lucien Daniel: Two new grafts.—L. Carpentier and G. Thieulin: The direct measurement of the magnitude of the retinal images in the dog and cat.—Ph. Joyet-Lavergne: The proportion of glutathione reduced is a character of the sexualisation of the cytoplasm.—Th. Moreux: Solar activity and certain phenomena of vegetation.—A. Goris and L. Lachaise: The phylactic action of brucine towards strychnine. If 8 mgm. or 10 mgm. of brucine is injected into dogs and one hour later a mortal dose of strychnine, all the dogs survive.—Etienne Wolff: The adaptation of amœba to saline solutions. Cysts without a membrane.

## Official Publications Received.

### BRITISH.

List of Members of the British Astronomical Association, September 1926. Pp. 37. (London.)

The Lister Institute of Preventive Medicine. Report of the Governing Body, 1927. Pp. 28. (London.)

Institute of Marine Engineers, Incorporated. Session 1926. Vol. 38: Thirty-eighth Annual Report and Financial Statement and Minutes of Annual Meeting held on Friday, March 11th, 1927, at 6.30 p.m. in the Institute Premises, the Minories, Tower Hill, London, E.1. Pp. ccvii. (London.)

Proceedings of the London Mathematical Society. Second Series. Vol. 25. Pp. ii+546. (London: Francis Hodgson.)

Irrigation in the Empire. Memorandum and Questionnaire by Dr. B. A. Keen. Pp. 8. (London: Empire Marketing Board.)

Ceylon Journal of Science. Section B: Zoology and Geology. Spolia Zeylanica. Vol. 14, Part 1, April 30th. Edited by Dr. Joseph Pearson. Pp. 133+12 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd.) 3 rupees.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 34: The Production of the Resting-Spores of *Phytophthora infestans* on Potato Tubers. By Dr. Paul A. Murphy. Pp. 407-412+1 plate. 1*s.* Vol. 18 (N.S.), No. 35: Some Further Cases of the Production of Diseased Shoots by Potato Tubers attacked by *Phytophthora infestans*, and a Demonstration of Alternative Sources of Foliage and Tuber Infection. By Dr. Paul A. Murphy and Robert M'Kay. Pp. 413-422+1 plate. 1*s.* 6*d.* Vol. 18 (N.S.), No. 38: Methylene-Blue (Reductase Test) in Milk Grading. By Dr. M. Grimes, H. S. Boyd Barrett and Dr. J. Reilly. Pp. 437-441. 6*d.* (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Western Australia: Geological Survey. Bulletin No. 87: A Geological Reconnaissance in the Central and Eastern Divisions between 122° 30′ and 123° 30′ E. Longitude and 25° 30′ and 28° 15′ S. Latitude. By H. W. B. Talbot. Pp. 30+5 plates. Bulletin No. 93: The Geology of portions of the Kimberley Division, with special reference to the Fitzroy Basin and the Possibilities of the Occurrence of Mineral Oil. By T. Blatchford. Pp. 56+8 maps. (Perth: Fred. Wm. Simpson.)

Abstracts of Dissertations approved for the Ph.D., M.Sc. and M.Litt. Degrees in the University of Cambridge for the Academical Year 1925–1926. Published by Authority. Pp. 74. (Cambridge: Printed at the University Press.)

Aeronautical Research Committee: Reports and Memoranda. No. 1044 (Ae. 231): Full Scale Pressure Plotting Experiments on Hull and Fins of H.M.A.R. 33. By Lieut.-Col. V. C. Richmond. Pp. 26+30 plates. 1*s.* 9*d.* net. No. 1073 (Ae. 255): Full Scale Measurement of Lift and Drag of a Bristol Fighter with Slotted Upper Wings and Standard Lower Wings. By J. K. Hardy. (A.2.b. Stability-Full Scale Experiments, 44. — T. 2386.) Pp. 3+3 plates. 4*d.* net. No. 1050: Reports and Memoranda of the Aeronautical Research Committee published between the 1st January 1925 and the 28th February 1927. Pp. 8. 4*d.* net. No. 1071: Wind Tunnel Tests of Aerofoil R.A.F. 34. By H. Davies. (A.3.a. Aerofoils-General, 171.—T. 2364.) Pp. 5. 4*d.* net. (London: H.M. Stationery Office.)

University of Reading: The National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1926. Pp. 62. (Reading.)

### FOREIGN.

Havsforskningsinstitutets Skrift. No. 23: Översikt av isarna vintern 1919–20. Av Risto Jurwa. Referat: Übersicht der Eisverhältnisse im Winter 1919–20 an den Küsten Finnlands. Pp. 30+15 plates. 20 Fmk. No. 37: Oversikt av isarna vintern 1914–15. Av Gunnar Granquist. Referat: Übersicht der Eisverhältnisse im Winter 1914–15 an den Küsten Finnlands. Pp. 45. 20 Fmk. No. 38: Regelmässige Beobachtungen von Temperatur und Salzgehalt des Meeres im Jahre 1924. Von Gunnar Granquist. Pp. 46. 20 Fmk. No. 39: Die thalassologische Terminfahrt im Jahre 1925. Von Erik Palmén. Pp. 22+1 plate. 10 Fmk. No. 40: Översikt av isarna vintern 1915–16. Av Gunnar Granquist. Referat: Übersicht der Eisverhältnisse im Winter 1915–16 an den Küsten Finnlands. Pp. 56. 22 Fmk. No. 41: Havsforskningsinstitutets värksamhet under år 1925. Redogörelse avgiven av Rolf Witting. Pp. 21. 5 Fmk. No. 42: Översikt av isarna vintern 1917–18. Av Gunnar Granquist. Referat: Übersicht der Eisverhältnisse im Winter 1917–18 an der Küsten Finnlands. Pp. 40. 18 Fmk. No. 43: Dagliga vattenståndsuppgifter 1924. Av Henrik Renquist. Referat: Tägliche Wasserstandsangaben 1924. Pp. 48. 9 Fmk. No. 44: Översikt av isarna vintern 1924–25. Av Gunnar Granquist. Referat: Übersicht der Eisverhältnisse im Winter 1924–25 an den Küsten Finnlands. Pp. 48. (Helsingfors.)

Akademie der Wissenschaften in Wien: Mathematisch-naturwissenschaftliche Klasse. Anzeiger. Jahrgang 63, 1926. Pp. viii+208. (Wien.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 17, Part 3: Studies on the Correlations between Morphological Characters, Chromosome-number and Resistance to *Puccinia triticina* in Pentaploid-Bastards of Wheat. By Yoshihiko Tochinai and Hitoshi Kihara. Pp. 133-161. (Sapporo.)

Svenska Linné-Sällskapets Årsskrift. Årgång 10, 1927. Pp. v+173. (Uppsala: Almquist and Wiksells Boktryckeri-A.-B.)

Proceedings of the United States National Museum. Vol. 70, Art. 9: A Review of the South American Two-winged Flies of the Family Syrphidae. By Raymond C. Shannon. (No. 2658.) Pp. 34+1 plate. Vol. 70, Art. 22: Richmond Faunal Zones in Warren and Clinton Counties, Ohio. By George M. Austin. (No. 2671.) Pp. 18. Vol. 71, Art. 3: On a Collection of Orthopteroid Insects from Java made by Owen Bryant and William Palmer in 1909. By A. N. Caudell. (No. 2675.) Pp. 42. Vol. 71, Art. 9: The Digger Wasps of North America of the Genus Podalonia (Psammophila). By H. T. Fernald. (No. 2681.) Pp. 42+2 plates. (Washington, D.C.: Government Printing Office.)

Bergens Museums Aarbok, 1926. Hefte 1. Naturvidenskabelig Række. Pp. 21+17+19+10+28+56. (Bergen: A.-S. John Griegs Boktrykkeri.)

Bergens Museum. Aarsberetning 1925–1926. Pp. 90. (Bergen: A.-S. John Griegs Boktrykkeri.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et procès-verbaux des réunions. Vol. 43, Rapports (Mai 1927). Pp. 50. Bulletin hydrographique pour l'année 1926. Pp. 58. Bulletin hydrographique. Appendice d'observations de l'Allemagne pour 1919–1925 et de la Lettonie pour 1925 et 1926. Pp. 20. (Copenhague: Andr. Fred. Høst et fils.)

Annuaire de l'Observatoire Royal de Belgique. 95me année, 1928. Par P. Stroobant. Pp. iii+291. (Bruxelles.)

Pubblicazioni della R. Università degli Studi di Firenze. Fascicolo N. 43: Osservazioni e memorie del R. Osservatorio Astrofisico di Arcetri. Pp. 51. Immagini spettroscopiche del bordo solare osservate a Catania e Zurigo nel 1922–23. (Appendice al Fascicolo N. 40 della Osservazioni e memorie del R. Osservatorio Astrofisico di Arcetri.) Pp. 8+6 tavole. (Firenze.)

CATALOGUE.

The Indian Empire: being a Catalogue of Books, Paintings and Engravings relating to India, Ceylon, Tibet, Burma, Persia and Afghanistan. (No. 497.) Pp. 78. (London: Francis Edwards.)

## Diary of Societies.

*SATURDAY*, JUNE 11.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (Summer Meeting).—Otological Session (Clinical Meeting), at 10.—Dr. G. Portmann: The Saccus Endolymphaticus and an Operation for Draining the same for the Relief of Vertigo.—Cases and Specimens by Dr. A. R. Friel, A. R. Tweedie, Dr. T. B. Jobson, N. Barnett, E. B. Barnes, and others.—Demonstration of Stereoscopic Transparencies of Specimens of the Temporal Bone, by Dr. A. Gray.

BIOCHEMICAL SOCIETY (in Biochemical Department, The Museum, Oxford), at 3.—V. B. Wigglesworth: The Digestion of Carbohydrates in the Cockroach.—P. C. Raiment: (*a*) The Oxidation of Uric Acid by Hydrogen Peroxide; (*b*) The Estimation of Oxalic Acid in Urine; (*c*) The Estimation of Oxaluric Acid in Urine.—P. Eggleton and M. G. Eggleton: The Chemistry of Phosphagen.—C. R. Harington and W. McCartney: The Erlenmeyer Amino-acid Synthesis.—F. Hawking: Synthesis of Vitamin B (Torulin) by Yeast.—H. W. Kinnersley and R. A. Peters: Use of Norite in the Concentration of Torulin.—P. G. Marshall and H. D. Kay: The Presence of a Nucleotide in Milk.—R. M. Beck and R. K. Cannan: The Peptic Digestion of Gelatin.—J. T. Irving: Metabolism of Glucose by Kidney Tissue in Vitro.—Demonstrations:—A Colorimetric Method for the Determination of the *p*H of Minute Amounts of Fluid, by V. B. Wigglesworth.—Synthesis of a Bacterial Growth Factor by Meningococcus, by J. Orr Ewing and V. B. Reader.—A Simple Fluorophotometer, by J. H. Jeffree and B. T. Squires.

*MONDAY*, JUNE 13.

ROYAL IRISH ACADEMY, at 4.15.

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Dr. A. T. Schofield: Time and Eternity (Annual Address).

INSTITUTE OF ACTUARIES (Annual General Meeting), at 5.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—H. E. Hurst: The Hydrology of the Nile.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (jointly with the Education Section) (at Royal Society of Medicine), at 8.30.—Dr. S. Ferenczi: The Psychology of the Pre-School Child.

MEDICAL SOCIETY OF LONDON.—Prof. H. Cushing: Annual Oration.

*TUESDAY*, JUNE 14.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Electrical Engineers), at 10 A.M.—J. Wilkinson: Presidential Address.—Seventeenth Report of the Gas Investigation Committee.—Examination of Products of Combustion from Typical Gas Appliances.—Part II. Gas Fires.—At 3.15.—T. Carmichael: Modern Carbonising Economics as exemplified by Results and Working Costs at the Works of the Portsmouth Gas Company.—Eighteenth Report of the Gas Investigation Committee—Studies in Carbonisation.—Part II. Size of Coal, Admixture, Inorganic Compounds.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Frederick Gowland Hopkins: The Task of Biochemistry (Croonian Lectures).

MINERALOGICAL SOCIETY, at 5.30.—A. F. Hallimond: On the Atomic Volume Relations in Certain Isomorphous Series.—Dr. P. K. Ghosh: Petrology of the Bodmin Moor Granite (Eastern Part).—Prof. P. G. H. Boswell: On the Distribution of Purple Zircon in British Sedimentary Rocks.—Dr. J. Drugman: On $\beta$-quartz Twins from Cornwall.—E. V. Holt and Dr. H. F. Harwood: The Separation of Manganese in Rock Analysis.—Dr. L. J. Spencer: Corundum Twins from Transvaal.

LONDON NATURAL HISTORY SOCIETY (at 40 Winchester House, E.C.), at 6.30.—Sir Frank Baines: Westminster Hall: its History, Architectural Design and Preservation.

QUEKETT MICROSCOPICAL CLUB, at 7.30.—Prof. H. Graham Cannon: The Feeding Mechanisms of Crustacea.

RÖNTGEN SOCIETY (Royal Society of Medicine), at 8.30.—Sir J. J. Thomson: The Structure of the Atom and Radiation (Silvanus Thompson Memorial Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting) (at North-Eastern Centre).

*WEDNESDAY*, JUNE 15.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Electrical Engineers), at 10 A.M.—G. M. Gill: Ovens as a Gas-Works Carbonising Plant.—Report of the Institution Gas Fellowship on Influence of the Ash Constituents in the Carbonisation and Gasification of Coal.—Part III. Gasification of Special Cokes: (*a*) In Steam, J. A. Sutcliffe and Prof. J. W. Cobb; (*b*) In Carbon Dioxide, W. R. Branson and Prof. J. W. Cobb; (*c*) In Oxygen, F. J. Dent and Prof. J. W. Cobb.—At 3.15.—J. P. Leather: The Dry Cooling of Coke.—Report of the Refractory Materials Joint Committee.

SOCIETY OF GLASS TECHNOLOGY (in University, Sheffield), at 2.30.—R. Wigginton: Gaseous Fuels for Furnace Heating.—Prof. W. E. S. Turner and F. Winks: The Thermal Expansion of Some Boric Oxide Glasses and some Remarks on the Influence of the Inhomogeneity of the Glass.

ROYAL METEOROLOGICAL SOCIETY, at 5.—J. Edmund Clark, I. D. Margary, and R. Marshall: Report on the Phenological Observations in the British Isles, December 1925 to November 1926.—Dr. G. C. Simpson: Past Climates.—H. M. Treloar: The Variation of Eddy Viscosity with Wind Velocity and Season. A Study based on Pilot Balloon Observations at Melbourne.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—J. E. Richey: The Structural Relations of the Mourne Granites (Ireland).—Dr. W. F. Whittard: The Stratigraphy of the Valentian Rocks of Shropshire: The Main Outcrop.

FOLK-LORE SOCIETY (at University College), at 8.—Miss Eleanor Hull: Female Deities in the British Isles.

ELECTROPLATERS' AND DEPOSITORS' TECHNICAL SOCIETY (at Northampton Polytechnic Institute), at 8.15.—E. Downs: Electro-refining of Silver.

EUGENICS SOCIETY (at Royal Society), at 8.30.—Miss Evelyn Lawrence: Intelligence of Institution Children.

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting) (at North-Eastern Centre).

*THURSDAY*, JUNE 16.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Electrical Engineers), at 10 A.M.—J. H. Canning: Some Experiences of Gas Service.

ROYAL SOCIETY, at 4.30.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.—Dr. Parkes Weber: Early Angioma Serpiginosum, with Another Early Case (previously shown) for Comparison.—Dr. G. B. Dowling: Rare Seborrhoide of the Face (Pringle). Acne Agminata.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Sir Frederick Gowland Hopkins: The Task of Biochemistry (Croonian Lectures).

CHEMICAL SOCIETY, at 8.—I. Vogel: Syntheses of Cyclic Compounds. Part I. Ethyl $\beta\gamma$-dimethyl Butane $\alpha\alpha\delta\delta$-tetracarboxylate and Some Cyclobutane Compounds Derived Therefrom.—B. Cavanagh: A New Method of (Absolute) Potentiometric Titration.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, W.) (Annual General Meeting), at 8.15.—Induction of New President, Prof. J. W. W. Stephens. Presentation of Chalmers Medal to H. L. Duke.—D. L. Fabian Hirst: Rat Flea Surveys and their Use as Plague Preventive Measures.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Summer Meeting).

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting) (at North-Eastern Centre).

*FRIDAY*, JUNE 17.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—Dr. R. A. Gibbons: The Cause of the Onset of Labour.

OXFORD UNIVERSITY JUNIOR SCIENTIFIC CLUB (in Department of Zoology and Comparative Anatomy, Oxford), at 8.15.—W. T. Griffiths: Nickel and its Alloys.

ASSOCIATION OF ECONOMIC BIOLOGISTS (at South-Eastern Agricultural College, Wye).

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Summer Meeting).

INSTITUTION OF ELECTRICAL ENGINEERS (Summer Meeting) (at North-Eastern Centre).

*SATURDAY*, JUNE 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 2.30.

PHYSIOLOGICAL SOCIETY (at Middlesex Hospital).

ASSOCIATION OF ECONOMIC BIOLOGISTS (at South-Eastern Agricultural College, Wye).

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Summer Meeting).

### PUBLIC LECTURES.

*SUNDAY*, JUNE 12.

GUILDHOUSE (Eccleston Square, S.W.), at 3.30.—Dr. R. E. M. Wheeler: Some of the Ancient Civilisations of Britain.

*TUESDAY*, JUNE 14.

EAST LONDON COLLEGE, at 5.—Sir Frank Dyson: The Eclipse of the Sun.

UNIVERSITY COLLEGE, at 8.30.—Prof. J. A. Fleming: A Hundred Years of Electrical Engineering.

*SUNDAY*, JUNE 19.

GUILDHOUSE (Eccleston Square, S.W.), at 3.30.—C. L. Woolley: Recent Discoveries at Ur.

### CONGRESS.

JUNE 16 AND 17.

CONGRESS OF THE INTERNAL COMBUSTION ENGINE (at Padua).